Country Update - Canada

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Discussion Topics

- Program and Policy Developments
- Industry Developments
- Trends in the Industry
- Commercial Demonstrations & Deployments

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Programs

- Canada continues to support the HFC sector through various programs, services & a tax credit

Policy Developments

- Carbon tax on all fossil fuels in British Columbia (BC)
- Low Carbon Fuel Standard (BC, Oregon & California)
- Product Purchase & Infrastructure Development Incentives (BC)
- Energy storage evaluation projects (Ontario)

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Industry Developments

- Hyundai FCVs
- Supplier Development initiatives with FCV OEMs
- Potential redeployment of FC Buses
- Low Carbon Fuel Standards in BC (HTEC, Blue Fuel Energy, Hydrogenics)
- Canadian Hydrogen Infrastructure Initiative (CHII)
- On-going collaboration with academic & public research facilities

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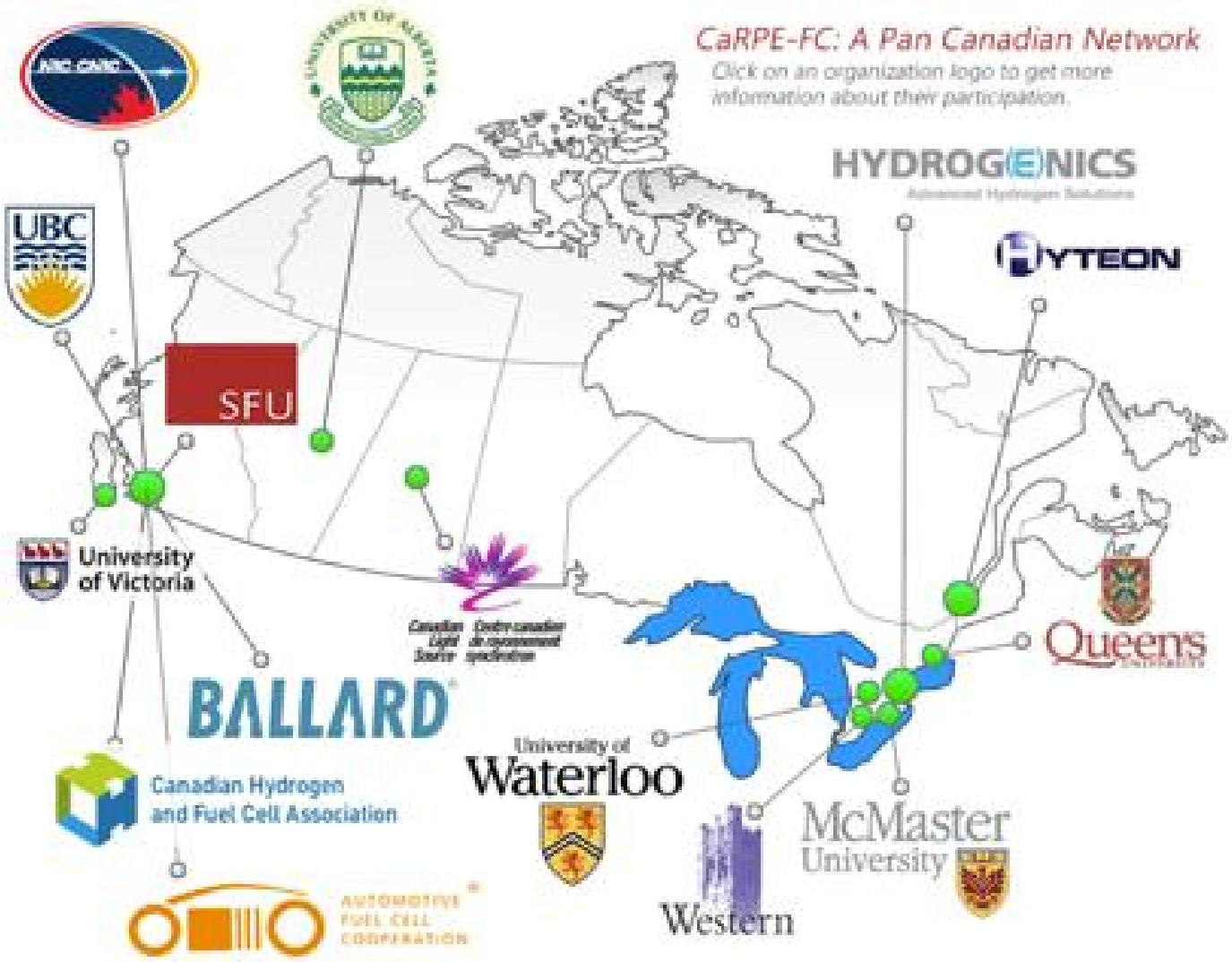

