Canadian Energy Leaders’
Insights and Recommendations
on Energy in Canada @ 150 and Beyond
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FOREWORD

Energy in Canada @150 and Beyond | Energy Leaders Commemorate Canada’s 150th Anniversary

BY GRAHAM CAMPBELL
Past President, Energy Council of Canada

Foreword to 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 150th anniversary of Confederation.

ENERGY: INTEGRAL TO CANADA’S STORY

Energy has always been an integral part of Canada’s story. From the beginning, Canadians have looked to energy for comfort, as a route to development of the country’s abundant natural resources, and as a source of economic activity that contributes significantly to societal well-being. Examples are many: from the early use of fire for warmth, to the pre-Confederation discovery of oil, to the first hydropower developments along eastern Canadian rivers, and to wind-DC systems on the Prairies.

The energy story continues. Today, energy is a prime mover in the Canadian economy, a critically-important component of our balance of payments, a source of investment and jobs, and a route to social development for our communities and First Nations.

Looking ahead, Canada’s energy outlook is positive. Many promising directions are apparent: clean technology, evolving market practices, finding a prudent balance between energy impacts and the environment, and the furtherance of energy’s role as a contributor to Canada’s regional development and growth.
As Canada celebrated its 150th year, the Energy Council of Canada gathered articles authored by energy leaders on topics of their choice. Their perspectives, based on executive and operational experiences in Canada’s energy sector, are most interesting.

The articles in this collection will enhance the understanding of the important roles that energy will play in Canada’s economic, social and regional development for the next 50 years. The current and future energy scene has provided a rich spectrum of material.

ISSUES FOR CONSIDERATION

Here are a few considerations which will have a bearing on Canada’s energy future to 2067:

- International, national, and provincial policies will drive a gradual decarbonisation of energy systems. We will see different pathways and paces of change, but the broad direction towards low-carbon energy is clear, driven by a growing public interest. What will the evolution of low-carbon energy systems look like, what are the important upcoming milestones, and where are the ‘sweet spots’?

- Consumers have become much more engaged in energy matters. For example, the cost of energy has emerged as a key issue. Consumers may be willing to pay a bit more for clean energy, but not a lot more. Public feedback in Ontario due to increased electricity prices confirms this. How can we raise awareness of the energy “value equation” and the fact that improved environmental performance costs more?

- Major energy projects also attract widespread attention. Are we making progress on understanding how best to incorporate the interests of affected parties such as First Nations and communities into the earliest interest-based dialogue between the proponent and the people? Can this mutually respectful dialogue continue into the design, construction, operation, and monitoring of the project? How can the decision-making processes be amended to achieve well-balanced energy decisions?

- For the end-use sectors, what are the breakthrough developments that will reduce costs and accelerate major improvements in environmental performance? Biorefineries, electric vehicles and natural gas for transportation, industrial process improvements, and Zero Net buildings are all in sight now. What’s coming next to make further major gains?

- To date, new technologies such as wind and solar are being put to use, in part as a result of technology-specific financial incentives and major reductions in supply costs. Will energy leaders envision and implement systems which integrate generation from wind, solar, biomass, tidal, and hydro – together with natural gas and energy storage – in clever, synergistic, and cost-effective manners?

- What technologies are most likely to see major decreases in equipment and operating costs, akin to the recent dramatic reduction in cost per watt for solar panels?

- How do we mobilize innovation in technology and policy and garner the essential investment to put new solutions to work?

- What do energy leaders see for the evolution of nuclear energy? Will small modular technologies emerge for providing both electricity and heat? Is a good solution at hand for managing waste, and will re-processing and re-cycling spent fuels be part of nuclear operations in the future?

- How will producers of energy commodities including bitumen, natural gas, oil and uranium respond to expectations of reduced environmental impact from their upstream and downstream operations? Technology and advanced operating practices are already a significant part of the answer. The sharing of new technologies through mechanisms such as the Canadian Oil Sands Innovation Alliance will be a key part of the story.
Looking at the North American energy market as a whole, and recognizing that the bulk of energy trade is bilateral across borders, will a case emerge for enhanced continent-wide energy trade to the advantage of both exporting and importing countries? How will access to new foreign markets impact the energy market in Canada and North America?

Looking at corporate strategy and the direction of future large-scale business investment, will the trend to “energy companies” continue, or will more specialization occur to achieve “pure play” efficiencies? What impact will the transition to low-carbon energy have on corporate strategies and investment patterns?

DURING 2017

The energy leaders’ articles have been posted on our website and social media channels as they were received. We hope that they have inspired dialogue and critique, and that this will happen more broadly through the publication of this e-book compilation and its dissemination within the energy community.

The articles have been grouped in this publication under four headings according to the general theme and content of each:

- Energy Transformation and Innovation.
- Aboriginal Energy Business.
- Canada Needs All Energy Forms and Technologies.
- Some Closing Observations.

The Energy Council of Canada trusts that this project has shone an interesting light on how Canada’s energy leaders foresee aspects of Canada’s energy future from now to 2067.

Graham Campbell was appointed President of the Energy Council of Canada on December 16, 2013. Graham has a broad perspective on energy issues based on his work in a range of energy sector organizations engaged in exploration, energy regulation, technology development and policy research.

After starting in the oil and gas industry with Shell Canada Resources, Graham’s career progressed through roles in government and regulatory agencies culminating as Director General, Office of Energy Research and Development, Energy Sector with Natural Resources Canada from 1997 to 2008. Graham’s earlier experience included the National Energy Board, the Canada Oil and Gas Lands Administration, and the federal departments of Energy, Mines and Resources and Indian and Northern Affairs. Following his work at NRCan, Graham undertook policy research at the Conference Board of Canada and he led the Carleton University Sustainable Energy Research Centre as its Executive Director. In the area of international energy collaboration, he served as the chair of the International Energy Agency’s senior technology committee, and he co-chaired the International Partnership for the Hydrogen Economy.

ENERGY POLICY, DECISION-MAKING, AND FOSTERING INFORMED ENERGY DIALOGUE
A NATIONAL ENERGY STRATEGY
The Holy Grail of Canadian Public Policy

BY DR. ROBERT SKINNER
President of KIMACAL Energy Strategies Ltd (a private advisory service); Executive Fellow, School of Public Policy and Energy Research Advisor to the President, Research, University of Calgary

Summary: Robert Skinner’s article traces the successive series of energy policy initiatives, starting with the 1842 launch of an assessment of the country’s mineral and resource potential, to more recent environmental and energy strategy initiatives. Two immutable realities strongly influence the evolution of energy policy-making – the widely-varied nature of Canada’s resources and geography, and the constitutional and legal provisions which define the role of governments and the rights of Canada’s First Nations.

THE LONG ARC OF ENERGY POLICY
In the mid-1860s, invasions by the Anti-British Irish-American Fenians, the political difficulties within the Province of Canada, and general indifference in London in the form of a Brexit-like sentiment regarding the colonies, helped hustle the Fathers of Confederation to the table in Charlottetown. Further impetus came in 1866 when the United States cancelled the 1854 Canadian-American Reciprocity Treaty, and with it the tariff-free export to the U.S. of the Canadian colonies’ raw materials, including Nova Scotia coal. The Alaskan Purchase the day after the passing of the British North American Act on March 29, 1867 presaged an enduring theme –the United States – in future energy debates in the new Dominion of Canada.

The commodity focus over the previous 350 years of Canadian history was dominated first by fish, then furs, then timber and their transport along waterways. As the fur trade inevitably led to discoveries of minerals, the British government looked for raw materials to feed its home industries, and to be transformed and shipped back to the colonies. In 1842, Sir William Logan was commissioned to conduct a geological survey of British North America, establishing Canada’s oldest scientific institute, the Geological Survey of Canada. Post-1867, geological surveys to tabulate the country’s mineral and coal resource endowment constituted fuel policy activity by the federal ministry that would be responsible for Canada’s energy policies many decades later.
Along the long arc of Canada’s energy policy history since Confederation, many themes stand out: “the Americans”, subsidies and special treatment, Central Canada’s interests over others’, denial of geographic realities, Arctic sovereignty, federal/provincial relations, national unity, free markets (or not) and sharing the resource rent. Real or perceived crises related to these themes were shaped within a constant flux of economic, political and technological developments and triggered policy debates. More often than not, external developments have been the dominant impetus for an energy policy adventure in Canada, and for a policy’s eventual demise.

As illustrated below, policy responses in Canada are constrained between two immutable realities. First, geology and geography determine the distribution of energy resources among and distances between the provinces and territories, and – critically – our relative size, population and proximity to the U.S.A.

Second, the Constitution defines the fundamental legal/political responsibilities and governance over natural resources. Aboriginal rights, more specifically the protective duties of the Crown, were declared by the Royal Proclamation of 1763. Only recently have these rights, reaffirmed in the Constitution and defined by successive Supreme Court decisions, become a critical factor affecting energy developments in Canada.

Environmental concerns in energy development gained prominence when, following U.S. President Theodore Roosevelt’s Conservation Commission in 1908, a trilateral North American conference was convened. Canada followed up with its own Conservation Commission. Whereas the Americans set aside vast areas protected as national parks, Canada had protective concerns of a different stripe; not granting U.S. access to our water power in perpetuity and protecting forests from American capitalists.

The Fathers of Confederation recognized that the five patches comprising the remaining British colonies in North America could hardly be stitched into a viable quilt if the sewing was left up to the provinces. So, they agreed that the threads – canals, ships, telegraphic communication, rails and “other works connecting two or more of the Provinces” – and therefore today’s pipes – wires and air transport, would be in the federal government’s remit.

By 1882 Parliament passed two bills that proved portentous for subsequent energy policy. First, gas lighting companies – then after lengthy debate, electric light companies – were determined to be interprovincial works and undertakings and therefore subject to federal oversight. The essence of these bills was energy transportation – the playing field for national energy debates to this day. The seeds were planted for what would constitute the responsibility of the National Energy Board 75 years later.

While provinces would jealously guard their autonomy over intra-provincial electricity generation and distribution, the unifying imagery of interprovincial wires attracted federal politicians’ attention, starting with Prime Minister John Diefenbaker, who in 1959 visualized a national energy grid from Labrador to British Columbia. To this end, Ottawa offered subsidies for regional interconnections. There were few takers. If they made economic sense, the provinces would have done them on their own.

Ottawa was destined to get drawn into spats along the energy value chains that crossed provincial boundaries, whenever some link – producers, transporters, consumers or investors – felt aggrieved, disadvantaged or sought special treatment. The persistent tension in Canadian economic policy – internationalists versus nationalists – dominated energy debate. The internationalist or continentalist view urged the economic efficiency of exporting to proximal markets while the nationalist argument
embraced a self-sufficiency sentiment favoring interprovincial movement of energy. The nationalist position confronted the intractable tyranny of distance between resources and markets – especially the very small Canadian market. The nationalists’ justification for intervention varied: strengthening the union or nation building, fuel self-sufficiency and supply security. The solution: federal subsidies, price controls, special tariffs and tolls. The consequences: inter-regional tensions, economic losses and distorted markets. But for long-distance pipelines and large-scale hydro developments, projects needed to include American markets to achieve economies of scale. This Joint Service Principle, given the suspicion of many Canadians about letting the neighbors enjoy access to “our resources”, invariably sparked policy debates in Parliament.

KING COAL: THE LONGEST REIGN

The first real fuel focus of the federal government was coal. It would dominate energy debates for the first eighty years of Confederation and enjoy a resurgence through the energy crises of the seventies only to become the pariah fuel in today’s proxy energy policy – global climate change. While coal was the last thing on the Fathers’ minds in the 1860s, the U.S. tariff imposed on Nova Scotia’s coal prompted the first fuel policy debate in the new Canadian parliament as the province sought to expand its exports to Lower and (less so) Upper Canada. To displace American coal, its advocates argued, would strengthen the new union. This would not be the last time nation-building would be advanced as a rationale for an energy development or policy. Eventually a duty on U.S. coal in John A. Macdonald’s National Policy of 1879 placated Nova Scotia. That province’s ability to extract special treatment for its coal interests has endured through 150 years – the latest example, the exemption from the phase out of coal-fired power plants under Ottawa’s climate policy.

Coal would dominate energy debates for the first 80 years of Confederation.

After World War I, with the development of coal mines in Western Canada, the rationale for intervention shifted from nation-building to national self-sufficiency. Coal miner strikes in Cape Breton and especially in the U.S. industry during the winter of 1921/22 inflicted major hardship in Ontario. Both sides in the House of Commons called for a National Fuel Policy and independence from strike-prone American suppliers. The debate centered on freight rates; Ontario wanted Alberta coal but not at a price greater than nearby American coal, raising the question of how to move Alberta coal 3,200 km to compete with Pennsylvanian coal 2,400 km closer. While the central government obliged with import tariffs, it refused to intervene on special rail rates or provide direct subsidies.

Meanwhile oil was in the ascendency as diesel replaced coal in locomotives and maritime shipping, heating oil replaced wood and hard coal in homes, and gasoline demand surged to serve the burgeoning automobile fleet. The war over, the government launched a Royal Commission on Coal (the Carroll Commission, 1946) to assess the health of the industry. Coal producing provinces wanted a national fuel policy. They argued that transport subsidies for their coal would be a fair counterbalance to the economic advantages under tariff protection enjoyed by Central Canada’s manufacturers. The Commission recognized there might be an “emergency supply” rationale for keeping mines operating, but in the end a coal policy would simply amount to being an instrument of Canadian welfare policy.

Oil had become a global commodity with acute geopolitical significance. A new era of energy policy had dawned. Like it or not – and in the seventies Canadians did not – our energy destiny would be determined mostly by others.

OIL – SWIMMING AGAINST GLOBAL CURRENTS

When it comes to fuel supply, two principal threats or crises tend to trigger politicians: dramatic increases in price and production booms. If simultaneous, policy makers go into a frenzy, responding with price intervention and
resource nationalism (i.e. revenue envy). Coal never offered much economic rent. So, coal policy debate was mostly about sustaining coal mining jobs and parts of the industry were subsidized for decades. But oil has considerable rent, especially during price surges, triggering major policy tensions between the producing and the vastly more populated consuming provinces.

The discovery of oil in Turner Valley, the subsequent transfer of jurisdiction for resources to the Province of Alberta, and the establishment of resource conservation regulations were significant events in Alberta’s history. The Leduc oil discovery in 1947, while important for the operating company and the province, would create the context for a set of important national energy policy debates. First of all, the subsequent prolific oil developments in the fifties brought into stark relief the degree of foreign ownership of the industry. Economic nationalism was rampant; its chief advocate, Walter Gordon, convinced Prime Minister Louis St Laurent to approve a Royal Commission on Canada’s Economic Prospects (1957). It raised numerous energy issues, mostly to do with pipelines and market access, which were subsequently examined by a Royal Commission on Energy (Borden Commission) that led to establishment of the National Energy Board in 1959. The Borden Commission examined but rejected the idea of extending the Interprovincial Oil Pipeline to Montreal to expand the market for surging production of western Canada oil.

**Oil had become a global commodity with acute geopolitical significance.**

With 50 per cent of Canada’s oil production shut in and President Eisenhower’s quota on oil imports announced in 1959, Canada sought special access to the U.S. market. Imports by pipeline were exempt under the national security provision establishing the quotas. Taking advantage of this exemption, the U.S. major oil companies, whose further investments in the Middle East and Venezuela were frustrated by the U.S. policy, developed their Alberta leases. To reinforce access to the U.S. market Ottawa announced the National Oil Policy in 1961. Consumers east of the Ottawa Valley line would enjoy lower world market prices while Ontario and the west would pay prices based on the much higher U.S.-determined price. Ottawa had thereby touched the third rail in oil policy – price intervention, a moral hazard that would dominate Canadian energy policy for nearly a quarter century.

The U.S., now worried about oil supply security, pressured Canada for a continental energy policy.

By 1970, for the first time, Canada’s oil demand equaled its production. The price had hardly increased, notwithstanding annual oil demand growing at nearly seven per cent. Ottawa’s policy makers, still concerned that Ontario imported coal while western coal was exported, confronted other looming issues, not the least of which were the pricing, export and financing issues associated with a possible northern gas pipeline. So they sought cabinet approval for an energy policy pilot study; it was intended to examine the rapid growth in demand, protection of the northern environment, allocation of oil and gas for export, state participation in the industry, security of supply, and of course foreign ownership.

But international events were rapidly evolving; ten years old, OPEC was asserting its sovereign control of oil production and taking pricing away from the major oil companies. The U.S., now worried about oil supply security, pressured Canada for a continental energy policy. But studies by the National Energy Board found that Canada would soon have insufficient oil and gas to export. New exports of gas were turned down for the first time. A looming crisis of energy security dominated the policy discourse. 1973 was a bumper year for energy policies worldwide. Ottawa introduced oil export controls and in June released its long-awaited An Energy Policy for Canada – a report for consultation with the provinces and the public. But all was pre-empted by oil prices having increased by 45 per cent. In September Prime Minister Pierre Trudeau announced a program of voluntary oil price restraint. A month later
during Ramadan, Syria and Egypt attacked Israel on Judaism’s holiest day, Yom Kippur, sparking a proxy war between Russia and the U.S., in the world’s most geopolitically strategic region. Prices skyrocketed. At Henry Kissinger’s urging, the industrialized countries created the International Energy Agency (IEA) to collaborate on policy and emergency oil-supply response. Ottawa imposed an oil export tax and cancelled the National Oil Policy. A new policy was announced, extending the price controls on domestic crude while pursuing self-sufficiency, creation of a national petroleum company, expediting an oil pipeline from Sarnia to Montreal and increasing energy research and development, especially on oil sands.

By the mid-seventies, the world price of oil had levelled off as Middle East tensions eased. Ottawa issued An Energy Strategy for Canada: Policies for Self-Reliance. Proposed policies included “appropriate” pricing, conservation, increased exploration, substituting domestic for imported supplies (coal received a new lease on life), massive investment in renewables, emergency preparedness, and of course Canadianization. These policies were aimed at making Canada self-reliant in energy within 10 years. Meanwhile, student demonstrations in Iran were a harbinger that this latest energy policy would, like its precursors, be overcome by international events. Ottawa’s energy planners explored future energy pathways in a Long-Term Energy Assessment Program (LEAP), released by the government as Energy Futures for Canadians (1978). It was presented as “a prologue to action” for a National Energy Program.

INTERVENTIONIST RESPONSES TO CRISIS

Canada, under a new Trudeau majority government, was not alone in its activist approach. Virtually every OECD capital enacted policies to address the oil crisis, cooperating through the IEA around agreed, highly dirigiste energy policy principles to reduce demand, increase domestic oil supply, and accelerate oil substitution. The 1980 G7 Summit in Venice focused almost entirely on the energy crisis; leaders’ intention to double the use of coal within 10 years was well received in Canada’s coal provinces. The summit’s exhortation of “Maximum reliance…on the price mechanism”, however, received a long blink in Ottawa, given the just-announced intention to set a made-in-Canada price. Back home, officials beefed up the LEAP proposals for the new government. Two critical factors underpinned the political context for what was to come in energy policy: a federal government with no seats west of Manitoba and the first Quebec referendum on sovereignty. The National Energy Program (NEP), set out in the new government’s first budget on October 28, 1980, became iconic for how not to do energy policy in Canada.
policy in Canada. Its goals were three-fold: security of supply, Canadianization of the oil and gas sector, and fairness in pricing and in revenue sharing. It amounted to a massive appropriation of rent from the petroleum sector aimed at increasing Ottawa’s share to 45 per cent. The NEP was the most detailed energy policy ever enacted in Canada, touching on everything from wood stoves to nuclear power. But six months after its launch, the world oil price faltered and the critical assumption of rising prices failed to materialize. Revenue did not align with the projected billions of dollars of planned expenditures. Retreat was in order but the damage to Canadian unity was acute.

By 1984, economics and technology had worked their magic. World oil demand had shrunk by eight per cent since 1979. Technology surprised the planners. Applying the newly confirmed theory of plate tectonics, the international oil industry succeeded in replacing much of the oil production lost through nationalization in OPEC regions. OPEC led by Saudi Arabia cut production and OPEC’s share dropped by more than a third. Aggressive G7 monetary policy led by the U.S., together with subsequent neo-liberal policies advocated by Margaret Thatcher and newly elected Ronald Reagan, changed the global economic policy context. Saudi Arabia, having made the lion’s share of production cuts, reversed policy and went for market share, flooding the market. The price crashed in late 1985. The era of price intervention in the oil market ended.

The return to energy price intervention in the form of carbon taxes is now national policy.

Brian Mulroney was elected on September 4, 1984 – ironically eleven years to the day from when Pierre Trudeau froze the domestic oil price. The NEP was soon dismantled. Energy policy became unmentionable in Ottawa. The NEP’s failure signaled that any future energy policy development would have to take a different approach. So, in 1987 the Minister of Energy launched the Energy Options Process – A Canadian Dialogue, a broad public consultative exercise. It delivered yet another report, Energy and Canadians into the 21st Century. The report was a predictable list of energy projects and ideas that appealed to all the regions. The process exposed an emerging social dimension essential to addressing complex policy issues, something that in 2017 utterly confounds not just policy making but basic project approval processes. Vacating the energy policy field, the federal government espoused a least-controversial position: dependence on markets and free trade, respect for provincial jurisdiction and the various provincial accords, and intervention limited only to meet health, safety and environmental requirements. It proved to be Canada’s shortest but longest-lasting national energy policy ever.

EMERGENCE OF CLIMATE CHANGE

As the energy options exercise concluded in 1988, federal environment officials in the weather service had successfully advanced climate change on the global stage as a major issue. Fresh off the success of the Montreal Protocol on Substances that Deplete Ozone and the release of the report of the Brundtland Commission (Our Common Future), which had considerable Canadian involvement, climate change became the new crisis. During an unprecedented heat wave, Canada hosted a policy conference in Toronto titled Our Changing Atmosphere: Implications for Global Security. A CO2 emissions target was proposed – 20% of 1988 levels by 2005 – as a first step to confront “Humanity(‘s)…unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war.” Climate change thus became the proxy for global energy policy development.

