Energy Council of Canada

Transformations Across the Energy Sector:

Past, Present and Future

Waterloo Institute for Sustainable Energy

November 5, 2014

Graham Campbell
President

Energy Council of Canada
Conseil canadien de l'énergie

WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE

Energy Council of Canada (ECC)

Energy Council of Canada
Conseil canadien de l'énergie

Our Mission:

To forge a better understanding of energy issues in order to optimally shape the energy sector for the benefit of all Canadians

- **A vehicle for strategic thinking and collaboration around energy dialogue in Canada**
- **Membership - executives from private and public sectors across Canada, service companies**
- **Covers all forms of energy, supply through to end-use**
- **Founding member of the World Energy Council (1923)**

2014 Themes and Priorities

- **2014 theme – *"Working together on energy"***
- **Advance the energy dialogue in Canada**
  - **Engage key stakeholders, find points of consensus**
  - **Inform public policy discussion**
  - **Learn from research and WEC Studies**
- **Recognize outstanding achievements by leaders in the energy industry**

Canadian Energy Persons of the Year - Recipients

2014 – Anthony Haines
2013 - Chris Huskilson
2013 - Ed Martin
2012 - Thierry Vandal
2011 - Rick George
2010 - Stephen G. Snyder
2009 - Charlie Fischer
2008 - Jacques Lamarre
2007 - Patrick D Daniel
2006 - Roland Priddle
2005 - Duncan Hawthorne
2004 - Nellie Cournoyea
2003 - Eric Newell
2002 - Richard Drouin
2001 - James K. Gray

Energy Council of Canada
Conseil canadien de l'énergie

ECC Events and Initiatives – Cross Canada

- Regional Member Forum – Ottawa in March
- Breakfast Roundtables – Vancouver, Regina, Montreal
- 2014 Canadian Energy Summit and WEC North America Region Energy Forum - Calgary
- Canadian Energy Person of the Year Award - Toronto
- Energy Policy Research Fellowships
  - University of Waterloo – Waterloo Institute of Sustainable Energy
- Canadian Network on Energy Policy Research
  - University of Calgary – School of Public Policy
- WEC Congresss, Executive Assembly

Energy Council of Canada
Conseil canadien de l'énergie

Recent World Energy Council Studies

- World Energy Trilemma 2014 (launch on November 24, WDC)
- World Energy Insight 2013
- World Energy Scenarios: Composing energy futures to 2050
- WEC World Energy Resources: 2013 Survey
- World Energy Perspective: Cost of Energy Technologies
- World Energy Perspective: Energy Efficiency Policies
- World Energy Issues Monitor 2015 – February 2015

In a world where many non-governmental organisations have clear partisan agendas, the World Energy Council stands out as a unique umbrella grouping of leaders dedicated to promoting the sustainable supply and use of energy for the greatest benefit of all.

Today's Presentation
Transformations Across the Energy Sector

- Energy transformations – general features

- Examining ongoing energy transitions
  1. Natural gas supply and LNG in British Columbia
  2. CO_2 synergies in Saskatchewan
  3. Electricity Transmission Infrastructure in Ontario
  4. Transforming Quebec's transportation sector
  5. Observations from 2015 Energy Summit and Forum

- What transformations do energy leaders see?

- Closing observations

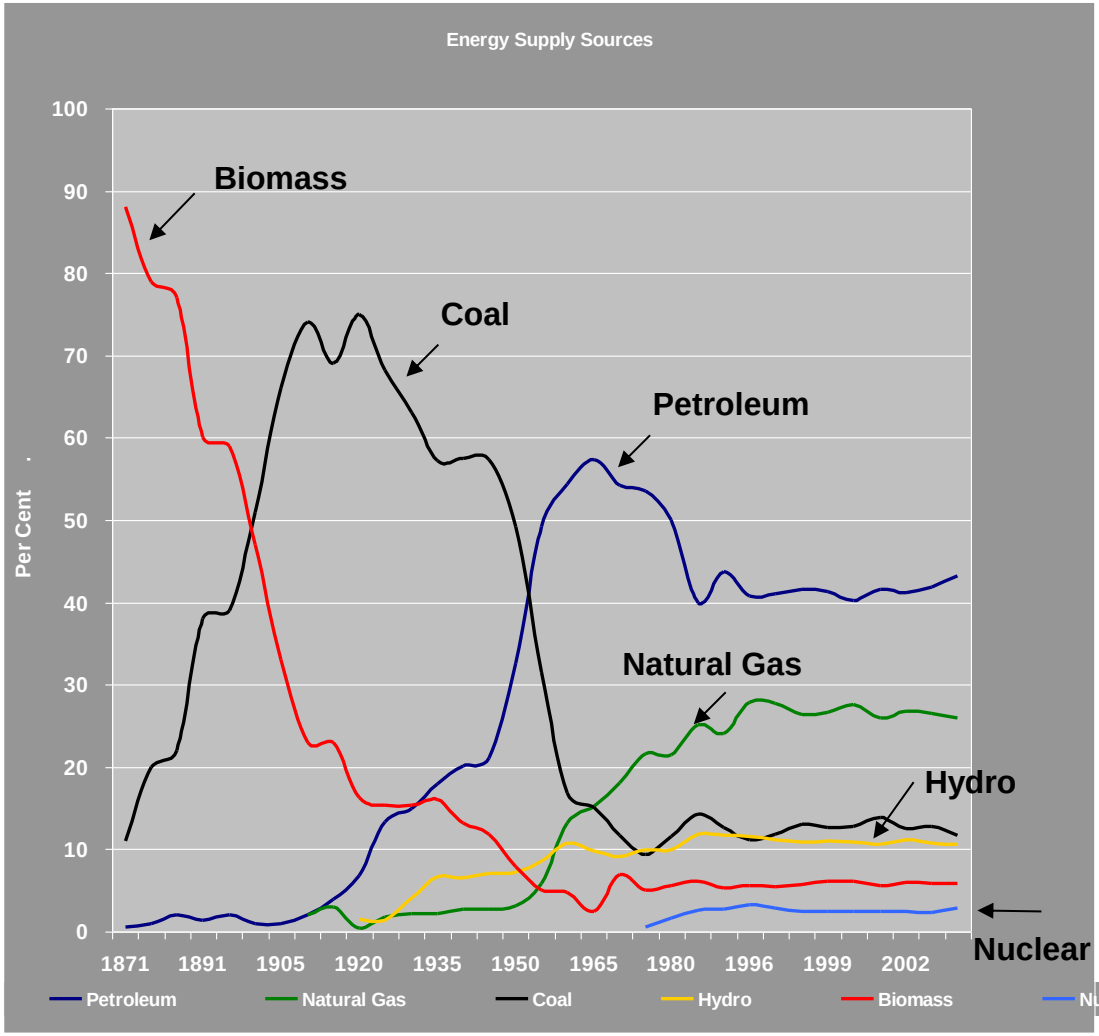
Energy Council of Canada
Conseil canadien de l'énergie

