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How tax incentives can assist Canada to become a competitive clean technology country

Peter van Dijk
Mackenzie Taylor
Angelo Bertolas

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Peter van Dijk
Executive in Residence, Global Risk Institute

Mackenzie Taylor
Business Analyst, Sustainable Finance, Global Risk Institute

Angelo Bertolas
Senior Tax Advisor

Executive Summary

Climate change is not only a global existential challenge, but it is also a once-in-a-lifetime opportunity for Canada to develop leading-edge clean technology (cleantech) solutions for the world, create high-paying jobs and boost the Canadian economy. In its 2020 Throne Speech, the federal government announced its priority to make Canada the most competitive cleantech market globally.

The world urgently needs cleantech solutions to mitigate and adapt to the impacts of climate change. Cleantech is a broad category of technologies that includes renewable energy such as wind, solar and green hydrogen. It also includes new technologies that reduce the greenhouse gas (GHG) emissions of existing fossil fuel energy sources and processes, capture and store carbon dioxide, and restore and optimize natural carbon sinks. To accelerate the development of these cleantech solutions and encourage investment in climate change mitigation and adaptation, Canadian federal and provincial governments should develop a comprehensive set of fiscal measures in the form of grants, subsidies, blended finance and tax incentives.

This paper focuses on implementing tax incentives to stimulate and hasten the transition to a low carbon economy while ensuring Canada's competitiveness as a cleantech titan. Historically, the opportunity to save taxes has always proven to be a powerful driver of human behavior. Properly designed and targeted, tax incentives can be a powerful tool and play a critical role in accelerating the innovations needed for a low-carbon future, essentially adapting our economy and infrastructure to a changing climate.

Tax incentives, carbon pricing and the phasing out of fossil fuel subsidies constitute a trifecta of levers that, if used together, could help Canada substantially advance our green and clean technology ambitions. We cannot achieve the outcomes we seek if we introduce carbon pricing and tax incentives while simultaneously maintaining fossil fuel subsidies.

Conventional carbon pricing theory assumes that an appropriate level of carbon pricing would defeat the purpose of tax incentives for cleantech. The thinking is that a proper level of carbon pricing ensures that the externalities of the damage inflicted by GHG emissions caused by fossil fuels will be internalized in the cost of fossil fuels. The internalization of GHG emissions' cost creates a level playing field for fossil fuels and clean energy sources such as solar, wind and green hydrogen, and – so the thinking goes – market forces will result in economic clean energy sources that will eliminate the negative impact of climate change. Although we understand this line of thought, our paper argues that combining an appropriate level of carbon pricing and market forces is insufficient to maximize Canada's chances to meet its net-zero commitment by 2050. To reach net-zero by 2050, in addition to gradually increasing carbon pricing, Canada should also phase out fossil fuel subsidies and simultaneously aggressively ramp up targeted cleantech tax incentives.

The Global Climate Change Challenge

The science is clear: our Earth's heating trend is accelerating due to anthropogenic GHG emissions[1]. The United Nations (UN) has cited three well-established scientific links, one being that carbon dioxide, the most abundant GHG accounting for approximately two-thirds of all GHGs, is mostly the product of burning fossil fuels[2]. In 2018, the Intergovernmental Panel on Climate Change (IPCC) issued a special report that rapid and far-reaching transitions in land, energy, industry, buildings, transport, and cities need to occur to ensure that we limit global warming to 1.5°C[3]. However, this has not changed the trajectory of GHG emissions. The National Oceanic and Atmospheric Association (NOAA) recently reported that Earth's carbon dioxide level hit a record high in May 2020, reaching an average of 417 parts per million[4].

The economic costs of more frequent extreme weather events, rising sea levels, and more intense wildfires are already evident. Less visible but more profound are deleterious changes to ecosystems and biodiversity, negative impacts on human health, and disruptions to food and water supplies[5].

Under the Paris Agreement, Canada has committed to reducing its GHG emissions by 30% below its 2005 levels by 2030 and net-zero by 2050. Large jurisdictions, like the European Union (EU), Japan, China, and the United States (U.S.),[6] have also announced their commitments to become net-zero by 2050. The UN's "Race to Zero" campaign is a joint commitment to reach net-zero emissions by 2050 and accelerate climate action in light of the COVID-19 pandemic. Supporters include 992 businesses, 449 cities, 21 regions, 505 universities, 38 investors and 120 member countries, representing over 50% of global GDP and covering nearly 25% of carbon dioxide emissions. All these net-zero commitments mean a rapidly growing demand for cleantech solutions, further instituting Canada's need to become a leader in the cleantech space.

The roadmap to net-zero is not yet clear, but the International Energy Agency's 2020 Special Report on Sustainable Recovery[7] outlines energy-focused policies and investments for government leaders of $3 trillion (2021-2023) to boost economic growth, create jobs and put emissions on a structural decline.