Many federal officials migrated from the Energy department to the Environment department and quickly got to work on a national climate plan, the Green Plan. Critical for the policy process in the capital, non-government environmental organizations (ENGOs), enjoying a close relationship with the Minister’s office and officials, were deeply involved in policy design. The socialization of policy was firmly
established. Officials would never again have autarchy over energy policy analysis and development. Technocratic analysis was trumped by political calculus. The Green Plan and successor commitments, such as under the Kyoto Protocol and the Turning the Corner Action Plan, were doomed to failure. Common to all was the political denial of the overwhelming and intractable role that carbon plays in the gearing of Canada’s economy. This disconnect between Canada’s climate commitments, energy sector and economic realities prompted the energy industry associations in 2003 to launch a call for an energy dialogue in Canada. Critically, North America faced a natural gas supply crisis. This low carbon “bridge fuel” to address climate change would increasingly have to be foreign LNG. Many believed that Canada needed a National Energy Strategy.

The following dozen years saw virtually every NGO as well as business groups, the Senate, a chorus of academics and think tanks, and the Council of the Federation put forward their recipe for a National Energy Strategy. But technological innovation surprised again. The merging of hydraulic fracturing and long-reach horizontal wells dramatically reversed the North American trend lines, not only for natural gas production, but critically for crude oil. While the ongoing social dialogue among industry and NGOs involved debate on everything from climate change to energy literacy, the government of Stephen Harper zeroed in on regulatory reform (advocated for by the Council of the Federation in 2007). The 2012 Jobs, Growth and Long Term Prosperity Act (an omnibus budget bill) made major changes to some of Canada’s environmental laws. It seriously upset environmental organizations, planting the seeds for more uncertainty when the government was voted out of office in 2015.

THE ROOTS OF OUR POLICY TENSION

Back in 1888, drawing on the surveys by Robert Bell of the Geological Survey of Canada, a Senate Select Committee reported, “The evidence…points to the existence in the Athabasca…of the most extensive petroleum field in America, if not in the world. The uses of petroleum and consequently the demand for it by all nations are increasing at such a rapid ratio, that it is probable this great petroleum field will assume an enormous value in the near future and will rank among the chief assets…of the Dominion.” Thirty years earlier, it had been discovered that certain gases including CO2 block infrared radiation. These two discoveries are at the roots of the major tension in Canadian energy policy today – the oil sands and climate change.

2015 proved a critical year for climate/energy policy in Canada. New governments in Alberta and Ottawa both committed to climate policy action. Following several years of discussions, the Council of the Federation – Canada’s Premiers – declared their consensus for a Canadian Energy Strategy. As if to underscore the political difficulty of agreeing on anything that is truly of national importance where energy is concerned, the premiers’ document assiduously – and remarkably – avoided any reference to the oil sands. Oddly, the premiers endorsed a principle to respect U.S. open access rules for electricity trade but ominously made no reference to the National Energy Board. In May 2016, the economic importance of the oil sands, indeed almost certainly the largest hydrocarbon deposit in the world, was demonstrated when wildfires caused a 50 per cent disruption of oil sands production for just 10 days, trimming the nation’s quarterly growth by 1.1 percentage points.

The return to energy price intervention in the form of carbon taxes is now national policy. In April, the federal energy minister launched Generation Energy, “a national conversation on energy” to be concluded by October of Canada’s sesquicentennial. In May, a specially-appointed panel recommended major changes to the role and location of the National Energy Board. After nearly 150 years, transporting fuels and energy continues to be a public policy challenge for Canada, a country blessed with energy resources. However, the search for the holy grail of a national strategy of how to manage that endowment continues to be cursed – perhaps because we have so much energy.

1 Journals of the Senate of Canada: Being the second Session of the Sixth Parliament, 1888, Queen’s Printer, p163.
DR. ROBERT SKINNER

Dr. Robert Skinner’s career in energy spans more than four decades in government, industry and academia. With Canada’s Energy department in the seventies he was involved in geological research, energy and environment policy and oil and gas market regulation and their eventual liberalization in the mid-eighties. He served as Assistant Deputy Minister of Energy Commodities from 1985 to 1988 and then as Director of the Policy Office of the International Energy Agency at the OECD in Paris, France. He left public service in 1995 and joined TOTAL’s downstream gas and power group where he advised on strategy and business development and the business implications of the European Union’s energy directives opening the European grid industries. In 1998, he opened TOTAL’s Canadian office in Calgary to gain entry to the oil sands. From 2003 to 2006 he directed the Oxford Institute of Energy Studies in Oxford, England. On returning to Canada, he advised Statoil on its entry to the oil sands and worked as Senior Vice President, Statoil Canada until mid-2011. Since then, he advises governments, industry and universities on strategy. He is associated with several energy and economic think tanks in North America and Europe. Dr. Skinner is currently the President of KIMACAL Energy Strategies Ltd, a private advisory service, and an Executive Fellow of the School of Public Policy and Energy Research Advisor to the Vice President, Research at the University of Calgary.
A NEW ENERGY FUTURE FOR CANADA?

BY MICHAEL CLELAND
Senior Fellow, University of Ottawa; Chair, Canadian Energy Research Institute; 2015 Canadian Energy Person of the Year

Summary: Michael Cleland reflects on whether Canada has an energy decision system that mirrors today’s realities and that is capable of dealing with tomorrow’s challenges, given the complex interplay of policy, planning, regulation and a growing cast of active participants from federal, provincial and territorial governments; to Indigenous and municipal governments; and a wide range of private stakeholders. He opines that the growing list of controversies and confrontations associated with decisions on major energy projects indicates that Canada has some work to do.

For about half of the 150 years since Confederation, energy has been one of the principal economic drivers in Canada. This fact is manifest not only in the fossil-fuel endowed West, but in the East Coast offshore, in several hydro-power endowed provinces, through Canada’s unique nuclear technology, and through the benefits of low cost, secure, reliable energy to sustain our society. What about the next fifty years?

If we take seriously our political commitments on climate change we are looking at radical changes in the way we use, and especially, produce and deliver energy. The scale and nature of the effort needed to make those changes poses challenges for Canadian energy vastly greater than any we have faced to date. At the heart of those challenges is a complex energy decision system involving policy, planning, regulation and a growing cast of active participants from federal, provincial and territorial governments, to Indigenous and municipal governments, to a wide range of private stakeholders. Do we have an energy decision system that reflects today’s realities and tomorrow’s challenges? Based on the growing list of controversies from one side of Canada to the other, and touching everything from pipelines to power plants of all sorts, we have some work to do.

BEYOND A FEW FIXES

Leave aside for the moment whether the changes contemplated in Canada’s Paris commitments are practical under any circumstances; the energy decision system is in need of reform no matter what it is we want to accomplish and a few “fixes” to energy regulators will fall far short of making it
It starts with society and its expectations. As illustrated by the evidence in several case studies recently undertaken by the University of Ottawa’s Positive Energy Project and the Canada West Foundation, Canadians no longer accept that energy decisions should be made solely by central governments. Governments are not trusted; deference to authority has steadily declined. At the same time tolerance for risk has sharply declined even as the risks appear ever more complex and difficult to understand. New authorities have stepped up and claimed a place in the decision system. Both Indigenous governments and municipal authorities are increasingly engaged in thinking about energy and expecting that their voices will be an important part of the process. A recently released report from the University of Ottawa explores some of the implications of these trends.

Meanwhile, the issues keep getting more complex. Some Canadians are coming to grips with the fact that the low cost electric power may be a thing of the past. The effects of rising costs both on economic competitiveness and on fairness for low income citizens have emerged as a central issue, most prominently in Ontario. Our case studies revealed consistently across Canada that local and regional environmental and social issues dominate community attitudes, and that addressing those is the sine qua non of community acceptance. Virtually every type of energy project – pipelines, fossil power plants, hydro projects, nuclear projects, wind farms – faces often intractable local opposition. On the other side of the coin, where there may be support for projects, many communities are insisting that they have a direct economic stake in those developments as well as a meaningful role in the decision processes. All of this has led to decision processes becoming longer and more costly as well as much more unpredictable with growing negative consequences for how Canada is perceived as a destination for investment.

Can energy development continue to be an economic driver in the world of 2050 if many of the sources of our comparative advantage are...
deliberately set aside for one reason or another? Should they be set aside at all when no other fossil fuel endowed economy in the world is doing likewise, or rather managed more carefully to reduce local impacts and carbon intensity? Where are Canada’s realistic opportunities to benefit economically from the emerging low carbon energy economy? In a system based primarily on renewable sources can Canada count on a stable, secure, low cost energy system as one of its major economic advantages in the coming century? How much can we reduce the energy intensity of our economy while maintaining economic competitiveness, particularly in the natural resource sectors such as minerals, agriculture, fisheries and forestry not to mention energy itself? What are the implications of potentially tripling (yes tripling and maybe more) the size of our electric power system at the same time that we drive to zero carbon electricity? How much of our energy system can be based on local actions such as increasing efficiency, better land use management, and development of local sources?

Emissions trends are nowhere close to the steady and steep downward trajectory contemplated by our Paris commitment.

All of this in turn will need to rest on an energy decision system that looks very different from today. We see at least three major areas of reform.

A RETHINK IN THREE PARTS

We need to rethink the relationship among three parts of the system: policy, planning and regulation. All of these are in need of reform. One reform is to build a more coherent policy system, one that today can fairly be described as often feckless, characterized by goals and commitments most often unmatched by commensurate action and sometimes inducing actions that are ill thought through, precipitate and harmful. Another is to build a planning system that today is underdeveloped and is difficult to reconcile with an otherwise successful market system but which will be an essential underpinning of any ambitious transformation based on broad-based public support. The third is to rebuild trust in the regulatory system, particularly by restoring its ability to act independently and objectively, making decisions that reflect the general direction coming from the policy and planning systems (where political accountability needs to rest) and based on evidence and trusted procedure without late in the game “guidance” from political actors.

We need to rethink the “role of local”. Local governments, both Indigenous and municipal, will have an important role both influencing energy decisions and in some cases being the deciders. But what is that role exactly? Much energy infrastructure has impacts and implications that extend far beyond any local community or even region. So where does local authority begin and end in any realistic scenario for the future? What is the unique role of Indigenous governments based on their distinctive legal position in the context of the Canadian constitution? To what degree can any community’s energy service needs be met by local actions? How can we build community energy planning capabilities and the human resource capabilities that need to underpin them so that they are compatible with the greatly increased responsibilities envisaged by many local leaders?

Finally, we need to rethink the role of citizens in energy decisions. Citizens are demanding a bigger say. But it remains to be seen whether they have the patience for the investment of time and effort needed to carry out that role constructively. How can policy, planning and regulatory processes be constructed so as to realistically engage citizens in ways that are seen as fair, open and real at the same time that decision processes reach timely conclusions without adding inordinately to risk
for investors? How do we build the sophisticated energy information systems that would be consistent with a 21st Century decision-making environment?

DISTINCTIVE CHALLENGES AND ADVANTAGES

These are all big questions and they contain within them a multitude of contradictions and inherently incompatible requirements. If they were easy we would have dealt with them long ago and it serves no purpose at all to simply blame the politicians who, after all, are reading and trying to respond to the public mood while balancing many competing priorities including the need for fiscal prudence.

Many of our regulatory systems, by world standards, are sophisticated and well managed.

Canada has a distinctive set of challenges in the energy business and they are the stuff of much public debate, albeit much of it ill informed or given to glossing over the tough questions in the hope that they will somehow go away or be overtaken by events. But Canada also has several advantages. Although the system is often described as “broken” we should also be realistic about what isn't broken. Many of our regulatory systems, by world standards, are sophisticated and well managed, based firmly on the rule of law and able – to this point at least – to arrive at broadly accepted decisions even if the process is getting ever more painful and protracted. We have a multitude of energy options, renewable and otherwise that we can build on to sustain cost competitive and secure energy systems while moving steadily to lower carbon emissions. We have world leading, environmentally and socially responsible companies across the energy spectrum. We have a variety of organizations engaged in research and other actions aimed at innovation, and a population of capable professionals whose energy and imagination can underpin the sorts of actions that we need to take.

Above all we have the beginnings of a dialogue. Indigenous citizens and their governments are at the table as full partners, being treated respectfully and seriously as constructive participants. At the local level there is a growing movement toward community energy planning and smart energy communities. This sort of dialogue is going to pose some tough challenges for senior governments. It will require investment in politically unrewarding things like public processes and energy information. It will force them to come to grips with the gulf between climate commitments and energy realities. And it will force them to focus their attentions on setting frameworks, relinquishing control over individual investment decisions and leaving ever more of them in the hands of independent regulatory authorities, local authorities and private investors.

If we invest now in getting our systems right the challenges of the 21st Century energy economy will still be tough. We need to be realistic about that. But Canadians have dealt with tough challenges in the past and if we reflect carefully on our past experience we will notice that we have done so based on systems and institutions that reflected Canadian capability, Canadian interests and Canadian values. That makes a good starting point for getting to 2050.
MICHAEL CLELAND

Michael Cleland is a private consultant with extensive experience in energy and environment policy.

He is Senior Fellow with the University of Ottawa’s Positive Energy Project, Chair of the Board of Directors at the Canadian Energy Research Institute, and a member of the Board of Directors of QUEST (Quality Urban Energy Systems of Tomorrow).

In 2015, Mr. Cleland was named Canadian Energy Person of the Year by the Energy Council of Canada. He is formerly President and CEO of the Canadian Gas Association, Senior Vice President, Government Affairs for the Canadian Electricity Association, Assistant Deputy Minister, Energy Sector at Natural Resources Canada, and Director General of the Energy Policy Branch.

From 1987 to January 1990, he was Assistant Director, Resource Policy Division in the Department of Finance.

Before joining the federal government, Mr. Cleland lectured at Dalhousie University and worked with the Nova Scotia Departments of Development and Municipal Affairs.
CANADA – RESPONSIBLE ENERGY FOR THE GLOBE

BY STEVE WILLIAMS
President and CEO, Suncor Energy

Summary: Steve Williams says Canadians need to end the current polarization in the debate on energy, and instead seize the opportunity presented by a national character that tends towards common understanding and inclusive approaches.

Resources and energy have been defining elements of Canada’s history. The 150th anniversary of our country’s Confederation provides us a unique opportunity to think about where we’ve been, but more importantly, where we’re headed.

For us in Canada, and indeed for many around the world, energy use is synonymous with the quality of life we enjoy. Energy delivers much of our well-being and high quality of life, including heating our homes, enabling transportation and commerce, and powering manufacturing. Energy also plays a vital role in our economy, contributing about $130 billion dollars to our Gross Domestic Product, shaping our industrial and service sectors, and positioning Canada as a strong trading nation. It directly or indirectly employs 640,000 Canadians from coast to coast.

As Canadians, we’ve come to appreciate energy’s economic contributions, but we can’t ignore that energy development and use happen in a broader societal context – shaped by environmental and social considerations which are just as important.

Unfortunately, much of the public discourse on energy in this context has devolved into a polarized debate. We’ve seen how energy conversations have become us/them propositions, how the environment is pitted against economy, how the status quo is being defended against an entirely new way of delivering energy, and how social considerations can sometimes be pushed aside.

These intense conversations – if we can call them that – aren’t working.

Through the debates, we’re coming to a realization that these intense conversations, if we can call them that, aren’t working. The polarization is not productive and there’s a risk that it may hold up progress for decades. There has to be a better way. It’s time for leadership in achieving a positive energy future for Canada – one which is progressive, yet practical.

The good news is that there isn’t a nation on the globe whose natural character is better suited to build common understanding and commitment to achieving a bright energy future than Canada.
Canadians tend to look forward, are inspired about what’s possible, and readily embrace inclusive approaches. It’s as much a part of our DNA as hockey and maple syrup, which bodes well for the years ahead.

Innovation and technology will be key levers as we make our way towards a low carbon energy future, both here and around the world. The Canadian oil and gas sector is investing over $1.3 billion annually in research and development, leading to improved environmental performance, resource efficiencies, and cost competitiveness. And there’s more to come. From 2010 to 2015, the number of patents related to the oil and gas industry more than doubled. And the oil and gas sector investment in research and development in 2015 grew by 1,400 per cent percent from 2009 – leading R&D investment in the country.

The Energy Futures Lab proposes building an energy system that contributes to reconciliation.

As a global environmental leader, Canada can export both our technologies and low carbon-intensity products worldwide, thereby doing our part to address global climate change. By not only reducing our own emissions through the introduction of renewable energy and development of low-carbon intensity fuels, Canada can use our experience, technology and innovations to assist other countries in meeting their own targets.

Our focus on innovation should not be just about technical expertise – it’s about embracing new ways of doing things when it comes to environment and community. We need to be open to innovative approaches to how we relate to and interact with one another, how we engage the public, how we develop policy, and so on. We have to be willing to each embrace the role and responsibility we have to contribute to solutions, and to change our behavior in a way that helps to address complex challenges such as climate change.

The Energy Futures Lab, which Suncor is proud to support, proposes building an energy system that contributes to reconciliation between Canada’s indigenous and non-indigenous peoples and is inclusive, accessible, and equitable to current and future generations. At Suncor, we’ve committed to being part of that journey, through a social goal aimed at changing the way we think and act towards Aboriginal Peoples.

Achieving our vision for Canada’s energy future will also require innovative approaches when it comes to public policy development. As we design energy systems and grapple with the challenge of climate change, we need to bring together diverse perspectives, and then be willing to take collective action. Canada needs to embrace a global vision of an energy future that is progressive, yet practical. Coming from a place of leadership in Alberta and Canada, we can ensure that we have a place at the global table to influence action on the global challenge of climate change.

It can mean a step into an uncertain world, but the alternative of standing on the sidelines and waiting for the perfect answer isn’t the way. We all want the same things – a prosperous economy, a healthy environment and vibrant communities. Those can pull us together, and inspire us to offer the best ideas for a positive energy future.

If you ask citizens around the world where they’d like their energy to come from, they often say they’d prefer it to come from Canada, more than any other place in the world. That should serve as inspiration – helping us create an energy future that is the envy of the globe.

Given our bountiful resources, our track record of innovation, and Canadians’ willingness to engage with others to overcome differences and reach solutions, I’m optimistic in what lies ahead for Canada and our energy future. O Canada, indeed.
STEVE WILLIAMS

Steve Williams began his career with Suncor in May 2002 as Executive Vice President, Corporate Development and Chief Financial Officer. He then served as Executive Vice President, Oil Sands and Chief Operating Officer.

Steve has more than 40 years of international energy industry experience, including 18 years at Esso/Exxon. He holds a Bachelor of Science (Hons.) in chemical engineering from Exeter University and is a fellow of the Institution of Chemical Engineers.

He is a graduate of the business economics program at Oxford University as well as the advanced management program at the Harvard Business School.
CAP-AND-INVEST: FINANCING CANADA’S ENERGY TRANSITION TO A LOW CARBON ECONOMY

BY PROFESSOR JATIN NATHWANI
Ontario Research Chair in Public Policy for Sustainable Energy, Waterloo Institute for Sustainable Energy, University of Waterloo

Summary: Jatin Nathwani proposes a ‘Cap and Invest’ system as a means of adequately financing an effective response to the climate change challenge. A small levy on the economy-wide consumption of fossil fuels could provide capital on the scale needed to support the transition to a low-carbon economy, within the timeframes to which we aspire and have committed to. This approach would take account of both the limits of government’s ability to re-direct existing budget allocations from current needs, and of the intergenerational nature of climate change burdens. A governance framework to ensure trust and prudence is also proposed.

The need for a bold measure to drive actions to reduce Canada’s greenhouse gas emissions is clearly evident. How to finance this climate change challenge is less than clear. We have a patchwork of solutions emerging around a ‘carbon tax’ or a ‘cap-and-trade’ regime with different flavours. This has the potential to descend into inter-provincial finger pointing or a stalemate at the federal-provincial table. The goodwill appears to be there but the harsh reality of delivering tangible results will come crashing in when the parties involved try to carve out a path that is least painful.

A cogent national strategy is required to deal – head on – with a future liability that is at its core a case of intergenerational burdens. The global context sets the parameters – climate science provides a solid foundation for action to part with fossil fuels but global energy poverty remains an intractable predicament. Income shifts and population growth in tandem drive energy demand and emissions upwards.

I propose a fresh approach – ‘Cap-and-Invest’ with a long view that moves us beyond the proposed solutions that shape the current discourse on putting a price on carbon.

The climate change challenge, at its core, is a governance challenge that is informed as much by energy technology choices as workable policy options.1 To achieve large reductions in emissions over a long period of time dictates the need for an economy-wide effort coupled with a

broad social consensus that embraces reason for change without the overhang of a “formal” treaty obligation.

The ‘Cap-and-Invest’ approach can be adopted by any jurisdiction but, for illustration, let us focus on Canada.

The essential building blocks of a national approach comprise:

I. A ‘cap- and- invest’ strategy with emphasis on investment and innovation as the drivers of change. The transition to a low carbon economy – measurable from one decade to the next – will require sustained, massive investments in our national scientific, technological and industrial capacity, to facilitate rapid deployment of existing and emerging solutions that reduce emissions on a time scale consistent with our national aspirations and international commitments. The trap to be avoided is to be confined to symbolic ‘feel-good’ gestures, premised on the notion that every little bit counts, and that will certainly achieve only a little.

II. A small levy on economy-wide consumption of fossil fuels – equivalent to one to two percent of the value of current consumption to generate a large pool of capital for investments in the de-carbonization of the economy.2

WHY IS THIS NECESSARY?

Primarily because existing or current budget allocations, by definition, are committed to meeting current needs and the ability of governments to re-direct funding away from hospitals, schools or day to day functioning of our social infrastructure would meet with extreme resistance. Under any political calculus, today’s demands always trump tomorrow’s issues, particularly as ethereal as carbon emissions.

An important additional distinction is also key. Climate change is an issue of inter-generational burdens. A levy on current consumption, on an on-going basis, spreads the burden fairly across all individuals in society over time. A levy on consumption, transparent and openly debated prior to implementation, is one way to establish a social contract between those who are taxed and those who manage the tax revenues for a clear and explicit purpose. To reduce complexity of management and uncertainty around investment decisions, a large pool of patient capital can then provide a reliable basis for meeting our obligations to our children and future generations.