Transitions are part of our energy history

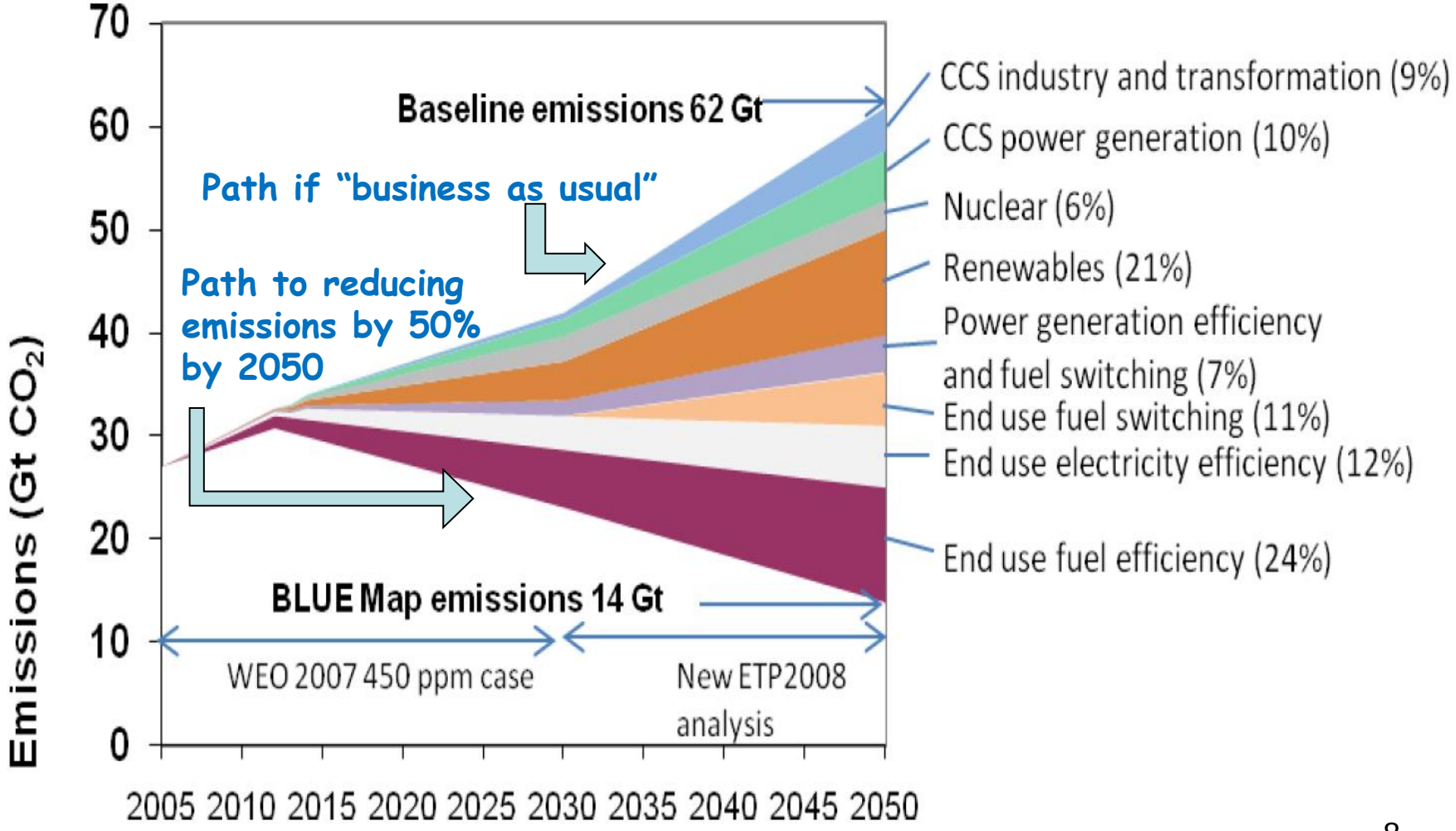
Canada's energy supply mix is always evolving

- Energy mix is driven by resource endowment, government intervention, new technologies and new infrastructure
- Energy mix is always changing, occasionally suddenly, as new commodities become available
- Each country, and each jurisdiction within it, will make use of the energy resources at hand – local economic development is a major driver
- Canada's energy history shows a progressive evolution of energy sources – never a more diverse mix than now
- Projections show an even broader mix in the future

Per cent share of energy used



Transformation calls for new technologies Essential to limit global temperatures to +2^{0}C



Source: International Energy Agency, Energy Technology Perspectives (2008)

Energy transformations also call for …

- Earning public support for new ways of doing energy, new energy projects
- New infrastructure – new configurations, re-purposing
- Leadership in government policy
- Accessing capital
- Regulation, standards
- Meeting HR requirements, training, new skills
- New market practices – paying for new services, billing, etc.

Examining Ongoing Energy Transitions Across Canada – Energy Council Events

1. Natural gas supply and LNG in British Columbia
2. CO_2 synergies in Saskatchewan
3. Electricity Transmission Infrastructure in Ontario
4. Transforming Quebec's Transportation Sector
5. Observations - 2015 Energy Summit and Forum

Powering B.C.'s Natural Gas Facilities:

Opportunities, Implications, Issues

2014 VANCOUVER Breakfast ROUNDTABLE

April 14, 2014

Vancouver Roundtable Speakers

- Doug Little, Vice President, Energy Planning and Economic Development, BC Hydro
- Paul Kariya, Executive Director, CleanEnergyBC
- Garry Wouters, Policy Consultant, Coastal First Nations
- Richard Dunn, Vice President Regulator and Government Relations, EnCana Corporation
- Ken Wiecke, Manager, Operations, Power and Process, AMEC Americas Limited
- Les MacLaren, ADM Electricity and Alternative Energy, British Columbia Ministry of Energy, Mines and Petroleum Resources

Transformation of BC`s Natural Gas Supply Industry

- To date, northeast BC has had conventional production practices, pipelines to markets in BC and the US
- Now, British Columbia is on the verge of aggressive growth in natural gas supply, creation of new LNG infrastructure
- New abundant natural gas supply from shale gas – fracking t
- LNG facilities will export gas to entirely new markets for Canadian resources - liquefied in large LNG plants and shipped in LNG vessels to export markets in Asia
- Many implications – powering the new facilities (natural gas or electricity), first Nations` interests, talent, environmental implications

Electrification Opportunities in Northeast BC
A number of important benefits

- **Economics**
  - **Competitively priced & reliable power from BCHydro's integrated grid**
    - **Enabled by large centralized facility sites characteristic of resource plays**
    - **No emissions from electric equipment and reduced carbon tax**
    - **Decreased maintenance costs for electric equipment**
    - **Increased equipment run-time and power reliability**