Canada's economy is impacted more by the climate crisis than most other economies. Because of its geographic location, Canada is warming twice as fast as the rest of the world[8], which will lead to high climate change adaptation costs. In addition, Canada's economic dependence on the natural resources sector will lead to steep climate change mitigation costs. The natural resources sector, a large GHG emitting industry, is a significant part of Canada's economy. Canada's natural resource economy is almost 20% of Canada's GDP[9], and more specifically, the energy sector makes up close to 10% of Canada's GDP. From 2000 to 2017, the GHG emissions from oil and gas production in Canada have gone up 23%, mainly from increased oil sands production[10].

Canada needs to raise vast amounts of capital to finance investments in climate change mitigation and adaptation. The longer we wait, the harder it will be to protect ourselves against the physical impacts of climate change and finance our economy's transition to a low-carbon economy. Some of the world's largest institutional investors, such as Norge Bank Investment Management, Norway's sovereign wealth fund, have already divested from four of Canada’s oil sands companies over concerns of high carbon emissions[11], making it much more difficult for these companies to transition to a low-carbon business model.

Under President Joe Biden, the U.S. will become an influential climate change leader in meeting the Paris Agreement's 2050 net-zero target. A recent BlackRock survey projects that sustainable assets under management will increase from 18% in 2020 to 37% in 2025. Climate concerns disrupt the business world as we know it: General Motors will offer nothing but emission-free cars and trucks by 2035. To avoid being left behind, Canada should urgently consider all tools at its disposal to convert to a low-carbon economy. Tax incentives can play an essential role in achieving this goal.

Canada's Climate Innovation Challenge

Canada consistently ranks high on the list of best countries to live in, but that is certainly not the case when it comes to the list of most innovative countries. Meeting Canada's 2030 and 2050 climate change targets requires a lot of innovation. Most of the necessary cleantech solutions to meet Canada's 2050 net-zero commitment under the Paris Agreement still have to be developed and commercialized. It is doubtful that market forces alone – even when supported by an adequate level of carbon pricing – will be sufficient to develop the technologies required to meet Canada's climate change commitments. Tax incentives can make an essential contribution to driving the development and commercialization of the required cleantech.

Under normal conditions, market-based competition should drive innovation in the economy, but climate change creates conditions that are not normal. Market-based competition alone will not drive cleantech innovation fast enough to halt climate change. As current energy markets do not incorporate the damage caused by climate change into prices, businesses focused purely on profits are not likely to invest in cleantech innovation without any additional incentives such as effective carbon pricing and tax incentives. Another critical reason companies don't invest enough in cleantech is the so-called lock-in effect: continuing to use existing high-carbon emitting technologies is less expensive than adopting new low-carbon technologies.

Also, there is the question of whether or not Canada fosters an entrepreneurial environment for innovation[12]. Canada's business culture and government policies have always favoured a conservative business-as-usual culture[13]. This business-as-usual culture is also reflected in Canada's poor economic performance and slow growth of our per capita GDP compared to the U.S.[14].

In Canada, significant public funds are directed towards R&D – for example, through the Scientific Research and Experimental Development (SRED) program. Canadian SRED spending on R&D is expected to reach $12.7 billion in 2020/2021[15]. However, the results have been somewhat disappointing from an economic return perspective for several reasons, including the fact that the SRED program has been purposefully designed to be more efforts-focused than results-focused. The SRED program is not sufficiently targeted towards developing and achieving strategic innovative technologies[16]. As a result, returns on R&D investments have been suboptimal. To spur low-carbon innovation, Canadian businesses must be encouraged to develop and scale cleantech solutions through effective tax incentives.

The federal government recently announced some of the incentives it is committing to achieve its climate change targets. To follow through on its announcements in its Throne Speech in September 2020, Bill C-12 was introduced in November 2020, requiring that national targets for reducing GHG emissions in Canada be set to attain net-zero by 2050. The government has not yet revealed the pathways we will take to meet these targets. In its Throne Speech, the federal government announced its priority to make Canada the most competitive cleantech market in the world. It was reported that the government would launch a new fund to attract investments in making zero-emission products and cut the corporate tax rate in half for these companies to create jobs and make Canada a world leader in cleantech [17]. Following this announcement, the federal government and the Canadian Infrastructure Bank announced a commitment of $2.5 billion for clean power to support renewable generation and storage and to transmit clean energy across provinces and territories; $2 billion to scale up energy-efficient retrofits; and $1.5 billion to speed up the adoption of zero-emission buses and charging infrastructure.

In a recent report published by the Institute for Sustainable Finance, it has been estimated that to reach Canada's 2030 climate targets, it would require an estimated $128 billion in capital investments [18]. Although the commitments announced are a step forward, Canada's low-carbon transition will require significant additional capital investments from both the public and private sectors. To attract this capital investment, tax incentives can play a significant role.

The Financial Industry's Response to Climate Change

Canada's unique economy is dominated by natural resources and the financial services industry. Both of these industries have significant roles to play in the transition to the low-carbon economy.

Financial institutions have started to initiate programs and investment strategies to stimulate the transition worldwide and in Canada. For example, Deutsche Bank announced that it is immediately cutting off financing for new oil sands and arctic oil and gas projects. Additionally, it will end its involvement with coal projects by 2025 [19]. Royal Bank of Canada (RBC) recently reported that it would no longer provide direct financing for exploration or development projects in the Arctic National Wildlife Refuge in northeastern Alaska, according to a new policy that also imposes restrictions on funding for coal mining and power generation [20]. In Canada, financial institutions have announced their support specifically for the cleantech industry. For example, pension plans, such as Ontario Teachers' Pension Plan, have announced that they will be investing in climate-friendly opportunities in renewables, energy efficiency and storage, clean energy transmissions, and other sectors [21].

