Progress on Canadian Climate Policy

Introduction

The David Suzuki Foundation would like to review climate change policies implemented in Canada, and is producing a report to show where and which jurisdictions have achieved progress through existing policy. DSF would further like to highlight non-GHG benefits achieved due to the implementation of climate policy. Lastly, DSF would like to evaluate the outcome of Canada's emissions if all provinces or the federal government had implemented existing "best-in-Canada" policies (as they came into effect) relative to Canada's emissions target for 2020, using Navius' economy and emissions model (CIMS).

This technical memo summarizes the work conducted by Navius for the DSF. The objective of the memo is twofold. First, the most important objective is to provide analysis that can be incorporated into DSF's summary report. Second, it provides the methodology used to evaluate Canadian GHG policy and gauges the impact of the policies had they been implemented in a co-ordinated fashion across the country.

We begin with the second objective, and then provide materials for DSF.

How GHG policy impacts were estimated and verified

To estimate and verify the impact of Canadian GHG policy, we undertook three key tasks:

Task 1. **Ensure published estimates are accurate and defensible.** Environment Canada recently published a report that summarizes the GHGs reduced by various Canadian policies. As a first step, we reviewed these estimates to ensure they are defensible.

Task 2. **Estimate impacts for important policies without published estimates.** While Environment Canada estimated the effect of several policies, some have not been analyzed publically. Where possible, we estimate the impact of these policies from unpublished work conducted by Navius or new analyses.

Task 3. **Identify non-GHG impacts of climate policy.** In addition to GHG impacts, climate policy is likely to have indirect benefits such as the reduction of air pollution. Here, we reviewed different sources to estimate these indirect benefits

Task 1: Ensure published estimates are defensible

Environment Canada (EC) recently released its *Sixth National Report on Climate Change (2014)*. In the report, EC provides a comprehensive list of federal and provincial climate policies that have been implemented to date. EC also provides estimates of the likely GHGs reduced as a result of these policies in 2020. This report forms the basis for GHG estimates reported here.

The first step of this analysis is to ensure that the estimates are reasonable and defensible. The GHG estimates provided in EC's report are provided by the implementing jurisdiction, which means that there is a wide array of methods used to estimate GHG reductions. Published estimates for federal policies were likely produced from EC's Energy, Environment and Economy Model for Canada (E3MC). Estimates for provincial policies were provided by the jurisdiction implementing the policy. For several policies (e.g., Alberta's Specified Gas Emitters Regulation, British Columbia's carbon tax, New Brunswick's Energy Blueprint, among others), Navius estimated the GHG reductions. It is unclear how other jurisdictions estimated their GHG reductions, but could be based on internal estimates.

We note four potential issues with these estimates, and describe how we have dealt with each of these issues in the analysis.

Double counting

In some instances, it appears that summing the reductions from policies would double count reductions. For example, the government of Alberta and the federal government have invested in carbon capture and storage (CCS) infrastructure in Alberta. The GHG reduction reported for both the federal and provincial contributions would encompass all reductions available from the final outcome.

In cases where estimates appear to have been double counted, we only reported one estimate.

GHG reductions from Ontario's coal phase-out

The GHGs reduced from Ontario's phase-out of coal appear to make two assumptions. First, they appear to assume that coal plants in Ontario would have operated at about a 60% capacity throughout the year. In reality coal plants in Ontario have not operated at this capacity since 2003. Between 2004 and 2011, coal plants operated closer to

37% capacity on average.[1] By assuming a higher capacity utilization, GHGs reduced from closing the coal plants are assumed to be higher.

Second, they appear to assume that any coal plant closure would be replaced with zero-emissions electric generation or a reduction in demand. This is problematic because some other generation will eventually need to fill the void left by coal. If the new source of generation is from natural gas, emissions from these plants would partially offset the reductions from coal. If some of the void is filled with renewables (as projected by the government of Ontario), renewables should be credited with some of the reductions.

We have dealt with the first assumption by using the same capacity assumption as the government of Ontario. It is entirely possible that coal units would have been operated more intensively by 2020 in the absence of the coal phase-out.

Regarding the second assumption, we estimated the reductions available from replacing coal-fired generation with zero-emissions renewable energy sources. Any remaining gap was assumed to be filled with natural gas.

