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Questions? info@cleanprosperity.ca
Dear Reader,

Welcome to the second issue of Environment and Economy Review.

This publication is an initiative of Canadians for Clean Prosperity, an organization which focuses on fostering ideas for pragmatic, economically friendly approaches to tackling environmental challenges. While our main focus has been on a revenue neutral carbon tax that is fair and lowers taxes for Canadian households and businesses across the country, we also believe in the importance of harnessing innovative new technologies and approaches to lower our carbon footprint.

That’s why in this issue of Environment and Economy Review, you will find articles from a diverse body of authors detailing how governments, businesses, and private citizens can incorporate innovation into their practices to mitigate the effects of climate change. From the oil patch, to the cars we drive, to the energy we consume, these distinguished authors offer essential insight into the way Canada’s economy is shifting to embrace less environmentally detrimental technology. And economy wide carbon pricing can help foster the development and deployment of these technologies. While each brings their own unique perspective, we believe that taken together, they can help inform Canadians about the exciting new technologies and approaches available to help us tackle the critical issue of climate change.

Sincerely,

Mark Cameron  Greg Kiessling
Executive Director  Chair
When it comes to climate policy and economic competitiveness, Canada can’t see the forest for the trees

WRITTEN BY
Perrin Beatty
CEO
The Canadian Chamber of Commerce

Being part of the chamber network – a group of 450 local chambers of commerce and boards of trade in almost every community in Canada – is like having my own personal version of the CBC’s Cross Country Check Up. Whether it’s touching base on the phone or traveling to speak to members in person, I’m reminded almost daily that the debates and issues consuming Parliament Hill receptions are not necessarily the same ones animating Main Street Moose Jaw.

Climate change is an excellent example. There’s no doubt that this is a serious economic and environmental issue, and governments and businesses must work to reduce emissions. I’ve noticed, however, an important difference in the conversations I have about climate policy in Ottawa and those I have with local chamber volunteers, members or staff across Canada.

In the capital, there’s optimism that the costs of climate policy are manageable. An argument I hear often is that only a sliver of Canada’s economy – businesses both exposed to trade and producing a lot of emissions – will be significantly impacted by plans carbon pricing regimes. The Pan Canadian Framework for Clean Growth and Climate Change – Canada’s national plan to address climate change – is rather sanguine about climate policy’s impact on competitiveness, pushing off what is bound to be a difficult conversation with the provinces on the issue until 2020.

Meanwhile, resonating through the chamber network is a remarkably consistent message: the cost of doing business in Canada is going up, and businesses of all sizes are feeling the squeeze. The World Bank conducts an annual ranking of the costs of doing business in 190 countries, which assesses how their regulatory environments support or constrain businesses. Canada ranked 4th in 2007. Almost ten years later we’ve slipped to 22nd, an incredibly fast decline.

Consider the following:

• Beginning in 2019, the government will be phasing in a 2% rise in the CPP premium;
• This year the minimum wage is rising in Alberta, Ontario, British Columbia and Quebec;
• In last year’s budget the government cancelled a planned tax reduction for businesses earning less than $500,000;
• In this year’s budget, the federal government announced a measure to automatically increase a range of business fees.

This is just a sample. It doesn’t include many costs increases specific to a particular town, province or territory, including municipal taxes or provincial fees. It also doesn’t include cost increases that are outside government control, such as raw materials.

Each one of these increases may not be a big deal when considered in isolation, but they add up. The problem is that there isn’t any level of government taking a look at the whole picture and acting to do something about it.

Adding to this anxiety about the cost of doing business in Canada are the initiatives underway in the United States, where the new administration is talking about drastic measures to improve American
competitiveness. The United States is Canada’s closest economic partner, but in many ways it’s our most significant competitor as well. Firms that leave Canada tend to go to the United States. When large multinationals consider where to invest in North America, they’re often choosing between Ontario or Ohio.

This is the context facing many small and medium-sized businesses as new climate policies are introduced. It’s one more cost increase on top of a mountain of costs increases, and they’re worried they won’t be able to carry the weight.

“Canada must do our part to address climate change.”

Now, the solution is not to ignore climate change or to refrain from new policies to reduce emissions. I’ve said it before, but it bears repeating: Canada must do our part to address climate change. However, it is crucial that the competitiveness of Canadian business is a core concern in the design of climate policies.

Much ink has been spilled on how to achieve this balance, and our prescriptions won’t surprise anyone who has been following this issue. Make carbon pricing regimes revenue-neutral and prioritize programs – tax reductions, targeted subsidies or technology funds – that reduce the negative impacts of these policies. Any additional climate policy should be carefully considered to ensure it complements carbon pricing policies.

Innovation and adaptation of new technologies and processes is essential. I’m pleased to see such an emphasis on clean technology in the federal and many provincial plans, and hope that this funding will translate into a real competitive advantage for Canada.

Canada’s provincial and federal governments have taken important steps forward to address climate change, but progress is not inevitable. There’s a risk that the added costs from policies and regulations to reduce greenhouse gas will be the straw that breaks the camel’s back for many businesses, leading to a revolt against climate policies. What one government does another can undo, as the current U.S. administration demonstrates daily.