III. Innovation in Governance is central to inspire trust and to ensure prudent investments will be made to deal with this specific challenge. To gain political acceptability of the levy on consumption, an “arms-length” independent investment board, enacted by an Act of Parliament – similar to the Canada Pension Plan Investment Board – would be necessary.

With a clear mandate, an impregnable governance structure and accountability for investment decisions, such an agency becomes the guardian of change. This is similar to the way in which the Canada Pension Plan Investment Board invests current contributions to cover future liabilities. The revenues from the levy3 would create a large enough pool of capital for investments to allow a transition to a low carbon economy over time.

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2 This is different from attempts to impose carbon pricing either through regulations (opaque); or a ‘carbon tax’ (transparent); or a ‘cap and trade’ regime limited to large emitters (producers) with ‘allowances’ granted free or auctioned. The ‘caps’ and the ‘tax’ burdens – when imposed on producers only – are subject to intense lobbying by companies (for example energy intensive production) exposed to trade competitive pressures. Governments relent and the end result is a diminution of effectiveness; either the taxes are lowered to a point with no impacts, or under a cap and trade regime, the free allowances undermine the market price on the trade exchanges (the European ETS being a good example). Without persistent long term price signals, investors do not commit to low carbon solutions.

3 One percentage point increase in the GST would generate approximately $8-9 billion per year in the Canadian economy. Raising the GST from 5 to 7 percent would create a pool of capital in the range of $18-20 billion per year. The “ring-fencing” of the revenues from the consumption tax becomes a credible pool of investment capital with scale and scope for effecting change to a low carbon energy system.
If the funds from the levy are matched by industry and invested strictly in projects that yield verifiable GHG reductions, then access to a much larger pool of capital becomes the “carrot” for industry. The competitive edge to Canadian industry – through access to low priced capital in support of innovations – has the potential to spur development of new solutions and over time a basis for a competitive advantage for Canada in global markets.

Maintaining tough national targets – a priority for the federal government - would give Canada a leg up in international diplomacy; re-directing funds from consumption to investment becomes the virtuous part of a twinned solution that becomes the foundational basis for a transformation to a low carbon economy through technological innovation.

JATIN NATHWANI
Professor Nathwani is the founding executive director, Waterloo Institute for Sustainable Energy (WISE) – whose vision is clean energy, accessible and affordable for all – and holds the prestigious Ontario Research Chair in Public Policy for Sustainable Energy at the University of Waterloo.

He is the co-director of the consortium ‘Affordable Energy for Humanity (AE4H): A Global Change Initiative’ that comprises 130+ leading energy access researchers and practitioners from 30 institutions and 16 countries. Prior to his appointment at the university in 2007, Professor Nathwani worked in a leadership capacity in the Canadian energy sector over a 30 year period.
ENERGY TRANSFORMATION AND INNOVATION
DISRUPTOR OR DISRUPTED: CANADA’S ROLE IN THE CHANGING GLOBAL ENERGY MARKET

BY ELYSE ALLAN
President and CEO, GE Canada and 2016 Canadian Energy Person of the Year

Summary: Elyse Allan describes the volatile, uncertain, complex and ambiguous world in which we live, and how we can go about securing a place for Canadian energy resources within it. This requires the energy sector – with appropriate support from government partners – to become a disruptor, and to speed up the pace of adoption and fully seize the opportunities presented by the digital industrial revolution. This will entail addressing challenges including appropriate carbon pricing design and promotion of energy careers among youth.

ADAPTING TO A VUCA WORLD

Demand for energy continues to increase, driven by growth in global population growth and per capita GDP. This is largely a good news story – it represents populations being lifted out of energy poverty, and gaining access to things we take for granted in Canada such as water treatment, clean cooking fuels, and mobility. But while the total demand for energy increases, how demand is being served – by what technologies, where and by whom – is shifting dramatically and rapidly. Start-ups are bringing transformative technologies to market much more quickly – and disrupting longstanding business models just as rapidly. Alongside this, there are escalating consumer and government expectations; people around the world are demanding cleaner, more energy-efficient energy sources at an affordable price. Where do Canadian energy resources fit in this equation?

There is uncertainty about how to respond to this changing global energy market. We are living in what is known as a VUCA world, one that is Volatile, Uncertain, Complex, and Ambiguous. One of the forces driving this is the impact of the digital industrial revolution on industrial operations and business models.

Our world has become volatile, uncertain, complex and ambiguous.

American software engineer Mark Andressen said, “Software is eating the world.” The combination of lower cost sensing technology and faster processing speeds means that information moves faster. To keep pace, we are driven to move faster, communicate faster, work faster and innovate faster – all of which makes the business climate more Volatile, Uncertain, Complex, and Ambiguous. Digital is revolutionizing every aspect of how energy and resource companies are managing operations, and raising the competitive stakes in the process.

And so the question arises: Will we be the disruptor or will we be disrupted?

For the Canadian energy sector, there can be only one answer. We must be the disruptor, the force driving change, if this sector is to remain internationally competitive and continue to play a lead role in the Canadian economy.

The path leading out of this VUCA world is the very same technology that is disrupting our industries and our traditional business models. The digital industrial revolution is the path to Canadian energy competitiveness in a cost- and carbon-constrained world. We need to invest and grow our in-house digital expertise, and then export that knowledge and expertise to countries that are building their own energy ecosystems.

The digital industrial revolution is the path to energy competitiveness.

It goes without saying that industry and government are partners in this race.

For industry, it is a matter of survival. Our foreign customers are not wedded to their Canadian suppliers. Like all customers, they are looking for security of supply at a fair price, and increasingly they are under pressure from their own local populations to source energy that is produced sustainably and cost-efficiently.

For government, it is a matter of sustaining and growing well-paying jobs for current and future generations of Canadians while honouring our domestic and global commitments to reduce environmental impacts.

The common element here is digital. Digital is the disruptor, the path to success in a cost- and carbon-constrained world. For Canada to continue to be a place of prosperity, we must lead the digital transformation in our energy sectors.

GOING DIGITAL

How does digital impact the energy ecosystem and make it both more sustainable and cost-efficient?

In short: real time data, gathered digitally from every part of your operations allows you to analyze and solve current problems quickly, and to predict future problems and prevent them before they occur. This eliminates downtime, optimizes asset performance and improves overall productivity.

We are already seeing the benefits of digital in action in Canada’s oil and gas sector.

For example, in Alberta’s in-situ oil sands operations, GE’s Adaptix software allows operators to be far more precise in their use of steam injection to melt underground bitumen and push it to the surface. This reduces both the use of steam and the natural gas needed to produce it, thereby reducing GHG emissions. The process yields immediate gains from one to six percent in costs and emissions.

Digital solutions like Adaptix will play a significant role in determining the future of this industry.

In the pipeline industry, pipeline integrity is of critical importance. If a leak occurs, speed of detection is one of the most important factors in containment. Current detection systems face challenges such as imprecise sensors and their sub-optimum placement along pipelines, land-
based surveys that miss leaks because of the timing of the survey, and numerous false alarms.

GE, in partnership with a company called HiFi Engineering, has developed detection technology that combines fiber-optic cabling with a cloud-based platform to enable virtually instantaneous leak detection—stopping little leaks from becoming big spills. The digital advantage is obvious.

**HOW GOVERNMENT CAN HELP**

Government and industry are partners in making Canada a leader in digital technology. The opportunity that digital offers to improve the competitive position of our energy sector is huge, but how can governments support this transformation?

First, we must focus on skills development. New recruits and the existing workforce need the skills to interpret the data produced by intelligent machines. Industry naturally has a key role in investing in digital training, however, more is needed.

By taking measures to enhance digital skills development at all levels, from kindergarten through post-secondary, governments can help ensure job seekers are prepared for a radically transformed workplace. Nobody wants to see high-skill, high-wage positions in the burgeoning digital economy remain vacant due to a lack of qualified Canadian applicants.

Governments can also do more to promote career opportunities in the energy sector among young Canadians.

Nobody wants to see high-skill, high-wage positions remain vacant.

There’s a bit of irony here. We all know that young, nimble minds are already very comfortable with digital. After all, technology is the ocean they have been swimming in since birth. We also know that the younger generation is very concerned about climate change since it is their future that is at risk. For many, conservation and environmental protection are no longer causes or issues for debate—they are now a way of life.

But they are not flocking to jobs in energy. In truth, they are more likely to be leading the opposition to new infrastructure projects, including renewable energy. This suggests that their perception is rooted in the past rather than the present or future.

That needs to change. The energy industry is not what it was a generation ago. It is now focussed on transitioning to a low-carbon future and on improving access to safe, reliable and clean energy for the populations of developing countries. These are missions that young people would certainly embrace. They’re just not connecting them with the energy sector.

Governments can help engage young people in developing the solutions we need to build new, stronger, more sustainable and competitive industries. There are many challenges ahead, and we need the skills, enthusiasm and commitment of younger Canadians to tackle them.

Next is carbon pricing. At GE, we recognize that climate change is real. Mitigating its effects is not an option—it is an imperative.

Carbon pricing will vastly accelerate the rate at which Canadian companies adopt new technology.

In this regard, carbon pricing has proven itself the most efficient policy tool available to governments. It is built on a simple premise: tax the things we don’t want, support things we want and need. It is the best way for governments to strike the right balance of being a responsible actor in the fight against climate change, and maintaining our legitimate role as an energy supplier to the world. Carbon pricing will vastly accelerate the rate at which Canadian companies adopt new technology because it changes the fundamental economic equation around risk and reward.

But competitiveness is a legitimate concern for Canadian companies, and returning carbon revenues to the economy is central to that equation. Canada has long struggled with productivity and innovation. Through revenue
recycling, governments can incent positive change in these areas and position Canadian companies to be more competitive in the future economy.

Governments can boost productivity by supporting innovation from conception all the way through to adoption. We are doing better at the front end of this equation – Canadian governments are increasingly active investors in technology development. We also see a need for government to look for ways to accelerate the adoption of innovative hardware and software by established companies and by governments themselves. And that means working with start-ups who already have the necessary skills.

I’ll go one step further. Be their first customer.

Governments have an enormous opportunity to support the digital industrial revolution through the power of the purse. Adopting value-based procurement that moves away from a ‘least-cost’ approach enables a broader range of desired outcomes, including the adoption of new and novel technologies. It provides the market pull that is so essential to technology deployment and establishes the proof points that enable widespread adoption.

These strategies can be difficult for government, which is by nature risk-averse. But the pace of digital innovation in today’s world demands a rethink of our modus operandi.

**SPEEDING THE PACE OF ADOPTION**

Think of the digital industrial revolution as a global three-legged race. Canadian governments and business are partnered together, which means that governments need to move at the same speed of business if we are going to place, let alone win.

We need to adopt digital technology faster because digital drives value. The digital industrial revolution is transforming the energy industry around the world, and Canada needs to be at the forefront of this revolution if we are to remain globally competitive.

Digital solutions are already at hand, however, the rate of digital adoption by industry in Canada is still too slow.

To illustrate the issue, here is a brief quote from the Canadian findings of PriceWaterhouseCoopers’ most recent CEO Survey:

“Most CEOs believe technology will completely reshape their businesses over the next five years. Meanwhile, the speed of technological disruption and its threat to traditional business models seems to be less of an immediate concern for Canadian leaders. Canadian leaders don’t view the hiring of people with innovation skills as a top priority.”

At GE, we refer to this as receptor capacity. While some organizations are quick to embrace new technology and are ready to manage the problems that sometimes arise with piloting innovation, others want to avoid taking on those risks and are happy to let others be the test pilot.

But in a VUCA world, wait-and-see is a losing strategy. All companies face the threat of Digital Darwinism, AKA “adapt or die”.

Canadian governments and Canadian businesses need to improve their receptor capacity. We need to be the digital disruptors, not the disrupted.

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ELYSE ALLAN

Elyse Allan is a passionate champion for Canada’s competitiveness, advancing the country’s science and technology base and competitive fiscal policy, and an active participant in policy development in a range of fields. Among other recognition, she has been named by Maclean’s and Canadian Business Magazines as one of Canada’s most influential business leaders, and is a member of the Order of Canada. The Energy Council of Canada awarded her the Canadian Energy Person of the Year award in 2016. Elyse’s GE career began in 1984 and has spanned the US, Canada and several industrial and consumer GE businesses.
INNOVATION AND ENERGY CHANGE

BY BOB HANF
Vice Chair, World Energy Council North America Region; and Executive Vice President Stakeholder Relations and Regulatory Affairs, Emera

Summary: Against a backdrop of accelerating energy-related change, Bob Hanf outlines Emera’s evolution over the past century-and-three-quarters, and its current role in helping foster transformation through generation changes, electrification, and various specific projects and initiatives. With local resource availability as a guiding consideration, Emera is helping bring about major GHG emission reductions and dramatic expansion of key transmission infrastructure. A focus on smarter electricity systems and better storage are among Emera’s efforts that are helping to bring about customer- and community-supporting energy change, while also fostering a culture of innovation in its operating areas.

IN A WORD, CHANGE

If there’s a single word that encapsulates what’s happening in the energy industry at this point in time, it would have to be “change”. Energy change is happening all around us, and it’s accelerating. We hear it in the growing call for lower-carbon energy. We see it in the technology innovations that are disrupting how we create, share and store energy. And we feel it in the way our customer expectations are shifting to a future where energy choice, control and “always on” reliability are commonplace.

As exciting and challenging as this change can seem, we believe it’s also something that energy companies are well positioned to meet – because change has been a constant in our industry. It has certainly been a constant at Emera, where we have grown and adapted to meet and anticipate the needs of our customers for more than 170 years.

COMMITTED TO CUSTOMERS AND COMMUNITIES

At Emera, our strategy has been to meet the demand for cleaner, affordable energy for over a decade. And our roots in clean energy run much
deeper – in some cases, to the earliest days of our utilities. What hasn’t changed is our commitment to customers and communities, and how we’ve sought to use sources of generation that make the most sense for each location we serve.

Emera’s history in Nova Scotia dates back to 1840. Today, almost 70 per cent of our business is located outside of Canada with 7,400 employees serving 2.5 million utility customers throughout Canada, the US and in four Caribbean countries.

When we started out, our predecessor Halifax Gas, Light and Water Company delivered coal for the gas street lights of Halifax. Coal and gas were the predominant generation resources in Nova Scotia at the time. Just after the turn of the last century, we added some hydro from our local rivers. We’ve been investing in renewable energy for a long time.

As customers’ lives evolved, natural gas became the dominant fuel following World War II, with electric trolley coaches replacing trams.

Oil emerged as a cheaper fuel than gas as the demand for electricity grew in the 1960s, but in 1973 the OPEC oil crisis hit. Nova Scotia Power had just become a crown corporation at the time, and the government decided to switch from imported oil to cheaper local coal as the primary source of generation. That meant the construction of new coal-fired power plants, mostly in Cape Breton, close to the mines.

Nova Scotia Power was privatized in 1992 and eight years later its holding company was named Emera.

Natural gas saw a re-emergence and, while we were still burning coal, by then most of it came from the international markets. But with the volatility of fossil fuel markets and a strong government policy focus on renewables, we knew we had to fundamentally transform the way we generated electricity.

That provided the impetus for Emera’s strategy to provide clean, affordable energy to our customers. It’s a strategy that has worked well for us over the past 12 years and, though it has been tweaked over time, it will carry us to success in the future.

Both government policy and consumer demand set the stage for our strategy. While it’s inevitable that government mandates will change, customer demand for cleaner energy grows stronger every year.

Our role in a transforming sector

As we look around, transformation in the energy sector is clear and widespread. Emera is playing a role in this shift in the sector in a number of ways.

First, through cleaner energy – generating more energy from renewables and from natural gas.

Second, through electrification – by helping our customers shift heating and transportation from higher-carbon fossil fuels to cleaner electricity using heat pumps and electric vehicles. This is happening at a time when the costs of these new technologies are falling rapidly.

And third, through the major projects and initiatives our teams are working on right across our business.

The natural resources available in the markets where we work drive us towards the most efficient and affordable clean solutions for our customers. At our affiliates in Florida and Barbados, that means the sun. In Nova Scotia, it’s the wind and the ocean.

We have made tremendous strides introducing renewable energy onto the grid in Nova Scotia and see great potential for future integration.

Nova Scotia Power has undergone the most rapid transition to renewable energy of any utility in Canada, setting a record 28 per cent of generation from renewable sources in 2016, up from eight per cent in 2007.

The team at NS Power has done that primarily by integrating proportionately more wind onto the system than anywhere else in Canada, with wind

Nova Scotia is also leading Canada in carbon reduction, with NS Power reducing greenhouse gas emissions by 34 per cent in the past 12 years. Nova Scotia is on track for a 58 per cent reduction by 2030 – almost double the federal target. And NS Power is on track to hit the goal of 40 per cent of electricity coming from clean, renewable sources by 2020.

Looking to the natural resources available locally, hydroelectricity and tidal energy have tremendous potential for us in the Atlantic region. The Maritime Link is a $1.6 billion project that will allow an abundance of clean hydro energy to flow from Muskrat Falls in Newfoundland into Nova Scotia and beyond.

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These two transmission projects add up to what we call the North American Eastern Energy Loop.
substation, a battery system in the basement of a commercial building and, on a smaller residential scale, a storage battery in a customer’s garage. We’re also working with partners to introduce more electric vehicle charging stations in Barbados and Nova Scotia while exploring the role of storage in using electric vehicles to support the grid.

And we’re bringing these renewable initiatives together with grid intelligence that will result in more reliable service for our customers. Emera companies are collaborating across our operating regions to take advantage of combined purchasing power and to share best practices. Through grid intelligence technology, including Advanced Metering Infrastructure (AMI, or smart meters), customers are gaining more visibility into their energy usage, allowing them to manage consumption and to see firsthand how renewable energy is part of our fuel mix.

The team at Barbados Light & Power is rolling out a four-year AMI deployment, which will play a key role in integrating renewables and balancing energy sources, while responding to changes in peak demand and ensuring reliable supply for customers. The team at Tampa Electric rolled out an initial AMI pilot in April 2016, deploying 2,500 smart meters in Hillsborough County. This was just the first step towards a goal of providing every customer in Tampa Electric’s service territory with a smart meter by 2020. A second phase of the pilot is currently underway, as the team works to install more than 20,000 smart meters in 2017. Nova Scotia Power is also advancing plans to roll-out smart meters to all of its customers, forecasting that over the lifespan of the project, smart meters will reduce costs by approximately $38 million, helping deliver rate stability to customers.

A CULTURE OF INNOVATION

I believe companies like Emera have an important role to play in fostering a culture of innovation in the Atlantic region. Innovation is the key to Emera’s success as we focus on projects that range from small to massive – each representing our strategy in action as we work to bring about the future of smart energy.

We’re a leader in renewable energy innovation in Canada and on the world stage, creating an industry right here in Atlantic Canada through collaborative research partnerships with industry, government and universities.

We committed $10M to Dalhousie University to create the Emera ideaHub incubator and accelerator.

For example, Emera has partnered with New Brunswick Power and the University of New Brunswick to establish the Emera & NB Power Research Centre for Smart Grid Technologies at UNB. Our affiliate Barbados Light and Power is working with the Barbadian government to completely electrify and power the island 100 per cent by renewable energy before 2045. The centre at UNB will attract world-class research and expertise to help create clean energy solutions for our customers in Barbados which will then be applied at our affiliates.

We have also committed $10 million to Dalhousie University in Halifax to create the Emera ideaHub – a world class engineering incubator and accelerator space that will provide students and start-ups with mentorship and support to bring ideas for their technology-based products to the market.

The Emera ideaHUB is a perfect fit for us as we constantly explore new ideas and technologies to provide safe, clean affordable energy to our customers.

Investing in innovation like this is not only important for our business, it is important to our community. The ideas that will be accelerated due to initiatives like Emera ideaHUB and the smart grid research centre will help Atlantic Canada launch great companies that will compete in global markets with the best in the world.

I’m proud that we at Emera are helping to lead the way in the rapidly evolving cleaner energy sector.
BOB HANF

Bob Hanf leads strategy and alignment for teams across Emera in the areas of stakeholder and regulatory relations, safety, environment, communications and government relations. Since joining the business in 2002, Bob has held progressively more senior roles within the Emera group of companies, most recently as President and Chief Executive Officer of Nova Scotia Power. Prior to that, Bob served as Chief Legal Officer for Emera in Halifax, Executive Chairman of Light & Power Holdings in Barbados, and President and COO at Bangor Hydro Electric Company in Maine. Bob has been part of the leadership team that has steered Emera from its origins as a single electrical utility in Nova Scotia to become one of the 20 largest North American publicly traded utilities, and a member of S&P TSX 60.
ENERGY PAST ≠ ENERGY FUTURE

BY COLIN ANDERSEN
Chair, Energy Council of Canada

Summary: Colin Andersen argues that past will be only limited prologue to our energy future in a time when a “Grand Transition” is underway, driven by digitization, decarbonisation and decentralisation, and characterized by considerable disruption. Electricity in particular is poised for transformation, after a relatively static first 100 years, and regulators will be challenged to move beyond today’s siloed approaches. He closes with a call to ensure that eliminating energy poverty is a component of the change and innovation to come.

THE GRAND TRANSITION

“What’s past is prologue.”

“The best predictor of the future is the past.”

Notwithstanding Shakespeare’s suggestion that history can teach us lessons, and insight on personal behaviour from the realm of psychology, in 2017 I would venture to say that our energy past does NOT equal our energy future.

Indeed, here in Canada as in the rest of the world – and while we will continue to build on a solid foundation – our energy future, owing to developments within the sector as much as to external forces, will bear only some resemblance to our energy past.

Some parts of our sector (putting aside whether we can even refer to energy as one sector anymore) remained largely the same for the first 100+ years. Think electricity in particular. Now, however, there probably isn’t a single segment that isn’t undergoing significant transformation of some sort.

To take that one step further, we are in fact going through a “Grand Transition”. So says the World Energy Council (WEC), of whom the Energy Council of Canada was a founding member back in 1923.