These financial market initiatives and priorities put high-carbon industries, such as the oil and gas and coal industries, at significant financial risk. Canada's energy sector currently has around $72 billion in capital expenditures and about $553 billion in project inventory over the next 10 years [22]. To limit global warming to 2°C, it has been estimated that 29% of global oil reserves will be stranded, thereby wiping out about $360 billion from the value of the top 13 international oil companies by reserves [23]. Therefore, federal and provincial initiatives must be enacted to ensure that the risk of stranded assets is mitigated, and Canada pivots to become a low carbon energy and cleantech provider.

Leveling the Fossil Fuel Playing Field

Phasing out fossil fuel subsidies

Unfortunately, global carbon emissions continue an upward trend. And as long as fossil fuels continue to provide energy more cheaply than clean energy resources, this trend will continue. It is therefore vitally important to phase out policies that subsidize fossil fuels.

An International Monetary Fund (IMF) report released in 2019 estimated that the total amount of oil and gas subsidies globally amounted to US$ 4.7 trillion in 2015 and US$ 5.2 trillion in 2017[24]. In Canada, the amount of post-tax subsidies amounted to US$ 43 billion, about 2.7% of Canada's GDP, and US$ 1,191 per capita[25]. Oil and gas subsidies in Canada have kept the industry alive. Without these subsidies, the industry would have experienced significant price volatility[26]. The oil and gas subsidies have started to have a higher opportunity cost for governments. These subsidies hold back transition innovation, creating a disincentive to find alternative energy sources to invest in.

Eliminating fossil fuel subsidies will level the playing field with emerging cleantech innovation and frees up government funds to increase much-needed investment in cleantech innovation.

The carbon pricing debate

Putting a price on carbon emissions – in addition to eliminating fossil fuel subsidies – further induces profit-motivated enterprises to divest from fossil fuels and to invest in cleantech innovation. Putting a price on carbon emissions is always a challenging policy issue as it raises the price of energy. Carbon pricing alone is insufficient to incent enough clean energy innovation to abate global warming in a timely fashion. Still, it is an essential complement to government incentives to change behaviour.

An argument can be made that tax incentives are not required to drive capital towards GHG emission reduction projects. Some have argued that a combination of eliminating fossil fuel subsidies and introducing an effective carbon price – either in the form of a carbon tax or in the form of a cap-and-trade system – is sufficient to drive innovation and investment in GHG emission reduction projects. In this context, an "effective carbon price" means a carbon price that approximates the external cost of GHG emissions. In other words, the amount of the carbon price should be sufficiently high to internalize the damage caused by GHG emissions into the cost price of fossil fuels. Although it is not precisely clear how high this carbon price should be, it is significantly higher than Canada's $30 per tonne of carbon emissions. The UN recommends a carbon tax of between $135 and $5,500 per tonne of carbon emissions[27].

For carbon pricing to be effective, not only is it important how high the carbon price is, but it is also critically important how much of the carbon emissions are subject to an adequate level of carbon pricing. According to an IMF Staff Paper released in November 2020, Canada currently has the lowest percentage of GHG emissions subject to carbon pricing, covering only 9% of GHG emissions or 71 million tonnes of carbon. Comparatively, the UK's carbon pricing scheme covers 23% of GHG emissions or 123 million tonnes of carbon. The concern would be whether or not Canada is pricing carbon emissions appropriately to effectively transition to a low-carbon economy and allow for the required cleantech innovation to occur. Suppose a large percentage of carbon emissions are not being taxed effectively. In that case, there is the obvious concern that businesses are not receiving enough of an incentive to reduce their GHG emissions[28].

Case Study 1

Alberta's carbon pricing system – The power of carbon pricing

Alberta provides a great example of how effective even a relatively low carbon price can be in reducing GHG emissions. It is sometimes forgotten that Alberta has been a true GHG emissions reduction leader. In 2007, Alberta was the first jurisdiction that introduced a carbon price on its large GHG emitters. Under its Specified Gas Emitters Regulation, emitters that did not reduce their emissions intensity by 12% or more had to pay $15 per tonne of carbon emissions above that 12% baseline. In 2017, the carbon price was increased to $30 per tonne of excessive carbon emissions. In 2018, Alberta changed the name of its carbon pricing regulation to the Carbon Competitiveness Incentive Regulation and, more importantly, how the baseline was calculated. The result of Alberta's carbon pricing system is that Alberta's electricity supply generated by burning coal has dropped from 64% in 2006 to 27% in 2020. Multiple coal plants have been retired, and the remaining coal plants are on average at less than 50% of their capacity. Also, electricity prices have not spiked in Alberta. Alberta's GHG emissions from the electricity sector in 2015 were 47 megatonnes. By 2018, that number had fallen to 33 megatonnes, and it is expected that by 2020 that number will have decreased further to 25 megatonnes[29]. An amazing success!