Here’s my message to Ottawa from Main Street: for the sake of the planet as well as our economy, don’t wait until 2020 to start taking about a plan for protecting Canada’s competitiveness. To lead on climate policy without putting Canadian business at a serious disadvantage, government will need to consider the full range of factors that weaken our competitiveness. As we increase business costs to address climate change, we urgently need to find ways to lower costs elsewhere. A Pan-Canadian approach to addressing climate change must go hand-in-hand with the Pan-Canadian approach to Canadian Competitiveness. As we increase business costs to address climate change, we urgently need to find ways to lower costs elsewhere. A Pan-Canadian approach to Canadian Competitiveness must go hand-in-hand with the Pan-Canadian approach to addressing climate change.

Governments across Canada are rolling out plans to support the deployment of low-emission technology. Ontario began a cap-and-trade market in January 1, 2017, but the province’s Climate Change Action Plan includes up to $375 million of research and development (R&D) support for low-carbon technologies, and billions more for subsidies to encourage consumers and businesses to use low-emission technology. Alberta’s government put in place a carbon tax, with some revenues devoted to supporting low-emission technology. The federal government’s policies include a $2 billion Low Carbon Economy Trust to support projects that reduce carbon emissions.

Government subsidies for low-emissions energy adoption are wasteful unless carefully targeted. Instead, governments should rely on carbon pricing as the main way to drive low-emissions energy innovation. The beauty of carbon pricing is that governments do not need to decide which technologies hold the most promise for reducing emissions. Governments should target their policies to the precise problems they intend to solve. Carbon pricing programs can directly target emissions. Subsidies are far less effective.
There are five rules that governments should follow to get the most energy innovation possible.

1. **Carbon price, carbon price, carbon price**

   Supporting technology development means not only investing in new technologies but also creating demand for clean technologies throughout the economy. Without policies that reflect the social cost of damages caused by pollution, newly developed low-emission technologies will not spread through the marketplace. That is the problem a carbon price fixes.

   Subsidy programs reflect a lack of trust by the government in carbon pricing policy. That lack of trust might become an expensive self-fulfilling prophecy. In a cap-and-trade program, subsidizing low-emissions energy use will reduce the demand for emissions permits, which will reduce the price of permits.

   A lower price for permits also means less revenue than expected to pay for the new subsidies. The government would then need to finance the subsidies from general revenues. That means either higher taxes or a bigger deficit if the government keeps the subsidies. In other words, a more costly system to reduce emissions will crowd out the less costly system.

2. **Limit subsidies for technology adoption**

   When faced with a mandate to provide alternative energy, firms focus their innovative efforts on the technology that is closest to market. Incentives for commercialization and adoption provide less incentive than R&D subsidies do to develop technologies that meet longer-term needs. Targeted small-scale subsidies can complement R&D subsidies by providing market experience with cutting-edge technologies. But, they should be used with the understanding that these subsidies raise the current cost of emission reductions with the hope of reducing future costs.

   Subsidies for electric vehicle adoption are a good example of wasted money. Ontario, for example, gives subsidies of up to $14,000 to purchases of electric vehicles. Hording that kind of cash over to the owner of a new Tesla, rather than supporting the harder-to-finance network of charging stations, is a poor use of government funds.

   Tax credits and subsidies for home energy-efficiency retrofits also get very little bang for the buck. For example, Ontario’s subsidies to retrofit apartments will cost as much as $900 million. They will cost taxpayers $425 per tonne of greenhouse gas emissions reduced. Studies of past similar programs found that around half the people who receive government retrofit grants would have done the retrofits regardless of government incentives.

   Whether subsidies are for electric vehicles or greener homes, governments are paying for what drivers or homeowners would have done anyway.

3. **Use research and development funding to complement private sector activity**

   Government R&D potentially crowds out private R&D efforts when governments target applied research topics. Government R&D will be most effective if it focuses on breakthrough technologies that are not yet close to market. One-time grants to small young firms that would otherwise have difficulty financing the fixed costs of commercialization also help complement private sector activity.

   Government policies should be targeted to the precise problems they intend to solve, and that only governments can solve. A carbon pricing program can directly target emissions. Subsidies for research and development solve a key problem: it’s hard to make quick money from research with applications in the distant future.

4. **Don’t go it alone**

   Foreign markets are many times larger than the domestic market for low-emissions technology. On average, increases in foreign demand have twice the impact on low-emissions innovation as domestic demand. The ability of Canadian firms to compete in global markets will be most important for developing a Canadian clean energy technology sector.

   That means Canadian government policies meant at encouraging domestic take-up of low-emissions technology are not likely to be effective in building a low-emissions technology sector.

5. **A mix of policies work best, but a carbon price is most important**

   While combining both R&D subsidies and carbon prices yields the largest economic benefit, a policy using only the carbon tax achieves 95 percent of the benefits of the combined policy. In contrast, using only a R&D subsidy attains just 11 percent of the benefits of the combined policy.