Our energy future will bear only some resemblance to our energy past.

Future chapters of this series of Energy in Canada @150 and Beyond articles will delve into these
areas in more detail, but what are some of the forces driving this transformation? Again, let’s start with the WEC, which sees three big trends – digitalization, decarbonisation, and decentralization.

Layer on the emergence of a sharing economy, rapidly changing demand patterns, accelerating innovation in both energy consumption and supply, increasing convergence with other sectors – all under a sustainability umbrella – and it adds yet another “d” word: disruption. And disruption itself has become a more and more common feature of transformation.

To illustrate some of these concepts, let’s start by looking at electricity:

Electricity is a relatively new technology. It has been heralded by many (electrical engineers in particular) as the greatest invention of the 20th century.

For its first 100 years, electricity was characterized by relatively few large generating plants sending electricity in one direction over long distances to load centres. Contrast that with today where we are already seeing peer-to-peer transactions amongst nearby pico- and micro-sized generators and consumers, often bypassing utilities. Indeed, thanks to enabling small-scale technology, some parts of the developing world are skipping the step of a national grid altogether.

Consumers in the first hundred years were largely passive, perhaps not even paying a lot of attention to conservation or where the power came from as long as it was there when they flipped the switch. Today’s consumers, if they choose, can be an engaged “prosumer”, producing electricity on their rooftop, actively managing consumption with digital assistance (“set and forget”), and even buying and selling electrons over a transactive grid depending on prevailing prices at different times of day. With asset ownership patterns rapidly changing, “sharesumers” are also rising to the fore.

Utilities and system operators initially bought generic electrons, sometimes favouring a particular generation source (nuclear, hydro, or natural gas) or characteristic (baseload, intermediate, or peaking). Not so much anymore. In the eyes of planners and developers these days, not all electrons are necessarily created equal. Clustered offerings, with their ability to provide more targeted value to the system – including power where and when it is needed, voltage support, frequency stabilization, and other ancillary services – mean that procurements and markets will rely on supply “bundles”, such as renewables, storage, and gas all intertwined together.

From a consumer perspective, electricity services have always been the focus – will the lights come on? Moving forward, the days of separately pricing a kilowatt hour may come to a close as customers look to have their cars optimally charged, their homes secured, their carbon managed, and their wifi provided all on one bill. What this means for the utility of the future, and the corresponding but currently disparate regulatory authorities now responsible for each component, remains to be seen. But “partner or perish” comes to mind.

Aside from having a more varied collection of items in the same shopping basket, tomorrow’s electricity consumers won’t just stick close to home. They will expect to roam with their EV as much as with their cell phone – with their road trip electrons showing up on their bill back at the
ranch. And thanks to the blockchain, they may feel less constrained by geography and borders when considering buy/sell transactions with peers.

It follows naturally from this that local empowerment will be more of a defining feature. Actions and influence of individuals, host communities, indigenous peoples, municipalities, and local businesses are taking more precedence than before. Central planning and policy making will continue to focus on market failure, consumer protection, and security but conceivably more of these benefits will be paid for by the taxpayer if there are fewer ratepayers left attached to the grid to pick up the tab.

THE FIRST THREE “D’S”

Now, let’s more specifically tie back to the WEC’s three “D’s” of digitalization, decarbonisation, and decentralization, and the transforming forces leading to my fourth “D” of disruption.

Digitalization is an enabler of much of what I have just described – smart grids and meters are going beyond dispatch and meter reading to smart appliances, pole sensors, set and forget conservation products, and EV charging. Blockchain means borders are less important and facilitates peer to peer trading of energy. And the digitalization of work is having profound impact already in the energy sector. Talent Management is a perennial Top 10 concern of Canadian energy leaders in the WEC’s annual Energy Issues Monitor. Workforce management in a sector with looming retirements and where tasks will be automated but not professions will be profoundly different. As machine learning drives into even more professions than now, and with its predictive, diagnostic, and judgement/sentiment elements, we can expect some fundamental shakeup in exploration, operations, and delivery. Automated work, blockchain, internet of things, big data, cyber hygiene – it’s not particularly surprising to see why digitalization is now seen for the first time by energy leaders as the number one uncertainty in the most recent Energy Issues Monitor.

Digitization is now seen by energy leaders as the number one uncertainty in the Issues Monitor.

We are likely now in a 20- to 40-year transition to a decarbonized future, where “evolution is more likely than revolution” as highlighted at the ECC’s kickoff workshop for the Generation Energy consultation process led by Natural Resources Canada. Solar and wind costs have come down faster than expected; with microgrids and storage poised to follow the same route. Zero marginal cost resources (such as wind and solar) are changing the way we dispatch power. Electrification could triple demand. These developments are having an impact now on prices paid. Decarbonisation will have differential costs and benefits, varying by job class, by region, and by sector. And as we have seen with the Paris Accord and the US election, national and international approaches to climate change policy can shift quickly. However, as we have also seen, subnational governments at the provincial, state, and municipal level have played and will continue to play a significant role in driving momentum. Still, actions to date do not meet our collective Paris ambitions, neither in Canada nor globally.

Consumers trust their utilities but are no longer wedded to them.

Decentralization in the form of distributed generation will enable better access to energy. Depending on what form it takes, decentralization can be both good for the environment, such as renewables, or more problematic, such as diesel. Likewise, decentralization can both add to as well as reduce system costs. The nature of the energy business is that assets are long-lived, and historically centralized, so this part of the transformation isn’t going to happen overnight. Consumers may trust their utilities, but are no longer wedded to them. Utilities will need to
transform, moving from selling unidirectional electrons to selling a variety of attractive, personalized services as noted earlier. Capital-driven revenue strategies will need to shift. Stranded assets and the communities that host them will have to be considered. Innovative thermal grid solutions could further drive customers, developers, and asset owners to as yet largely unregulated behind-the-meter solutions.

And will there be less socialization of costs in a future where you pay only for your own use/share of energy, capacity, and transmission? Will this lead to more democratization of our system (yet another “D” word)?

DISRUPTIVE FORCES

Elyse Allan, President and CEO of GE Canada, and the Energy Council’s 2016 Canadian Energy Person of the Year, says in her Energy in Canada @150 and Beyond article: “I’m speaking of course of the technology race that we all find ourselves in. Call it the IT Revolution, the Digital Revolution, the Internet of Things... whatever we call it, we are all faced with the reality that technology today is disruptive, and these disruptions are occurring at an accelerating pace. Technology is reshaping the competitive landscape for energy companies around the world – and this is one race I can assure you where the tortoise does not win.”

To expand on Elyse’s point, and link to issues that have been raised in ECC/WEC discussions over the past while, I offer the following observations.

In a sharing economy, for example, fewer people will own an individual car. Peer-to-peer energy transactions enabled by blockchain and diverse microgrids will change asset ownership, affecting how power and heating and cooling services are delivered and by whom. Virtual aggregators will serve “community” grids of infinite potential configurations.

Demand patterns are shifting as the electrification of cars, home heating, and mass transport encompasses increasingly greener forms of generation.

The pace of innovation is picking up, with rapid disruption becoming the norm (a topic explained in more detail by the ECC’s Young Energy Professionals group in its article entitled Mutually Assured Disruption”).

Sectors are converging even more quickly, inside the energy sector and increasingly with outside sectors as well – responding to a roaming consumer looking for bundled “set and forget” services (entertainment and communications, home security, a charged EV, and a comfortably heated or cooled home) from whichever provider wins on convenience and affordability.

Distributors could simultaneously become more local (individual prosumers and microgrids) and also less local (crossing global regions thanks to interconnectivity) and will focus on services as opposed to capital. The same way paying for minutes for your phone has largely shifted to unlimited calling, energy pricing will shift away from the underlying electrons and gas molecules to the services supplied. Regulators will likewise have to transform, themselves converging across sectoral domains.

Driven by corporate social responsibility and the desire for resilient investments that can withstand the increasing number of extreme weather events and cyberattacks, for example, corporate and public sector boards are increasingly building sustainability principles into their long-term fiduciary obligations and reporting on them – enabled by better data, carbon accounting methodologies, and a growing recognition of shared societal responsibilities.

What does this mean for our energy future? These four D’s are going to require innovation, and lots of it, as summarized in Chart 2, which I used as the basis for separate remarks on Energy Digitalization, as well as Climate Change Resiliency, at the recent 2017 World Energy Week put on by the World Energy Council in Lisbon.
With a recent “Chatham house rules” discussion at an Ontario Energy Network roundtable also as inspiration, I am going to use the regulatory construct as a framing device to highlight a few of the areas listed. As past CEPY honouree Michael Cleland writes in his article in this series entitled A New Energy Future for Canada?, “Canadians no longer accept that energy decisions should be made by governments. Governments are not trusted, deference to authority has steadily declined. At the same time, tolerance for risk has sharply declined even as the risks appear ever more complex and difficult to understand.” Deference to authority is a thing of the past, and as a result, our current regulatory constructs need a rethink.

On a similar note, a finding I heard several times at the World Energy Council’s recent Executive Assembly in Lisbon: 70 per cent of world energy leaders don’t think regulators are ready for what lies ahead. With an engaged consumer empowered by a blockchain-enabled transactive grid, sector convergence, disruption and innovation are what lie ahead for energy regulators.

Regulators have no choice but to keep up and, indeed, are doing so.

Regulators often get a rough ride when it comes to their perceived lack of enthusiasm for encouraging innovation – whether it is in technological change, utility experimentation, or consumer empowerment. Indeed, they are seen by some as captured by Boomer processes and immune to Millennial realities, unable to quickly remove barriers to innovation and integrate proven technologies faster. Getting out of the way is often seen as a major regulatory innovation in and of itself.

The world is going there regardless – regulators have no choice but to keep up and, indeed, are doing so.

With sectors converging (energy, telecom, consumer protection, transportation safety), siloed regulators must likewise come together in how they work. This includes dealing more closely with planners and governments owing to the increasing complexity of issues both are facing. Ideally, governments should decide upon an overall framework and then leave it to the regulatory and planning bodies to implement and adjudicate.

Space does not permit me to delve into other areas of the Canadian energy sector as deeply, but many of these electricity ideas and examples apply equally. Indeed, in WEC’s words, we are in the middle of a Grand Energy Transition – not just an electricity transition.

And as we progress through this Grand Transformation there is one big issue that I sincerely hope we crack once and for all. Two billion people live in energy poverty worldwide. Regrettably, there are people in Canada in that situation, primarily living in remote, largely Indigenous communities in the north. As we decarbonize, digitalize and decentralize it would be a shame not to address this issue. As UN Secretary-General Ban Ki-Moon said: “Energy is the golden thread that connects economic growth, social equity and environmental sustainability.” The Grand Transition is underway, and hopefully this part of our energy past will not be part of our energy future.

I hope you enjoy the articles in this series. Happy 150th Canada and happy reading.
COLIN ANDERSEN

Colin Andersen is the principal of Colin Andersen Consulting Services and Chair of the Energy Council of Canada. Previously CEO of the Ontario Power Authority; he has also served as Deputy Minister of Finance, of Revenue, and of the Cabinet Office (Policy) in the Ontario government; and has served as Treasury Board Secretary. Andersen has advised successive governments on all aspects of fiscal planning and stewardship of financial resources; and led strategic asset management initiatives, extensive intergovernmental negotiations, and large-scale infrastructure and procurement projects.
MUTUALLY ASSURED DISRUPTION
Change and Change Alike in Canada’s Electricity Sector

BY ROBYN BUDD
KPMG
BEN WEIR

Summary: The authors describe an emerging trend of reciprocal disruption affecting what are traditionally termed “disruptive actors”, in an attempt to reintroduce balance to the electricity sector. Specific examples include: net metered distributed generation, where debate continues over grid integration and valuation; and large-scale renewables, where regulators are looking for new ways to value products such as capacity and reliability. The authors express the hope that a more stable state will emerge from this mutually disruptive process, to the advantage of ratepayers and the grid.

A CHANGING BALANCE OF POWER

While certainly before these authors’ time, the Cold War was a period characterized by the threat of nuclear war between the United States and the Soviet Union; when Mutually Assured Destruction (MAD) was the mantra of the day. MAD was a state of affairs which garnered stagnation and inaction between major players. No one wanted to do anything that could shake up the balance for fear of the potential consequences to themselves. Today’s electricity sector, on the other hand, is more aptly characterized as a system of mutually assured disruption, rather than destruction.

Now, as policy and regulation start to catch up, we are beginning to see a secondary wave of disruption.

Throughout the industry, disruptive actors using new technologies and business models are actively seeking to change the balance of power (no pun intended) between incumbents and themselves. Distributed generation, storage, renewables, engaged customers, demand response, etc. all fit into this category. These disruptive actors have the potential to introduce greater amounts of environmental sustainability and cost efficiency into the electricity sector. The disruptions, however, are not always deployed in ways that lead to the most optimal outcomes, and in many
cases, they are introduced within regulatory frameworks ill-suited to accommodate them. This leads to push back from incumbents including system operators, distributors, and centralized generators. Now, as policy and regulation start to catch up to the realities of the day, we are beginning to see a secondary wave of disruption which affects the disruptors themselves in an attempt to reintroduce balance. The disruption to incumbent business models caused by the new actors assures the corresponding regulatory disruption to the new actors, in turn.

We have seen this dynamic in a number of different arenas but perhaps no more prevalent today than net metered distributed generation threatening distributor’s business models, and low marginal cost renewable generation eroding wholesale market revenues for large generators.

NET METERING: THE APPEAL AND THE CHALLENGE

Of these two issues, net metering seems to receive the bulk of the media’s attention because it touches the largest number of people (each rooftop solar system represents another interested energy customer with skin in the game) and because it has the potential to cause serious issues for electricity distributors’ revenue streams. This is a recipe that has encouraged some very public battles over how to integrate distributed solar into the grid, and, maybe more importantly, over how the energy it produces should be valued by other non-solar customers, distributors and system operators.

Most provinces in Canada have some version of a net metering regulation. In its most basic form, net metering provides a mechanism for smaller electricity customers to produce their own renewable electricity, consume a portion of that electricity behind their meter, and export any extra electricity to their distributor for a credit. Because net metering regulatory frameworks generally guarantee this method of credit valuation (at full retail rates), many distributors have bristled at connecting increasing amounts of net metered generation because it can impact their bottom line. It does this by allowing net metered customers to avoid paying certain charges (like distribution and transmission charges) when these charges are calculated volumetrically (i.e. based on kWh consumption). If a customer uses less electricity from the grid, they pay less of those charges. The problem is, if the net metered customer isn’t paying those charges, someone else is. From a distributor’s and regulator’s perspective, that can be dangerous.

Full retail rate compensation for net metered customers has some justification. Distributed generation, in sufficient quantity and density, can avoid transmission and distribution system expansions. It can also provide a benefit in the form of avoided greenhouse gasses (if the grid uses fossil fuel generation). If the costs of the grid are not getting paid for, however, it presents a big problem for the longevity and reliability of the system. Because of this, we are seeing more and more the process of mutually assured disruption described above. Regulators and legislators are looking more closely at rate structures that will allow distributed generation to continue to proliferate, but in a way that won’t jeopardize distributors’ ability to recover their costs. Structures like Value of Solar Tariffs, fixed distribution and transmission charges, and specific rate classes for net metered customers are popping up throughout the United States, and even here in Canada. The Ontario Energy Board, for example, has moved distribution charges for residential customers to a fixed basis. This means that net-metered customers will no longer be able to avoid the distribution charge regardless of how much electricity they generate themselves. These rate structures seek to accomplish different things, but are similar in that they generally impact the business case for net-metered generation negatively. Hurting the business case for net metering is certainly not the goal of regulators, who are instead trying to ensure that distributors can remain viable, and that
distributed generation is being compensated in a way that reflects the value it provides – both of which are very good things. Solar companies and net metered customers have enjoyed full retail rate compensation for their projects, but must learn to work within these revised regulatory frameworks if they want to continue to do business. The disruptors are becoming disrupted themselves.

**THE BOOM IN LARGE SCALE RENEWABLES**

The disruptive influence of renewable energy has not just been felt on the smaller scales of rooftop solar and residential rate classes. Over the past 10 years, Canada has seen a corresponding boom of renewable energy development at much larger scales. Traditionally, the electricity system has followed a standard model based on centralized generation located outside of urban centers, fed by a controlled supply (think nuclear, natural gas, coal, and hydroelectric dams). System operators had a limited number of large players to manage, all of which were focused on the business of energy supply, and electricity prices would fluctuate in step with the price of the natural resources used to supply the power.

Enter the disrupting actor of large-scale renewable energy development. Backed by government climate change goals and supporting policies, the diaspora of renewable energy has broken into the traditional model of electricity generation. It is much more distributed, with streams of power feeding into the grid from urban areas, rural communities, and previously untapped run-of-river sources; and from non-traditional developers such as community co-operatives, Indigenous communities, municipalities, and large corporations that are trying their hand at electricity generation for the first time. Not only are these wind, solar, waterpower and bioenergy sources intermittent, requiring regular management through flexibility products like regulation services and fast-ramping back-up generation, but their fuel supply is free, or nearly free, meaning they can bid into electricity markets at zero, or close to it. The introduction of zero marginal cost generation (not to mention the various procurement incentives and long-term contracts) has introduced a new business model into the mix, and has had the disruptive impact of lowering market prices for incumbent generators with higher marginal costs.

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**Zero marginal cost generation has introduced a new business model.**

This also is a case of mutually assured disruption. The disruptors have sufficiently shaken up the market, but the market pendulum swings back and we are starting to see the push back disruption to the disruptors. Electricity market overhauls are being considered by system operators in an attempt to rebalance the playing field for all generators, as is the case in Alberta and Ontario where capacity markets are being implemented. Similarly in the United States we are seeing zero emission credits for nuclear facilities and notices of proposed rule-making for additional compensation for facilities that have sufficient available fuel resources. While still in nascent stages, we believe we will soon also see a proliferation of new operability and connection requirements, to which renewable generators are not currently subject, to force them to provide grid services for reliability.

Each of these actions taken by regulating authorities are essentially intended to value and pay for products that the system used to receive from incumbent centralized generators (capacity, reliability, ancillary services) simply by virtue of their existence. With the disruptive force of large scale renewable deployment, the longevity of those incumbent generators is threatened and regulatory bodies are searching for ways to make sure they can survive. New models, like capacity markets, could prove difficult for intermittent renewable generators to utilize while requirements to provide grid services will likely hurt their bottom line (at least initially). Combined with a shift away from long term contracting as the central means of procuring renewable generation, we see a market oriented future that is less than clearly beneficial for disruptive large scale renewable generators.
SEEKING A STABLE EQUILIBRIUM

Large-scale renewable energy development and net metering are two examples of disruptive forces that have spurred regulatory reactions with mutually disruptive results. Other disruptors such as energy literate consumers, the sharing economy, technology advancements in storage, blockchain, the internet of things, and electric vehicles are also on the scene. Despite some rhetoric of the assured destruction that will result, the double-edged sword is that these advancements too will likely lead to mutually disruptive outcomes. The models that are initially used to deploy these forces and technologies will not likely be the models that exist five years from now. Regulation and market forces catch up and require disruptors to modify how they do things. The hope is that these second waves of disruption will result in a more stable equilibrium between both sets of actors based fundamentally on mutual sustainability, and importantly, that this more stable state will be better for ratepayers and the grid.

ROBYN BUDD

Robyn Budd held senior advisory roles with the Ontario Ministry of Energy and the Independent Electricity System Operator during the boom of renewable energy in Ontario, and was the project manager for the policy development of the Large Renewable Procurement program. She is currently a Senior Consultant with KPMG’s Infrastructure Advisory practice, and lives in Vancouver.

BEN WEIR

Ben Weir is a Senior Policy Analyst with the Ontario Ministry of Energy working on renewables policy. He has worked previously for the Canadian Solar Industries Association as Director of Policy and Regulatory Affairs, and with the Ontario Independent Electricity System Operator and Ontario Power Authority on renewables procurement initiatives.
ENERGY TRANSITION IN CANADA – A CHANCE TO WORK TOGETHER

BY ARNE WOHLSCHELGE
Vice President, Power and Gas, Siemens Canada

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 CO2-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.
The conventional power generation sector now has to be re-designed.

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.

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

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 CO2 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 electrolysers 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 as the Mainz Energy Farm.

Efficiency has to be the goal across the energy sector.

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 CO2 reduction of 350,000 tonnes annually. The environmental benefit is equal to taking approximately 75,000 cars off the road¹.

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.²

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

¹ As calculated by the United States Environmental Protection Agency Greenhouse Gas Equivalencies Calculator (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator)

² From the report “Digital enterprise: established players must reinvent themselves” (http://reports.weforum.org/digital-transformation/digital-enterprises-established-players-must-reinvent-themselves/)
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.

Every corporation with an energy sector footprint faces big decisions.

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 CO2 emissions by 521 million tonnes in that same time frame.

Worldwide, Siemens has also publicly committed that production facilities and buildings will achieve a net-zero carbon footprint by 2030, and CO2 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.
ARNE WOHLSCHLEGEL

Arne Wohlschlegel is vice president of Siemens Canada’s Power and Gas Division and a member of the executive leadership team of Siemens Canada Limited. His oversight responsibilities include sales and operations of power plant equipment for the power generation and industrial sectors. He joined Siemens as a field service engineer in 2000 in its gas turbine engineering headquarters in Germany. Wohlschlegel is a member of the Board of Directors of the Energy Council of Canada.
THE POWER OF ELECTRIFICATION

BY DAVID COLLIE
President and Chief Executive Officer, Electrical Safety Authority

Summary: David Collie calls for three key collective efforts to ensure that safety and technology keep pace with each other as the second electrical revolution progresses.

This summer we celebrated the 150th anniversary of Canada's Confederation. Throughout the year we've looked at the immense transformations our nation has experienced. The Canadian Pacific Railroad stitched the country together from coast-to-coast. The discovery of oil and gas in Alberta transformed a poor, agriculture-based economy into a global energy power. The St. Lawrence Seaway connected the industrial heartland of Quebec and Ontario to the Atlantic Ocean and ports around the world.

