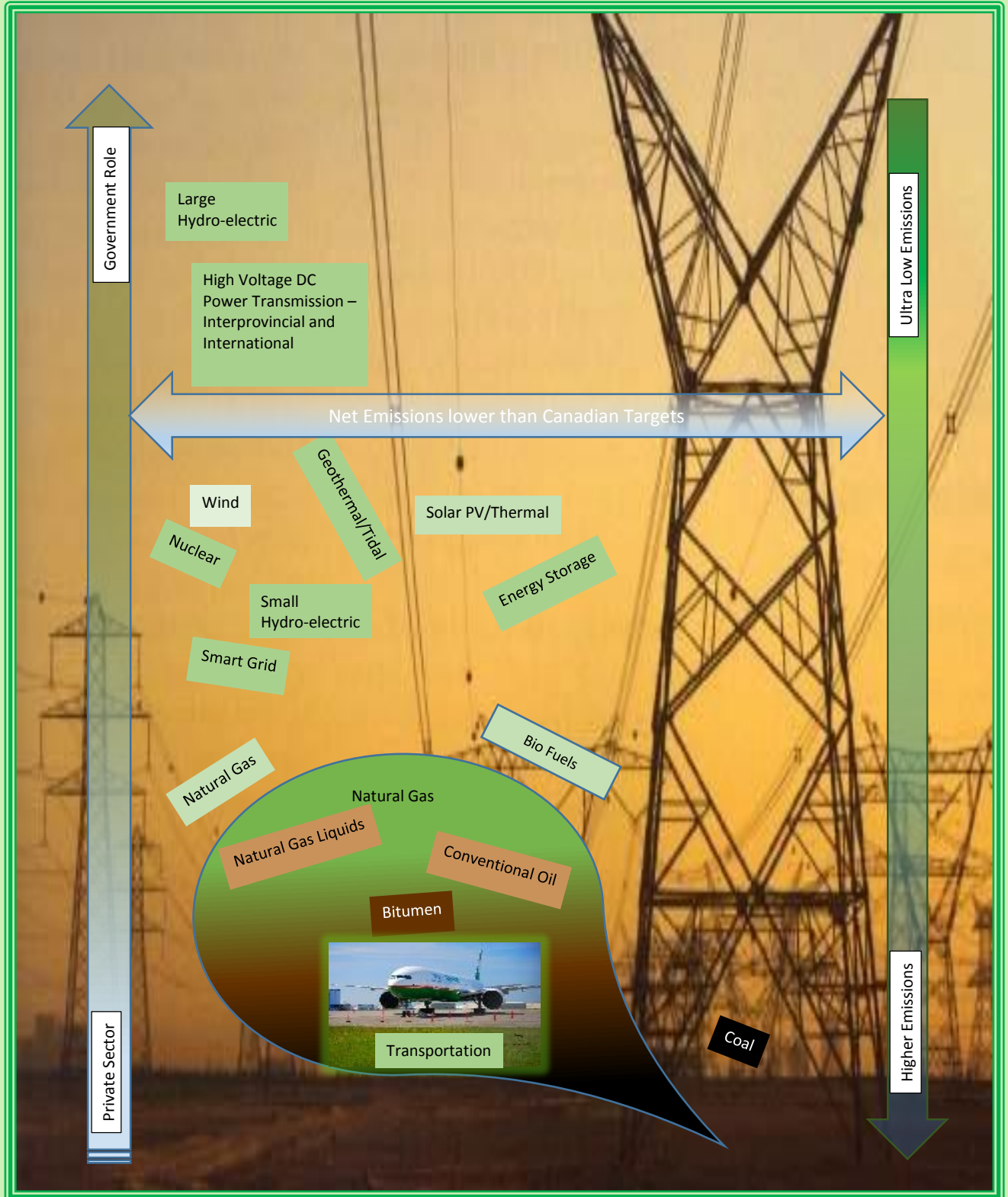




THE BOWMAN CENTRE

Leading Innovation in Canada's Energy Sector



Leading Innovation in Canada's Energy Sector

This document, released in February 2016, has been prepared in part as a response to Canada's Premiers' report, Canadian Energy Strategy, July 2015.

Visionary Big Projects – A History of Canada

Natural resources development in Canada in the past has been achieved by visionary big projects implemented through collaborative public/private sector undertakings.

Twelve early national projects contributed significantly to Canada. They were wide-reaching visionary projects that led to a Canadian innovation strategy. That strategy released a torrent of new entrepreneurial activity and new technology. The resulting “innovation ecosystem” developed value and supply chains which brought these projects to fruition and lifted Canada's national technological and business foundation to a world scale capability and performance.

How were these big projects launched and how were they financed?

They were launched by visionaries who overcame critical obstacles at crucial times. Eight of the initiatives were launched as various government crown corporations with private sector involvement. Five have been divested to the private sector. Four were launched as private sector initiatives with a significant portion of the risk shared by governments. Nine of the twelve large-scale projects are now fully private-sector enterprises. All twelve were successful and continue to generate wealth. They were national projects serving a long-term national interest¹.

What drove those projects?

Those projects did not satisfy the short-term decision criteria used by business to screen and select from an array of business opportunities competing on primarily economic decision criteria. Projects involving movement of people or goods and communications had poor economic justification drivers. This was also true for the five energy projects.