   With a looming carbon price, businesses and people will have a bottom-line incentive to buy energy-efficient homes and renovate or buy low-emissions vehicles. Any new subsidy program should only apply to instances in which people or businesses would not make the decision to invest in low-emissions technology.

   The optimal policy mix can also help families cope with higher energy prices from cap-and-trade or carbon taxes. At least some of the revenue these policies generate should be returned directly to taxpayers. Policymakers should follow the lead of British Columbia. There, the government used revenues from the province’s carbon tax to help taxpayers. It reduced low-income tax brackets and offered tax credits to low-income households.

   It’s time that government take a look at their plans for rolling out low-emissions technology to make sure they follow these five rules. If not, government policies are going to be an overly costly way to reach Canada’s long-term greenhouse gas emissions reduction targets.
If we want to reduce greenhouse gas (GHG) emissions, carbon pricing is an essential foundation, ideally as simple, predictable and revenue neutral as possible. But is it, as some economic purists contend, enough on its own to move us to a low carbon economy, or put another way, a clean growth economy?

There are many so-called complementary policies that are a bad idea – inefficient, wasteful, and sometimes counterproductive. But not all of them by any means are a bad idea and some are essential compliments to price signals.

Increasingly there is recognition that the many potential opportunities are to be found in our communities, essentially the municipally governed spaces as well as those managed by indigenous governments where most of us live and work, where we use nearly 60 percent of all the energy Canadians consume and where we generate about 50 percent of our GHGs. Many of these opportunities will become economic due to carbon pricing, but often they will need some nudges from other government actions, such as information programs and building and equipment standards for efficiency and emissions performance.

By far the most important area of policy for the longer term concerns municipal planning. Canada’s long term aspiration is to radically reduce GHGs to zero or close to zero. The only way that we can make that real (practical and affordable) is to reshape our communities to become Smart Energy Communities. Carbon pricing alone cannot do this.

The approach to Smart Energy Communities needs to start with a strategy based on a deep understanding of a given community’s energy profile. What are the community’s energy needs – and not just for electricity which typically accounts for less than a quarter of all demand, but all of it including heat and mobility. Then, what are the options for satisfying those needs in ways that are safe, reliable, affordable, and environmentally sound? What are the options that pay multiple dividends such as lower costs or better air quality as well as GHG reduction? With these questions in mind we believe that a few basic principles – the ones that underpin Smart Energy Communities - need to anchor any sensible energy strategy.

The first principle and the one that almost always pays multiple dividends is to reduce the need for energy in the first place through energy efficiency. There are many examples to be found across Canada where a focus on efficiency has produced results that are not only cost-effective but, in the case of buildings, has created spaces that are more comfortable for their inhabitants. One example is the Southwoods Development in Edmonton where Christenson Developments has constructed apartments for seniors that have energy efficiency as one of their main selling points. The Southwoods community offers reduced utility costs through the inclusion of a state of the art geothermal heating system, and reduced electrical costs by means of a gas fired co-generation system.

A particular aspect of efficiency involves using the right form of energy in the right application. In simple terms, energy can be said to have various levels of “quality”, with electricity being the highest quality – flexible and with almost unlimited applications but the move to low carbon will place increasing strains on our power production capacity. With all of the costs and impacts of the full life cycle of energy in mind, from production to use, an energy strategy at the community level should consider where high quality energy is best used and essential. Beyond that, with all costs accounted for including a price for carbon, the market can most often best determine where lower quality energy such as low temperature air or water might do the job more efficiently and cost-effectively.

Yet another aspect of efficiency concerns the management of heat. Of all the energy that comes into our economy, in all forms whether oil or gas or various ways of generating electricity, more than half ends up as what is known as “rejected” heat, stockpiled as GHGs in the atmosphere. The Energy Research and Innovation Centre (ERIC) in the University of Alberta suggests that co-generation systems, which can be defined as systems that produce both electricity and heat from the same fuel source, can capture this heat and reduce the quantity of GHG emissions. Such systems can be as simple as the cost-effective old technologies of steam and gas turbine power plants, or as complex as the highly efficient, advanced technologies found in modern combined cycle gas turbine power plants.

Previously, the majority of the heat produced in co-generation systems was wasted in the exhaust and vented into the atmosphere, whereas today a significant portion of this energy is being captured and used. Co-generation has many potential applications, including the production of electricity and heat in large scale facilities such as industrial plants and power stations. However, it can also be adapted to smaller scale facilities such as school buildings, hospitals, and even single family homes. The key is the design of the systems to ensure that the heat is collected and used as efficiently as possible.

Another clean energy strategy is the use of geothermal energy. This involves taking advantage of the earth’s naturally occurring heat, which is stable and not affected by weather conditions. Geothermal energy can be used for heating and cooling buildings, or to generate electricity.

One example is the Southwoods development in Edmonton, which uses a geothermal heating system to provide energy to the apartments. This system is highly efficient and reduces the amount of emissions produced by the community. The geothermal energy is collected from deep underground sources and used to heat and cool the buildings.