Of all the transformations in our history, the electrification of our nation is possibly the most transformative.

It's difficult to overstate how radically electricity has changed our lives. In less than a century electricity went from a physical curiosity to a necessity of daily life. Machines powered by electricity freed us from the toil that made up the bulk of people's lives in the age before electricity. Something as simple as doing a load of laundry used to consume hours that are now free for learning, for family and for fun.

A SECOND ELECTRICAL REVOLUTION

Today we are seeing changes around the world that build on the first electrical revolution in ways that not long ago, we never would have imagined. Technology like artificial intelligence, micro-generation and power-over-ethernet are transforming not only the electricity sector, but the fundamental ways in which we interact with electricity.

Technology often advanced faster than safety during the first electrical revolution.

There are many long-term repercussions to consider for stakeholders throughout the system. Each will be affected in different ways – and the challenges for each will differ – but we all share the responsibility of ensuring the system remains safe and reliable.
The first electrical revolution was an era in which often technology advanced more quickly than safety. Over the course of a century we built a regulatory system that ensured safety was always in step with technology. As we stand on the cusp of the second electrical revolution we must work together to ensure that safety and technology continue to move forward together.

**MAINTAINING SAFETY IN A TIME OF CHANGE**

There are a number of ways to facilitate the evolution of the electrical system while also ensuring that the system remains safe for all stakeholders. Many of the initial steps have been taken, but it’s up to all of us to keep up during an exciting period of change.

First, we need to focus on the end user.

Historically, electricity has been delivered from a centrally-managed system to an end-consumer without the consumer engaging with the system itself. As a consumer you simply had to plug in to be connected; generation, distribution and transmission was someone else’s responsibility. No longer.

New technologies like micro-generation and large scale batteries are democratizing the electrical system. Some households and businesses are already turning from electricity recipients into mini power generators, even storing energy until it’s needed. This changes the way they interact with the electrical system. It is up to governments, regulators, system operators, and product manufacturers to account for the end user and design systems with human engagement (and safety) in mind.

Next, we have to take a global view of safety standards and regulations.

As the pace of globalization increases, more and more products are being produced outside of Canada. At the same time, the pace of product development from concept to commercialization has increased dramatically.

We need to use this opportunity to evolve the way we approach regulation by making our processes more flexible and adaptable and ensuring that safety principles are built in to the evolution of the electrical system.

Finally, we must address legacy systems through collaborative innovation.

Just because we’re moving into a new world, we can’t simply flip a switch and get rid of legacy risks like dangerous coil stove burners and improper or aging wiring in seniors’ residences and low-income housing units.

We must embed safety into the fundamental fabric of innovation.

The key is to engage stakeholders across the industry, including those that haven’t traditionally been part of the electricity system. Builders, manufacturers, the financial community and home owners can also contribute their expertise and help the industry develop solutions that will give all consumers safe access to updated infrastructure and emerging technologies.

150 years ago, safety was an individual concern. As new technologies emerged, there was a slow but steady march toward the safety system we have in place today. Responsibility for safety today rests across a spectrum of stakeholders from individuals to organizations to governments. As we look towards our future, we must embed safety into the fundamental fabric of technological innovation and ensure that we all move forward safely together.
DAVID COLLIE

David Collie has been Chief Executive Officer, President and Director of the Electrical Safety Authority, since 2009, and previously served as Chief Executive Officer and President of Burlington Hydro Electric Inc. He has a wealth of related industry experience gained in both the private and public sector, with distribution utility management expertise encompassing the full spectrum of electricity, water and natural gas systems. He held a role in the restructuring of Ontario’s electricity industry and focused on bringing conservation initiatives to electricity customers in Burlington and the province. He holds MBA, CPA, FCPA and Chartered Director designations, and has completed a strategy and governance course at Harvard University.
ABORIGINAL ENERGY BUSINESS
A SUCCESS STORY: ABORIGINAL POWER AND RENEWABLE ENERGY

BY JP GLADU
President and CEO, Canadian Council for Aboriginal Business

Summary: JP Gladu highlights the growing strength of Aboriginal partnerships with corporate Canada, noting in particular the important role of renewable energy projects in Aboriginal economies. He calls on industry and government to focus on relationship building with Aboriginal communities in the pursuit of an equitable and prosperous economic future.

Aboriginal peoples in Canada are increasingly leaving their economic mark on the national stage. The Aboriginal business segment of the economy – including Aboriginal entrepreneurs, Aboriginal Economic Development Corporations (AEDCs) and successful partnerships with corporate Canada – are helping to create greater self sufficiency and economic prosperity. In fact, in 2011, TD Economics forecast that the combined income of Aboriginal households, businesses and government sectors would be $32 billion in 2016. Since that forecast was generated, the resource and construction booms have noticeably tempered and commodity prices have severely reversed course. Amid these cross currents, Aboriginal market income came in at just under target, at $30-31 billion in 2016.

Aboriginal businesses are a fast-growing income source and Aboriginal partnerships with corporate Canada continue to strengthen. In a signal that the tide is changing, Aboriginal socio-economic challenges are increasingly being viewed as opportunities not obstacles. This is evident across all sectors including forestry, oil and gas, LNG, mining, and renewable energy projects. Aboriginal renewable energy projects are playing their part in the Aboriginal economy, whether through medium or large energy developments across the country.

Renewable energy is playing its part in the Aboriginal economy.

According to a CBC news report released on October 11, 2017: “An increasing number of Indigenous communities are becoming partners in renewable energy projects in Canada and creating thousands of jobs as they do it. A new national survey shows nearly one fifth of the country’s power is provided by facilities fully or
partly owned and run by Indigenous communities. It represents a dramatic increase in the last decade in renewable energy projects like hydro, wind and solar power. There are now 152 medium to large renewable energy projects with Indigenous involvement. That’s up from approximately 20 projects in 2008. Each medium to large project generates electricity for at least 400 to 500 homes. There are also another 1,200 smaller projects built with Indigenous participation that generate electricity for local communities.”

Many communities have embraced wind, solar & battery energy storage.

Renewable energy has always existed in the Aboriginal world where respect for the land is respect for the Creator. In the 21st century many communities have embraced wind, solar and battery energy storage as a path to sustainable economies powered by Mother Earth. These are decisions made by the communities and their leadership. In large part, this has been the result of an Aboriginal economy that is growing through partnerships, joint-ventures and equity stakes in larger projects, and involving corporate Canada and Aboriginal businesses and communities.

The renewable energy sector has taken off and industry partners have figured out how to work within the Green Energy and Green Economy Act in Ontario. According to the Canadian Council for Aboriginal Business (CCAB) research department Aboriginal businesses and communities have significant resource and labour challenges as they navigate the mine field of bureaucracy from within. However, growing their economies through strong governance systems and leadership locally has been the recipe for success. Aboriginal community members are generally the shareholders and ultimate beneficiaries of AEDC success on large projects, including renewable energy. Great things can be done when the resources and capacity, which build real understanding and empowerment, receive the attention and support they need.

There are important opportunities for Aboriginal participation through sustainable growth. What really needs to happen is industry and government need to visit these communities and build relationships based on inclusion and mutual respect for each other’s concerns and interests. Aboriginal business people have had to make the most with a lot less. If business wants to work with Aboriginal peoples it should consider participating in the CCAB Progressive Aboriginal Relations (PAR) program, and incorporating it into operational and strategic parameters. Corporate Canada needs to change its internal corporate culture: it’s not just about the bottom line. It’s also about Aboriginal people, their communities, culture and traditions; and about combining deep respect for the past with a commitment to an equitable and prosperous economic future.
JEAN PAUL (JP) GLADU

Jean Paul (JP) Gladu is President and CEO of the Canadian Council for Aboriginal Business (CCAB) based in Toronto. Anishinaabe from Thunder Bay, JP is a member of Bingwi Neyaashi Anishinaabek located on the eastern shores of Lake Nipigon, Ontario. JP completed a forestry technician diploma in 1993, obtained an undergraduate degree in forestry from Northern Arizona University in 2000, holds an Executive MBA from Queens University and the ICD.D from Rotman School of Management University of Toronto. His career path includes work with Aboriginal communities and organizations, environmental non-government organizations, industry and governments from across Canada. Currently, JP serves on the Board of OPG and Noront Resources.
CANADA NEEDS ALL ENERGY FORMS AND TECHNOLOGIES
CANADA’S ENERGY STORY AND OUR PLACE IN THE WORLD’S ENERGY FUTURE

BY TIM MCMILLAN
President and CEO, Canadian Association of Petroleum Producers

Summary: Building from early discoveries in the 1800s, Canada has become one of the world’s largest producers of oil and gas. Innovation has made both further discoveries and our current focus on sustainability possible, and positions us well to meet growing energy needs even in a lower-carbon world. Industry collaborative efforts are already helping make this possible, and Canada is a preferred supplier of the oil and gas the world will continue to need in the decades ahead. The outlook for Canadian energy is tremendously positive, providing we are able both to develop the infrastructure needed to get our products to market, and to foster a competitive regulatory and fiscal environment.

In many ways, Canada’s energy story over the 150 years since Confederation is a reflection of our history as a whole, and of our character as a nation. The tale of Canada’s energy explorers, innovators and entrepreneurs also provides insight into what the next 150 years could hold, and how Canada can help lead the way toward a future of energy abundance through the responsible production of its oil and natural gas resources.

CANADA’S ENERGY STORY: ENTREPRENEURISM MEETS INNOVATION

Today, Canada is considered a major energy producer. We are the world’s sixth-largest oil producer and fifth-largest natural gas producer. The Canadian oil and natural gas industry supports about 500,000 jobs (direct and indirect) while contributing $12 billion annually to government revenues (all levels). In 2016, the industry invested $38 billion in capital.

But it wasn’t always so. Canada – and North America’s – first commercial oil well was drilled in Ontario back in 1858. James Miller Williams, a carriage maker and entrepreneur, dug the well near Oil Springs, a village in Lambton County. He also opened a large refinery in Hamilton in 1860.

The discovery of natural gas soon followed. In 1883, a Canadian Pacific Railway crew accidentally found natural gas near Medicine Hat, Alberta, while drilling for water. By 1890, community leaders in Medicine Hat were taking advantage of the find, drilling to supply natural gas for local cooking, heating and lighting needs.
These early discoveries highlight the spirit of exploration, persistence and entrepreneurism that still today characterizes Canada’s oil and natural gas industry. Further discoveries and a focus on sustainability have required a critical additional ingredient: innovation.

For example, the search for and production of offshore oil along Canada’s East Coast has been advanced through technologies like remotely operated submersible vehicles, gravity-based platforms and improvements in offshore drilling technology. Advancements in hydraulic fracturing techniques and horizontal drilling have allowed for the production of previously inaccessible shale gas and tight oil resources in Western Canada. Meanwhile, the use of multi-well drilling pads has greatly reduced the amount of land disturbed by drilling operations, while the use and recycling of saline water is decreasing the impact on water use.

Beginning with Karl A. Clark’s patented hot-water extraction process in 1928, generations of scientists and engineers have worked to find ways to extract bitumen from oil sands formations. This led to the creation of the Great Canadian Oil Sands (now Suncor Energy) in 1967 – the country’s first successful, commercial oil sands mining operation.

Since then, steam-assisted gravity drainage (SAGD), a process pioneered by a chemical engineer named Roger Butler, has enabled a less-invasive method of extracting bitumen from deposits too deep underground to mine. The technology has a reduced land footprint compared with mining, and producers are working to reduce the GHG emissions intensity of their operations through the development of more energy-efficient methods of steam generation.

THE NEXT 150: CANADA’S PLACE IN THE WORLD’S ENERGY FUTURE

Canada’s energy story shows that innovation is in our industry’s DNA. It’s a key reason why we are well-positioned to meet the challenges of the next 150 years. One challenge will be meeting the energy needs of a growing planet.

In its 2017 World Outlook energy forecast, the International Energy Agency (IEA) estimates the world will need 30 per cent more energy in 2040 than we use today. That means more energy for India, China and around the world. That also means more energy for the three-billion-plus citizens of the planet who today still have to burn wood or animal dung to heat their homes or cook food for their families – let alone someday drive a car, fly somewhere they haven’t been, or use iPhones made with oil.

The fact is global energy demand is growing. Energy demand drives energy production. This means more energy is needed – in all forms.

Certaintly, our global energy mix is changing. Renewable energy supply is increasing. But it won’t happen overnight. The IEA says that wind, solar and geothermal energy sources will increase 400 per cent by 2040. Even with such a large increase, these energy sources will only account for six per cent of the total energy mix in 2040 – meaning that even in a lower-carbon future, the world will continue to need more energy from oil and natural gas.

It’s expected that by 2030, India will be the number-one importer of oil in the world, ahead of China and the United States. Today, India consumes 4.4 million barrels per day – more than we make in all of Canada. That will grow. In fact, India and China will need about nine million more barrels of oil per day by 2040 than they consume today.

Meanwhile, growth in global natural gas consumption is expected to jump 45 per cent by 2040. Natural gas is the cleanest-burning hydrocarbon, producing 50 per cent fewer GHG emissions than coal when used to generate electricity.

It’s worth noting that the IEA forecast incorporates policy shifts driving to meet commitments to reduce GHG emissions, arising from the Paris Accord. A key challenge for our industry will be
to find innovative ways to continue supplying oil and natural gas the world needs, and that also help us meet our nation’s GHG emissions reduction targets.

Canada is the top choice as a source of oil and gas imports.

The good news is that we’ve already started. Energy companies are working together to create more energy with less impact. Since 2012, Canada’s Oil Sands Innovation Alliance (COSIA) – a unique collaboration of oil sands companies – has invested $1.33 billion to create hundreds of innovations, aimed at everything from cutting GHG emissions to eliminating tailings ponds and speeding up land reclamation.

Another industry-led group, the Petroleum Technology Alliance Canada (PTAC), has also made significant investments into environmental innovation. This includes funding projects that can help our industry develop technologies that enable cost-effective petroleum production within a low-carbon economy.

Some of the technologies being developed through groups like COSIA and PTAC include: specialized tubes that reduce the amount steam (and therefore energy) needed for underground bitumen recovery; microalgae that gobble up carbon dioxide emitted from industrial smokestacks; vent gas capture units that redirect natural gas normally emitted into the atmosphere to be used instead as fuel for compressor engines; and satellites that can identify CO2 and methane emission hotspots from outer space.

**THE FUTURE IS NOW: BECOMING AN ENERGY LEADER**

Today, Canada produces about 3.9 million barrels per day of oil. We are poised to grow even more. In CAPP’s 2017 Crude Oil Forecast, Markets and Transportation report, we forecast Canadian oil production will grow to 5.1 million barrels per day (b/d) by 2030. But this is a drop in the barrel – so to speak. The advent of oil sands production technologies has blessed Canada with the third-largest oil reserves in the world; just under 170 billion barrels at last count.

We also have an estimated 300-year supply of natural gas (based on domestic consumption rates). There’s about 1,100 trillion cubic feet of natural gas, much of it found in shale plays across Western Canada – the Montney, Duvernay and Alberta’s Deep Basin. There could also be potential from shale plays in Quebec and New Brunswick, if regulations in these provinces are updated to allow the use of this safe and proven technology.

The fact is, we have energy the world needs and wants. In the 2017 Global Energy Pulse, a first-of-its-kind global survey conducted by Ipsos Public Affairs in April, Canada was the top choice for where people would like to see oil and natural gas imported from. The survey gathered responses from more than 22,000 people from 32 countries around the world.

Around the world, most oil is state-owned and controlled – but Canada has half of all the free-market oil in the world. That is a tremendous opportunity to attract investment into Canada – bringing in capital for projects that would create jobs and economic growth for our nation.

We also have the ingenuity and commitment to sustainability that will allow us to deliver our oil and natural gas resources in a safe, environmentally friendly and cost-effective manner. We are positioned to become a preferred global supplier of choice in a lower-carbon world.

This is all good news – but only if we can deliver our products to market.

The key will be to build the energy infrastructure – including pipelines and LNG facilities – needed to get our resources to growing energy markets overseas. The approval and construction of the Trans Mountain pipeline expansion from Hardisty, Alberta, to the West Coast is an important step. We’ll need to take more.

Another key will be ensuring we have the right regulatory policies and fiscal framework to keep Canada’s industry competitive relative to our competitors around the world. For example,
continued lengthy delays and uncertainties concerning Canada’s regulatory review process for energy projects would seriously undermine investment in our industry. Ultimately, it would allow Canadian producers to be crowded out by others who are as willing to meet global energy demand, but less committed than we are to environmental sustainability.

With our first 150 years behind us, it is time Canada begins laying the groundwork for the next 150 years. While our history has made us who we are today, it’s the future of our energy industry, and the focus on innovation that will help determine who we become tomorrow. We are an energy leader. We have an opportunity to grow. By applying our trademark Canadian resourcefulness – our entrepreneurs and innovators, our engineers and environmental scientists, and our ideas and capital – we can help create a bright energy future; one that builds prosperity for all Canadians by meeting the growing energy needs of the world.

TIM MCMILLAN

Tim McMillan became president and incoming CEO of CAPP in October 2014. At the time of his appointment, he was minister of rural health in the government of Saskatchewan. He had previously served as minister of energy and resources and had a strong connection to the energy industry over many years, including ownership of an oilfield services company. He grew up on a family farm near Lloydminster, and has an economics degree from the University of Victoria.
CANADA NEEDS ALL ENERGY FORMS AND TECHNOLOGIES
EMBRACING THE EXCITEMENT OF ENERGY

BY AL MONACO
President and CEO, Enbridge Inc.

Summary: In the following remarks, presented on the occasion of receiving the Canadian Energy Person of the Year award for 2017, Al Monaco urges greater awareness of the positive ways in which energy underpins our lives and technological advancements. In a world no longer driven by concern with energy scarcity, but still facing rapid population growth, he posits five key factors that will shape our energy future, and argues that North America is developing a tremendous competitive advantage as a global supplier of low-cost energy. Achieving its full potential, however, will require finding means to move beyond current polarized debates.

ENERGY UNDERPINS IT ALL

Think about most exciting things happening in our world today:

- Technology (AI; digital & robotic technologies; blockchain);
- Health care (surgical robots, genome editing);
- Transportation (ease of air travel, Uber, electric and autonomous vehicles); and
- Entertainment, sports and recreation (think virtual reality theme parks).

A short while ago, these were viewed as disruptors; today they’re reality.

And while we think a lot about these exciting technological advancements, there’s one thing that underpins all of it – energy, which also has its own technology story. But we don’t think about Energy in the same way. It takes unfortunate tragedies like Harvey and Irma to make us think about what life would be like without energy.

In fact, when some people think about energy – particularly hydrocarbons – they see it as a problem. It’s ironic, because energy pervades every aspect of our lives – in a very positive way. That reality gets lost in what is a deeply polarized debate about energy in society today. In my view, that debate is no longer one of extremes where activist environmental groups are pitted against oil companies.
When some people think about energy, they see it as a problem.

It’s mainstream, and here’s why I say that. If we took a national poll, a segment of people would say that hydrocarbons are inconsistent with the environment and action on climate. Another segment would say that energy is critical to our economy and way of life. My goal in this paper is to unify these two points of view by talking about the future of energy. Because in my view, when it comes to energy, the environment and the economy are not mutually exclusive.

Before we get to the future of energy, let’s recap where we’ve been.

THE FUTURE OF ENERGY

The focus of energy used to be on supply. Our biggest concern was running out of energy, so we produced and consumed whatever we could – wood, coal, and over time, oil and gas.

We now know that the world isn’t running out of energy. As we’ve removed the shackles of energy scarcity, energy is now free to be shaped by demand, consumption and end-use. Energy is now ruled by consumers; it’s about getting the kind of energy they want, when they want it, and how it gets to them. Consumers are saying they need low-cost, efficient and sustainable energy.

Energy is now free to be shaped by demand, consumption and end-use.

At the same time though – and we don’t talk about this enough in Canada – global energy demand isn’t slowing; it’s growing, rapidly. Two hundred years ago, there were less than 1 billion people in the world. Now, we add 1 billion people every 12-14 years. There are 7.6 billion people on the planet today, but we’ll have nearly 10 billion by 2050. By this time next week we’ll have added another 1.5 million to the population.

These people are going to need energy – lots of it. And, I believe that North America is developing a tremendous competitive advantage in providing the world with the low-cost energy it needs.

With that, there are five things that will characterize our energy future.

1. Permanent reduction in the cost of energy

First and foremost, we’ve entered a new phase of energy cost competitiveness. Some say that the cost reductions and supply growth we’ve seen in the energy sector are temporary. I think much of it is permanent and there is opportunity for more. Technology is not just about drones, it’s transforming every part of the energy business!

Technology has unleashed massive resources beyond anybody’s expectations. Increased supply is putting downward pressure on prices, changing the economics of our industry and forming a new energy paradigm of “lower forever”. I liken this to a virtuous circle effect where lower cost energy supply pushes out higher cost supply, which begets more intense competition for the marginal unit of energy supply to come on.

That in turn induces more technology, and so on. Natural gas is being found at below three dollars! And, new Canadian energy champions – like ARC and 7 Generations – stack up against anyone in North America. The full cycle cost of North American oil has dropped from $70 per barrel to $56 per barrel in five years. The breakeven cost of U.S. shale oil is heading to $40 (perhaps $35 or lower) and the oil sands are on the way to $50, or less.

That’s what’s happening on the transportation side as well. We use digitization to maximize our capacity, conserve power, and enhance reliability. Big data platforms allow us to assess billions of pieces of information from sophisticated tools that inspect pipelines. Cost reductions in energy supply are real and lasting.

2. Greater energy efficiency

Second, our future will be characterized by greater energy efficiency.

Aggressive fuel standards, efficiency measures and consumer behavior are driving energy intensity lower. In 2016, if it hadn’t been for energy efficiency, the world would’ve used 12 per
 cent more energy than it did. That’s the equivalent of the EU’s energy requirements for one year. Between 2000 and 2016, energy use per unit of economic output in the industrial sector fell by nearly 20 per cent. And, as one of North America’s largest gas utilities, our DSM programs reduced consumption by 10 billion cubic metres. This trend will continue to further improve global energy efficiency.