- **Environment and supporting 'green' LNG**
  - **Greenhouse gas mitigation and managing emissions**
  - **Potential to offset 2.5 – 4 MT/year of CO_2 by electrifying all future Montney development**
  - **~50% reduction of 'well-to-ship' GHG emissions for LNG**

- **Social-license, earning public support for energy projects**
  - **Address stakeholder concerns about emissions and noise**
  - **Support ongoing consultation and engagement with stakeholders**

Issues arising from the transformation in the BC`s natural gas sector

- **Impact on electricity sector - BC Hydro expects significant growth in electricity demand in for gas supply operations in northeast BC region and for the expected LNG plants - plans for new generation facilities, new transmission lines and other electricity infrastructure**

- **Transformation today, think about implications down the road - carefully consider the implications for the environment, the regional economic development implications, and the legacy any project will leave for future generations**

- **Interests of local people matter – earn public support by working in partnership with First Nations on their traditional territories, achieve mutual benefits, build long-term relationships**

Issues arising from the transformation in the BC`s natural gas sector *… continued*

- **Opportunities to do things differently - EnCana is electrifying facilities to improve energy efficiency, improve return on investment, care for environment, maintain their ``social licence``**

- **Industry is cautious due to large investments - $20B for LNG facilities and $30 - $40B including upstream supply, so take a conservative approach and choose natural gas for compression (global standard)**

- **Developing gas resources and new markets is a primary policy goal of BC`s government – new production in NE BC, new LNG facilities, new export markets, natural gas for transportation**

- **Still lots to do – negotiate fiscal regime, industry investment, build First Nations partnerships, time is limited, beat competition**

Synergies in CO_2 Supply and Use in Saskatchewan

Regina Breakfast Roundtable

April 14, 2014

Hotel Saskatchewan, Regina, Saskatchewan

Transformation in the Power Generation Sector Managing CO_2 and Plant Refurbishment

- Coal-fired power plants across Canada are aging
- New federal regulations to limit emissions from coal for power generation
- Regulations are a driver to manage emissions, need to refurbish older units
- Saskpower's Boundary Dam project
  - Refurbishment of one of four generation units
  - Added capture facilities for CO_2 and SO_2
  - Integration with an enhanced oil recovery project and subsurface storage
- A world first, in Estevan Saskatchewan