The development also uses other clean energy strategies, such as solar panels on the roofs, which generate electricity for the community. The development is a prime example of how smart energy communities can be developed and how they can contribute to reducing greenhouse gas emissions and improving the quality of life for their inhabitants.

1. Smart Energy Communities improve energy efficiency, enhance reliability, cut costs, and reduce GHGs. They do this by integrating conventional energy networks (electricity, natural gas, district energy, and transportation fuel) in communities to better match energy needs with the most efficient energy source; integrate land use and transportation planning; harness local energy opportunities; and focus on the importance of energy efficiency for whole communities.


3. The energy decision principles we suggest here are well documented. For more information, see: QUEST. (2012) Fuels & Technology for Integrated Community Energy Solutions. Accessed May 24, 2015. Accessible at: http://www.questcanada.org/hub/quest-publications. As well, examples of leading practices for Smart Energy Communities can be found on the Smart Energy Communities Atlas, an online repository of smart energy projects, policies, programs, plans, and resources in Canada. Accessible at: http://www.questcanada.org/hub/atlas.
put another way, wasted heat. The biggest single source of rejected heat is internal combustion engines for transportation where capturing waste heat is inherently very efficient. Other sources include power generation and industrial processes where high quality energy is needed for the initial purpose (such as turning a turbine or processing materials), but where a lot of the initial energy remains in the exhaust stream and typically ends up on the rejected energy pile. Here is where communities across Canada have discovered opportunities in combined heat and power (CHP) and district energy (DE) applications. Less obvious opportunities can be found in the capture of the heat in waste water, a low quality form of heat but potentially still useful and a cost-effective source under the right circumstances. One example of how communities have incorporated CHP and DE is in Cornwall, Ontario. The Cornwall District Energy System uses two gas-fired CHP generators to produce power as well as space heating for two hospitals and 12 local government and commercial buildings. Through the use of this CHP system, the buildings have a thermal efficiency which approaches about 90 percent during winter compared to about 35 percent efficiency for conventional electric only generating plants.

Still on the subject of waste, here too are lots of opportunities to turn what otherwise is simply a burden into an energy opportunity. Canada’s forest industry has been doing that for decades, taking waste wood such as bark and branches and using it to power saw mills and pulp mills. The same principle can be applied in many agricultural operations. This is a good example of a double dividend where an extremely powerful GHG source (methane) that might otherwise be vented to the atmosphere is captured and combusted, making effective use of existing infrastructure and making the gas system inherently more sustainable.

Most of the energy discussion in Canada these days is all about renewable energy but it is striking that up to this point most of the opportunities we have been talking about have involved efficiency one way or another. This should tell us something about the value of approaching the energy issue strategically and knowledgeably as well as the value of viewing our energy options through the community lens. But through the community lens we can also see numerous renewable energy options, especially for thermal energy. Energy captured by use of heat pumps, whether ground source or air source is the most obvious potential and one where, again, efficiency is often the foundation so that the heat pump is meeting a much reduced demand. For instance, the Benny Farm Complex in Montreal was re-developed to have ground source heat pumps and radiant floor heating, a solar domestic hot water system, and heat recovery with high efficiency boilers. The Forks Market in Winnipeg uses a geothermal system to harness energy stored in the earth, the Assiniboine River and groundwater as well as to capture heat produced in the market itself. Another potential opportunity respecting thermal energy involves cooling, this time using cold lake or sea water as the source, something that many Canadian communities have access to in abundance. Thermal energy can also be supplied by solar sources, passively such as through building orientation or more actively, using solar thermal systems to raise the temperature of inlet water for heating systems.

As solar technology has evolved in recent years the potential for photo-voltaic (PV) systems to be cost effective is growing steadily. These sorts of systems can be deployed in many different places including on the roofs of buildings. And one thing communities have in abundance is roofs. One of the many successful projects related to thermal solar collectors and PV in Canada is the Drake Landing Solar Community in Okotoks, Alberta. This was the first initiative to use a local distribution system (loop) to collect heat using rooftop solar panels, use on-site solar PV generation (power) to pump the heat and store it underground during the summer months using borehole thermal energy storage so that it could be used for residential space heating during winter months.

The last point leads us to the final principle which involves thinking of our energy grids as strategic resources. The grids – power, gas, and thermal - not only carry energy, but can be used together to balance systems so as to account for the intermittency of renewables, respond to different demand profiles depending on time of day or season and bring into the system energy “resources”, such as landfill gas and waste heat. This principle in turn brings us back to the point that the only realistic way to think of the grids and the only realistic way to capture the opportunities we have been describing is by viewing energy through the lens of a community.

A great deal of Canada’s energy conversation of late has been about all the things that we - or some of us - don’t want to build, whether pipelines, power lines, and power plants of all sorts - renewable or fossil. Much of the opposition is organized in communities by community leaders and sometimes it is fair and reasonable, other times not so much. Our point is that citizens of communities are much more than the people who say no. They are people who need diverse forms of affordable energy for their well being and who quite rightly believe that those energy needs should have a reduced impact on the environment. Communities often have many of the tools needed to ensure our desired future of a clean growth economy. A sustainable energy future for Canada, such as the one envisioned by the Paris climate change agreement will only come about if it is part of a system of inherently sustainable communities, specifically. Smart Energy Communities. That in turn will need acknowledgement and policy support from senior governments.