CaRP-FC Outreach & International Networking:

1. ***Germany-Canada Joint workshops*: Jun. 2014,& <u>upcoming Mar. 2015</u>**
   - Canada **<u>CaRPE-FC</u>** network and Germany **<u>GECKO</u>** network collaborated on the topics of advanced fuel cell characterization techniques.
   - Next meeting is coupled with the 12th Symposium for Fuel Cell & Battery: Modeling & Experimental Validation, Freiburg, Germany, March 25-27, 2015

2. Potential Collaboration with UK Fuel Cell Network is being explored
   - ***UK Hydrogen and Fuel Cell Supergen*** (H2FC) led by ***Prof. Anthony Kucernak***, Imperial College, London.
   - CaRPE-FC has provided LOI to engage on scope discussion. SuperGen is pending funding approval.

3. In discussion with France Hydrogen and Fuel Cell network
   - Participated in SFU led initiatives to connect with H2FC researchers from France.
   - **Hydrogène, systèmes et Piles à combustible" (HySPàC)**
   - **Scientific Director:** Prof. Olivier JOUBERT, CNRS
   - Additional Contacts: Prof. Christophe Coutanceau (Université de Poitiers) – Electrocatalysis, Dr. Christophe Turpin (LAPLACE, Toulouse) –Fuel Cell Engineering

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Trends in the Industry

- **Ongoing R, D & D**
- **Revenue from the sale of commercial products & services are improving**
- **Increase in collaborative partnerships internationally**
- **Foreign & domestic investments**
- **Increasing interest & investments in hydrogen production & the use of excess power &/or vented H2 from industrial processes**

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Commercial Demonstrations & Deployments

2MW PtG Energy Storage Project in Ontario (Hydrogenics/Enbridge)

Canada/US Power to Gas (PtG) Analysis Project – CED project

- Development of a techno-economic analysis tool designed to assess and compare the benefits of using HFC vs conventional solutions for energy storage & PtG systems (completed).

Next Steps:

- Identifying commercial sites, with excess power, to test and evaluate the SW and identify potential PtG opportunities in NA.
- Software to be integrated into EPRI`s Energy Storage Valuation Tool