The message is clear: nation-building projects depend on intergovernmental cooperation and take years to reach commercial fruition. Typically, they are not initiated by private companies.

The Present State – Big Projects in Past Fifty Years

There have been too few big project undertakings in the last 50 years. If this continues Canada will forgo major quality job creation opportunities. Billions of dollars per year in wealth generation will be lost and it will threaten our ability to meet our GHG emission reduction targets.

¹ *Canada; Becoming a Sustainable Energy Powerhouse*, Canadian Academy of Engineering, Energy Pathways Task Force Edited by Richard J. Marceau and Clement W. Bowman (<http://bowmancentre.ca/Powerhouse.html>)

Leading Innovation in Canada's Energy Sector

Energy as a System

Historically, energy in Canada has been developed in hydrocarbon and electricity sectors, each with numerous sub-categories². Development of these energy components has been fragmented and not based on an overarching view of energy as a system. That disconnected approach served us in the first three quarters of the 20th century to address local, regional and national issues of the time. Such an approach is not appropriate for the future.

Effecting **real change** requires a 21st century innovative approach that responds to our climate challenges. Such innovation will provide affordable, clean and reliable energy and will promote economic growth critical for Canada's energy security in a carbon constrained world³.

Canada is well positioned to meet the massive changes of our time due to our rich endowment of natural resources, educated and diverse population and proximity to markets. Referring to these advantages Prime Minister Trudeau stated Canada not only will "**manage change, but take advantage of change**"⁴.

One opportunity to effect "real change" is, at a policy level, to view all of Canada's energy sources as part of an integrated "**energy system**". Development of any one energy source must take into consideration the implications on other sources. Doing so would allow the energy system to capitalize on energy related strengths unique to each province and community in order to optimize energy extraction, processing, delivery and use. This optimization would come from maximizing the benefits of each energy source and minimizing the economic and environmental shortfalls of the system as a whole.

Such a policy would affect the direction of change so that investments will lead to growth that is not only smarter (innovation led) but also more inclusive and sustainable⁵.

There is considerable overlap in energy source features. We know electricity can be produced using hydro-electric, nuclear, fossil fuels, solar, wind, bio-mass and other small-scale renewable sources. These sources overlap with energy sources best suited for transportation. Policies that address the strengths and weakness of each to optimize the overall "energy system" would support the Federal Minister Mandate letters which overlap in many areas that involve energy, science, technology, environment and business.

² Hydrocarbons - natural gas, condensates, conventional oil, bitumen. Electricity - hydroelectricity, coal, natural gas, non-hydro-renewables, nuclear and electricity transmission. Biogenic energy sources - transportation fuel ethanol, bio-diesel and bio gas for district heating and small scale electricity power generation.

³ Paraphrased from the **Mission Innovation** mandate per COP21. (<http://mission-innovation.net/>)

⁴ Justin Trudeau, Davos Switzerland, January 20, 2016

⁵ **The Entrepreneurial State: Debunking Public vs. Private Sector Myths**, Mariana Mazzucato, Public affairs, Oct. 2015

Leading Innovation in Canada's Energy Sector

Innovation in a Low Carbon Environment

Canada is well positioned to take advantage of the COP21 agreement. Low emission hydroelectric as well as other non-hydraulic but revenue challenged electricity production could be used to make “emissions room” for revenue rich hydrocarbon development and processing. Although not technically energy sources, innovation in energy transmission systems, i.e. power lines, pipelines, marine, rail, are part of the energy system. East - west and north - south transmissions systems would enable market access for low GHG intensity electricity production which would more than offset transportation and other energy and non-energy industrial emissions.

Moving from the Current State to Potential Future States

In harvesting its raw resources for export, Canada has earned its reputation as ‘hewers of wood and drawers of water’. It is time to reverse this trend and invest in innovative technologies to process those resources into high value products for domestic and international markets. For example, develop new processes to use the unique properties of bitumen to produce high value products such as carbon fibers, graphenes, premium asphalts and other carbon based non combusted products. Doing so would break the paradigm that bitumen’s end use leads to GHG emissions. Continued gas and oil extraction could be enabled, from a GHG perspective, by integrating extraction with the low emission electricity part of the “energy system”. That Low emission power generation may also be configured to store energy for release during peak periods and help integrate intermittent renewable energy sources such as wind farms.

The advent of high voltage direct current transmission (HVDC) makes it possible to technically and economically transmit large blocks of energy over thousands of kilometers. HVDC transmission systems may also reduce transmission system “line Losses”. HVDC makes it possible for large power dams to provide economic peaking capacity at a distance.

Adopting an energy system policy would enable the **Canadian Energy Strategy** vision: “Canada is a global leader in providing a secure, sustainable and reliable supply of energy that is delivered with a high standard of environmental and social responsibility, consistent with efforts to reduce greenhouse gas emissions, and contributes to continued economic growth and prosperity for all Canadians”⁶

Metrics

Associates of the Bowman Centre⁷ have extensive energy sector experience and seek to work with the Council of the Federation to define desired future states and metrics for measuring progress.

⁶ Canadian Energy Strategy, Canada's Premiers, The Council of the Federation, July 2015, Page 11

⁷ www.bowmancentre.ca Bowman Centre Associates have several hundred years of cumulative energy sector experience.