Unless we get it done where we live and work we will not get it done at all.
Climate Change: A Tale of Two Narratives

WRITTEN BY
Gord Lambert

During the summer and fall of 2015, I had the privilege of serving on the Alberta Climate Leadership Expert Panel. We had the opportunity to hear many perspectives from experts and citizens inside and outside of Alberta. We participated in 17 expert workshops on all aspects of the issue and received 580 submissions.

Over time I observed that people generally used two very different frames of reference when they engaged with us. Both are relevant and can even be seen as two sides of the same coin. But they lead to very different conversations and outcomes.

The Problem Narrative: Carbon Math

The carbon math narrative is informed by the science of the climate change issue. It is the Problem we are striving to solve. Rising concentrations of greenhouse gases in the atmosphere leads to rising temperatures. The consequences are widespread ranging from increases in severe weather events, to sea level rise to ecosystem disruption from coral reefs to fisheries and agricultural productivity.

The world's governments are committed to limiting temperature rise to 2 degrees Celsius or even an aspirational goal of 1.5 degrees, as enshrined in the Paris Agreement. If countries follow through on their Paris commitments, it will place us on a low carbon future trajectory compatible with a 2 degree outcome.

Temperature goals can in turn be translated into greenhouse gas reduction obligations or a "carbon budget," with countries, sectors and companies taking on a proportionate share of the necessary emissions reductions. Many organizations, such as 350.org, and many individuals concerned about climate base their views on a carbon budget approach.

For countries, sectors and companies who are major producers of hydrocarbons, the implications of translating the 2 degree goal to specific carbon reduction obligations inevitably leads to a conclusion of "leave it in the ground." For the rest of the world that depends on hydrocarbons as consumers, the costs and implications of leaving it in the ground are not defined or stated.

As a panel we quickly realized that reducing emissions in Alberta to meet a 2 degree carbon budget – say a 30% reduction in emissions by 2030 – would be simply unrealistic with dramatic and disruptive economic and social consequences. While 2 degrees is what we need to aspire to as a planet, it needs to be accompanied by plans showing how we get there in a plausible way. Declaring an ambitious target without committing to the actions necessary to achieve it is a dialogue we have had inside and outside of Canada ever since Kyoto. Our panel chose to focus on real actions, outcomes and policies as a basis for defining our success instead of relying on carbon math plus magic.

At the heart of the climate math narrative, is a negative vision – limiting or avoiding greenhouse gas emissions. This negative goal may be necessary, but it does not inspire positive action and engagement.

A corporate CEO could adopt a vision for a company based on "avoidance of bankruptcy," but that would hardly inspire great corporate success. Martin Luther King was undoubtedly more successful in inspiring people to act against racism with his "I Have a Dream" speech than he would have been had he framed it as "I Have a Nightmare."

The problem narrative of carbon math also leads to the tendency to blame and shame governments, regions or companies who produce hydrocarbon energy. By placing blame and shame on oil and gas producing jurisdictions and on projects like the TransMountain pipeline, the problem narrative ignores the continuing necessity for fossil fuel use.

We do not use oil because we produce it. We produce it because we need it. That is our reality today and every major energy outlook forecast has concluded that we will continue to need hydrocarbon based energy for decades to come. Even aggressive scenarios such as the IEA's 450 Scenario which involves high carbon prices, and a major shift to renewables deployment and electric vehicles still predicts oil consumption of 76 million barrels per day in 2035. This is about 20% lower than today's levels, but shows that oil will remain an important part of the global energy supply even in a carbon constrained future. But the oil required to meet that demand must have the lowest possible carbon footprint at a globally competitive cost. This illustrates the challenge for Canadian producers and the urgent need to drive an aggressive innovation effort.

The climate issue is the ultimate issue of the commons. A polarized environment where there are good guys and bad guys makes for great campaigning, but it creates friction and conflict that is counter-productive to the collective effort needed to achieve real progress and solutions.

The choices we made in the 19th and 20th centuries to use oil and coal were made in a context that did not include awareness of the risk of climate change. We now need to reimagine our energy systems for the 21st century to meet the challenge of decarbonization. But we can't ignore that we have critical global scale needs for mobility, heat and power.

The Solution Narrative: Carbon Competitiveness

The solution space for climate change issue is the urgent need for transition in the way we produce, transport, process and use energy. The energy system of the 21st century and beyond needs to be decarbonized, cost competitive, reliable and
Imagine the Canadian oil sands being the source of oil that’s 30-50% less greenhouse gas intensive, requiring 30-50% less energy use, and in turn, 30-50% less cost per barrel. This type of step change makes profitable growth possible even in a low commodity price world. And it creates the conditions for enhanced royalty and tax revenues for governments.

