



# Energy Compass

# 2020



and beyond

A Recommended Canadian Energy Decision Framework.

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## **A Recommended Canadian Energy Decision Framework --- A Corollary**

### **Introduction**

This Report prepared by the Canadian Society for Senior Engineers (CSSE) intends to provide a compass direction going forward into the next decades, taking into consideration the realities facing the Canadian Energy Industry and the impact decisions will have on the well-being of Canadians in the remaining first half of the 21<sup>st</sup> Century. This Report Builds on the pioneering efforts of those early Canadians who possessed the vision, engineering skills and entrepreneurial spirit to build Canada's existing energy systems that are the backbone of our collective endeavours and well-being. The CSSE recognizes ongoing work to enhance existing technologies and to develop new energy systems to meet growing demands for sustainable energy sources.

The CSSE is cognizant of the different levels of government and their jurisdictions in energy related policies, as well as the variety of options and different economic potential in each of Canada's Provinces and Territories with respect to the exploitation of their inherent energy resources. This Report provides a National overview of direction to meet Canada's energy needs in a coordinated manner in the coming decades. It encourages and promotes policies that will maximize the well-being of all Canadians, building on our existing engineering expertise and know-how and inherent resources.

New technologies are being developed that can be exploited within an overall Canadian energy decision framework, rather than being dealt with in an uncoordinated and ad-hoc manner, as appears often to be the case today. This Report points out existing Canadian energy strengths and builds on those for the coming decades in a coordinated way forward. Leadership is required at this time to define a national alignment of our Canadian energy future as a key element of our national identity.

This Report by experienced senior engineers with diverse leadership backgrounds, provides an evaluation of the various forms of energy production, distribution and use in Canada, and makes recommendations on elements that might be considered in establishing a vision for fulfilling Canada's sustainable energy needs. Among several recommendations that would lead to an effective exploitation of Canada's diverse indigenous energy resources, it particularly supports, in priority order: 1) continuing development of our uranium natural resources and increased use of nuclear power; 2) expanded utilization of our water resources via large and small hydro development with concurrent use of stored water as a "smart grid" energy storage medium; and 3) use of our natural gas resources in gas-fired combined cycle electric power plants. This Report supports a Canadian Energy Decision Framework leading to a comprehensive, regionally

cooperative, nationally coordinated regulatory and strategic environment for energy exploitation for the well being of all Canadians.

## Major Energy Market Transformations

Historically, there have been several major energy market transformations:

- 1) from biomass to coal and steam as an energy currency in the industrial revolution,
- 2) from hydro mechanical to hydro electrical at the turn of the century,
- 3) from coal by rail to oil and gas by pipeline and from static energy use to individual mobile energy use following the first world war,
- 4) the advent of nuclear power after the second world war,

Now with the ubiquity of electrical currency distributed widely via electrical “grids.”

## New Energy Market Transformation: Sustainable Energy

The world is on the cusp of a new major energy market transformation:

- 5) the current thrust towards sustainable energy systems.

## Canada’s Leadership Potential

The late decades of the 20<sup>th</sup> century and the first decade of the 21<sup>st</sup> century saw a world-wide emergence of concerns about the earth’s environment and a growing awareness of the need for sustainable energy. It is important for Canada to provide an *energy decision framework* that will be vital to enhance and focus the disparate moves towards sustainable energy systems. One of the biggest tasks facing governments is what to do about the twin problems of tough carbon-emission targets and the looming crunch in electricity generation. Canada has the potential to be a leader among nations in the continuing development and application of indigenous resources and advanced technologies. Leadership and national alignment with reference to a clear energy framework for the future will be needed for Canada to achieve its potential as an energy superpower in traditional and newly developed sustainable energy systems. Energy production and use optimization represents Canada’s best chance for a sustainable competitive advantage.

## Current State of Canada’s Energy Resources

As the quality of life of modern society depends on having sufficient, affordable energy available for its development, Canada is fortunate to possess bountiful and richly varied indigenous energy resources. At the same time, international demand for energy is growing rapidly and this provides Canada with considerable new economic opportunities.

However, Canada’s power generation and delivery infrastructures face many challenges to meet the increased energy demand from industrial growth, its population and exports while at the same time responding to increased international and domestic pressure for environmental sustainability and more stringent regulations. Required is an efficient and environmentally benign energy resource extraction and processing infrastructure, the early replacement of

inefficient and aging electrical grid infrastructures and generating facilities, and significant improvements in vehicle efficiencies and transportation infrastructures.