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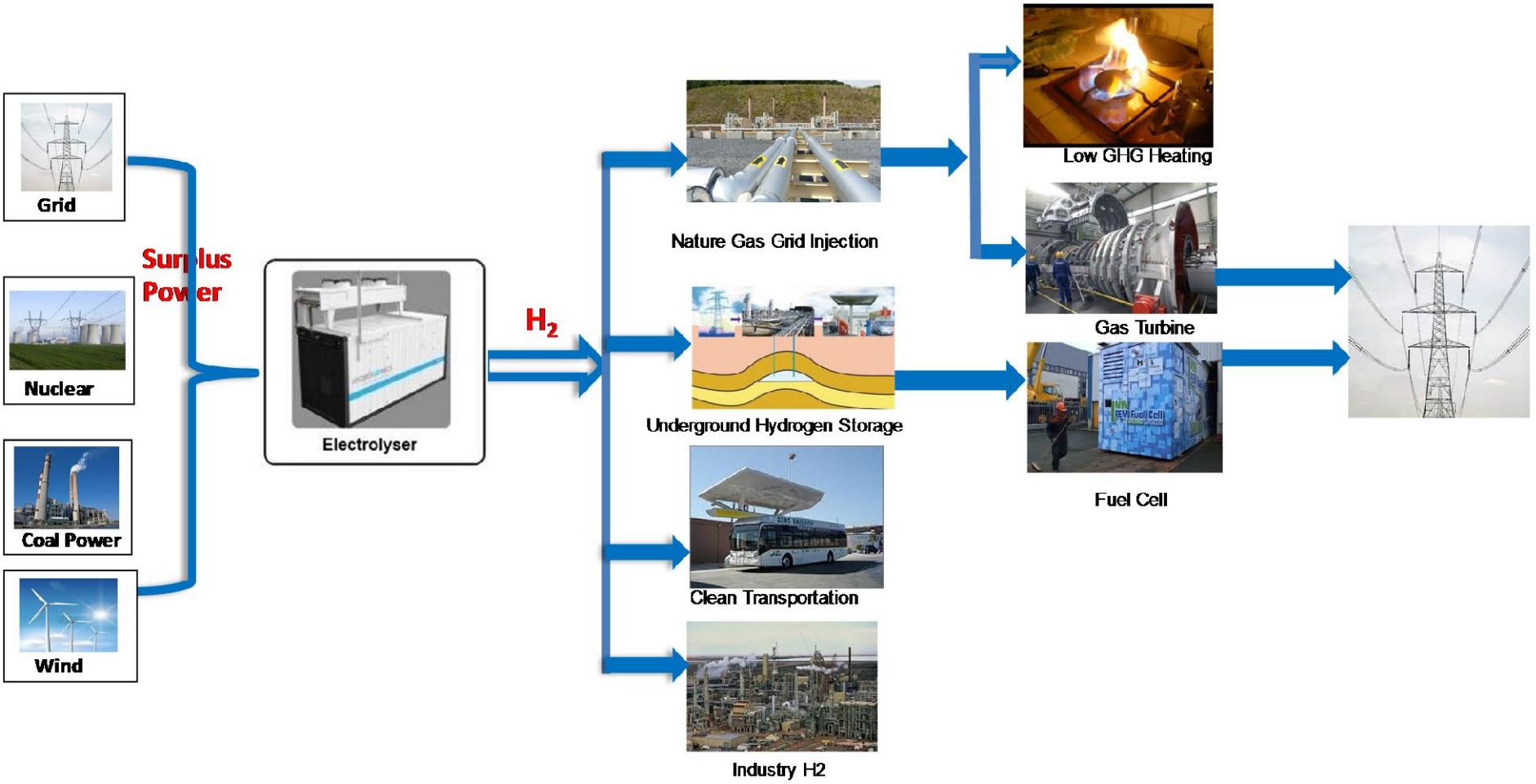

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Deployments – Illustrative Examples