The use of radio frequency based technology is being piloted by Suncor and partners that would achieve even larger emissions reduction benefits and with even lower costs. Reductions in greenhouse gas emissions of up to 70% are seen as possible but even with today’s technology, big improvements are possible. Companies like Cenovus and MEG told us how process improvements in SAGD extraction like boiler efficiency, steam quality, infill wells, and advanced measuring and monitoring are examples of individually small steps that can add up to big impacts. The need for carbon competitiveness is relentless. And we need quick wins as well as game changing new technologies.

As oil producers become more carbon competitive, their carbon levy payments – based on their emissions intensity – will decline, as will their operating costs, improving profitability. They can also market their technology improvements to others in Canada and abroad.

In addition to driving improvement in producing oil with less energy input and cost, there is a need to look for non-combustion uses of hydrocarbon molecules in chemicals, plastics, and hundreds of other products. New ways to capture maximum value from our hydrocarbon molecules is essential to creating resilience and diversify our economy in a carbon constrained future.

We are seeing the market work in Alberta as households, businesses, and government take on the Carbon Competitiveness journey. We are attracting major capital investment into renewables. We are moving away from coal for electricity generation to one which will be 70% natural gas based and 30% renewables based. This is accelerated and enabled by using carbon pricing but it also creates value for communities and firms throughout the province where natural gas production creates jobs and returns royalties to governments that support our education and health care needs.

Households are being given incentives to save energy. Homeowners are installing new furnaces, windows, insulation, and advanced smart home monitoring. Many small and medium sized businesses and new startups are seeing demand for their energy saving products and services increasing.

The scale and complexity of attempting to achieve similar economy wide results using prescriptive regulation is simply implausible. It would be far costlier and more complex. And it would constrain innovation and entrepreneurship instead of incenting it. Some suggest that carbon pricing will make Canada uncompetitive by forcing business to undertake costly measures to reduce emissions. I would counter that complacency would be a far more damaging outcome. In a dynamic competitive world, we have no reason to be complacent. Canada is lagging the rest of the world in innovation and productivity. Other countries are adapting more quickly to a carbon constrained world. Failure to innovate would have serious negative implications especially in commodity based businesses like oil and gas where Canada is a relatively high cost, high emissions supplier. In that regard, pursuing carbon competitiveness and using carbon pricing to engage the power of the market is mission critical.

In summary, the problem narrative of carbon math and the solution narrative of energy transition and carbon competitiveness may be opposite sides of the same coin, but they are very different in inspiring engagement. The technology and innovation necessary for energy transition is accelerated and enabled by carbon pricing and effective supporting policies. The journey to achieve carbon competitiveness is one that every Canadian household, business, and governments need to engage in. Rather than being painful, it can lead to enhanced prosperity, improved quality of life, and a resilient and sustainable future for current and future generations.
What do we mean by clean prosperity? Is it connected solely to energy production, or is it best looked at from an energy technology standpoint? Is the goal clean energy in and of itself? Or are we seeking a clean reliable energy source that underpins a broader sustainable development agenda — where prosperity acquires a human face, since it includes fundamental elements of a healthy and prosperous life, not just to some but across humanity?

To illustrate: much focus has been placed by the global community, rightfully, on the COP21 Paris Agreement, which aims to reduce greenhouse gas (GHG) emissions and slow the progress of climate change in both developed and developing countries. Much focus is also placed on the United Nations’ 17 Sustainable Development Goals (SDGs), an ambitious agenda to put an end to hunger and ensure every person has access to clean water, healthy food, reliable energy — by 2030. One could argue that prosperity for many lies in the interaction and mutual reinforcement of the two. More to the point: how can the ambitions of one meet and support the ambitions of the other in a real, practical way?

To answer this, let’s look at how a specific energy technology can be the root cause of advances towards these important sustainable development goals, while contributing substantive results — to the decarbonization necessary to achieve the COP21 climate change targets. That technology is nuclear. Many will be surprised at how it leads all other energy systems in bringing COP21 and the UN’s SDGs together for the benefit of humanity. In fact, nuclear science & technology meets 9 of the 17 SDGs.1

Let’s start with energy. Energy is connected to nearly everything we do and consume. From the food we eat, to the water we drink, to keeping the lights on in our operating rooms and affording children an education, it is a foundation of our daily lives. Nuclear technology, as many know, produces energy for electricity, largely through reactor-based civil power plants and utilities.

Our future just may depend on raising this awareness — and translating it in policy and action.

But few realize that we can use nuclear technology to address many other social challenges. Nuclear science is helping with the diagnosis and treatment of many diseases, cleaning contaminants from wastewater and using nuclear isotopes can better assess ocean and land health are just a few examples.

It is important to look in more detail at this contribution of nuclear technology to quality of life, to recognize these other critical applications. Our future just may depend on raising this awareness — and translating it in policy and action.

Human Health

Diagnostic nuclear medicine is critical to curing and extending the life of patients who have been diagnosed with challenging health problems by assessing functions of the body, including vital organs, tissues and even blood. Medical isotopes and radionuclide therapies help to detect and destroy cancerous cells in the body, while radiopharmaceuticals can aid in the imaging of patients to provide doctors with an inside window into body function and health.