3. A more sustainable energy future

Third, lower emissions will drive a more sustainable energy future. In the U.S., fuel switching from coal to natural gas has brought emissions below 1992 levels, while the economy grew by 80 per cent. You know all about that here in Ontario. And, LNG will do the same thing globally – led by low-cost North American natural gas exports. And, that’s not all. Since 1990, oil producers have reduced emissions intensity by up to 50 per cent. We’ve seen leaps in innovation for Canadian energy through technology accelerators like EVOK, COSIA and the Clean Resources Innovation Network. Suncor’s new Fort Hills operation will deliver oil with a carbon intensity that’s four per cent below the average barrel refined in North America. This kind of performance will give Canadians the confidence that we can meet local and global emissions reduction goals, while continuing to grow our economy. The fact is that Canadian energy will fit prominently in meeting global demand, not just because we have a lot of it, but because we produce it sustainably with the environment in mind.

4. All sources of energy supply

Fourth, the world will need all sources of energy supply. The cost of renewable energy has dropped dramatically. Just look at the cost of offshore wind. A recent renewable auction in the UK produced record low prices for offshore wind energy. A remarkable 50 per cent cost reduction in two years! Renewables will grow at a fast pace – no doubt about it.

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**Canadian energy will fit prominently in meeting global demand.**

Even so, conventional fuels will still make up 75-80 per cent of global energy requirements in 2040. Natural gas will see the highest growth given its low cost, efficiency, existing infrastructure, high reliability and lower emissions. That was part of our thinking with the Spectra transaction. Boeing and United are looking at fuel efficiency and sustainable biofuels, but there is no immediate zero carbon solution for air travel, shipping or heavy freight. There are no easy replacements for hydrocarbons that provide the energy intensity for heavy industry (steel, cement, chemical processes). And, while EVs are showing impressive growth, it will take a while to penetrate the market. My point is that we’re going to need all sources of energy supply to feed dynamic global demand. And with greater sustainability and technology, we can ensure we keep emissions in check.

5. Greater global energy connectivity

Fifth – global connectivity – this is the one that brings this all together. Our energy future will be characterized by the connection of low-cost supply with ever-growing demand. And, North America will be a leading global energy exporter. Let me explain. Half of global energy growth through 2040 will happen in non-OECD countries, including China and India. At the same time, North America is developing an unparalleled competitive advantage in providing low-cost energy. That synergy, between global demand and North American energy supply, is huge. Since lifting of the U.S. crude oil export ban, crude exports have exploded. The natural gas story is even more exciting. By 2025, North America is expected to be one of the largest exporters of natural gas, or LNG, globally. And, the U.S. is already the second-largest exporter of natural gas liquids, having built nine new export facilities since 2012.
You can see what I mean by the North American energy advantage. And it's probably clear by now that rather than looking at protectionist measures, we need to think of North America as an energy trading powerhouse.

Yet, realization of that opportunity depends on the continued connectivity of our North American energy markets – the largest and most integrated energy system in the world. We have low-cost supply; we have cross-border infrastructures for electricity, oil, natural gas; we have deeply integrated supply chains and labour markets; and we have technology to reduce GHGs.

In short, we have the ability to fuel a thirsty, growing global economy. We need to preserve that advantage, and Canada is a big part of that.

CHALLENGES AND BUILDING PUBLIC TRUST

I hope we agree that this vision of a more affordable, abundant, efficient, sustainable, and globally connected energy future is an opportunity. But, to realize our competitive advantage, we need new and timely infrastructure. Opposition to energy development – and to pipelines in particular – is making that difficult.

It’s resulting in major permitting delays; what used to take two years now takes four or more. More importantly, there’s very little predictability in timelines. At minimum, that drives higher costs and increases the cost of capital. Worse, it locks out capital investment required to unleash the competitive advantage.

What do we need to do to enable this positive energy future? One element of that is building the public’s trust in what the energy sector does. Realization of opportunity depends on connectivity of energy markets.

At Enbridge, we’re pushing ourselves – every day – to be truly world class on safety and environmental protection. We have changed the way we engage with landowners, communities, Indigenous peoples, environmental groups and governments. We’re investing more time on the ground with communities – not just “consulting”, but acting on the input we receive. Today I spend a good deal of time engaging our stakeholders, letting them know what kind of company we are. We’ve made building sustainable relationships with Indigenous communities a top priority. We’re working to find solutions that respect Indigenous peoples’ strong connection to the land and the natural environment and that involves shared economic growth.

This is a tall order, but I can see how partnerships between energy companies and Indigenous communities will be a key driver to reconciliation between Canada and Indigenous peoples. At Enbridge, we believe that sustainability and shareholder value creation are entirely compatible. In fact, we’ve delivered strong dividend growth for over 20 years. And, we expect that to continue.

CONCLUSION: CANADA NEEDS TO GET ON BOARD

To close, North America has the potential to be an energy export juggernaut. To achieve this vision, we need to get beyond the polarized debate. The time has come to develop pride in the role that the Canadian energy sector is playing.

We need to acknowledge how energy fuels our quality of life. And, we need to be equally excited about the role Canada can play in reducing global GHG emissions.

The time has come to develop pride in the role of Canada’s energy sector.

I believe this is a vision worth pursuing – a vision that unifies Canadians. Where we embrace energy in the same way as those “exciting” areas I talked about at the beginning; a vision that acknowledges that energy and the environment can go hand in hand. And in many ways, Canada and North America have already done a lot to prove that. I’m here to tell you that Canada’s energy sector has embraced change.
And – if you look carefully – I think you’ll see that the future of North America’s energy sector looks very bright.

So let’s make it happen, by capitalizing on our approach to lower cost, sustainable and globally connected energy.

**AL MONACO**

Al Monaco has been president and CEO of Enbridge Inc. since 2012, and also sits on the company’s board. He previously served as president, gas pipelines, green energy and international. He has more than 30 years experience in the energy industry including the upstream oil and gas exploration, development, and pipelines businesses. He was named 2017 Canadian Energy Person of the Year by the Energy Council of Canada.
CANADA NEEDS ALL ENERGY FORMS AND TECHNOLOGIES
Summary: A form of Canadian energy generation almost as old as the country itself, hydropower has delivered almost incalculable environmental benefits to date, and has helped us create one of the world’s cleanest electricity grids. With unmatched dispatchability, it also represents a key strategic advantage in a carbon constrained world.

Clean and renewable, hydropower is one of Canada’s most potent weapons in the fight against climate change. It always has been and always will be. It’s almost as old as Canada itself. In fact, the oldest operating Canadian hydropower facility dates back to 1891. It can be seen from the top of Parliament Hill, on the Ottawa River, in the heart of the nation’s capital. The amount of air pollution and carbon emissions avoided over time, thanks to facilities like this across Canada, is almost incalculable.

Fast forward to today and hydropower is the country’s number one power source, providing more than sixty per cent of Canada’s total electricity generation. This makes Canada’s grid one of the cleanest and most renewable in the world – definitely the cleanest in the G7 group of countries. Even with its vast geography and comparatively small population, Canada is the world’s second largest hydropower generator. With a population almost forty times our size, only China generates more. When it comes to hydro, Canada clearly boxes well above its weight class.

So this is the state of the industry at Canada’s 150th birthday. But what about the next 150 years and beyond? Incredible as it may seem and as big as Canadian hydropower is, we could still more than double our current installed capacity. And that potential exists from coast to coast to coast.

An important and sometimes forgotten hydropower quality is its unmatched dispatchability.

In an increasingly carbon-constrained world, Canada’s clean and renewable hydropower is an enviable strategic advantage. An important and sometimes forgotten hydropower quality is its unmatched dispatchability. Simply put, you can turn hydropower on and off faster than any
other electricity source. This attribute is essential as newer renewables like wind and solar join the climate change battle. Hydropower is the best positioned to help smooth their variable generation onto the grid because it offers massive energy storage through its considerable reservoirs and water management techniques. This same advantage makes hydropower extremely important in avoiding and managing blackouts while increasing grid reliability. It might seem basic but hydropower does not need electricity to make electricity. This is why it has been a first choice for generating power in Canada throughout its history.

Hydropower will need to continue managing environmental impacts while earning social acceptance.

Canada is one of the world’s few net energy exporters. This means we have more than enough of every form of energy to meet our own needs. Hydropower is no exception, it makes up the majority of the electricity that Canada exports to the United States. This is important, especially given that the United States has significantly larger power demand than Canada and its own electricity system’s GHG emissions are much higher per kilowatt hour of electricity generated.

In fact, every terawatt hour of hydropower that Canada sends south can help displace between a half a million and a million tons of carbon per year. From a climate perspective this is good for Canada, the United States, North America and the world. Then consider, for all the benefits it provides, Canadian hydropower represents less than one percent of total U.S. electricity consumption. Opportunities for the clean and sustainable growth of Canadian hydropower are clear.

Developers are proud to contend that in Canada, hydro is the best way to make electricity. Is it the only way? No. Is it perfect? Nothing is. Does it enable other electricity sources? Definitely. Will it be as big a part of Canada’s future as its past? Likely bigger.

Despite its many advantages, the case for hydropower in Canada has never been easy and its development has not been without struggle or difficulty. Hydropower will need to continue avoiding, mitigating and offsetting environmental impacts while earning social acceptance. Early engagement and partnership with Indigenous people will remain central to the success of any project going forward. Canada is however, recognized by the rest of the world as both a pioneer and leader in this clean and renewable technology. The history of Canada is hydropower. So is the future.

**CANADIAN HYDROPOWER ASSOCIATION**

The Canadian Hydropower Association (CHA) is the national trade association dedicated to representing the interests of the hydropower industry. CHA members represent more than 95% of the hydropower capacity in Canada.
CANADA NEEDS ALL ENERGY FORMS AND TECHNOLOGIES
CHAPTER 6

WIND ENERGY’S COMING OF AGE

BY ROBERT HORNUNG
President, Canadian Wind Energy Association

Summary: Robert Hornung sees the world resolutely moving towards a low-carbon future. Canada, with its huge quantity of high-quality clean energy reserves, has a unique opportunity to lead the transition. After briefly pointing out highlights of wind energy developments in Canada and rapidly-growing global investments in wind energy, he indicates that a recent study found no operational barriers to the integration of 35% wind energy generation into the grid provided a number of cost-effective transmission investments were made.

LATEST SPIN ON A LONG TRADITION

The thousands of wind turbines delivering clean electricity to millions of homes across the country may be a marvel of modern engineering and innovation, but they are also just the latest spin on harnessing an energy resource that has been powering Canadian lives, in one way or another, since before there was a Canada.

Before oil was discovered in Alberta, before Quebec built its first hydro dam, and before the first uranium was extracted from deposits in northern Saskatchewan, early settlers were building windmills to grind grain and pump water. By the 1920s, small-scale wind generating systems were starting to dot the Prairie landscape, providing electricity to power lights and charge batteries.

As the electricity grid was extended into rural areas, the use of on-site windmills declined. The desire to capture and use the renewable power of the wind, however, never disappeared. The oil crises of the 1970s sparked new interest in wind energy production, but this time at a larger scale. In Canada, this modern era is considered to have begun at Cowley Ridge in southern Alberta, where 52 Kenetech 375 kW wind turbines were installed in 1993 and 1994.

The desire to capture and use the renewable power of the wind never disappeared.

The Cowley Ridge project was decommissioned last year after 23 years of service, long eclipsed by the technical sophistication of newer wind turbine models and the rapid expansion of the
industry across Canada. By the end of 2016, there were 6,288 wind turbines – some nearly 10 times more powerful than those early Kenetech machines – operating at 285 project sites in all 10 provinces, Yukon and the Northwest Territories. Installed wind capacity has grown by an average of 18 per cent – or 1,327 MW – a year for the past five years, making Canada the eighth largest wind energy producer in the world. The sector now supplies six per cent of Canada’s electricity needs, and has been the country’s largest source of new electricity generating capacity over the past decade.

REVOLUTIONARY IN SCOPE

The industry’s growth in Canada is part of a renewable energy revolution underway across the globe. Clean energy is now big business, with worldwide investment totaling $348 billion last year. The year before that, a record-setting $468 billion flowed into the sector, the first time more money was invested in renewable energy than in power from natural gas, coal, and oil combined. And even though overall investment in clean energy was down in 2016, the total capacity installed was virtually the same, thanks to falling technology costs.

The global wind industry installed 56.5 GW of new generating capacity in 2016, its second-best year ever. More and more wind farms are being built at prices that rival, and often undercut, their competitors. According to the U.S. financial advisory firm Lazard, the levelized cost of wind energy has plummeted 66 per cent since 2009, and looking forward, the International Energy Agency forecasts it will drop another 26 per cent by 2025. Wind is already Canada’s most cost-competitive source of new electricity generation alongside natural gas. And unlike natural gas, it is not impacted by carbon prices or commodity price fluctuations, and so will only become more affordable over time.

Is it any wonder then, that wind energy can be found at the centre of any credible strategy to combat climate change and capture clean growth opportunities?

We see it around us. Alberta and Saskatchewan are moving forward with plans to install as much as 7,000 MW of new renewable energy capacity on their grids by 2030 to replace retiring coal and reduce electricity sector greenhouse gas emissions, with most of it expected to be wind. The release of Quebec’s new 2030 energy policy in late 2016 set the stage for wind to play a major role in the province’s efforts to decrease fossil fuel use and accelerate the transition to a low-carbon economy. The federal government has promised to phase out coal-fired generation by 2030 and has set a target of generating 90 per cent of Canada’s electricity from non-emitting sources by 2030, up from 83 per cent today.

The levelized cost of wind energy has plummeted 66 per cent since 2009

Even as U.S. President Donald Trump reverses some of the climate change actions of his predecessor, he will not be able to roll back renewable energy. States in the U.S. northeast have independently made strong greenhouse gas emission reduction commitments and are in the market for significant amounts of new clean energy supply. Hydro and wind energy producers in Canada are responding, forming partnerships with transmission developers to help fill that demand.

These trends are only going to accelerate over time. They have to. Canada has made a commitment to reduce carbon emissions 30 per cent below 2005 levels by 2030. Some provinces have gone further, adopting targets consistent with the Paris Agreement’s objective of limiting global temperature rise this century to less than 2°C and seeking emissions reductions in the order of 80 per cent by 2050. The only way to meet this objective is to fundamentally transform the way we produce and use energy.

It will mean powering more and more of our activities and industries with clean, non-emitting electricity. We’ll be driving electric vehicles, using electricity more often to meet heating
and cooling needs in significantly more energy efficient buildings, and employing innovative processes that integrate energy efficiency and clean generation technologies to drive both costs and emissions down in some industrial sectors.

The commercial and industrial sector has become one of the fastest-growing customers for wind energy.

We are already starting down this path. Bloomberg New Energy Finance released a study last year predicting that electric vehicles will make up 35 per cent of new car sales by 2040. Wind turbines are powering remote mines in the Northwest Territories and Northern Quebec right now, and are doing the same in Chile, Argentina, Australia and other places around the globe. Over the last couple of years, the commercial and industrial sector has become one of the fastest-growing customers for wind energy. More than one third of new wind power purchase contracts in the U.S. are being signed by non-utility customers, and the market is expanding to include countries like Germany, South Africa, Mexico, Chile, Brazil and the U.K. IKEA owns two wind farms in Alberta, part of its global strategy to produce more renewable energy than it uses by 2020.

UNEXPLOITED OPPORTUNITY

In a world increasingly demanding clean energy solutions, Canada’s vast and diverse renewable resources are a strategic advantage. And when it comes to wind energy in particular, it’s an opportunity we have barely begun to exploit. That became very clear last year, when the Canadian Wind Energy Association released the results of a ground-breaking study that found Canada can reliably and cost-effectively get more than a third of its electricity from wind energy.

The Pan-Canadian Wind Integration Study (PCWIS) found no operational barriers to achieving 35 per cent wind penetration. Reaching that mark would require new transmission interconnections to allow the free flow of wind-generated electricity between markets, but with wind displacing more expensive coal- and gas-fired generation in both the U.S. and Canada, the fuel cost savings would pay for that infrastructure in just three or four years, while at the same time racking up billions of dollars a year in new clean energy export revenue and reducing emissions on both sides of the border by tens of millions of tonnes.

It sounds like a big leap from where we are today, and it is. But it is also in step with what jurisdictions around the world are already doing. Iowa got nearly 37 per cent of its electricity from wind last year, South Dakota got more than 30 per cent and three other U.S. states surpassed 20 per cent. Denmark meets 40 per cent of its electricity demand with wind, Portugal is at 30 per cent and Ireland is within striking distance of that mark. In our own country, P.E.I. is already at 25 per cent and has plans to increase its installed wind capacity by a third.

BRIDGING THE GAP

So how does Canada bridge the gap and get to where we know we need to be? We have the resources and we have the technology. What we need now are policies that drive investment in the right direction. Pricing carbon is a good first step, but it will only get us so far. We also need smart limits on emissions from natural gas-fired generation that allow it to play a transition role as an enabler for more renewable energy while not becoming a long-term barrier to it, strategic transmission investments that connect wind-rich regions with those in need of clean electricity, and electricity market designs and rules that recognize and reward the value wind energy brings to the grid.

The world is resolutely moving towards a low-carbon future, and Canada, with its huge quantity of high-quality clean energy reserves, has a unique opportunity to lead the transition. If we seize it, Canada will not just compete, but thrive, in the next century of clean growth.
ROBERT HORNUNG

Robert Hornung has been president of the Canadian Wind Energy Association (CanWEA) since August 2003. He represents the interests of Canada’s wind energy industry, including wind farm owners, operators, project developers, consultants, manufacturers and service providers. Robert is also a Board Member of the Global Wind Energy Council and was named a Fellow of the Royal Canadian Geographical Society in 2009.
CANADA NEEDS ALL ENERGY FORMS AND TECHNOLOGIES
FIVE POSSIBILITIES FOR ENERGY TECHNOLOGY

BY JOHN BARRETT  
President and CEO, Canadian Nuclear Association  
JOHN STEWART  
Director of Policy and Research, Canadian Nuclear Association

Summary: John Barrett and John Stewart share their thoughts on five possibilities for energy technology arising from Canada’s nuclear sector and how they could unfold in the medium-to-long term. Starting with what they see as the most likely, they profile recycling of nuclear fuel, advances in small and/or advanced nuclear reactors, district energy systems driven by nuclear energy, fusion energy, and widespread penetration of electric vehicles.

Forecasting is hard. There are many possible futures and only one real one, so the odds of being wrong are high. Yet industries and governments need to build infrastructure with fifty- to one-hundred-year implications.

Canada’s nuclear energy industry is a foundation stone, not just of our present energy system, but of the sustainable energy system we’re building. This is not just marketing hype: it’s backed by real investment decisions, which in turn must be backed by informed judgements about likely future scenarios.

So let us share with you the Canadian Nuclear Association’s views on five technology possibilities arising from Canada’s nuclear sector and how we see them unfolding in the medium-to-long term – starting with the outcomes we see as being most likely.

1. RECYCLING OF NUCLEAR FUEL

Likelihood 100% (technical success accomplished, commercialization proceeding)

Recycling of nuclear fuel is a fait accompli, and Canada made it happen. Nuclear has always been highly sustainable because of its low life-cycle environmental impacts and uranium’s abundant presence in the earth’s crust. Recycling fuel pulls nuclear more tightly into the renewable and sustainable end of the environmental spectrum.

Canada’s CANDU reactor designs have always been uniquely well-suited to burning recycled fuel. This was recognized decades ago and research in this area has gone on ever since. In 2011, CANDU vendor SNC-Lavalin (SNCL) and China National
Nuclear Corporation (CNMC) began collaborating to develop the Advanced Fuel CANDU Reactor (AFCR). AFCR runs on recycled uranium fuel from light water reactors (LWRs) that are in use in many countries.

AFCR can use recycled uranium to increase uranium utilization efficiency – or it can use thorium, a new fertile material of much greater abundance than uranium. This is attractive for countries such as China that have reserves of used uranium from conventional LWRs as well as indigenous thorium. This opens up potential new markets for AFCRs worldwide.

CANDU reactor designs have always been uniquely well-suited to burning recycled fuel.

An AFCR can be fueled by reusing the recycled uranium from the spent fuel produced by four LWRs, helping China reduce its spent fuel volume. By doing this, China also generates more electricity from carbon-free sources, with benefits for local air quality – a big concern in much of the country – as well as for global climate goals. Each AFCR twin reactor saves up to 13 million tonnes of CO2 per year when displacing traditional coal-fired power plants.

China already operates two CANDU reactors that are world leaders in high-capacity power generating performance.

2. WIDESPREAD USE OF SMALL AND/OR ADVANCED REACTORS

Likelihood 90% (very high in the global market)

Until now, designers of power reactors aimed to serve major power grids where large plant size is an advantage. But not all reactor designs served such markets. Some needed to be far smaller, such as those for research or experimental purposes at many universities (as at Québec’s École Polytechnique, Ontario’s McMaster University, the Saskatchewan Research Council and elsewhere). And some were not only small, but modular: they were meant to be easily removed from their installation and perhaps transported when they needed to be refueled or replaced. Small reactors have been very successful for sixty years in propelling naval vessels like aircraft carriers, submarines and icebreakers in the fleets of several countries.

Small reactors produced in a factory by the dozens or hundreds – and returned to the factory when decommissioned – could be more widely applicable than reactors built-to-purpose on site in ones, twos and fours. Small modular reactors could drive more large ships, heat building complexes, process natural resources, and supply reliable power to remote communities – all without carbon emissions.

Combined with passive safety systems, new fuel cycles, low emissions and smaller waste volumes, these changes could transform the availability of carbon-free energy in our society in the coming decades. Canada’s Terrestrial Energy is an exciting case of a more innovative design.

Many elements of these changes have already been demonstrated; there’s not much doubt that they can work as technologies. Rather, the remaining barriers are concentrated in the regulatory sphere (would a licence allow reactors to be operated remotely?) and the economic sphere (given a certain regulatory model, how many units must be produced for the business case to work?).