Boundary Dam - CCS on a Coal-Fired Plant

Steam to Electricity Generator

Enhanced Oil Recovery and Storage Weyburn Oil Field

CO_2 Absorber and Stripper

Subsurface Storage Well

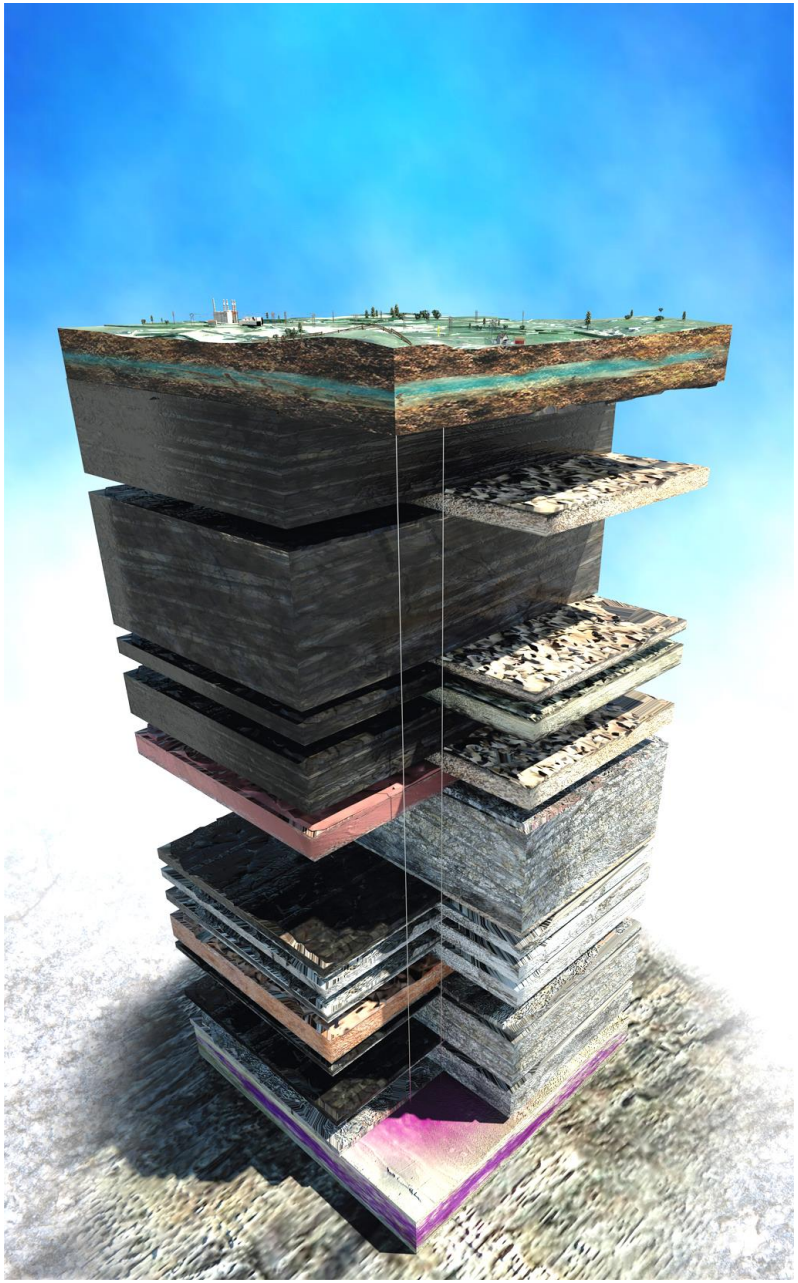
Saskatchewan Coal

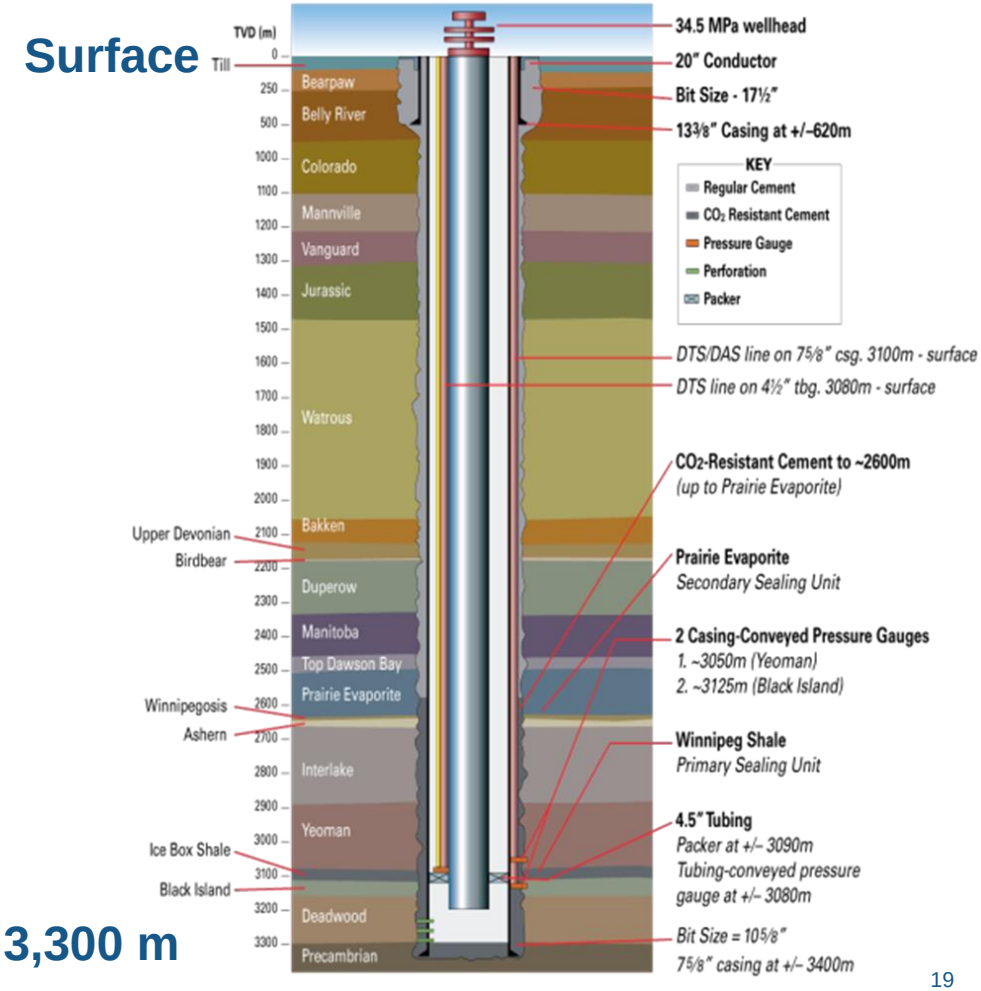
Boiler

SO_2 Absorber and Stripper

Sale of Acid Gas

Aquistore
CO_2 Subsurface Storage and Monitoring Project





Upgrading Infrastructure

Electricity Transmission and Distribution in Ontario

New Energy Infrastructure Takes Time
New HVDC Power Line - Bruce Plant to Milton

- HydroOne project
- A new 176-kilometre 500 kV double circuit transmission line
- Consultations:
  - 11 communities consulted
  - Four public meetings
  - Three Public Information Centres (PIC)
  - One pre-construction PIC
  - 8 First Nations and Métis communities
  - 350 private properties acquired
- Timeline:
  - Public Consultation Start: Oct. 2006
  - Construction Start: March 2010
  - In-service date: May 2012

Transforming Québec's

Transportation Sector

Convertir le secteur québécois des transports à l'électricité et au gaz naturel : occasions, conséquences et préoccupations

Converting Quebec`s Transportation Sector to Electricity and Natural Gas: Opportunities, Implications and Issues

Petit déjeuner-TABLE RONDE à MONTRÉAL

Montréal, Québec

15 mai 2014

Transformation in the Transportation Sector
Québec Context

- 50% of Québec‘s emissions from the transportation sector – all electricity from hydro
- Opportunity to reduce GHGs by transforming the transportation sector
- Electric motors – personal and light-duty vehicles
- Natural gas for freight – heavy-duty trucks

Strong, sustained policy leadership is essential to drive major transformations

2009 | 2010 | 2011 | 2012 | 2013

Action Plan by Hydro-Québec on electrification of transport in 2009-2013 Strategic Plan

Action Plan 2011-2020 of government of Québec on electric vehicles

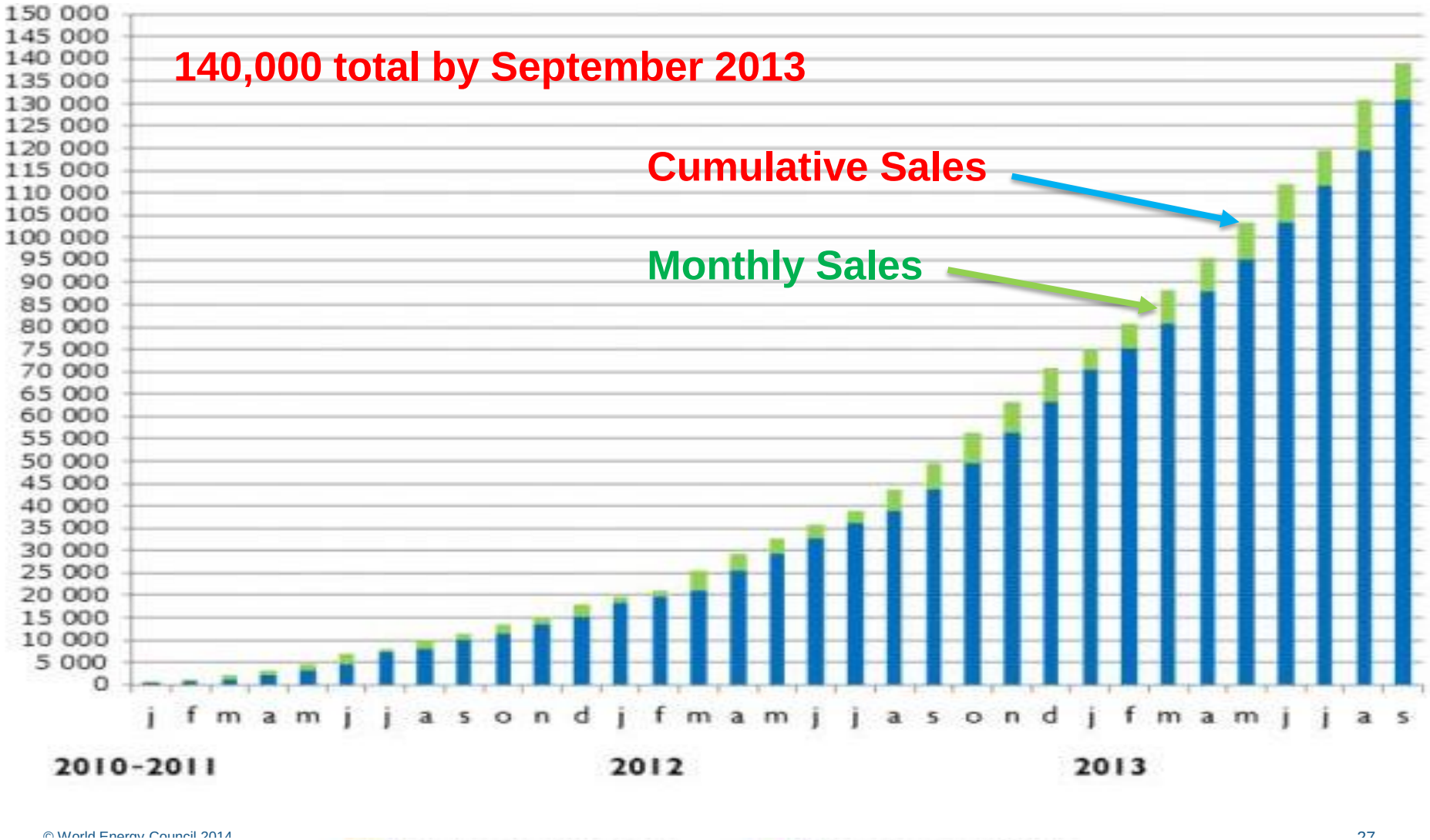
Strategy by government of Québec on electrification of transport