Many of the medical products used today in hospitals and clinics are sterilized

1. The 9 SDGs that nuclear meets are Industry, Innovation and Infrastructure, Good Health and Well-Being, Climate Action, Clean Water and Sanitization, Life Below Water, Affordable and Clean Energy, Partnerships for the Goals, Life on Land and Zero Hunger.

For more information on nuclear science and its applications you can visit cna.ca
by gamma rays from Cobalt-60, which is harvested and produced in Canada. Disposable syringes, surgical gloves, bandages, sheets, and even surgical instruments rely on Cobalt-60. Gamma radiation technology is used to sterilize approximately 40% of all single-use medical devices in the world.

**Food And Nutrition**

The World Health Organization has highlighted the importance of nutrition stating, “over one-third of child deaths are linked to nutrition.” Investing in maternal and child health can save millions of lives each year and preventing stunted growth and impaired brain development. Knowing which nutrients, the body absorbs, and which it does not, helps medical professionals identify the source of undernutrition and thus the means to treat it.

Radiation is used to preserve seeds and food products and breed disease-resistant plants, making them more resilient to extreme weather. As one example, the International Atomic Energy Agency (IAEA) has been using a nuclear technique called mutation breeding to produce coffee plants that are more resistant to diseases like coffee leaf rust.

Irradiation technology safely preserves food without the use of potentially harmful chemical fumigants and insecticides. Moreover, radioisotopes reduce post-harvest losses by suppressing contamination.

**Environment And Sustainability**

Crop and livestock losses caused by insects – such as the tsetse fly and screwworm – are considerable. Nuclear science can help prevent crop losses by sterilizing the eggs of these insects. Thus, no offspring are produced and crops losses reduced.

Water is essential to sustainable development. Nuclear technology applications help determine the size and condition of underground aquifers and understand phenomena such as ocean acidification and its impact on marine ecosystems. Finding new sources of fresh water in the form of groundwater aquifers, identifying pollutants, and providing energy to power large-scale desalination operations are just a few other benefits of nuclear technology.

**Electricity and Power**

Sustainable development relies upon access to clean, sufficient, and affordable energy. Demand projection for electricity by the U.S. Energy Information Administration sees an increase of 50% by 2040 as the living conditions for over a billion people improve. Electricity is therefore the single most important contributor to human development and the betterment of humanity and is one of the main pillars of the UN's Sustainable Development Goals. To illustrate: access to electricity from clean sources would help to reduce the use of open indoor fires, which, per the World Health Organization (WHO), cause 4.3 million deaths every year because of indoor air pollution. By including nuclear power in its energy mix, a nation reduces harmful emissions, expands electricity supplies, and improves quality of life through better health.

The nuclear industry is pursuing innovative research and development in nuclear energy options for the future. These involve more efficient fuels and new fuel cycles, Generation IV reactors, hydrogen production, small modular reactors and fusion energy. Such innovative technologies focus on achieving dramatic improvements in flexibility, safety, cost, environmental footprint, construction time, and applications for remote or off-grid areas who currently lack affordable and reliable sources of energy.

**Industry and Consumer Products**

Nuclear technology in the industrial sector includes the measurement of density, moisture content and geological composition, material analysis and level and flow rates in oil & gas exploration and production. In industrial radiography, nuclear substances are used for the non-destructive examination and testing of advanced materials.

Other applications include:

- Producing coated paper.
- For manufacturing of luminous paint and products, including exit signs, airport runway lights, dials, gauges and watches.
- To toughen rubber in radial tires and to align the steel belts in those tires.
- Cosmetics, hair products and contact lens solutions.
- Smoke detectors.
- Radioisotopes that emit energy are used in heart pacemakers and to power navigation beacons, satellites and space vehicles.

**Public Safety**

The use of nuclear techniques, specifically neutron beams in materials research, has direct significance to public safety. In addition to assisting inspection techniques for oil and gas pipelines, such R&D is used for assessing ship hull integrity and railroad track failure analysis as part of accident investigations. Radiation is used to scan luggage at airports to detect explosives and concealed weapons, and to check packages for illegal narcotics.

**Summary**

Nuclear technology is a proven, scalable and efficient means to decarbonize electricity. It is therefore plays an essential role in the daunting task of achieving the COP21 GHG reduction targets. At the same time – and closely interrelated – it is a key contributor to the achievement of several UN Sustainable Development Goals in the areas of poverty and hunger, improving health, sustainability, climate change, and protecting oceans and forests.

Nuclear is a formidable tool for improving the lives of millions of people. What is missing, however, is increased understanding, continued policy support, and investment in nuclear technologies are needed to help ensure that this contribution is maximized. If we are truly looking for clean prosperity for as many as possible in the most sustainable way possible – our governments and citizens should think anew about nuclear technology. The solution lies within their grasp.