Lack of an integrated framework to assess all policies

Many of the estimates provided in EC's report are from different sources. As discussed above, estimates of federal policies are likely from EC's E3MC model, Navius produced results for several provincial policies (the only reason we know this is because we recognize the numbers) and it is unclear about others.

The downside of using several different methods, as noted in EC's report, is they are not internally consistent. This can lead to several inconsistencies in the results. Interactions between policies implemented at a federal and provincial level may not be accounted for. The reductions would likely be different if they had all been estimated in the same framework because all models use different assumptions. Some of the estimates may be missing equilibrium feedbacks. For example, it is unclear whether Ontario's coal phase-out affects electricity prices and how this affects demand. I can speak to EC's E3MC and our models (which include equilibrium feedbacks), but I'm unfamiliar with the methodology used for other provinces.

While a lack of consistency is a problem, we have not tried to resolve it in this analysis.

Reductions are weighted towards regions with published estimates

[1] Statistics Canada, 2014, CANSIM tables 127-0004, 127-0006 and 127-0010.

Some regions have not conducted analyses to estimate the GHGs reduced by their policies. Specifically, reductions are not available for most policies implemented in Manitoba and Québec.

As discussed below, we have made attempts to estimate reductions for the major policy initiatives in these provinces.

Task 2: Estimate impacts for important policies without published estimates

There are important gaps in the GHG reductions reported by EC. Some provinces do not report GHG reductions from their policies (Manitoba and Québec are most notable).

The method used to identify the GHG impact of several policies is briefly described below.

Manitoba coal and petroleum coke heating ban

In this policy all entities currently using coal or petroleum coke must submit a plan on how they will convert to a lower GHG alternative by 2012, and implement that plan by 2017. This is an important policy, especially because Manitoba has relatively low levels of GHGs to begin with.

To estimate the GHGs reduced by this policy, we assumed that all coal and petroleum coke consumption would be replaced with natural gas. Based on these assumptions, the policy reduces emissions by 340 kt CO_2e.[2]

We note this assumption is imperfect. Some coal consumption in Manitoba occurs in areas without access to natural gas, therefore substituting to natural gas would not be an option. These areas are likely to 1) switch to electricity (which has a low GHG intensity in Manitoba), 2) switch to a fuel oil or propane (which has a higher GHG intensity than natural gas), or 3) reduce demand (which would lead to a full reduction in GHGs).

British Columbia's Clean Energy Act

This is a major policy initiative in BC, for which no estimates are available. To estimate the impact of this policy, we ran our Integrated Electricity Supply and Demand (IESD) model. The model was previously used to estimate the impact of the CEA for another project.

[2] Statistics Canada, 2014,CANSIM table 128-0016.

Québec's cap-and-trade policy and building standards

In 2012, Navius completed an analysis for the National Roundtable on the Environment and the Economy to quantify the GHG impact of various federal and provincial policies. The model used for this analysis was reused here to estimate the effect of both Quebec's cap-and-trade policy as well as for provincial and federal buildings standards. For Québec's cap-and-trade policy, we assumed the price would gradually increase from its current level (about $10 per tonne) to the level expected by ICF $33 per tonne CO_2e.[3]

Task 3: Identify non-GHG impacts of climate policy

While the direct objective of climate policy is to reduce GHG emissions, these policies also have several side benefits. An important side benefit is the reduction of other air emissions, which have negative health impacts. Additionally, several policies can improve energy efficiency and reduce energy costs for households or firms.

Several sources can be reviewed to quantify the impact of side benefits from climate policy. Specifically, the *Regulatory Impact Analysis Statements* published by the federal government produce a wide range of estimates on the side benefits of climate policy.

Materials for DSF report

In the following sections, we describe and summarize the effect of key climate policies in Canada.

No need for coal emissions: Regulations to reduce emissions from coal plants reduce Canada's emissions by 25 million tonnes of carbon dioxide or equivalent.