Developing and using our energy resources effectively requires that attention be paid to economic viability, sustainability, distribution and to the potential impact of exploiting them on the environment.

## **The Way Forward**

Within that framework of external and internal constraints and opportunities, the Canadian energy sector faces a competing world market for energy production, with a trend developing towards a mix of electrical energy sources from Canadian produced as well as imported technologies. Canada's leadership position in the energy sector is being challenged by potential importation of foreign systems which have the potential to supplant Canada's advanced technologies in energy generation.

CSSE provides a fresh look to guide our collective actions to reflect the mandate of governments *"To enable and enhance the well-being of Canadians"* as base policy criteria. Balancing the complex and interactive demands and opportunities requires a Canadian Energy Decision Framework as the foundation for a regulatory and strategic decision-making regime that encourages safe, measured, effective and market-driven exploitation of various energy resources while assuring that public interests are taken into proper account.

There are a number of energy generating options that would fill the gap between immediate increasing demand and major expansion of large scale electricity generating capacity. Within that category falls the conservation of energy in our homes and buildings, which is slowly making inroads into the Canadian building and construction sector, thus reducing energy demands. An infrastructure and enabling technology to conserve energy being used and conveyed electrically is required to address the need for development and penetration of "smart grids" both at the energy user, supplier, provincial and interprovincial, national, and international levels. Increased vehicle efficiencies can be achieved through improved design.

Equally, addressing the challenge of aging plant replacement, nuclear plant life extensions and increasing growth provide opportunities to use Canadian indigenous natural resources of uranium, natural gas, building small and upgrading existing hydro, coal, oil and possibly geothermal, wind, solar and tidal. Recognising the limitation of the latter three, stemming from their intermittency is the need to 'backstop' these sources to ensure continuous supply.

The use of nuclear, large scale hydro and natural gas rank the highest in terms of sustainability and contribution to the well-being of Canadians. These options meet established environmental guidelines and provide long term reliability of electrical energy supply.

Canada's oilsands are a unique world-scale resource and will require continuous technology research and development to ensure their potential contribution to Canada's energy supply and economy is not prematurely attenuated by sustainability concerns. Similarly, Canada's nuclear

industries must be safeguarded and strengthened to meet world wide competition for advanced development of this high energy output, low greenhouse gas emission technology.

## National Vision

There is an urgent need to bridge the gap between federal and provincial jurisdictions looking at Canada's overall energy network as a national resource to be built and utilised to the optimum benefit of all Canadians, while strengthening Canada's internal trade and industrial development. This, among such things as streamlined regulations, can manifest itself in a national grid of east-west oriented interconnections, to optimize the flow of energy across Canada's six time zones and industrial landscape.

## CSSE Study - *A Recommended Canadian Energy Decision Framework*

The above summarizes a study conducted by the CSSE using a methodology that identified Canada's currently-recognized 26 "energy alternatives", the general things that we Canadians can do, and are doing, regarding energy, and ranked those energy alternatives according to their relative importance (or "relevance") to maximizing the future well-being of Canadians.

Energy decisions affect nearly all aspects of our lives. Therefore a "relevance tree" (or "means-to-an-end construct") approach has been used to provide a systematic evaluation of each energy alternative. **Each energy alternative was evaluated according to its relevance to the health, security, economic and education criteria affecting the future well-being of Canadians.** The ranking results from those evaluations. The 26 energy alternatives comprise: (a) the use of the 10 primary forms of energy indigenous to Canada, (b) the 10 general energy-conservation measures, and (c) the exporting of 6 forms of energy surplus to Canada's energy needs. The major conclusions reached, in the context of maximizing the future well-being of Canadians, are:

- (1) Use of our indigenous energy far outweighs using imported energy;
- (2) Conservation of energy outweighs exporting our surplus energy;
- (3) For provinces without extensive hydraulic energy ("hydro") potential the best energy alternative is to use our indigenous uranium in the form of nuclear energy, followed by indigenous natural gas, oil, coal, biomass, geothermal, wind, solar and tidal in that order.
- (4) Improving the energy efficiency of our buildings, energy use in transportation and reducing wastage of energy rank highly;
- (5) Canada needs a nation-wide, smart electrical grid, mainly for security and economic reasons, particularly with the growing incidence of brownouts, blackouts, and the possibility of cyber attacks on electrical plants and control systems.

For further copies of this document or the CSSE Report entitled "*A Recommended Canadian Energy Decision Framework*" please email Arnold Eyre at [arnoldeyre@hotmail.com](mailto:arnoldeyre@hotmail.com).