*Dr. Barrett was Chair of the 2016 Nuclear Industry Summit’s Working Group on the Benefits to Humanity of Nuclear Technology.*
The Canadian Auto Industry is Driving Towards a Cleaner, Safer and Smarter Future

THE CANADIAN AUTO INDUSTRY IS DRIVING TOWARDS A CLEANER, SAFER AND SMARTER FUTURE

Our challenge is to understand the change, respond and thrive in a period of transformation. We recognize that as a global company it’s not only about what vehicles we make, but also how we make them. From advanced manufacturing operations to landfill-free facilities and zero emission vehicles – we believe that the power of collaboration and the commitment to address climate change will not only strengthen our company and make us more competitive, but also improve the world we live in.

We’ve made strategic investments in technologies that are rewriting the rules of vehicle use and ownership, including Internet connectivity, car-sharing, electrification, alternative propulsion and autonomous driving. There is tremendous potential in these technologies and huge long-term benefits for our customers and communities around the world.

So, how are we driving sustainability forward?

As we look to the future, we believe that electrification will be a critical pathway of change for mobility and transportation. Zero emission vehicles, both battery-driven or fuel cell, will ultimately help us take most of the greenhouse gases out of mobility.

At GM, we’re committed to growing the electric vehicle market for the long term as customer adoption of advanced electrification accelerates.

It began with the introduction of the Chevrolet Volt plug-in electric hybrid in 2011. Now in its second generation, the Volt has been Canada’s best-selling electric vehicle for four years running and has since received the Green Car of the Year award from both the Automotive Journalists Association of Canada and Motoring TV.

Then in 2017, a game-changer entered the scene: the Chevrolet Bolt EV. Building on the same technology that powers the Volt, the Bolt EV set the range benchmark for an affordable electric vehicle capable of going the distance by delivering up to 383 kilometers of range on a full charge with zero emissions. With a Canadian MSRP starting at $42,795 before government incentives, the Bolt EV has put truly cutting-edge technology within the reach of customers and cracks the code of affordability and long range. Both the Bolt EV and Volt were recognized as 2017 winners of the Canadian Green Car Awards Zero Emission and Plug-in Hybrid categories respectively.

We’re seeing significant excitement over the Bolt EV from customers coast-to-coast. Deliveries took place across Canada in March 2017 to passionate individuals aspiring to reduce their own carbon footprint and environmentally conscious companies using the Bolt EV to deliver up to 2,000 courier packages to customers on a single charge every day! Learn more about the Chevrolet Bolt EV at gminnovates.ca.

But sustainability is not a lone venture – it takes a commitment to collaborate. In order for electrification to truly take hold, we need to align technology, infrastructure, governments and consumers. We’re proud to be the Canadian EV leader and it gives us an obligation to engage in a realistic conversation about the pace of EV change and how to manage it. While customers are excited about EV technology, they still have questions. We recognize that change takes time, and we’re working together with key partners to address consumer concerns. Provinces like Ontario are actively collaborating with General Motors on these issues. From incentives to reduce cost, and education on how electrification is critical to our future, to ramping-up charging station infrastructure along highways and in communities, it’s through these combined efforts that we will create the biggest impact on the environment and the auto industry.

Accelerated turnover of vehicle technology improves the environment and it’s a strong boost for the local economy.

In addition to electrification, we need to be mindful of the greenhouse gases being emitted by older model vehicles on the road today. Some passionately believe that EVs are the ‘silver bullet’, but EVs currently only make up about 1 per cent of new vehicle sales. While we encourage electrification, we should also take action to retire a greater portion of the 35 per cent of Canadian vehicles that are 12 years or older – they are responsible for 12 per cent of total greenhouse gas emissions. That’s nine million older vehicles with higher emissions – it’s like having a third of the population walking around with analogue phones. If Canada could upgrade these older vehicles with current technology, every replacement vehicle would reduce greenhouse gas emissions by 20-30 per cent. Accelerated turnover of vehicle technology improves the
Finally—it’s not just about the vehicles we drive, but how they’re produced. GM’s efforts to reduce greenhouse gases begins at the manufacturing facilities where vehicles are built. Globally, General Motors achieved a record number of landfill-free facilities in 2016, exceeding 2020 commitment four years early. GM now operates 152 global facilities that recycle, reuse or convert to energy all waste from daily operations.

In Canada, General Motors operates five landfill-free facilities and was named one of Canada’s Greenest Employers in 2017 thanks to collaborative efforts with suppliers, employees and dealers. Regular waste audits have achieved an overall waste diversion rates of 95 per cent, higher than provincial and industry averages reported by the Ministry of Environment and Climate Change. A unique “Green Dealership” pilot program also kicked-off in 2016 which aimed to expand and create green dealerships for the future – including the installation of solar power generation, electric vehicle parking, LED lighting and automation, rainwater collection, energy efficient windows and doors and native landscaping.

Sustainability is a business approach. All of these initiatives contribute to GM’s top and bottom lines by driving efficiencies, generating revenue, saving money—and the environment. By looking at ways we can grow and strengthen our business for the long term, we are also reducing our environmental footprint while maximizing social benefit.

In this unprecedented time, the opportunities ahead are endless and General Motors is excited to lead automotive sustainability towards a future that’s cleaner, safer, and smarter.