Electricity generation in Canada comes from many different sources: from clean and renewable wind, solar and hydro as well as from non-renewable fossil fuels. Of all these sources, coal is by far the dirtiest option for generating electricity, producing almost

[3] Navius Research, 2012, *Economic modelling of provincial, territorial and federal climate change policies*; World Bank, 2014, *State and trends of carbon pricing*.

double the emissions for every electron arriving at a Canadian household relative to the next dirtiest option.[4]

The opportunity to reduce emissions from coal is enormous. Between 2009 and 2011, coal accounted for 13% of electricity generated in Canada, but accounted for 76% of emissions from the electricity sector. Emissions from coal generation are also significant at a national level, accounting for 11% of Canada's total emissions.[5]

To address this serious problem, the government of Ontario decided that they no longer require electric generation from coal. In 2007, they decided to shutter all coal plants by 2014. In April 2014, Ontario achieved its objective by closing its last coal plant in Thunder Bay.[6] The success of Ontario's policy shows that the electricity system can be transformed very rapidly. In seven years, the province managed to close 6,300 MW of coal capacity – the equivalent of 20% of their installed capacity in 2007.

Efforts to reduce emissions from coal plants have come in all shapes and sizes. While Nova Scotia's electricity system is significantly smaller than Ontario's their policy is no less significant. Using a declining cap on the emissions from their electricity sector, the province hopes to achieve 2.5 million tonnes of reductions by 2020.

The government of Canada and other provincial governments have also taken strides to phase out coal emissions. The government of Canada has established deadlines for coal plants to be either closed or retrofitted to meet stringent emissions standards. The emissions standards for retrofitted coal plants are sufficiently strong to require "carbon capture and storage" (an innovative method of capturing CO_2 from a plant and putting it back in the ground). The impact of this policy is expected to modest in the near-term (2020), as most coal plants are required to be closed or retrofitted after 2020. In the long-term (by 2060), the emissions from coal plants will be virtually eliminated.[7]

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[4] Environment Canada, 2013, *National Inventory Report: 1990-2011*. The comparison is between coal and natural gas. Although generation from refined petroleum products is more GHG intensive than natural gas, it is uncommon in Canada.

[5] *Ibid.*

[6] Statistics Canada, 2014, CANSIM table 127-0010; IESO, 2014, *Ontario's supply mix*; Ontario Power Generation, 2014, *Ontario Power Generation moves to cleaner energy future: Thunder Bay station burns last piece of coal.*

[7] Government of Canada, 2012, *Reduction of carbon dioxide emissions from coal-fired generation of electricity regulations.*

The benefits of Canada's efforts to close coal plants are not limited to reducing the damages from climate change. In addition to emitting GHGs, coal plants are also large sources of emissions responsible for smog and respiratory ailments.

A study by the Canadian Medical Association indicated that air pollution was responsible for lost productivity, increased healthcare costs, reduced quality of live and a loss of life. They pegged these costs at $4 billion in Ontario alone.[8]

The government of Canada predicts that the federal regulations will, literally, save lives. Between 2015 and 2035, they expect 900 fewer premature deaths, 120,000 fewer asthma episodes and 2,700,000 fewer days of breathing difficulty.[9]

Although it is impossible to monetize the effect of fewer people dying, the health benefits of these efforts are expected to exceed any additional costs from replacing coal plants with cleaner generation. The government of Canada estimates that their efforts are worth over $7 billion until 2035.[10]

Accelerating Canada's electricity system towards the future: Incentives for renewables reduce Canada's emissions by 21 million tonnes.

Renewable resources will be essential to our electricity system if the globe limits the rise in temperatures to 2^{o}C. Technologies that harness renewable energy, like wind and solar, do not produce any GHG emissions and offer the best opportunity to develop a zero-emissions electricity system.

The federal and several provincial governments have implemented policies to drive investments in renewable resources. The government of British Columbia requires that 93% of electricity generation in the province be from clean and renewable resources. (We note that a loophole was introduced allowing electricity generated for LNG export plants to fall outside of this policy). Over time, an increasingly larger share of electricity generation is projected to be from wind as a result of this policy.[11]

Ontario guarantees a price for electricity produced from wind and solar resources to incentivize their adoption. By 2021, Ontario expects wind and solar capacity to reach

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[8] Government of Ontario, 2011, *Ontario shutting down two more coal units.*

[9] Government of Canada, 2012, *Reduction of carbon dioxide emissions from coal-fired generation of electricity regulations.*

[10] *Ibid.*

[11] Government of British Columbia, 2010, *Clean energy act*; Navius Research, 2014, IESD model.