Carbon pricing remains a controversial political issue, which is unfortunate because a gradually increasing carbon price is a very efficient tool to help Canada, including the provinces, transition to a low carbon economy. It is essential that increases to the carbon price are gradual and predictable, allowing companies to adjust and avoid significant disruption.

Even if governments and companies resist carbon pricing, this may soon be futile. The consensus is that global carbon pricing will be widely adopted, and carbon prices will gradually be increased. Therefore, any stragglers will be forced to adopt carbon pricing through a mechanism of border price adjustments on carbon-intensive products from countries that don't have a sufficiently high carbon price. This means that procrastination by governments will come with a hefty price tag – governments should act quickly. In other words, if you see that change is inevitable, you may as well embrace the change with enthusiasm.

Tax Incentives Versus Government Grants

In theory, the government does not have to use its tax system to encourage the development and adoption of innovative climate technologies and solutions. Grants can sometimes achieve similar results. They can be used to reduce the risk in early R&D projects and attract investment from the business and investment community. Tax incentives can be beneficial for profitable businesses to invest in early R&D, but they are not effective for businesses that incur losses such as startups.

Although government grants can be useful tools to encourage investment in climate solutions, grants have their limitations. To mobilize individual Canadians in helping solve the climate change problem, Canada should provide incentives for Canadians to invest their savings in climate change solutions. Administering these incentives through the tax system – for example, through the introduction of enhanced climate change-focused RRSP and TFSA programs – would be the most effective way of mobilizing individual Canadians to decarbonize our economy. Capturing Canadians' hearts and minds will be critically important to combat climate change successfully, and tax incentives can play an essential role in that respect.

There is a longstanding debate whether targeted boutique tax incentives are the right tool for the government to encourage the development and adoption of specific technologies. The argument goes that specific tax incentives are fundamentally bad policy. They pick winners and losers, complicate the tax system, are difficult to unwind, and are open-ended from a cost perspective. Supporters of this view prefer that the government uses grants as opposed to specific tax incentives.

Although these arguments certainly have some validity, it is also true that most of the issues underlying these arguments can be resolved by having Canada adopt a comprehensive legislative tax incentive framework that is subject to a regular proactive and transparent administrative review process of specific tax incentives. This process would also allow for a gradual phase-out – as opposed to an abrupt elimination – of particular tax incentives that are no longer needed from an economic policy perspective. A gradual phase-out process for tax incentives also enables the assessment of the economic impact of the phase-out. It would make Canada's investment climate more competitive by making the availability of tax incentives more predictable.

Case Study 2

Carbon capture tax credits – A U.S. tax policy to promote carbon capture that is worthy of Canadian consideration

Initially introduced in 2008, U.S. Internal Revenue Code (IRC) Section 45Q provided a US$ 20 tax credit per metric ton for carbon dioxide (CO_2) that is permanently sequestered (removed from the atmosphere). The tax credit was initially capped at 75 million metric tons, and the IRS reported that in 2014, 35 million metric tons had been claimed. The tax credit was recently updated and expanded, increasing the benefit to $50 per metric ton of CO_2 permanently sequestered.

A great deal of support exists for a Canadian version of the U.S. 45Q production tax credit. A coalition of environmentalists and companies from hard-to-decarbonize sectors – including the oil and gas industry – have pushed for such a measure to be included in the upcoming federal budget. Efforts continue to persuade the government to implement a Canadian version of the U.S. 45Q tax credit to encourage clean-technology investment in Canada, level the playing field with the U.S. and help to meet our commitment to net-zero by 2050.

A Canadian version of IRC Section 45Q would fit perfectly in the federal government's priority – announced in its Throne Speech – to make Canada the most competitive cleantech market in the world. Considering the high upfront investment costs for carbon capture technology, Canada should consider complementing a 45Q production tax credit with a complementary

investment tax credit for investments made in carbon capture technology. Canada will need carbon capture technology even more than the rest of the world, and incentivizing the development and scaling of this technology through a combination of a production tax credit and an investment tax credit will make a significant contribution to making Canada the most competitive cleantech market in the world.

Jason Kenney's Alberta government has also been lobbying for a 45Q equivalent. This could be a unique federal emissions-reduction policy that reduces Alberta's and Saskatchewan's sense of alienation. A private member's bill tabled by Conservative Calgary MP Greg McLean in December 2020 shows support for the policy and bodes well for the implementation of long-term cleantech tax incentives. Long-term tax incentives will enable investors to make crucial long-term cleantech investment decisions.

The arguments for these particular tax incentives are very compelling indeed. They could be lifelines for the fossil fuel, steel, cement and fertilizer industries that have limited ways to reduce their emissions. The challenge is that technologies to capture CO_2, then bury it or convert it into other products, have very high upfront costs. For companies to feel they can afford the investment in carbon capture technology, governments must de-risk the investment in carbon capture technology. The U.S. recognized this, and through IRC Section 45Q provided future revenue certainty with production tax credits. As a result, dozens of carbon capture, utilization, and storage (CCUS) projects have entered development and will likely accelerate with the policy's recent extension and enhancement. Canada can do better by introducing a 45Q-like production tax credit supplemented with an investment tax credit for CCUS technology. Canada must do better considering the ambitious climate-focused policy agenda of the new U.S. administration of President Biden.

