



## Energy in Canada @ 150 and Beyond

### Energy Transition in Canada – A Chance to Work Together

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*One in a series of papers prepared by Canadian energy sector leaders – at the invitation of the Energy Council of Canada – exploring key aspects of our ongoing national energy story on the occasion of the 150<sup>th</sup> anniversary of Confederation.*

**Summary:** Arne Wohlschlegel calls for the embrace of a zero GHG emission goal for conventional power generation, based on a diversified portfolio and balanced approach. Canada is positioned to play a growing role both as energy supplier and in global climate efforts. Electricity decarbonisation alone will not, however, be sufficient to achieve our goals, making “sector coupling” essential. Digital technologies such as 3D printing, additive manufacturing, and blockchain-enabled microgrids will also enhance efficiencies and create other new opportunities. Wohlschlegel closes with a call for collective vision, and decisive action and investment, in support of Canadian leadership in the energy transition.

#### Multiple Paths to Zero Emissions

It's widely accepted that we have to strive for sustainability in the energy sector. Aspiring to lower GHG emissions in all sectors is essential and the industry is well on its way with decarbonisation initiatives. An increasing number of electricity generating assets are non-emitters and support goals set by the Paris Climate Change Agreement. According to the climate protection plan, greenhouse gas emissions have to be reduced by 55 percent by 2030, and by at least 80 percent by the year

2050. In order to achieve further decarbonisation, the conventional power generation sector – which will also be necessary in the future – now has to be redesigned to use less CO<sub>2</sub>-intensive technologies.

Canada, in particular, scores high in global comparison with our large non-emitting electricity generation portfolio. A zero GHG emission goal for this sector is no longer a theoretical concept – it is indeed possible – and this new reality is one we must embrace, and in fact, help create.

Certainly there are multiple pathways to that destination. Hydro, wind, solar and nuclear represent carbon-free fuel sources for generation. Clean, affordable natural gas or biomass fuels as a low-carbon fuels cannot be ignored along this journey of transition.

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#### The conventional power generation sector now has to be re-designed.

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There are pros and cons for each path forward when social, environmental, technical and commercial aspects are evaluated. Modeling outcomes carry a lot of uncertainty as disruptions are difficult to predict. The challenge will be to agree on the “best” solution



for our society. Every energy faction promotes their own fuel technology as the best fit, but energy experts also agree that a diversified portfolio and balanced approach will likely result in a feasible outcome. There is no question that the transformation of our energy sector will be a road trip with some trial and error.

Right across the energy sector, there are ways to use today's technologies, to enable sustainable, successful energy solutions. Imagine, for instance, a natural gas fired turbine power plant that switches to hydrogen fuel and thereby eliminates carbon dioxide from exhaust emissions altogether. While this is currently in the development phase, it illustrates the potential of incorporating new technologies into existing assets in a way that benefits the environment and the business case.

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### An important energy source presents one of our biggest challenges: fossil fuels.

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Energy leaders in this country have been talking about the future energy transition for years and a few have in fact started to invest in new technologies that appear promising. They realize that the traditional way of doing business is not going to work in the future and that something new and disruptive is needed. Others in the sector find a cautious approach more prudent, and wait for regulatory certainty or for technology trends to reach maturity. Change can be hard. It takes vision, leadership and commitment.

In general, Canadian companies are well positioned to become leaders in sustainable energy. As a resource-based country, Canada has long been an energy supplier to the world, and to achieve success going forward, this country can maintain and even increase that global contribution. World leaders met at COP23 in Germany in mid-November, and with the US withdrawal from Paris commitments, the opportunity is there for Canada to take a strong leadership position in global climate efforts. Energy is a major factor in meeting the COP goals and our industry can drive change for the future.

An important energy source presents one of our biggest challenges going forward: fossil fuels. Clearly, this industry will continue to play an important part in our energy mix for the foreseeable future – but this must happen in the larger context of decarbonisation. Canada is on the path to exit from coal, but oil and natural gas remain important commodities for export that can provide global GHG reductions if used to replace coal-fired generation. They are also key to continued economic growth and prosperity in Canada.

### Sectoral Linkages Will be Key

Can the climate goals be achieved if only the electricity supply is decarbonised, since it accounts for only 11 per cent of Canada's CO<sub>2</sub> emissions? That will be far from enough. It is vital to link various sectors such as oil and gas, transport, buildings and industry more closely to the energy sector, often referred to as "sector coupling". E-Mobility for example, demonstrates this coupling. In areas where electrification is not widely effective yet, such as in aviation and shipping, green fuels may be the answer. Hydrogen produced through renewable energies (aka "Green Hydrogen"),



can play a key role as an energy source as well as a basic material in refineries and industrial processes. Siemens' expertise in electrolyzers provides an outstanding basis for power-to-gas technologies. Hydrogen also makes it possible to store excess electrical energy produced by photovoltaic and wind systems.

Siemens is working with Hydrogenious Technologies; Dr. Daniel Teichmann, of HT, has explained, "It is possible to store hydrogen safely, as it is bonded to what is known as a Liquid Organic Hydrogen Carrier [LOHC]." One cubic meter of LOHC carrying hydrogen replaces approximately 60 gas cylinders, and the hydrogen no longer needs to be transported in molecular form. Instead, with this chemical storage method, the cargo consists of a low-flammable, non-explosive oil. Already, Siemens and our partners have commissioned the world's largest hydrogen electrolysis facility located in Germany and known as the Mainz Energy Farm.