10,700 MW (over 25% of installed capacity) as a result of their efforts.[12] Ontario's push for renewables is equally important in light of its plans to shutter its coal plants. Without the push for renewables, the gap from coal plants would likely be filled by natural gas (a lower-emitting fuel, but still a source of GHG emissions).

Technologies that harness renewable energy still have room to mature. As manufacturers and electricity system operators gain experience with renewable technologies, their costs are expected to decline. Therefore, a push for renewables in the near-term will reduce the cost of a zero-emissions electricity system in the future. The modular price for solar panels has declined by 83% since 2008 as manufacturers have gained experience.[13] The cost for wind turbines has also shown significant declines in cost. Between 1990 and the early 2000s, turbine costs have declined by about 70%, although costs have increased slightly more recently due to greater material costs. More cost declines are expected with a concentrated effort to encourage renewable generation.[14]

Putting carbon where it belongs: Provincial and federal investment in carbon capture and storage reduce emissions by 3.8 million tonnes.

The first step responsible for the majority of human-induced climate change is the removal of fossil fuels from the ground, followed by their combustion. The problem originates when the resulting carbon dioxide and other greenhouse gases are finally released into the atmosphere.

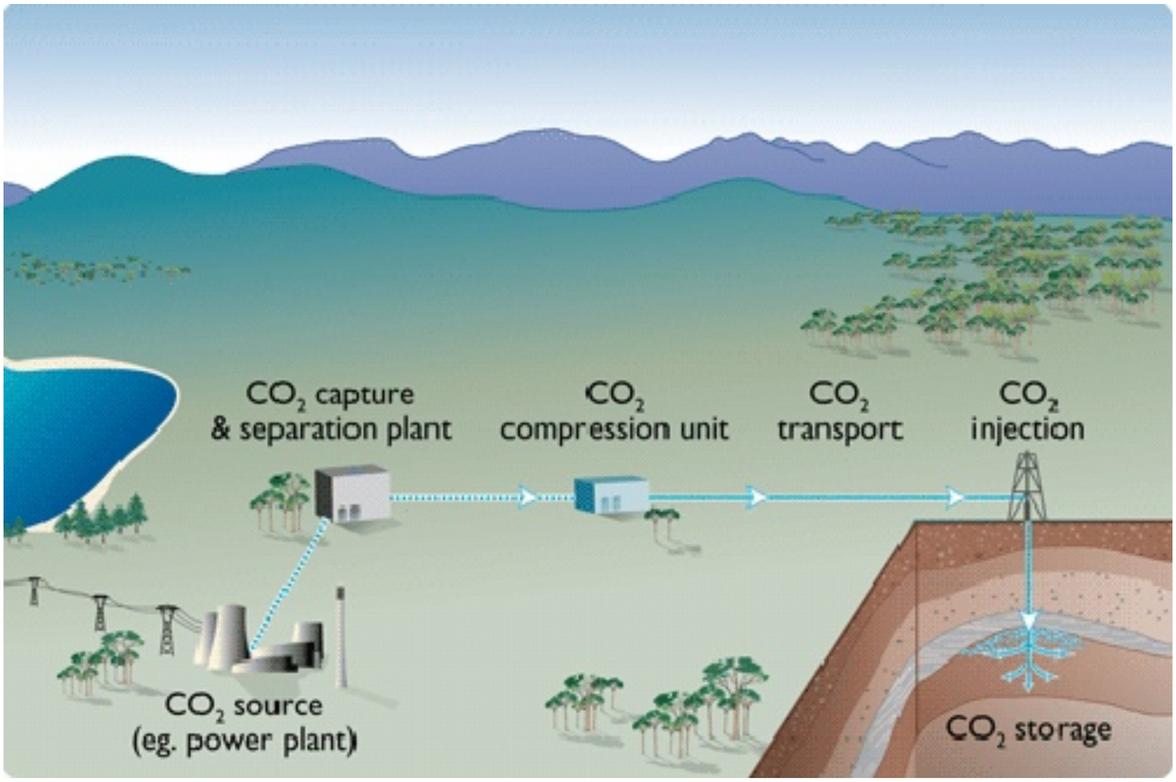
Carbon capture and storage, or "CCS", is an innovative way of allowing industry and utilities to virtually eliminate the final step in which carbon dioxide is emitted into the atmosphere. Using this technology, carbon dioxide is stripped from other emissions and sent to a location where it can be permanently stored underground. In other words, carbon is temporarily "borrowed" from the ground and then later "returned". A schematic of CCS is available in Figure 1.