Implementing a Comprehensive and Targeted Tax Incentives Program

Meeting Canada's 2030 and 2050 GHG emission reduction targets will be a significant challenge. To achieve those targets, Canada needs to use all of the tools at its disposal, including all fiscal policy tools. Canada should not just rely on eliminating fossil fuel subsidies and gradually increasing the carbon tax to $170 per tonne by 2030. Also, Canada should introduce a comprehensive and targeted set of tax incentives to drive capital to cleantech innovation, GHG emission reduction projects, and climate change adaptation measures.

Tax incentives can provide compelling incentives to investors to supply the required capital for this low-carbon transition. Policymakers must draw upon a range of tools to stimulate energy innovation effectively. For instance, tax incentives can and should be used to stimulate firms to support research that benefits society as well as themselves. If a tax incentive encourages economic actors to carry out an activity that benefits society as well as themselves, then it is well-targeted. If the activity only benefits the economic actor, then it is most likely an unwarranted subsidy.[30]

When are tax incentives efficient and effective tools?

Tax incentives are not a panacea. In general terms, tax incentives are not very useful during the early R&D stage but can be very effective during the adoption and commercialization phases of innovations.

In his 1962 book "Diffusion of Innovations"[31] Everett Rogers, a professor of communication studies at the University of New Mexico, explains how, why and at what rate new ideas and technologies spread through the economy. Diffusion is the process by which an innovation is communicated over time among the participants in a social system. Four main elements influence the spread of a new idea: the innovation itself, communication channels, time, and the social system. The innovation must be widely adopted to self-sustain itself. Within the rate of adoption, there is a point at which an innovation reaches critical mass. This is when the number of individual adopters ensures that the innovation is self-sustaining.

The five categories of adopters are innovators, early adopters, early majority, late majority, and laggards. Diffusion presents itself in different ways and depends on the type of adopters and their innovation-decision process. The adopter categorization criterion is innovativeness, defined as the degree to which an individual adopts a new idea or technology.

Figure 1: Diffusion of innovation/technology adoption S curve

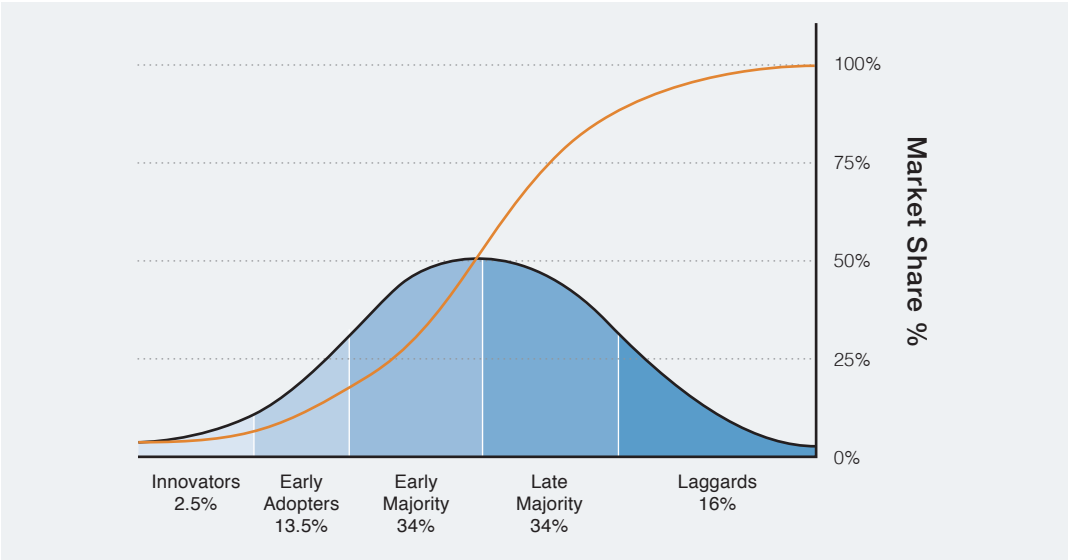


Figure 1 illustrates Professor Rogers' Diffusion of Innovation or Technology Adoption S Curve. The blue line represents the five groups of new technology adopters, and the yellow line represents the market share of the new technology.

Innovations are adopted slowly. This also applies to cleantech innovations. Considering the climate change urgency, cleantech and other climate change innovations must be incentivized beyond eliminating fossil fuel subsidies and increasing carbon pricing. Tax incentives can play a very useful and efficient role in incentivizing commercialisation and adoption of cleantech and other climate change innovations; however, they are not the right tool to encourage and accelerate early-stage R&D.

Early-stage R&D may generate knowledge leading to breakthrough innovations. However, R&D is generally underfunded by businesses because financial returns from R&D are usually slow to materialize and highly uncertain. Financial returns are also not necessarily realized by the businesses that undertake and fund the R&D. The government should play a proactive and significant role during the R&D – and especially the early R&D – phase. Generally, R&D tax credits, even when they are refundable, are not the most efficient and effective funding mechanism for early-stage R&D. More generous, targeted and actively managed public funding of R&D through grants, subsidies and loans, may be more effective than tax incentives to encourage and accelerate climate change focussed R&D.