Plus need clear goals and milestones

Québec electrification milestones 2013-2017

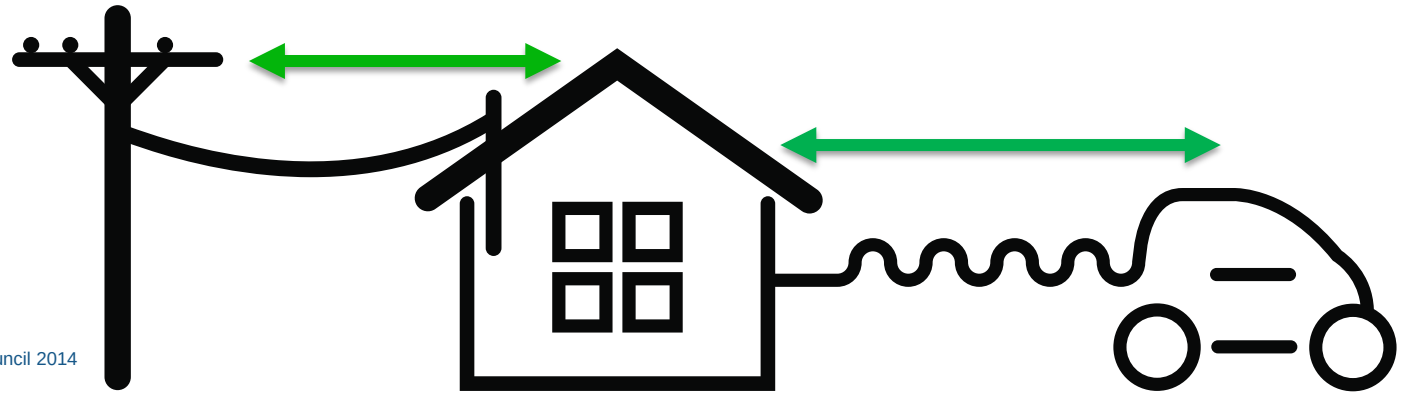
Rechargeable Electric Vehicles	Charging Stations
Up to $ 8,000 for electric vehicle purchase incentive	Up to $1,000 charging station incentive (240V)
Demonstration project for taxi fleet	Up to 5,000 $ for installation of charging stations at workplaces
Electrification of fleet for departments and for public sector organizations	Add 500 charging stations for a public charging circuit
Electric vehicles for the energy department	Rapid charging stations along major transportation corridors
	Add 1,000 charging stations at government buildings for employees and visitors

Purchases of Electric Vehicles 2010 - 2013
US Consumers are responding



Transformation in how electricity is supplied
Vehicles power homes during peak demand periods

- **Use the energy in the vehicle when at home to:**
  - **Feed the Hydro-Québec network in peak demand periods (V2G)**
  - **Feed the home in case of power interruption (V2H)**
- **Develop two-way distribution technologies**
- **Testing in real-world operating conditions**
- **Partnerships with l'Institut de recherche d'Hydro-Québec and Quebec companies**



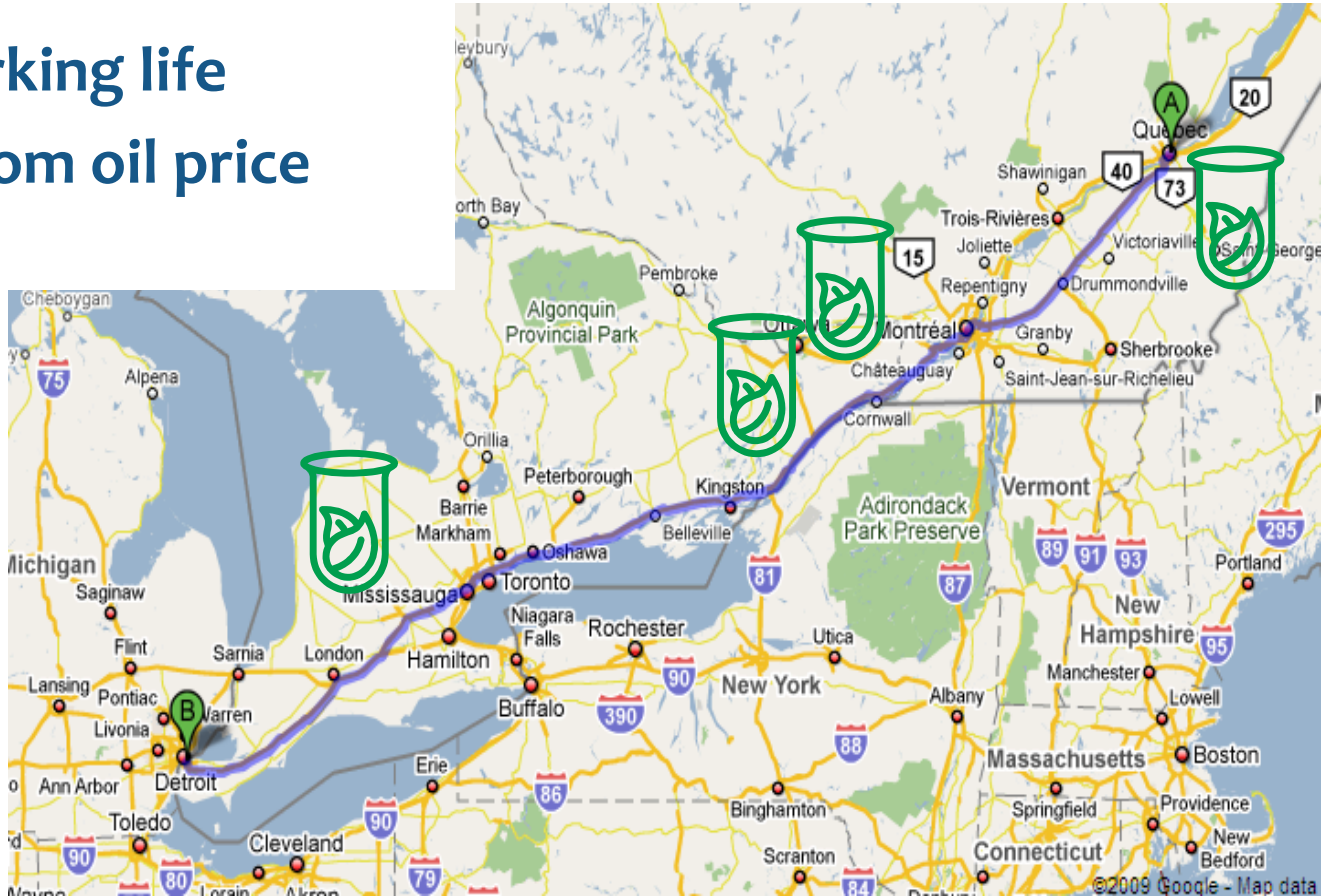
Transformation from Diesel to Natural Gas Heavy-Duty Freight by Transport Robert