[12] Government of Ontario, 2014, *Long-term energy plan*.

[13] Clean Energy Canada, 2014, *Tracking the energy revolultion*.

[14] National Renewable Energy Laboratory, 2012, *IEA wind task 26: the past and future cost of wind energy.*

Figure 1: Schematic of carbon capture and storage



Source: Danish centre for earth system science, 2010

The potential for CCS is large. The National Round Table on the Environment and the Economy indicated that CCS could reduce Canada's emissions by about 325 Mt CO_2e by 2050.[15] The technology is suitable for large point sources of emissions (e.g., fossil fuel power plants or large industrial sites). Furthermore, some industrial processes naturally produce GHG emissions (e.g., cement, fertilizer and steel manufacturing). The only currently known way to eliminate these emissions is to adopt CCS.

Both the federal and governments of Alberta and Saskatchewan have made direct investments in CCS. In Alberta, the federal and provincial governments have invested in Shell Canada's CCS project at the Scotford oil sands upgrader as well as the pipeline infrastructure required to transport CO_2 to a storage site. In Saskatchewan, the federal and provincial governments have invested in SaskPower's conversion of one coal unit at the Boundary Dam power plant to use CCS, which began operation this year. Com-

[15] National Round Table on the Environment and the Economy, 2008, *A technology roadmap to low greenhouse gas emissions in the Canadian economy: A sectoral and regional analysis.*

bined, these pilot project investments amount to $1.9 billion and will contribute to 3.8 Mt of reductions annually by 2020.[16]

While the impact of CCS is modest in 2020, it could prove significant later on. To date, there is little experience with the technology throughout the world and many demonstration projects have been delayed or cancelled. However CCS has room to mature. As manufacturers accumulate experience, costs are expected to decline and its deployment will become more economic.[17]

On the road to cleaner transport: Federal regulations to reduce emissions intensity from vehicles reduce emissions by 16 million tonnes.

Reducing emissions from transportation will be critical to achieving our climate goals. In 2011, transportation accounted for about 28% of Canada's GHG emissions (excluding pipelines). If left unchecked, these emissions are expected to continue growing.[18]

With leadership from British Columbia, Québec and California, the federal government has implemented two initiatives to harmonize regulations across the country and with the United States. The first aims to reduce emissions from passenger vehicles, and the second aims to reduce emissions from freight trucks.

The *Light-duty vehicle GHG regulations* were first implemented in 2011 and established limits for the emissions intensity of the passenger vehicle fleet. By 2020, new passenger vehicles sold in Canada must be, on average, 44% below the emissions intensity of the passenger vehicle fleet in 2011 (see Figure 2).[19] These regulations are estimated to reduce emissions by 13 million tonnes of carbon dioxide or equivalent by 2020.

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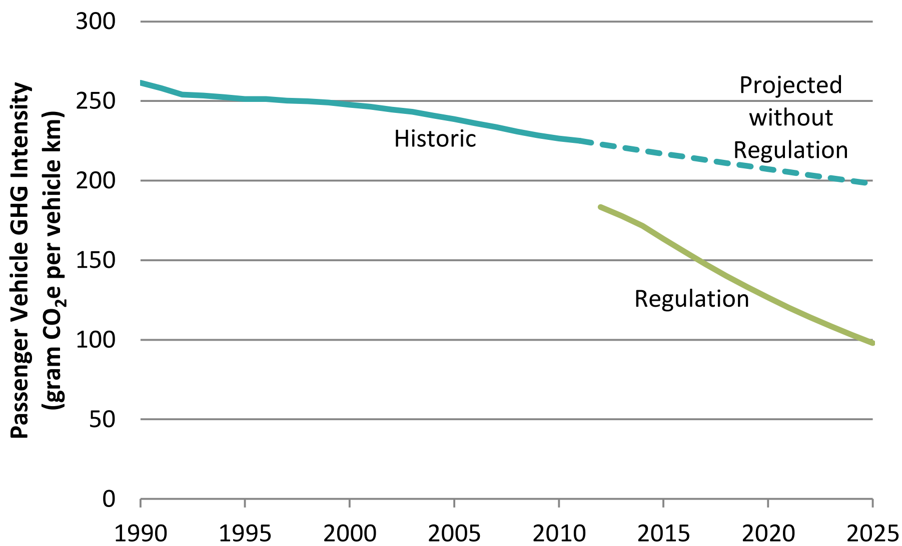
[16] Environment Canada, 2014, *Canada's sixth national report on climate change*.