Combining and aligning fiscal incentives for cleantech can be a powerful tool in making Canada a climate change leader. For example, Canada can combine:

- targeted R&D grants for Canadian cleantech innovators,
- accelerated depreciation for Canadian adopters of Canadian cleantech, and
- reduced corporate income tax rates for Canadian companies licensing Canadian cleantech to the world – also referred to as a "Patent Box" for Canadian cleantech.

This approach can supercharge the development of Canadian cleantech, accelerate the adoption of Canadian cleantech in Canada, and ensure that Canadian cleantech does not leave Canada. This approach can also make a significant contribution to improving Canada's lagging innovation and productivity performance.

Different players in the innovation process are in different tax positions and looking for different tax incentives. For example, accelerated depreciation will have no value for a start-up that does not generate any taxable profit yet. However, if you combine accelerated depreciation with flow-through shares, it becomes a powerful incentive for the start-up to attract investors in a taxpaying position.

R&D tax credits are certainly not efficient and effective for start-up companies but can be for mature, profitable companies. Besides, Canada's current Scientific Research and Experimental Development (SRED) tax credit system is intended to support general R&D efforts, and is ineffective as a tool to drive targeted cleantech innovation. To change that, Canada needs to adopt a much more proactively managed and targeted approach for funding cleantech innovation.

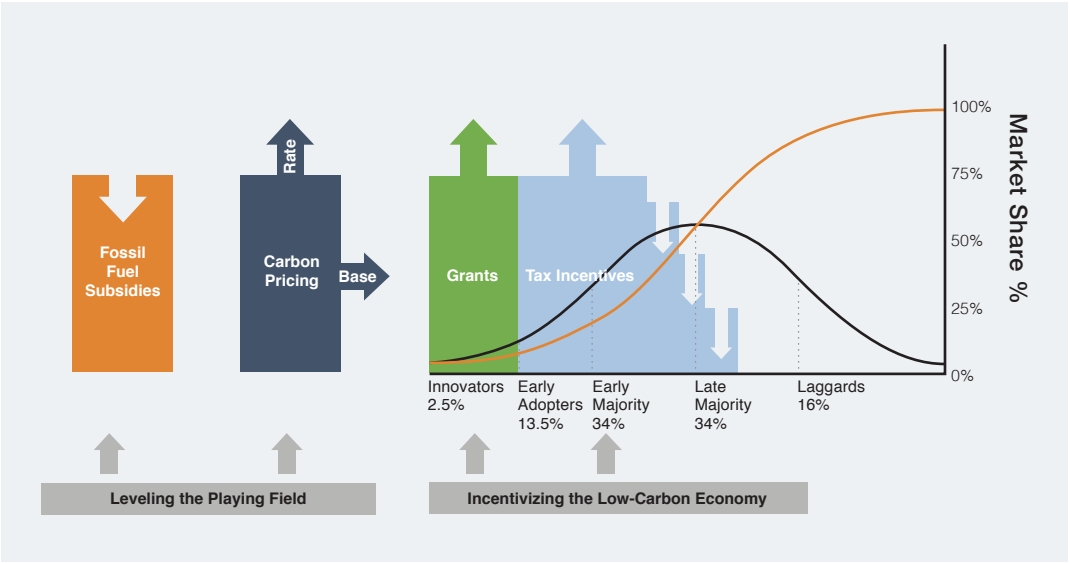
Once a new technology has been developed, the next challenge is to commercialize the new technology. This is the phase where early adopters play an essential role. Also, growth-oriented investors – such as private equity growth funds – that focus on identifying companies that are successfully moving along the early stages of the adoption curve play a vital role during this commercialization or early-adoption phase. In addition to providing tax incentives, the government can also play an essential role as a market-maker by developing a cleantech innovation-based procurement program.

Tax incentives can take various forms, such as an investment tax credit (ITC) or a production tax credit (PTC) (See, for example, Case Study 2). ITCs require funds to be invested in qualifying assets – such as developing a windfarm or carbon capture and sequestration technology – and PTCs require the generation of qualifying goods and services – such as wind energy produced or carbon captured and sequestered or used.

At some point along the innovation adoption curve, there is a point at which a new technology reaches critical mass – the point where the number of individual adopters ensures that the innovation is self-sustaining. Although this critical mass point is somewhat subjective, it is probably reached when the market share of an innovative technology reaches an adoption rate of 50% or more. At that point, new technologies are mature, and tax incentives are no longer required, nor are they effective and efficient. When the critical mass point is reached, tax incentives should be gradually reduced and – over time – phased out.

Widely adopted, mature technologies should not benefit from government tax incentives, as these mature technologies can sustain themselves. Therefore, Canada should adopt a comprehensive legislative tax incentive framework subject to a regular administrative review process. (See Figure 2)

Figure 2: The 3-step fiscal measures plan for climate change



Canada would be better served if the government sets the framework for tax incentives, including broad fiscal and policy parameters, but delegates detailed decisions about eligibility and duration to an executive branch or agency with input from non-governmental advisors and stakeholders. Such an approach would bring more expertise into decision-making, avoid arbitrary political decisions, limit incumbent stakeholders' power, and raise the odds of incentives being phased out as technologies mature or extended as promising new technologies emerge. Perhaps, Canada's Supercluster framework can play a role in this context.