Benefits of LNG:

- Energy security
- Reduction of GHGs
- Extension of working life
- Independence from oil price fluctuations

LNG Station

Transport Robert's "Route Bleue"



Transformation from Diesel to Natural Gas Heavy-Duty Freight by Transport Robert

- **LNG Re-fueling Stations:**
  - **Boucherville - opened in September 2011**
  - **Mississauga - opened in January 2012**
  - **St-Nicolas - opened in October 2012**
  - **Cornwall - opened in September 2013**

- **Freight Trucks:**
  - **115 trucks in service, 180 in total ordered – Peterbilt, Kenworth**

- **By the numbers …**
  - **More than 400 trained operators**
  - **1.5 millions de km using LNG per month**
  - **More than $30,000,000 of investment**
  - **Valuable experience with LNG in the transportation sector**

Transformation from Diesel to Natural Gas Challenges Encountered by Transport Robert

- Developing the network of LNG stations
- Availability of engines using LNG from manufacturers
- Sufficient re-fueling stations
- Adapt regulations for LNG trucks and operations
- Retain and improve on energy efficiency gains
- Break the myths around LNG

Observations

2014 Energy Summit

and

World Energy Council
North America Region Energy Forum

June 24 - 26, Calgary, Alberta

Transformation Across the Energy Sector: Past, Present and Future
Four Thematic Tracks

Thematic Tracks	Presentations, Sessions
Perspectives from Governments	• Honourable Diana McQueen, Minister of Energy, Alberta • Kelly Block, Parliamentary Secretary to Minister of Natural Resources Canada • Honourable Rich Coleman, Deputy Premier, Minister of Natural Gas, British Columbia • Gabriel Heller Green, Director General of Investments, Undersecretary of Hydrocarbons, Energy Secretariat of Mexico • ''Energy Conversation – Officials from Canada, United States, Mexico
Energy Sector Overview and Energy Policy	• An Evolving Energy Landscape, Perspectives from World Energy Council, Marie-José Nadeau, Chair, WEC • Transformation in North American Energy Sector: Past, Present and Future • Developing a Canadian Energy Strategy • Earning Public Support for Resource Development Projects
Oil and Gas	• Energy Infrastructure Developments and Implications • Race for LNG Exports • MX – US – CA Dialogue on Oil and Gas Transformations
Electricity	• Technological Innovations in Electricity Sector • Electricity Market Evolution • Dialogue on Electricity Market Transformations

Transformations – CA, MX, US

Ms. Kelly Block
Parliamentary Secretary
Minister of Natural
Resources Canada

Gabriel Heller Green
Energy Secretariat
of Mexico

Matthew Coon-Come
Grand Chief
Grand Council of the Cree

Marie José Nadeau
Chair, World
Energy Council

Javier Estrada
Energy Secretariat
of Mexico

David C. Boyd
Minnesota Pubic
Utilities Commission

Francisco Barnes
Commissioner
Mexico National
Energy Commission

Dean Oskvig
President and CEO
Black and Veatch
WEC NA Vice Chair

Transformations in Energy
Highlights from Presentations and Dialogue

- **NA supply picture has changed fundamentally - significant implications for commodity flows, lower gas prices, changes to generation mix, abandonment of older or higher-cost plants, impacts on traditional markets**

- **Electricity sector impacted significantly - by both technology changes, new generation paradigms, market practices and grid configurations**

- **Policy responds – push for diversification of markets, interplay between gas and electricity markets, new understandings about earning public support**

- **Governments respond – Mexico pursuing aggressive energy reforms, focus on responsible resource development, attention to security concerns, recognize benefits of working together on energy in North America**

What transformations do energy leaders see?

Highlights from the 2015 World Energy Issues Monitor

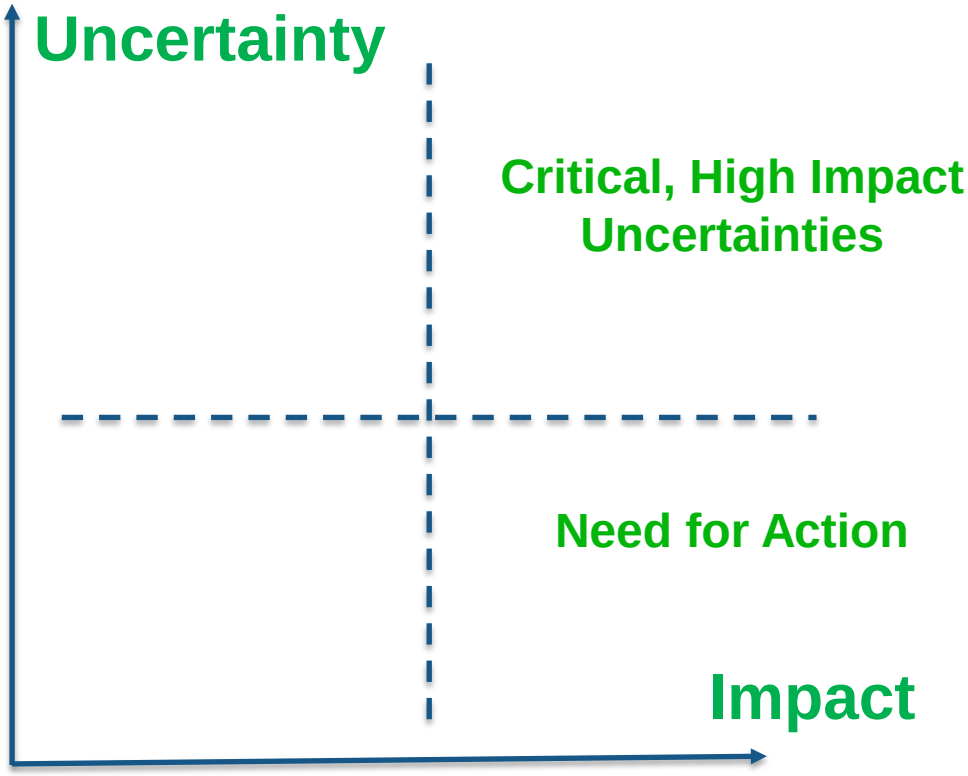
Views of
Global Leaders
North American Leaders
Canadian Leaders