[17] ICO2N, *Carbon capture and storage economics.*

[18] Environment Canada, 2014, *National inventory report 1990-2011*; National Energy Board, 2013, *Canada's energy future 2013*.

[19] Natural Resource Canada, 2014, *Comprehensive Energy Use Database*; United States Environmental Protection Agency, 2010, *EPA and NHTSA finalize historic national program to reduce greenhouse gases and improve fuel economy for cars and trucks*; Government of Canada, 2010, *Passenger Automobile and Light truck greenhouse gas regulations*; Environment Canada, 2013, *Regulating greenhouse gas emissions from light-duty vehicle (2017-2025).*

Figure 2: Passenger vehicle GHG intensity



The *Heavy duty vehicle GHG regulations* call for reductions in the emissions intensity of tractor trailers, smaller delivery trucks/vans and buses. The target for reductions varies by vehicle type, but ranges from 10% (e.g., buses) to 20% (tractor trailers). By 2020, this policy is expected to yield 3 million tonnes of reductions, and the reductions would continue to accumulate after 2020.[20]

The impact of other policies are more difficult to quantify, but equally important. Land-use planning that enables more pedestrian and cycling friendly communities reduces the need driving altogether. Shipping more goods by rail, versus truck, produces significantly fewer emissions. Improving transit infrastructure, such as Ontario's *Big Move*, enables passenger transportation with fewer emissions.[21]

In addition to mitigating environmental damages from climate change, these regulations are expected to deliver many benefits to Canadians. With improved energy efficiency for vehicles, households will have lower fuel costs (valued at over $27 billion by 2020). Furthermore, improved efficiency of transportation reduces the emission of criteria air contaminants (CAC), responsible for smog, respiratory and other illnesses.

[20] United States Environmental Protection Agency, 2011, *Paving the way toward cleaner, more efficient trucks*.

[21] Environment Canada, 2014, *Canada's sixth national report on climate change*.

Based on estimates by the Canadian government, reducing CAC emissions would yield over $1 billion in reduced health costs by 2020.[22]

Possibly one of the most important outcomes of these regulations, in conjunction with similar regulations implemented in the United States and other countries, is they are important drivers of innovation. Vehicle emissions standards established far into the future give automotive manufactures ample opportunity to develop new cars that emit fewer or no emissions. With continued pressure, we can eventually arrive at a zero emissions transportation system.

Growing, instead of extracting, our fuels: renewable fuels reduce GHGs by 2 million tonnes.

Renewable fuels further accelerate GHG reductions achieved from transportation. Renewable fuels do not add "net" GHGs to the atmosphere, as any carbon in the fuel originally comes from the atmosphere (rather than the ground).

The development of renewable fuels may be critical in the long-term, as some demand for liquid fuels is likely to remain. Long-haul freight by ship, rail or truck all depend on fuels that can be easily stored. Renewable fuels could help meet the need for these fuels in the future.

The federal government, British Columbia, Alberta and Ontario have taken the lead to require renewable content in transportation fuels. The ethanol content for gasoline is required to exceed 5%, while the renewable content in diesel is required to exceed 2%. Manitoba has further provided financial incentives for biodiesel production in the province. These efforts are likely to reduce emissions by about 2 Mt by 2020.

We can reduce our energy consumption: policies for inducing energy efficiency reduce 15 million tonnes.

One of the simplest ways of reducing GHG emissions is to use less energy. Households can reduce their emissions by purchasing furnaces that consume less natural gas or improve the insulation of their homes. Moreover, reducing the demand for electricity also reduces emissions at the point of electric generation.