The answers will vary among jurisdictions and applications, but they are very likely to be positive in some cases. So we see little doubt of widespread use of small modular reactors in some countries by 2050. Canada should be a leading contender due to high energy use, many remote communities, and already possessing a safe, sophisticated and viable nuclear industry.

Providing almost unlimited clean energy to communities that have been energy poor is an exciting idea.

This has the potential to dramatically liberate Canada’s development in regions that are currently limited by being off the grid. Providing
almost unlimited clean energy to communities that have been energy-poor is an exciting idea that truly catches the imagination of many. And for those operating remote mining sites or using fossil fuels for bitumen extraction in oil sands production regions, such clean, mobile power sources could be a real game-changer, providing quantities of needed energy but without GHG emissions.

3. DISTRICT ENERGY SYSTEMS – SERVING MULTIPLE BUILDINGS WITH NUCLEAR ENERGY

**Likelihood 70% (high in the global market)**

Building heat, especially in cold climates like Canada’s, is a difficult energy and emissions problem. Today, heating buildings is overwhelmingly accomplished with carbon-emitting fossil fuels. Generally, each building has its own system, making it harder to achieve efficient scale and apply professional management. And heat losses are enormous, partly because there are few public measures to manage them.

District energy systems – in which a single furnace supplies heat, and possibly air conditioning and power as well, through pipes and wires to a cluster of buildings – look like an important step forward in solving these problems. ENMAX’s District Energy Centre in Calgary is a great example. While it’s powered by a fossil fuel (natural gas), it’s very efficient because it applies professional management and supplies energy at a large scale.

The challenge is not just to build many more such systems, but to build them with a low- or zero-emission source of energy, particularly one that’s reliable in the middle of a dense city through a Canadian winter. Even with better storage, it’s hard to see renewables doing that.

Small nuclear reactors certainly look like a good answer. Even with the modest uncertainty around their licensing and commercialization, we see them quite likely to be applied in this way by 2050. Burnaby, BC’s General Fusion is well advanced in prototyping the heart of a magnetized target fusion reactor. Other approaches are being pursued at the Universities of Alberta and Saskatchewan, and elsewhere.

As with flight, it’s impossible to know exactly how far away that first liftoff is.

4. FUSION ENERGY

**Likelihood 60% (for technical success – commercialization less predictable)**

Imagine this: it’s 1897, and you’re asked to speculate on the outlook for transport in the 1930s. What do you say about flight?

You could say, “Heavier-than-air flight is theoretically possible, but it’s always supposed to be right around the corner and we’re still waiting. So we’ll believe it when we see it, and write it off until then. Let’s assume the aviation future will be balloons and airships.”

Or you could say, “We give heavier-than-air flight a better-than-even chance of working well technically by 1930, but it’s very hard to say how competitive it will be.”

Seeing this as a metaphor for fusion energy, we prefer the second answer. Fusion’s certainly possible; the challenge is just to get more energy out of the system than you have to put into it (net positive energy). As with flight (actually achieved in 1903), it’s impossible to know exactly how far away that first liftoff is. We suspect it will happen sooner rather than later, and will be well controlled for energy production by 2050. Burnaby, BC’s General Fusion is well advanced in prototyping the heart of a magnetized target fusion reactor. Other approaches are being pursued at the Universities of Alberta and Saskatchewan, and elsewhere.

Nuclear generating stations were in service in the 1950s, just twelve to fifteen years after the first controlled fission reaction. But that process was accelerated by determined joint government-industry development, rapidly expanding power demand, and a lack of good electricity generating alternatives. Between now and 2030, even where power demand is growing rapidly, fusion would have to compete with many energy sources and with safe, sophisticated existing reactors – not to mention new, more advanced designs.
5. WIDESPREAD USE OF ZERO EMISSION VEHICLES (ZEVS)

**Likelihood 100%** (but with great uncertainty around how widespread, what technologies will come out on top, and what that will mean for the rest of the energy system)

Why discuss vehicles in an article about nuclear technology? Because transport is about 30 per cent of all our energy use. Major changes in vehicles’ energy supply will place new demands on the whole energy system, including nuclear. There will be changes, but it’s hard to know which changes and what this means for those of us who supply energy.

Because road vehicles are a major source of both dirty air and greenhouse gases, the pressure to move to lower emissions is very strong. Rechargeable, all-electric vehicles (EVs) are already available and, while somewhat expensive to buy, are a real option for some consumers. And they are becoming competitive in many urban fleet-purchase decisions. We will see more rechargeable electric vehicles. We just can’t say how quickly or widely they’ll be taken up.

That being said, we think the media, and many analysts, have over-focused on rechargeable EVs. A major zero-emission alternative may have been underestimated: hydrogen-powered fuel cell vehicles, which carry a tank of hydrogen gas and turn it into water and electricity, driving the wheels. Hydrogen fuel cells have had successful demonstrations in Canada, notably in city buses powered by Canada’s Ballard Power Systems. They avoid the range-limit and recharge-time problems of rechargeable EVs, which are turn-offs for consumers. If distribution of hydrogen for vehicles was as available as electric charging stations, then hydrogen might be very competitive.

But that’s a big if. Hence the difficulty of predicting what kind of ZEVs we’ll drive, or how many of us will drive them. And hence the difficulty of knowing what this means for the energy supply system. We might need to generate more power at night, when EVs are being recharged. Alternatively, we might need to make and distribute hydrogen throughout the economy in very large quantities. Both of these are tailor-made applications for sustainable nuclear energy. But they are very different in terms of implementation, and that’s a big variable for the whole energy system.

We think the media, and many analysts, have over-focused on rechargeable EVs.

With its small footprint, scalability, and reliability, nuclear technology is virtually certain to have a place at the heart of future low-carbon energy systems – but we can’t say for sure how its workload will be shared by heating, resource processing, electricity generation and/or hydrogen production.

**THE BOTTOM LINE: KEEP OUR EYES ON THE ZERO EMISSION PRIZE**

People like gadgets, and we become loyal to causes. It’s easy to become passionate about one technology or another.

But while we’re all pursuing our preferred technology pathways, it’s important not to confuse means with ends. Keep one eye on the ultimate goal. We often talk about technology and change like they are ends in themselves.

Recycling nuclear fuel, better and more useful reactors, cleaner heat for buildings, fusion power, zero-emission vehicles: these are all seductive ideas in their way. They all have believers – as do renewable energy, microgrids, biofuels, geothermal energy and other pathways.

But let’s remember that their desirability and success have to be measured by whether and how they help us get to what we’re all really after. Assuming we are not widely mistaken about climate change, its causes, and the main threats to our ecosystem, that further goal is zero net emissions sometime in this century. And remember that even this is not an end in itself. We reduce emissions for a reason: we need a sustainable planet to live on.
DR. JOHN BARRETT

Dr. John Barrett has expertise in international relations, Canadian foreign policy, corporate business planning and strategic communications. His career spans the federal public service, international organizations, policy think-tanks and universities. He has guided numerous international negotiations, held various diplomatic postings, and served in the NATO international staff. Dr. Barrett is currently on leave from the Department of Foreign Affairs, Trade and Development.

JOHN STEWART

John Stewart leads the development of policy and research products at CNA, and co-chairs the Public Affairs Advisory Committee. He also chairs the Policy Committee of Canada’s National Electricity Roundtable, and is CNA’s representative to the Washington-based Global Nexus Initiative. John worked with the U.S. Embassy in Ottawa from 1990 to 2010. An advocate for the productive integration of immigrants into Canadian society, he has led two of Ottawa’s immigrant services organizations.
CANADA NEEDS ALL ENERGY FORMS AND TECHNOLOGIES
CANADA’S FUTURE IS ELECTRIC

BY THE CANADIAN COUNCIL ON RENEWABLE ELECTRICITY

Summary: The Canadian Council on Renewable Electricity overviews Canada’s uniquely strong and still expanding position in renewable energy generation, and the foundation this provides for deeper electrification and decarbonisation across the building, transportation and industrial sectors. With the right policy support and a clear roadmap, a doubling of this country’s renewable electricity output is within reach.

Though they haven’t received nearly as much attention in recent years as our fossil-energy deposits, Canada is awash in renewable-electricity resources. For decades, Canadian utilities and developers have responsibly tapped into them to power our homes and industries.

THE RESULT?

Canada is a global leader in renewable electricity, which accounts for more than 65 per cent of Canada’s electrons, the highest such proportion amongst G7 nations. That’s something to be proud of. But it’s also just a taste of what’s to come; because Canada has many renewable resources yet to harness—and very good reason to do so.

Around the world, governments and utilities are turning their attention to renewable sources of electricity – from the sun, wind and water – to provide clean, reliable and affordable power for homes and businesses. Supportive policy coupled with falling technology costs have made renewable sources of power the preferred choice for both meeting new electricity demand, and for cleaning up grids dominated by fossil fuels.

Here in Canada, the role of renewable sources of energy will continue to grow in our electricity system, as coal-fired power is phased out by 2030 and natural-gas fired power is more stringently regulated. Indeed, the federal government is seeking to meet a target of 90 per cent non-emitting electricity by 2030.

Canada has the highest proportion of renewable electricity in the G7.

But that isn’t where the opportunity for renewable electricity in Canada ends.

As a signatory to the Paris Agreement, Canada has committed to reducing its greenhouse gas (GHG) emissions by 30 per cent below 2005 levels by 2030. While many developed countries,
such as the United States, will be able to achieve a significant proportion of their reductions by reducing reliance on coal-fired power within their electricity systems, Canada’s already relatively clean grid means that a majority of reductions will have to be found in other sectors.

While this may appear a significant challenge at first glance, a deeper look reveals the opportunity presented by our abundant supply of renewable sources of electricity.

How? Through the increased electrification of sectors – buildings, transportation, and industry – currently reliant upon fossil fuels.

CHANGING THE PRIMARY ENERGY MIX

As illustrated in our report, Powering Climate Prosperity: Canada’s Renewable Electricity Advantage, renewable electricity must meet a growing proportion of our primary energy needs in the decades ahead if we are to achieve our climate change targets. Carbon-based fuels provided Canada with 70 per cent of its primary energy needs in 2010 – the most recent year for which reliable data exists.

We still have a very long way to go to reduce our coal, gas, and oil consumption and slash our carbon emissions, but analysis after analysis concludes that this is the pathway Canada must follow to achieve deep decarbonization:

- “Fuel switching to decarbonized electricity is the single most significant pathway toward achieving deep emissions reduction globally. It allows demand sectors to reduce their end-use emissions by switching from refined petroleum products, natural gas and other fossil fuels to clean electricity. This abatement is only made possible through both decarbonization of existing electricity generation as well as a large expansion of new zero emissions electricity sources.” – Pathways to Deep Decarbonization, Canada Report

- “Low-emission electricity is the foundation for economy-wide emission reductions in transportation, buildings, and industry. While Canada already benefits from relatively low-emission power generation, remaining high-emission generation facilities will need to be replaced, and all provinces will need to expand low-emission electricity generation capacity to meet growing demand and enable further reductions.” – Council of Canadian Academies

Renewable electricity must meet a growing proportion of our primary energy needs in the decades ahead.

- “Electricity as an energy carrier has a pivotal role in achieving economy-wide deeper emissions reductions. It is a highly versatile form of energy and converting electricity into end-use energy services can be done at high efficiencies. As such, an economy-wide transition from current energy end-use fuel mix to one dominated by electricity is an option to satisfy future energy demands, while achieving deep GHG gas emissions reductions.” – Canadian Energy Research Institute

- “Electrification has been identified as an essential step in all deep GHG mitigation analyses. The electrification of end use applications that are currently using fossil fuels is fundamental, for example, using electricity to power certain cars, trucks, building appliances and heating systems, and energy requirements for some industries.” – Canada’s Mid-Century Long-term Low-Greenhouse Gas Development Strategy

By 2022, total cost of ownership of a battery electric vehicle is predicted to be lower than a traditional car.

RENEWABLE ELECTRICITY IN END-USE APPLICATIONS

Around 70 per cent of the energy used in commercial and residential buildings is used for heating, generating substantial emissions. Better insulation has already led to a substantial decrease in heat intensity for new buildings, with approximately a 40 per cent reduction for residential heat intensity between 1990 and 2012. This reduction is expected to continue although at a slower pace. With these low heating
loads, electric (and solar) heating, potentially in combination with heat pumps, is becoming a very economic option and will allow buildings to reach close to zero emissions by 2050, with all energy needs in residential and commercial buildings powered by electricity.

**EV VIABILITY**

By 2050, transport will be the largest GHG emitter in Canada under the Deep Decarbonization Pathways project reference-case scenario, almost three times the total carbon budget for all sectors. Fortunately, recent technological improvements – mostly in battery technology – have made the full electric car a viable alternative to internal combustion engine cars. Full electric cars may have lower GHG emissions than gasoline-powered cars even in areas with relatively dirty electricity supply. For example, an average car driver will reduce lifecycle GHG emissions when switching to a similar battery electric car in all states of the United States. In Canada, with relatively low emissions in its GHG profile, the switch from gasoline to electric cars will see even larger potential GHG reductions.

At present, fully electric cars still only represent less than one per cent of new vehicle sales, but this modest showing is about to change. Battery costs have already come down 60 per cent over the last five years and will continue to decline, further making full electric cars increasingly competitive. Bloomberg predicts that by 2022 the total cost of ownership for a battery electric vehicle will be lower than a traditional car (at $70 oil) at which point electric vehicle sales will really start to take off. Major car manufacturers are already preparing for these changes with almost all major manufacturers introducing electric car models.

As cars electrify, it’s important to ask if Canada has enough clean and renewable electricity to fuel them. Fortunately, Canada has tremendous untapped renewable energy potential of all types. In fact, if all current light duty vehicles in Canada were plug-in electrics, just half of Canada’s undeveloped hydropower potential alone could power the entire Canadian fleet plus twenty-five per cent of the U.S. light duty vehicle fleet as well. Apply Canada’s marine, solar and wind power potential to the challenge and Canadian renewables offer a North American-scale solution for electrifying transportation.

**INDUSTRIAL SECTORS**

Many industrial processes use heat and factories typically burn fossil fuels to generate it – the source of most industry-related emissions.

In principle, these emissions can be reduced dramatically by a combination of energy efficiency measures, biomass, electrification, CCS and a number of smaller measures. Electrification via the use of heat pumps and electric boilers will certainly be one of the most substantial GHG reduction measures especially in light industries. The Deep Decarbonization Pathways project estimates the market share of electric boilers in industrial heat generation to increase from seven per cent in the reference case to 40 per cent in 2050, which would under this scenario be responsible for over 50 per cent of the total non-oil & gas GHG abatement.

The more we electrify our economy – from buildings, to transportation, to industry – with renewable resources, the faster and deeper we can cut greenhouse gas pollution and ensure Canada stands out as a climate change leader.

**LEADERSHIP AT THE NEXT LEVEL**

This, then is the opportunity: Canada can become a global climate leader by taking our renewable-electricity leadership to the next level. Doing so would mean not only cleaning up our grids, but also roughly doubling our output of renewable electricity to increase the role of renewables in Canada’s primary energy mix. That is no small challenge, but also a huge opportunity.

Across the country renewables are now a cost-competitive option for new electricity owing largely to the fact that there is no cost for wind, water or sunshine. While we already produce a significant amount of renewable electricity, we’ve barely scratched the surface of our renewable-
energy potential – recent assessments suggest that renewable electricity resources could readily supply one and a half times the nation’s energy needs. We have resources available from coast to coast to coast, and the diversity of sources – from hydro, to wind, to solar to marine – offer different characteristics that complement each other to ensure we can increase the overall supply of clean, affordable, reliable electricity across Canada.

With the right policy support from provinces and the federal government, we could repower our factories, buildings, trains, vehicles, and more with clean electrons and accelerate our shift to the low carbon economy. This is how we will power prosperity into the coming decades as the world shifts to lower carbon energy sources.

To do this in a comprehensive, efficient and effective way, we – along with numerous other stakeholders who signed on to A Canadian Opportunity: Tackling Climate Change by Switching to Clean Power – believe that Canada needs a national roadmap or action plan for electrification. As a relatively new policy area, it faces some significant barriers. A roadmap for electrification would help fill information gaps that exist today, and lay out a national vision aligned with the pan-Canadian effort to tackle climate change and the Council of the Federation’s Canadian Energy Strategy.

Canada has the opportunity to leverage our competitive advantage in renewable electricity to power our future climate prosperity. It is an advantage we must seize.
CANADIAN COUNCIL ON RENEWABLE ELECTRICITY

The Canadian Council on Renewable Electricity educates and engages Canadians about the opportunity to expand the production and use of renewable electricity across the country. The founding members of the Council are the Canadian Hydropower Association, Canadian Solar Industries Association, Canadian Wind Energy Association, and Marine Renewables Canada.
SOME CLOSING OBSERVATIONS
SOME CLOSING OBSERVATIONS

BY GRAHAM CAMPBELL
Past President, Energy Council of Canada

Canada’s energy story spans thousands of years starting with the arrival of our first peoples and their coast-to-coast-to-coast habitation of the land. It continues today, in a state of rapid transformation that blends all forms of energy – fossil, nuclear, all forms of renewables, geothermal and biomass – into Canada’s energy mix. Energy has become a centre-piece of policy dialogue, consumer engagement, and active public debate.

The articles in this series contribute to telling parts of Canada’s energy story. They draw out ideas and factors that will shape the next chapters in that story, in the near future and over the five decades to 2067. Each author has offered recommendations for actions to improve future energy outcomes.

Based on the insights and recommendations within these seventeen interesting and wide-ranging articles, a few observations stood out which are briefly elaborated on below:

- There are overwhelmingly positive views on the vision for energy in Canada.
- Good policy-making and good decision-making is nevertheless tremendously challenging within a very complex environment with many divergent voices.
- The ongoing transformation towards a low-carbon economy, with its many disruptions and disruptors, carries with it significant implications and opportunities for all energy players.
- Canada will continue to derive many advantages from making sustainable use of a combination of all energy forms for supply and end-use.
- Aboriginal peoples are becoming directly involved in the energy economy to an increasing degree.
- Innovation – as applied to both technology and energy policy – will play a central and essential role in addressing environmental challenges and in positioning companies for global competitiveness.
1. POSITIVE VIEWS ON A STRONG ENERGY VISION

Energy has become widely recognized as a key component of Canada's economy, as a source of employment and a channel for investment, and as a pathway to social development and regional growth.

Canada's energy future will be shaped by the positive views on our ability to arrive at a challenging but clear vision for energy. An underlying tenet of the articles is that energy will continue to be major area of growth and opportunity in this country. Yet while this is taken as a given by Canada's energy community, more needs to be done to widely profile the value and benefits that energy supply, transportation and end-use bring to the Canadian economy and society. In doing so, we will build broader buy-in to a strong energy vision and pride in the role of energy in Canada.

Resources and energy have been defining elements of Canada's history. For us in Canada … energy use is synonymous with the quality of life we enjoy. Energy delivers much of our well-being and high quality of life, including heating our homes, enabling transportation and commerce, and powering manufacturing. If you ask citizens around the world where they'd like their energy to come from, they often say they'd prefer it to come from Canada …. That should serve as inspiration – helping us create an energy future that is the envy of the globe.

Steve Williams, Canada – Responsible Energy for the Globe

2. THE CHALLENGES OF GOOD POLICY-MAKING AND GOOD DECISION-MAKING

Energy has always been attractive to policy-makers as a pathway towards advancing government objectives. Based on recent experience, this will continue. And energy policy-making and decision-making will in fact only become more complex in the years ahead.

After nearly 150 years, transporting fuels and energy continues to be a public policy challenge for Canada, a country blessed with energy resources. However, the search for the holy grail of a national strategy of how to manage that endowment continues to be cursed.


Policy makers face a very complex challenge. The issues associated with energy are manifold: implications for the environment, the impacts on Canada's Aboriginal people and affected communities, inter-jurisdictional issues arising from the prominent energy responsibilities of the provinces and territories, and the need to simultaneously advance environmental policy and while developing energy resources. More broadly, there are often developments outside of Canada that have immediate impacts on Canada, including international oil prices and climate agreements, to name but two.

How can policy, planning and regulatory processes be constructed so as to realistically engage citizens in ways that are seen as fair, open and real at the same time that decision processes reach timely conclusions without adding inordinately to risk for investors? How do we build the sophisticated energy information systems that would be consistent with a 21st Century decision-making environment?

Mike Cleland, A New Energy Future for Canada

While the challenges are great, many recommendations for improving policy making have come forward. Opportunities to strengthen energy decision-making include incorporating the role of local governments and Indigenous people in the decision-making process, and constructively engaging individual citizens in a well-informed way.

Consideration of large energy projects through public regulatory review processes has become the focal point for often heated public intervention by those who will be impacted by the project, or believe they may be. To date, these concerns have typically emerged late in multiple project review processes, rather than being addressed in an open, respectful and trusting manner early in the process.
The impacts are significant. They can include frustration and delays on the part of communities set to derive benefits from projects, and financial impacts and uncertainty on the part of the project proponents. They can also include a sense on the part of other stakeholders that concerns with project impacts have not been adequately heard and/or addressed.

3. SEIZING OPPORTUNITIES FROM ENERGY TRANSFORMATION, DEALING WITH DISRUPTION

Canada is in the midst of a profound transformation affecting all segments of the energy system, as are all OECD countries. The oil and gas supply picture has been transformed due to dramatic increases in North American production based on shale oil and gas production technology, and major advances in managing upstream environmental impacts. In the electricity sector, government policy and industry initiatives are driving a fundamental change in the generation mix towards a low-carbon mix of fuels – including natural gas, an increased share of hydropower and all forms of renewables, biomass and continued use of nuclear power. Operations and market transactions are being transformed, most notably by digitalization. And proactive consumers are directly supplying their own electricity and linking with others on community-scale systems.

...three big trends – digitalization, decarbonisation, and decentralization. Layer on the emergence of a sharing economy, rapidly changing demand patterns, accelerating innovation in both energy consumption and supply, increasing convergence with other sectors – all under a sustainability umbrella – and it adds yet another “d” word: disruption.