The EU Sustainable Finance Taxonomy has a similar architecture. It is fundamentally a piece of framework legislation, and the Sustainable Finance Platform, appointed by the European Commission, plays the role of an expert panel that identifies which activities and technologies qualify as sustainable under the EU Taxonomy.

Case Study 3

The solar panel example – From basic research to commercial production

The first solar cell capable of powering everyday electrical equipment was made in the 1950s at Bell Labs in New Jersey. These silicon-based panels were costly and converted just 6% of sunlight into electricity. Although solar panels' costs have come down dramatically and silicon solar cells currently convert up to 22% of sunlight into power, they are maxed out in terms of efficiency.

A new development, perovskites technology, offers the potential for dramatic increases in power output and could ultimately replace silicon altogether. Perovskites are a group of inexpensive materials that are abundant in the Earth's crust. They are being used to create the next generation of solar technology, Perovskite Solar Cells (PSC). These PSCs could eventually be twice as efficient as the current silicon-based solar cells and flexible enough to wrap around entire buildings. Besides improved solar efficiency, they work better than silicon in the shade, on cloudy days or even indoors. PSCs can be printed using an inkjet printer and can be as thin as wallpaper. For example, using perovskites, Singapore's Nanyang Technology University (NTU) has developed an industrial coating technique called "thermal co-evaporation." NTU found that it can produce 21 cm^2 solar cell modules with a record power conversion efficiency of 18.1 %[32].

With high efficiencies achieved in science labs, stability and challenges in upscaling the production of PSCs still has to be addressed on the road to commercialization of this technology. For example, currently, PSCs use lead. Research is underway to assess whether lead can be replaced with tin, but the concern is that the use of tin may reduce the efficiency of the PSCs.

Following the early-stage R&D conducted at universities and science labs, PSCs are likely at the innovation and early-adopter stage of the Innovation and Technology Adoption S Curve. To enter the next phase of the S Curve and begin commercial production, investors would require government incentives to normalize the investment return and offset the significant risks associated with a new technology. Incentives, such as grants and tax incentives, help overcome early-stage obstacles by reducing the risks of adoption. In the earlier stages of adoption, the government must bear most of the risk because the benefits are difficult for private investors to capture. In the later stages, the benefits are primarily privatized, as long as there is a carbon price or regulatory policy that addresses the environmental externalities of high-carbon energy sources.

Proper targeting of tax incentives strongly influences their effectiveness. Tax incentives would be advantageous in the perovskite technology situation to continue the momentum. In fact, this innovative technology could become an excellent employment creation opportunity for a government committed to embracing new low-carbon energy sources and converting stranded manufacturing facilities[33].

There are already examples of fossil fuel companies that are beginning to recognize that change is inevitable and embracing it with enthusiasm. Hunt Consolidated is a $4 billion U.S. oil and gas company and one of the U.S.'s largest privately held firms. Last year, with the

backing of the U.S. Energy Department's National Renewable Energy Laboratory (NREL)[34], Hunt established a subsidiary, Hunt Perovskite Technologies (HPT), and became a founding member of the U.S. Manufacturing Advanced Perovskite Consortium (U.S. MAP)[35] in an effort to commercialize the potential of perovskite technology.

HPT is a firm believer in the potential of perovskite technology: "We have worked in collaboration with NREL for many years, and we look forward to working with U.S. MAP as well as other global business partners to realize the potential of perovskite technology for meeting much of the world's energy needs in the future."[36]

This is an excellent example of how government support can nurture innovation along the Innovation and Technology Adoption S Curve into commercialization. It is also a perfect example of an oil and gas company recognizing the need and opportunity to embark on a low-carbon journey.

Which activities and technologies should qualify for tax incentives? The need for a Canadian transition taxonomy

Canada's economy depends heavily on high-carbon industries, such as the oil and gas, mining, transportation, and construction industries. It is critically important for our economic future that we support our high-carbon industries with their transition to a low-carbon future. Tax incentives can also be very useful and efficient tools to support companies committing to changing their high-carbon business models into low-carbon business models.

One of Canada's critical challenges is defining what criteria have to be met to qualify for tax incentives. Canada needs a classification system that identifies which technologies, activities and projects are worthy of benefitting from tax incentives. Such a classification system is generally referred to as a "taxonomy." Around the world, several green taxonomies have been developed. Although there is a private sector initiative underway in Canada to develop a voluntary transition taxonomy for market players, we currently don't have an official standardized taxonomy from the government.

A recent example is the EU Sustainable Finance Taxonomy. The criteria used by the EU Taxonomy to identify sustainable or green activities are science-based and allows the EU to meet its 2050 net-zero commitment under the Paris Agreement. Canada could simply adopt the EU Taxonomy, but that would not be sufficient to support the transition of most high-carbon business models to low-carbon business models because the EU Taxonomy either doesn't cover some of those business models or the qualification criteria are too stringent. Even within the EU, there is significant pushback from some industries and member states against the EU Taxonomy's strict qualification criteria[37].