2014 WEC World Energy Issues Monitor

- Survey of energy leaders across the globe to gather their opinions on a common set of energy issues

- Results plotted on a two-dimensional ‘’map” as …
  - Degree of uncertainty
  - Degree of impact
  - Significance

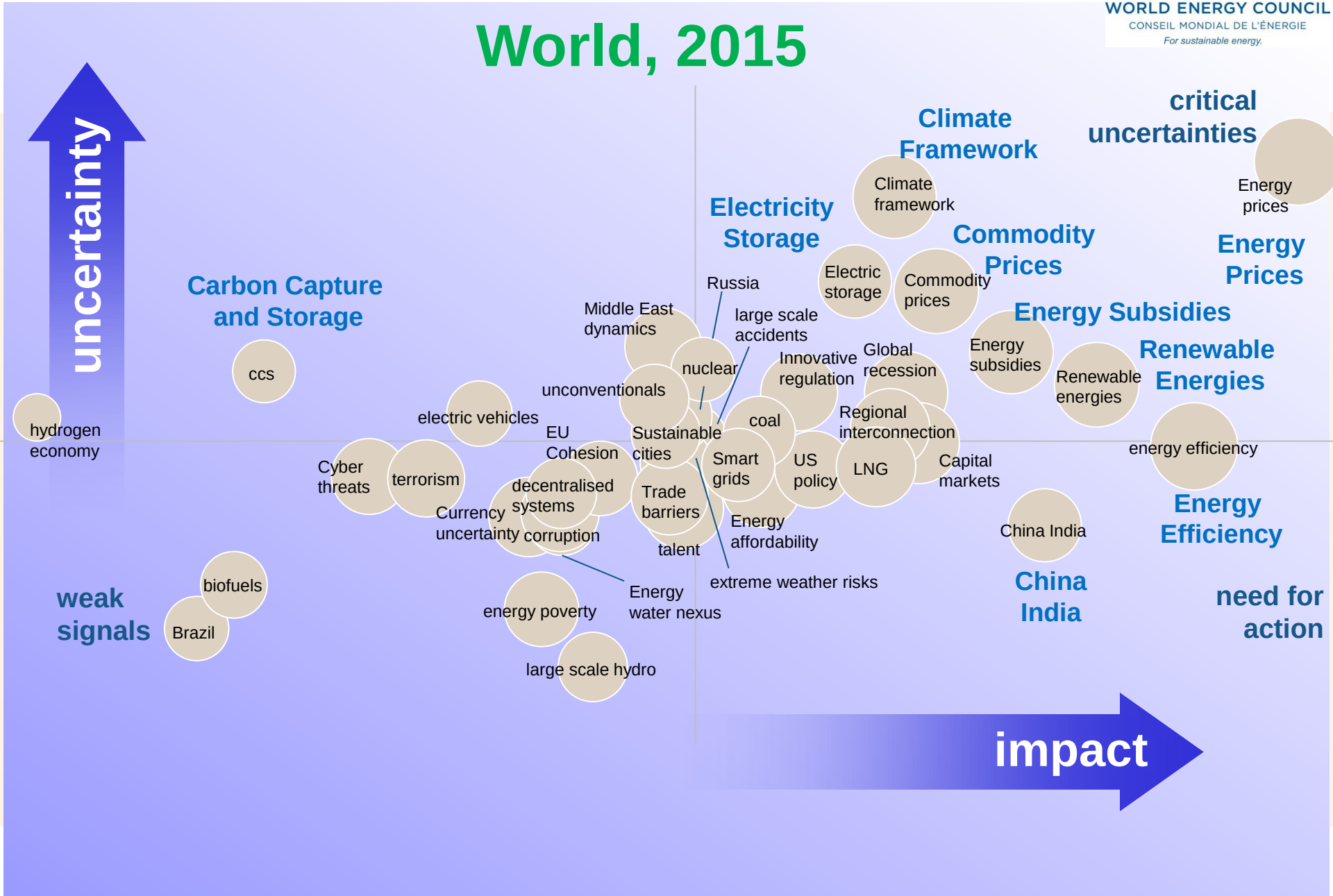
- ‘’Maps” for World, North America, Canada show significant differences



World Energy Issues Monitor

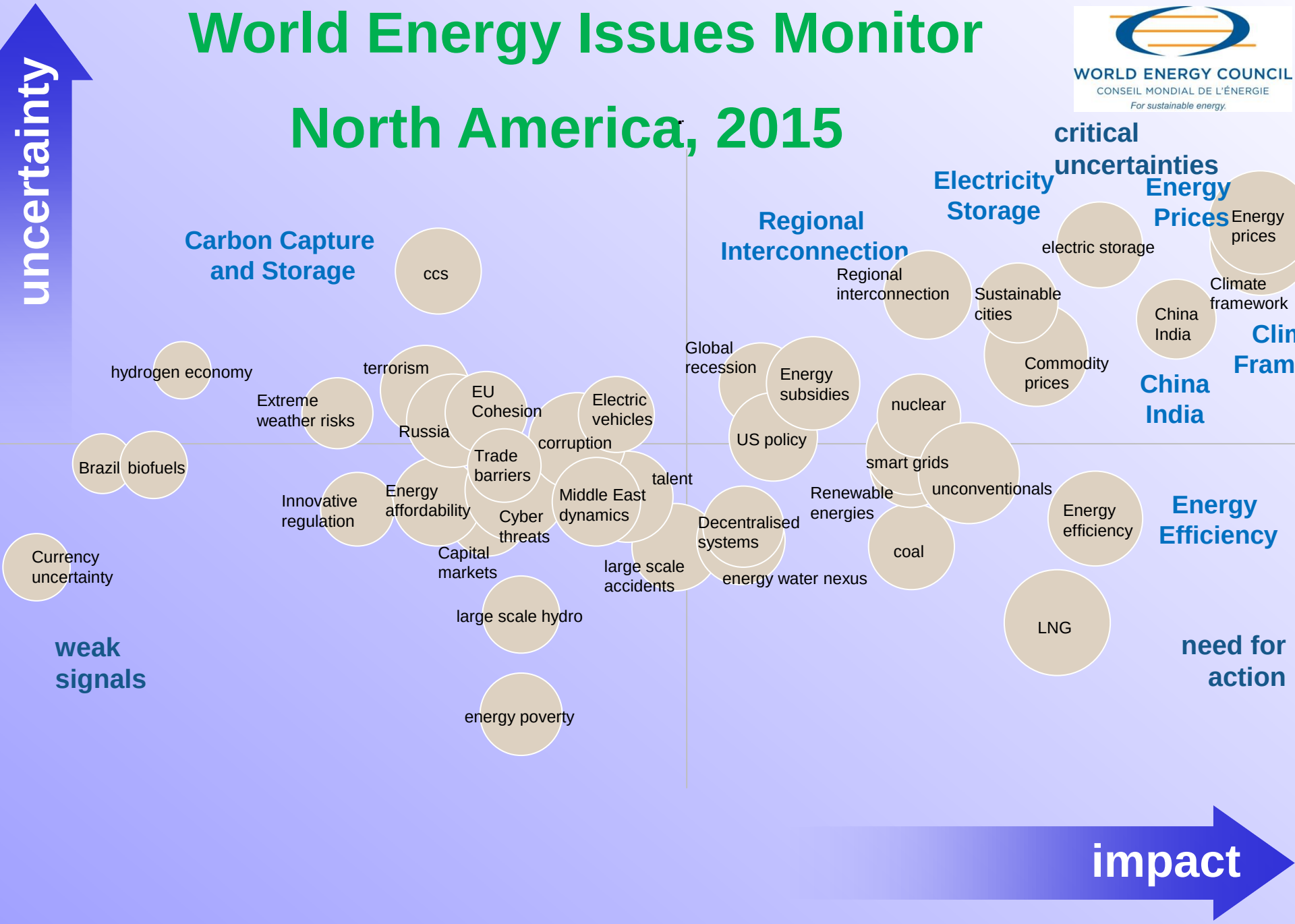
WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE
For sustainable energy.