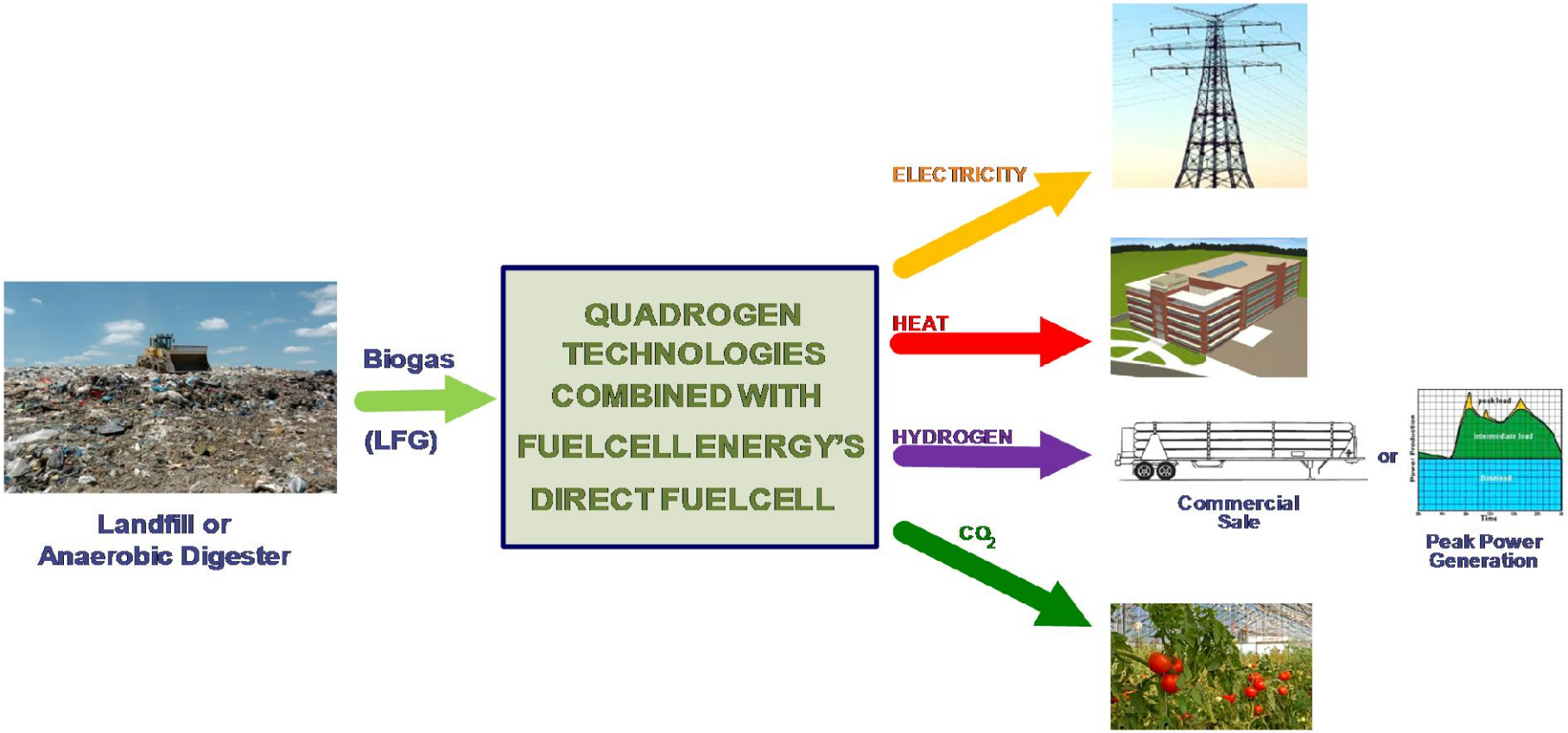
- **Waste Water & Landfill Gas Reclamation (FC Energy & Quadrogen)**
  - enabling distributed hydrogen/heat/power/carbon dioxide production

1) Orange County Sanitation District, California
   - Waste water treatment plant (June 2011)

2) Microsoft Data Processing Centre, Wyoming
   - Waste water treatment plant (Oct 2014)

3) Village Farms, British Columbia
   - City of Vancouver Delta Landfill (Q2 2016)

Landfill Gas Reclamation Country Update - Canada



Deployments – Illustrative Examples

- **Combined Wind, Diesel & Energy Storage (Glencore, Tuglic Energy & Hydrogenics)**
  - Glencore mine, Nunavut
  - Off grid location, 100% dependent on imported diesel
  - Pristine location, largest employer in the territory
  - Federal, Provincial Industry support
  - 3 MW wind turbine (to date)
  - Operational: summer 2015

Tugliq Energy Co.
Proximity Next Energy

Autonomous microgrid
CONCEPT

Wind + Diesel + Energy Storage

RAGLAN MINE
A GLENCORE COMPANY

Windfarm near Arctic mining site

Inexhaustible renewable electricity
Excess wind energy

Industrial Electrolyser

Water
H_2O

Flywheels

Inexhaustible renewable electricity
Secondary energy source

Renewable electricity
Primary energy source

Batteries Li-Ion

Primary H_2 Storage

Low Pressure H2 storage

H_2 Hydrogen

Electrical and Heat Loads (multiple)

Green Heat

Hydrogen Fuel Cells

20%

Diesel Electricity
Primary source

Diesel gensets

80%-100%

Diesel tanks

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THANK YOU

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