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### Efficiency has to be the goal across the energy sector.

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Back in Canada, Alberta has committed to the Climate Leadership Plan that will phase out pollution from coal-fired energy production by, or perhaps before, 2030. Siemens has partnered on two projects with immediate, positive environmental implications that allow the province to fully harness Alberta's abundant wind power: the Western Alberta Transmission Line, and the Eastern Alberta Transmission Line. These new transmission lines feature bidirectional flow of power, the ability to carry energy from north to the south, and from south

to north. The south to north energy is largely derived from wind power. These systems are up to 50 per cent more efficient than previous systems and amount to a CO<sub>2</sub> reduction of 350,000 tonnes annually. The environmental benefit is equal to taking approximately 75,000 cars off the road<sup>i</sup>.

Another significant achievement is the Smart Grid Innovation Network (or SGIN for short), a collaboration between Siemens, NB Power and the University of New Brunswick. The SGIN is helping to create an ecosystem for smart grid related businesses, as well as start-ups, to have access to lab environments that support the development and solidification of their concepts and ideas; and provide an environment to test products and services for interoperability, and to conduct utility grid impact and customer acceptance testing on the path to commercialization.

Storage and transmission efficiency is vitally important. In fact, efficiency has to be the goal across the energy sector. Canada's generous supply of hydro power and fossil fuels has historically suppressed the need for efficiency – in the days before the impacts of global warming were understood, it simply felt as though there was enough energy, regardless of loss in transmission or production. That can no longer be the attitude.

### Becoming Digital Enterprises

When it comes to innovation that supports sustainability, digitalization plays an undisputed and important role moving forward. The World Economic Forum puts it plainly – *To survive disruption and thrive in the digital era, incumbents need to become digital enterprises, rethinking every element of their business.*<sup>ii</sup>



Consider technologies like 3D printing and additive manufacturing.

Siemens has advanced the development of 3D-printed gas turbine blades. The new 3D process has reduced production time on new prototypes from two years to two weeks. Additive manufacturing is also making an enormous difference in heightened efficiency when it comes to rapid prototyping – and it will not stop at the prototype stage. Additive manufacturing has been used to produce gas turbine blades that were successfully performance-tested under full-load conditions. That opens a window to unprecedented manufacturing opportunities in the future.

Another technology coming to play more and more in the energy sector is blockchain. Blockchain enables microgrids to document transactions amongst parties – a small number of households in a neighborhood perhaps – and microgrid controllers enable the energy produced by one house via renewables to move to the next house. Blockchain records the transactions as neighbours buy and sell energy from one another. This concept is already becoming reality in Brooklyn, New York where Siemens and LO3 Energy are testing a microgrid that allows neighbors with and without solar panels to buy and sell solar power from each other on a blockchain platform that automatically documents each transaction. If a hurricane should hit, this isolated network could operate self-sufficiently. Innovative and disruptive technologies that enable more consumer choice, such as peer to peer energy trading, will need to be considered by the energy sector moving forward.

Unlike a microgrid, however, the energy transition and climate change mitigation cannot

be achieved in isolation. No one country or one business, no matter how large, can accomplish this on its own; neither can one sector – like our energy industry, for instance.

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### Every corporation with an energy sector footprint faces big decisions.

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Making our world more sustainable requires the involvement of everyone – the academic universe, industry, the population at large, and, perhaps especially, governments. Every corporation with a footprint in the energy sector is facing big decisions – decisions about phasing out certain elements of their business, decisions about developing sustainable alternatives, and especially decisions about major investments that will shape our collective future. Governing leaders need to create frameworks that enable and accelerate the deployment of energy-efficiency and low-carbon technologies.

### **We Won't be Judged on our Past**

Siemens has built a strong foundation over the last 170 years, leading the way in innovation and adaptability, but when it comes to what needs to be achieved tomorrow, those historic accomplishments really don't matter. Because we will not be judged on our past – but on our present, and on our preparedness for the future.

Siemens offers a broad portfolio to help customers become more sustainable. In 2016, the Environmental Portfolio generated revenue of €36 billion and represented 46 per cent of Siemens' total global revenue. It helped clients reduce their CO<sub>2</sub> emissions by 521 million tonnes in that same time frame.



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Worldwide, Siemens has also publicly committed that production facilities and buildings will achieve a net-zero carbon footprint by 2030, and CO<sub>2</sub> emissions, currently 2.2 metric tonnes annually, will be cut in half by 2020. This goal means an investment of €100 million in energy efficiency projects at its facilities.

It is time to be bold, to adopt sustainability as a business plan and understand the pioneering role organizations play in the fight against climate change. There is a need to shift our thinking about how to view sustainability – it is not simply an environmental necessity, it is also an opportunity for competitive gains.

For Canada, the path forward is a one we must travel together. With courage, vision, decisive action and investment, the Canadian energy industry can seize the opportunity to prove itself as a world leader.

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<sup>i</sup> As calculated by the United States Environmental Protection Agency Greenhouse Gas Equivalencies Calculator (<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>)

<sup>ii</sup> From the report "Digital enterprise: established players must reinvent themselves" (<http://reports.weforum.org/digital-transformation/digital-enterprises-established-players-must-reinvent-themselves/>)