World, 2015



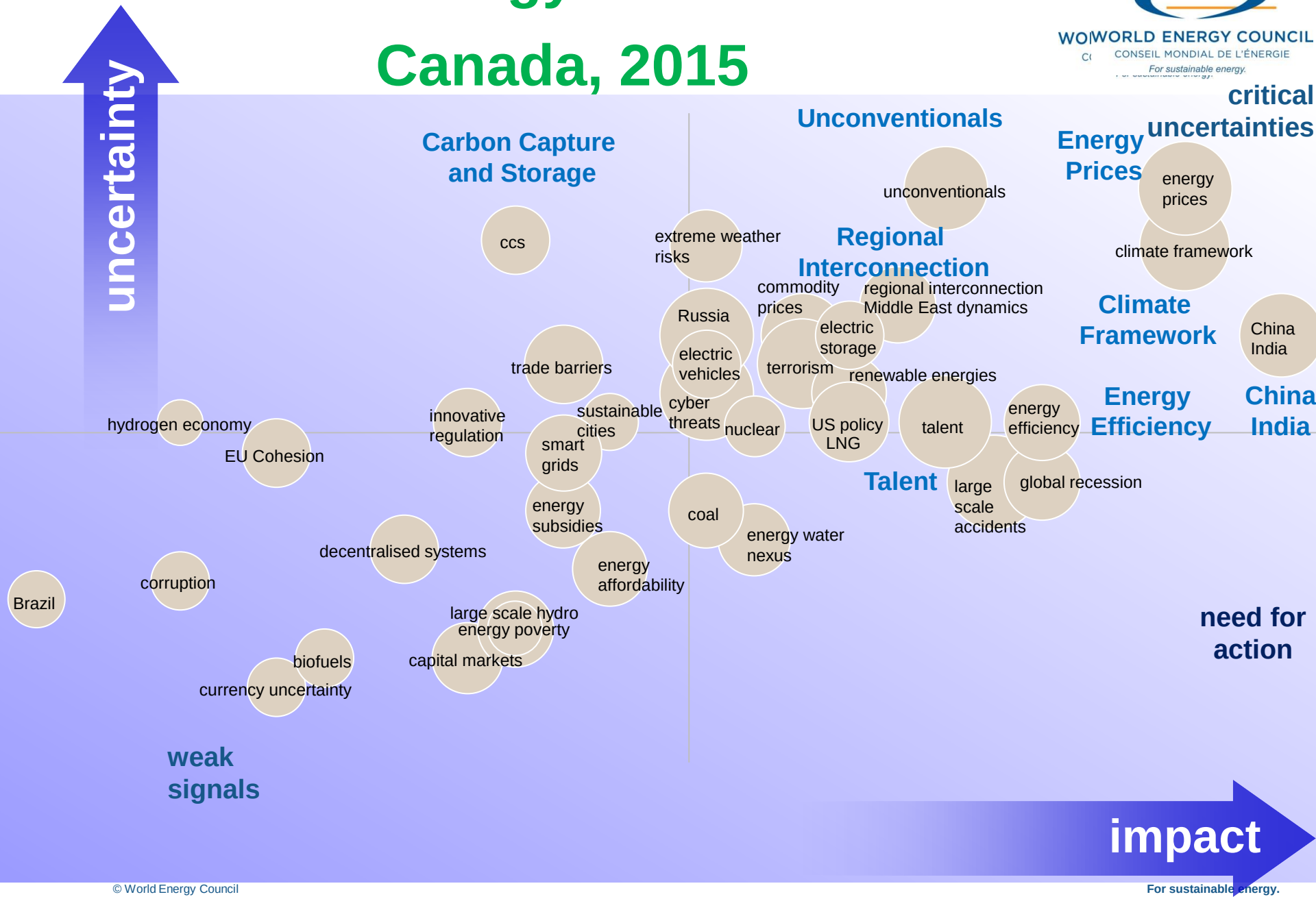
World Energy Issues Monitor

North America, 2015



World Energy Issues Monitor

Canada, 2015



Transformations Across the Energy Sector: Past, Present and Future

Closing Observations

Words of Wisdom
Transformations in Energy Systems

***Energy Myths and Realities: Bringing Science to the Energy Policy Debate*.**
Vacliv Smil. American Enterprise Institute Press. 2012

1. ***"Distrust any strong, unqualified claims re the pace, timing, and extent of future adoption of new energy systems of conversion technologies"***

2. ***"Do not underestimate the persistence and adaptability of old resources"***

3. ***"Do not uncritically embrace unproven new energies and processes – social contours and technical foundations cannot be re-shaped in a decade or two"***

Words of Wisdom About Making Changes in Energy Systems *… continued*

4. ***"Be mindful of extensive, and often very expensive, infrastructural requirements"***

5. ***"Energy transitions are inherently prolonged, typically lasting decades not years"***

6. ***"Let us not have any illusions that persistent myths can be uprooted simply by appealing to reason"***

Source: *Energy Myths and Realities: Bringing Science to the Energy Policy Debate*. Dr. Vacliv Smil. The AEI Press. 2012

Thanks for your attention

Any Questions?

Graham Campbell
Energy Council of Canada

Graham.campbell@energy.ca
613 889 6376

www.energy.ca
www.worldenergy.org

Energy Council of Canada
Conseil canadien de l'énergie


University of Waterloo - Compendium ‘68