A very prescriptive taxonomy such as the EU Taxonomy will not meet Canada's need to convert high-carbon businesses into low-carbon businesses gradually. Canada needs a "Transition Taxonomy" as soon as possible. In the meantime – as an interim measure – Canada could consider adopting the EU Taxonomy as a basis for qualifying for tax incentives.

In addition to adopting the EU Taxonomy and developing the Transition Taxonomy, Canada should adopt an overarching strategic transition framework under which a company commits to its own individual 2050 net-zero pathway and implementation plan – informed by the green and transition taxonomies – and to disclose against this commitment and plan based on the Task Force on Climate-related Financial Disclosures (TCFD) framework[38]. Some of the high-level criteria for a company to qualify under the Canadian transition framework – and be entitled to tax incentives – would include:

- Committing to achieving net-zero GHG emissions by 2050 (including scope 1, 2 and 3 emissions),
- Having a detailed, science-based implementation plan with interim targets and milestones for achieving its 2050 net-zero commitment (including aligned capital investment and remuneration plans),
- Comprehensively disclosing its climate-related risks and opportunities following the TCDF framework,
- Performing and disclosing climate risk scenario analysis for short-, medium-, and long-term timeframes,
- Having its implementation plan, disclosures and scenario analysis verified by a qualified third-party, and
- Constructively engaging with governments and regulators on climate change to expedite Canada's transition to a low-carbon economy.

Investments in companies that meet these conditions would benefit from tax incentives and be eligible for the enhanced RRSP and TFSA programs.

Some Examples of Tax Incentives Canada can Consider

Canada has many corporate and individual tax incentive tools at its disposal to drive capital towards qualifying GHG emission reduction technologies and projects.

Some examples of potential business tax incentives include:

- Refundable R&D tax credits – a percentage of R&D expenses is credited against the tax liability and is refunded if the tax credit amount exceeds the tax liability
- Accelerated tax deductions for investments in cleantech – a percentage exceeding book depreciation is deductible against taxable income
- Tax credits for investments (ITCs) in cleantech – a sizeable percentage of capital investments in cleantech is credited against the tax liability
- Tax credits for income generated (PTCs) with investments in cleantech – income generated with cleantech (for example, wind-power or carbon captured and sequestered) benefits from a reduced tax rate
- Tax credits for cleantech licensing income – cleantech royalties benefit from a reduced tax rate (often referred to as a "Patent Box")
- Import duty exemptions for inputs used by the cleantech industry

Some potential individual tax incentive examples include:

- Enhanced RRSPs – an additional annual RRSP contribution limit or a super RRSP contribution deduction (more than 100%) for investments in qualifying cleantech investments
- Enhanced TFSAs – an additional annual TFSA contribution limit for investments in qualifying cleantech investments
- Flow-through shares – investors use tax deductions of companies in which they own shares

In addition to the federal and provincial governments, lower-level governments can also use tax incentives to reduce the impact of climate change. An example of a municipal tax incentive would be reduced property taxes for buildings meeting net-zero carbon emission standards.

Case Study 4

A simple example of the impact of tax credits for investors in cleantech – Investor tax credits and flow-through shares [39]

"Take, for example, an angel investor considering making a $100,000 investment in a small company for a 10% equity share. If the small company qualifies for a 30% investor tax credit, the investor does not only receive the 10% share in the company but can also claim 30% of that investment against the investor's income tax liability, in this case, $30,000. In effect, this decreases the cost of investment to $70,000, reducing the risk and increasing the likelihood of future profits."

By reducing the cost of the investment, the government can attract much-needed capital to the cleantech sector. There is an existing Canadian experience to draw from, as British Columbia's Small Business Venture Capital Tax Credit offers a 30% tax credit to six priority areas, with one being cleantech. A 2010 study found that the tax credit generated more tax revenue for the government than it cost and created jobs for the sectors benefitting from the tax credit. Other provinces are adopting similar models, such as the Alberta Investor Tax Credit. These tax credits typically operate on an application basis, allowing a government to control the program's cost by providing a limited pool of money.

In Conclusion

Climate change is real and will have a major impact on Canada's economy and society. Not only is climate change a major risk, but it is also a huge opportunity. Canada needs to urgently mobilize all Canadian governments, businesses and citizens to do everything possible to mitigate and adapt to the impact of climate change.

Properly designed and targeted, tax incentives can be a powerful tool and play a critical role in accelerating the innovations needed for a low-carbon future. This paper argues that:

- Fossil fuel subsidies should be phased out to remove the market inefficiencies that subsidies create.
- Carbon pricing should be broadly adopted as it is the most economically efficient market mechanism to move towards a low-carbon economy.
- Targeted tax incentives should be introduced to accelerate the commercialization and adoption of and investment in climate change mitigation and adaptation technologies and solutions.
- Grants should be used to support early-stage R&D.

Mitigating and adapting to the impact of climate change and seizing the opportunity of climate change truly is a nation-building opportunity for Canada. Tax incentives can play a powerful role.

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