Colin Andersen, Energy Past ≠ Energy Future

At the same time, several features of the energy scene remain unchanged. Consumers continue to expect reliable, safe and economical energy services, and are reluctant to pay much more for initiatives aimed at superior environmental performance. The global demand for energy continues to increase steadily, driven primarily by economic development and rising quality of life in Asian countries.

...global energy demand isn’t slowing; it’s growing, rapidly. Two hundred years ago, there were less than 1 billion people in the world. Now, we add 1 billion people every 12 - 14 years. There are 7.6 billion people on the planet today, but we’ll have nearly 10 billion by 2050 ... Conventional fuels will still make up 75-80 per cent of global energy requirements in 2040.

Al Monaco, Embracing the Excitement of Energy

This creates a promising market opportunity for Canada’s oil and gas producers. The overall dominance of fossil fuels in the global energy mix will continue for some time.

At the same time, the rapid pace of technological change continues in the renewable sectors, exemplified by much lower equipment costs for solar and wind generation.

Aspects of the ongoing energy transformation, both positive and disruptive, have been profiled by the authors in this series of articles.

Our energy future will be characterized by proactive consumers, engaged in supplying their own electricity and participating in community-scale grids. Instead of generation exclusively from a few centralized large-scale utilities, generation will come from decentralized utility-scale sources, from households, and from electricity trade; and it will be supplemented by electricity from a variety of storage technologies.

Digitalization is at the core of the ongoing energy transition.

... How does digital impact the energy ecosystem and make it both more sustainable and cost-efficient? In short; real time data, gathered digitally from every part of your operations allows you to analyze and solve current problems quickly, and to predict future problems and prevent them before they occur. This eliminates downtime, optimizes asset performance and improves overall productivity. We need to adopt digital technology faster because digital drives value.

Elyse Allan, Disruptor or Disrupted: Canada’s Role in the Changing Global Energy Market
Recognizing that the transformation can be disruptive, governments need to facilitate training in new ways of doing things and in use of new technologies, and support research and innovation to identify opportunities for Canadian companies. Governments can also play an important role as “first customer” through procurement strategies, and can help to build receptor capacity in companies that would otherwise be ill-prepared for the transition.

Among the significant and complex impacts of the ongoing transformation of the energy system is a process through which the original disruptors of the formerly centralized electricity system are now themselves being disrupted as they interact with other new market entrants. Two examples are the threat that net-metered distributed generation poses to distributors’ business models, and the erosion of wholesale market revenues for large generators by low marginal-cost renewable generation.

Today’s electricity sector… is more aptly characterized as a system of mutually assured disruption, rather than destruction … Disruptive actors using new technologies and business models are actively seeking to change the balance of power… Distributed generation, storage, renewables, engaged customers, demand response, etc. all fit into this category. Now, as policy and regulation start to catch up to the realities of the day, we are beginning to see a secondary wave of disruption which affects the disruptors themselves in an attempt to reintroduce balance.

Robyn Budd and Ben Weir, Mutually Assured Disruption: Change and Change Alike in Canada’s Electricity Sector

Measures to address such market impacts are being implemented by regulators. One example is creation of a capacity market to sustain the services – such as system reliability and back-up power – that incumbent centralized generators traditionally provide.

Each wave of disruptive technology will precipitate renewed disruption in the market. This should be anticipated as a regular market feature going forward.

Regulation remains an important, but often overlooked component of implementing public policy. An immediate requirement is to restore trust in the regulatory system. The rapid pace of change in market operations, and the unanticipated impacts on the businesses of incumbent market players, put the onus on governments and regulators to keep regulations in step with evolving markets.

… to rebuild trust in the regulatory system, particularly by restoring its ability to act independently and objectively … and based on evidence and trusted procedure without late-in-the-game “guidance” from political actors.

Mike Cleland, A New Energy Future for Canada

Suggestions for essential elements of a state-of-the-art regulatory system are: keeping safety at the forefront in the course of updating regulatory systems; recognizing that households and businesses are now generating and storing electricity in addition to consuming it; putting more focus on end-users; being aware of global changes in technology and markets (and recognizing that equipment is often sourced outside of Canada); and being mindful of safety in aging legacy systems that will continue to function for years to come.

New technologies like micro-generation and large-scale batteries are democratizing the electrical system. This changes the way they interact with the electrical system. It is up to governments, regulators, system operators, and product manufacturers to account for the end user and design systems with human engagement (and safety) in mind… We must address legacy systems through collaborative innovation … we can’t simply flip a switch and get rid of legacy risks. The key is to engage stakeholders across the industry, including those that haven’t traditionally been part of the electricity system.

David Collie, The Power of Electrification

Energy companies in Canada find themselves at the leading edge of the energy transformation. Both companies that are large and well-established, and those that offer new
technologies and ways of doing business, are aggressively moving the transformation forward. 

… with the volatility of fossil fuel markets and a strong government policy focus on renewables, we knew we had to fundamentally transform the way we generated electricity. That provided the impetus for Emera’s strategy to provide clean, affordable energy to our customers … primarily by integrating proportionately more wind onto the system than anywhere else in Canada.

Bob Hanf, Innovation and Energy Change

An example in this series is the electricity story submitted by Emera Inc. It illustrates the company’s leading-edge approach to transformation that simultaneously delivers benefits to customers, significantly reduces already low carbon emissions, and secures the company’s position in the North American electricity market.

Emera’s strategic pathway is similar in many ways to the actions taken by its peers in the electricity sector. Its features include a strong commitment to the expectations and needs of customers; a shift to a low-carbon generation mix (including natural gas, oil and petroleum coke, renewables, hydropower and biomass); and significant investments in electricity systems outside of Canada.

Forward-looking elements of Emera’s strategy involve increasing the share of low-carbon generation; assisting customers to increase electrification of their end-use applications; installing smart meters and electricity storage to better manage demand and supply; and continuing to grow its presence in the North American electricity market.

4. MAKING SUSTAINABLE USE OF A COMBINATION OF ALL ENERGY FORMS FOR SUPPLY AND END-USE

Canada has been blessed with energy resources which are richly diverse, abundant, and world-scale in quality and quantity. Development of our resources of fossil fuels, uranium, hydropower, wind, solar, geothermal, and biomass has been at the heart of Canada’s energy story to date. The sustainable development of this full spectrum of resources will continue to be key in upcoming decades.

Every energy faction promotes its 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.

Arne Wohlschlegel, Energy Transition in Canada – A Chance to Work Together

Fossil fuels have been a mainstay of the energy story. The sector provides reliable and economical energy services in buildings and in the transportation and industrial sectors, as well as providing a major source of revenues for governments to support health and social programs. It also supplies jobs and regional development opportunities and is a major contributor to Canada’s balance of payments.

The IEA says that wind, solar and geothermal energy sources will increase 400 per cent by 2040. Even with such a large increase, these energy sources will only account for six per cent of the total energy mix in 2040 – even in a lower-carbon future, the world will continue to need more energy from oil and natural gas. We also have the ingenuity and commitment to sustainability that will allow us to deliver our oil and natural gas resources in a safe, environmentally friendly and cost-effective manner. We are positioned to become a preferred global supplier of choice in a lower-carbon world.

Tim McMillan, Canada’s Energy Story and Our Place in the World’s Energy Future

Forecasts of global energy demand point to dramatic growth in Asian countries as they increasingly make modern energy services available to their people and thereby raise standards of living.

Emissions from the use of fossil fuels dominate the GHG profiles of most countries. This includes emissions from the production and transportation of the commodities, but more importantly from the role of fossil fuels as the primary source of energy in end-use sectors. The upstream oil and
gas industry is making significant progress in reducing environmental impacts arising from its operations. Investment has increased significantly in research and demonstration projects targeted to improved environmental performance, resource efficiencies, and cost competitiveness.

**Hydropower** has been another mainstay of Canada’s energy system since well before Confederation. From its origins as a source of mechanical power to grain mills and early industrial operations, hydropower has grown to provide over 65 per cent of Canada’s electricity, emissions-free.

*Clean and renewable, hydropower is one of Canada’s most potent weapons in the fight against climate change. It always has been and always will be. It’s almost as old as Canada itself. In fact, the oldest operating Canadian hydropower facility dates back to 1891. But what about the next 150 years and beyond? … We could still more than double our current installed capacity. And that potential exists from coast to coast to coast.*

**Canadian Hydropower Association**, Hydropower: Storied Past, Brilliant Future

Hydropower strengthens Canada’s electricity generation portfolio through, among other benefits, quick dispatchability (which contributes to real-time management of the electricity system), improved reliability, very low carbon emissions, and energy export revenue that contributes to Canada’s balance of payments.

The future of hydropower is bright, due to the above characteristics, and due to the fact that considerable hydropower potential remains to be developed. Key recommendations include: gaining social acceptance for new large-scale projects from coast-to-coast-to-coast; early engagement and partnership with Indigenous people based on respect, mutual trust and shared benefits; and leveraging Canada’s hydropower experience and expertise in countries around the world.

**Nuclear power** contributes 17 per cent of Canada’s emission-free electricity production and is a key part of Ontario’s and New Brunswick’s generation mix. Centralized power generation has dominated the nuclear power sector to date.

*Canada’s nuclear energy industry is a foundation stone, not just of our present energy system, but of the sustainable energy system we’re building. This is not just marketing hype: it’s backed by real investment decisions, which in turn must be backed by informed judgements about likely future scenarios.*

**John Barrett** and **John Stewart**, Five Possibilities for Energy Technology

Looking ahead, new areas of opportunity for the nuclear sector include: the ability of CANDU reactors to use re-processed fuel to increase uranium utilization efficiency; and deployment of small modular reactor configurations applicable in remote communities and mining sites, and as community-scale power providers which also provide heat for building clusters.

**Wind energy** is growing rapidly, both globally and in Canada. Supply costs have decreased significantly, for both wind and solar equipment, and we are becoming more adept at integrating such renewables into local and regional grids.

*The industry’s growth in Canada is part of a renewable energy revolution underway across the globe. Clean energy is now big business… A record-setting $468 billion flowed into the sector, the first time more money was invested in renewable energy than in power from natural gas, coal, and oil combined. In a world increasingly demanding clean energy solutions, Canada’s vast and diverse renewable resources are a strategic advantage.*

**Robert Hornung**, Wind Energy’s Coming of Age

To further grow the contribution of wind energy to Canada’s supply picture, policies are needed to drive investment in the right direction. Pricing carbon is a good first step, but it will only get us so far. We also need strategic transmission investments that connect wind-rich regions with those in need of clean electricity, and modernized electricity market designs and rules that recognize and reward the value wind energy brings to the grid.
In addition to generation from renewables, the **expanding the use of renewables in end-use applications** opens up interesting possibilities to advance the transformation to a low-carbon economy. There are various sector-specific opportunities to use renewables to advance electrification. For the residential, commercial and light industrial sectors, this includes electric heating using heat pumps complemented by enhanced building and equipment insulation. It also includes electric boilers and supplying green electricity to electric vehicles. One recommendation is to develop a national roadmap for electrification – linked to the effort to address climate change – which would lay out a national vision and help fill information gaps.

… a deeper look reveals the opportunity presented by our abundant supply of renewable sources of electricity. How? Through the increased electrification of sectors – buildings, transportation, and industry – currently reliant upon fossil fuels. We have resources available from coast to coast to coast, and the diversity of sources – from hydro, to wind, to solar to marine – offer different characteristics that complement each other. With the right policy support from provinces and the federal government, we could re-power our factories, buildings, trains, vehicles, and more with clean electrons and accelerate our shift to the low carbon economy.

**Canadian Council on Renewable Electricity**, Canada’s Future is Electric

A useful approach to advancing an optimal combination of all energy sources available in Canada would be to find a way to **link the major energy suppliers and users in a strategic dialogue**. The sectors involving oil and gas, electricity, transportation, buildings and industrial operations are all critical partners in such engagement. For example, as coal is eliminated from the generation mix, a combination of natural gas turbines and wind and solar electricity will significantly advance the low-carbon agenda. Alberta and Saskatchewan are moving aggressively in this direction.

### 5. Canada’s First Nations Are Becoming Directly Involved in the Energy Economy

The growing engagement of Aboriginal people and communities in energy development is an exciting and positive development. These communities have always used renewable energy and biomass. Increasingly, their engagement in diverse energy projects has brought income, jobs, and economic activity.

*The Aboriginal business segment of the economy – including Aboriginal entrepreneurs, Aboriginal Economic Development Corporations (AEDCs) and successful partnerships with corporate Canada – are helping to create greater self-sufficiency and economic prosperity. Aboriginal renewable energy projects are playing their part in the Aboriginal economy, whether through medium or large energy developments across the country. A new national survey shows nearly one fifth of the country’s power is provided by facilities fully or partly owned and run by Indigenous communities.*


Aboriginal partnerships with energy sector companies have been developed and strengthened. As a result, one fifth of the country’s power is provided by facilities fully or partly owned and run by Indigenous communities, as reported in a recent national survey.

To grow Aboriginal involvement in energy businesses we need to: solve the significant challenges in developing community and labour capacity; continue to develop governance arrangements and local expertise in project management; and build on recent experience with Aboriginal involvement as shareholders and beneficiaries. With respect to building partnerships with corporate Canada, the key is establishing sound relationships from the outset based on inclusiveness, mutual respect, and trust.
6. INNOVATION – TECHNOLOGY, POLICY,
AND SUPPORTING MEASURES

Innovation is a key strategic pathway towards effective, cost efficient, and practical solutions that will lead the energy transformation in the future and position energy companies to thrive.

While innovation is often first associated with technology development, innovation is perhaps even more important in policy-making and regulation. The rapid pace of change, and the increasing diversity and complexity of managing energy systems, are driving the search for innovative policies and regulations in step with developments in technology and markets.

Our focus on innovation should not be just about technical expertise – it’s about embracing new ways of doing things when it comes to environment and community. We need to be open to innovative approaches to how we relate to and interact with one another, how we engage the public, how we develop policy, and so on. We have to be willing to each embrace the role and responsibility we have to contribute to solutions, and to change our behavior in a way that helps to address complex challenges such as climate change.

Steve Williams, Canada – Responsible Energy for the Globe

Governments can boost productivity by supporting innovation from conception all the way through to adoption. We are doing better at the front end of this equation – Canadian governments are increasingly active investors in technology development.

We also see a need for government to look for ways to accelerate the adoption of innovative hardware and software by established companies and by governments themselves. And that means working with start-ups who already have the necessary skills.

Elyse Allan, Disruptor or Disrupted: Canada’s Role in the Changing Global Energy Market

But governments need to continue to accelerate the adoption of innovative hardware and software, by both established companies and by governments themselves. And that means working with start-ups that already have the necessary skills.

The need for a bold measure to drive actions to reduce Canada’s greenhouse gas emissions is clearly evident. To achieve large reductions in emissions over a long period of time dictates the need for an economy-wide effort coupled with a broad social consensus that embraces reason for change without the overhang of a “formal” treaty obligation.

Jatin Nathwani, Cap-and-Invest: Financing Canada’s Energy Transition to a Low Carbon Economy

One innovative policy recommendation is to create a “cap and invest” program as a component of Canada’s climate change framework, and in order to avoid placing the onus of paying for emissions reduction on future generations. This would involve a small levy on energy consumption today, the proceeds from which would be used for sustained and significant investments in national scientific, technological and industrial capacity. The goal would be to facilitate rapid deployment of existing and emerging solutions, which will reduce emissions on a time scale consistent with our national aspirations and international commitments. This policy proposal would also entail creation of an arm’s length independent investment board to manage the funds. These funds could be matched by investments by industry in order to further accelerate GHG reductions.

Other benefits arising from innovation include the joint engagement of the business and the academic communities, which will generate economic growth and new jobs as ideas are brought to fruition.

Before closing, there is an important final observation that addresses one of the World Energy Council themes - energy equity. Over one
billion people across globe have no convenient and affordable access to energy services. The reality is that the very favourable energy situation of Canadians is in sharp contrast to those who daily face acute energy supply challenges. Although progress is being made through the availability of micro-solar and lighting systems, there remains a pressing need to do much more.

… billion people live in energy poverty worldwide. Regrettably, there are people in Canada in that situation, primarily living in remote, largely Indigenous communities in the north. As we decarbonize, digitalize and decentralize it would be a shame not to address this issue.

Colin Andersen, Energy Past ≠ Energy Future

We look forward to hearing from readers about their personal observations after reading the articles.
APPRECIATION

The Energy Council of Canada sincerely thanks the 20 authors of the articles compiled in this e-book for their participation in the Energy in Canada @150 and Beyond project. We greatly value their observations and insights, and the helpful recommendations they have shared.

Through their participation in this project they have advanced the Energy Council’s efforts to foster insightful, multi-sectoral dialogue on energy matters of importance to Canadians, while also helping to inform energy policy and to create value for their fellow Energy Council members.

Thanks also to Kevin Hanson, Communications and Corporate Affairs Consultant, for editing and providing the summary box for each article. The Energy Council wishes to thank Sara McGillivray, Coordinator of Communications for her diligent work coordinating this project.

The Energy Council welcomes feedback on the articles at any time.
ABOUT THE PROJECT

Energy in Canada @150 and Beyond is an Energy Council of Canada project undertaken during 2017 to mark the 150th anniversary of Canadian Confederation.

This project is a continuation of the Council’s prominent role in fostering dialogue in one of the world’s most important energy-producing countries.

This project provided a forum in which leading energy leaders shared their insights on a topic of their choice addressing the current status of key energy issues, and on the ways in which they are likely to unfold in the future. Authors from across the country addressed a diversity of topics, ideas and insights.

MOTIVATION FOR THE PROJECT

The Energy Council of Canada undertook this project to promote its goal of fostering insightful, multi-sectoral dialogue on energy matters of importance to Canadians. The Council is guided in all its activities by a broad energy sustainability objective; by the vision of an affordable, stable and environmentally-sound energy system providing the greatest benefits for all Canadians; and by the three World Energy Council themes of energy security, energy equity, and environmental sustainability. As anticipated, the author’s submissions illuminate various issues that are inherent in the pursuit of these objectives and vision.
The project was further justified by the prominent importance of energy in Canada, both throughout Canadian history and to our present circumstances and our future national well-being and global positioning. Highlighting energy ideas and insights during the country’s sesquicentennial seemed particularly timely.

All aspects of energy production and use – in Canada and globally – are in rapid transition, and this project serves to highlight and analyze both recent and anticipated developments. Significant energy-related advancements and innovations often take shape “beneath the waves” and escape broader attention. Highlighting such developments, with their potential to help address today’s environmental and social issues, was solidly endorsed by the Council’s board of Directors. The submissions profile ambitious and aggressive industry efforts across all major energy sub-sectors.

THIS PUBLICATION

This eBook is a compilation of the 18 submissions, grouped thematically and followed by some closing observations. It has been designed for convenient online access and wide dissemination. It can also be printed. Please contact the Energy Council to obtain the appropriate print file (Press Ready) to use at the printer of your choosing.

In keeping with its global perspective, the Energy Council will be sharing this publication with the World Energy Council, its global parent body. This will make it accessible to energy leaders in its 97 member countries and around the globe.

The Energy Council of Canada hopes that you will find these articles insightful and thought-provoking, and that they lead to further discussion and elaboration. As always, we welcome your feedback at any time.
ABOUT THE ENERGY COUNCIL OF CANADA

The Energy Council of Canada is a vehicle for strategic thinking and dialogue, collaboration, and action by senior energy executives in the private and public sectors with an interest in national, continental and global energy issues.

The Council’s mission is: to bring its Members and energy stakeholders together to forge a better understanding of Canada’s energy opportunities and issues with the aim to optimally shape an affordable, stable and environmentally-sound energy sector for the benefit of all Canadians.

The Energy Council of Canada and its members believe that the sustainable supply and use of energy is essential. The use of energy to produce goods and services, and the production and delivery of energy for those purposes must be managed sustainably, with attention to:

- Energy security - management of primary energy supply, reliability of energy infrastructure, and meeting current and future demand,
- Energy equity - accessibility and affordability of energy supply;
- Environmental sustainability - supply and demand-side energy efficiencies, development of energy supply from renewable and low-carbon sources; and,
- National competitiveness: innovative, robust, and flexible value chain for Canadian energy commodities and products destined for local, regional and global markets as key contributors to Canada’s prosperity.

The Board of Directors approved a Strategic Plan for 2016 – 2018 during its meeting in November 2015.

The plan focuses on achieving the Energy Council’s vision for Canada’s energy sector: An affordable, stable and environmentally-sound energy system providing for the greatest benefit for all Canadians.
Four strategic goals will guide the Energy Council over the next three years:

- Positioning our organization as a leader in enhancing energy dialogue: The Energy Council of Canada will become a more substantive, influential and high-profile organization playing a leading role in addressing important energy matters through five channels of engagement – global, national, federal, provincial and municipal.


- Sharing and contributing to WEC Studies: The Energy Council will raise the awareness, profile and dissemination of the World Energy Council’s policy reports, technical reports, and energy updates to increase the sharing and use of this informative material, and inject Canadian information and insights into WEC studies.

- Creating Value for Members: The Energy Council will serve its Members by enhancing the “value added” they receive.

We fulfill our mission by encouraging and facilitating collaborative, regional and nationwide dialogue to inform effective public policy on energy aimed at creating a more sustainable energy future for the energy sector in Canada and for the world. We hold public policy forums, various member activities, and host the annual Canadian Energy Person of the Year Award. We engage our members and stakeholders in well-informed dialogue, seeking to develop consensus on positive ways forward on energy issues. We support research in partnership with WEC member countries across the globe and with two universities in Canada. The program of research studies gives the Energy Council of Canada and the World Energy Council the knowledge, credibility, and respect, and we aspire to be where all stakeholders come for advice and guidance on energy issues and policies.

Continental energy dialogue is organized by the annual conferences of the WEC North America Region Energy Forum, hosted in turn by the United States Energy Association, Mexico’s WEC Secretariat, and the Energy Council of Canada.

The Energy Council of Canada is the Canadian arm of the World Energy Council, after joining as a founding member in 1923. We represent Canada and organize Canadian contributions and participation in WEC activities, contributing to development of global expert knowledge, energy information and policy perspectives.