The federal government's ecoENERGY efficiency program introduced and raised energy efficiency standards for a range of products. It also promoted more energy efficient products through the ENERGY STAR initiative. And, up until 2012, the program offered

[22] Government of Canada, 2010, *Passenger Automobile and Light truck greenhouse gas regulations*; Environment Canada, 2013, *Regulating greenhouse gas emissions from light-duty vehicle (2017-2025)*.

subsidies for home retrofits to improve efficiency. In total, the program will realize 6.5 Mt of reductions by 2020.[23]

In addition to federal efforts, most provinces encourage improved electricity efficiency through "demand-side management" programs. These programs subsidize and encourage the adoption of more efficient technologies that consume electricity. Although the reductions achieved through these programs were not available for this report, they are important contributors to our climate goals.

Improving energy efficiency can be a win-win for both the environment and the economy. Reducing the growth of electricity demand through energy efficiency is often cheaper than adding and operating new electricity units. Utilities often estimate costs for improved efficiency under $40 per MWh, while the cost of installing and operating a new natural gas power plant costs close to $60 per MWh.[24]

An additional benefit of energy efficiency is it often reduces electricity consumption when it is most costly to generate. Electricity demand is not constant throughout the day or year, and the days and hours with highest demand require "peaking" plants that are exclusively dedicated to those times. As peak load requires a costly unit to be installed and available, these periods have the highest cost of generating electricity. In Alberta, for example, prices for electricity occasionally reach $1,000 per MWh (the maximum allowed under Alberta Electricity System Operator rules).[25]

In much of eastern Canada, electricity consumption is highest on hot summer days when air conditioners are operating at full capacity. In much of western Canada, electricity consumption is highest on cold winter evenings when household lighting is most intensive. Fortunately, many energy efficient devices (e.g., LED light bulbs or more efficient air conditioners) have the important benefit of reducing peak load and costs for the electricity system. A 53% improvement to air conditioning in Ontario (i.e., from the efficiency of stock in 2011 to a very high efficiency option) would reduce peak load by 8%.[26]

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[23] Environment Canada, 2014, *Canada's sixth national report on climate change*.

[24] Gillingham K, Newell R, Palmer K, 2006, "Energy efficiency policies: a retrospective examination", *Annual revenue*

[25] Alberta Electricity System Operator, 2014, *Annual market statistics reports*.

[26] Navius Research Inc, 2014, IESD model; Natural Resources Canada, 2014, *Comprehensive energy use database*; The California Energy Commission, 2014, *Database for energy efficiency resources*.

Carbon pricing is not taboo: provincial carbon prices reduce emissions by 15 million tonnes.

Carbon pricing is, perhaps, one of the most poorly understood and maligned climate policies in Canada. Carbon pricing has been called "a tax on everything" and "job-killing".[27] Fortunately, there is now sufficient experience with carbon pricing in Canada to prove this rhetoric false.

Alberta, British Columbia and Québec have been leaders in North America in the implementation of carbon pricing. While each province has taken a different approach, the benefits of the policy have been demonstrated.

In 2007, Alberta became the first jurisdiction in North America and the sixth jurisdiction in the world to implement a carbon price.[28] Alberta's "Specified Gas Emitters Regulation" calls for large industrial facilities to reduce their emissions intensity. For every tonne in excess of their targets, industry is required to pay $15 per tonne of carbon dioxide or equivalent. A portion of the revenue earned from the carbon price is used to invest in low- and zero-emissions technologies. This policy is expected to reduce emissions in Alberta by 10 million tonnes by 2020.

British Columbia introduced the first carbon "tax" in North America that is applied broadly throughout the economy, covering approximately three quarters of provincial emissions. The policy is the strongest carbon price in North America at $30 per tonne of carbon dioxide or equivalent. This tax is expected to realize about 3 million tonnes of GHG reductions by 2020. British Columbia's carbon tax is also "revenue-neutral". All revenues earned from the carbon tax are used to cut existing business and personal income taxes and provide transfers to households that would otherwise be disadvantaged by the tax. So for every cent collected in British Columbia's carbon tax, there has been a one cent decrease in other taxes or a transfer to people would otherwise be disadvantaged.

Québec implemented a cap-and-trade policy in 2013. All revenues earned from Québec's policy are reinvested into GHG mitigation and adaptation initiatives.

Any fears that carbon pricing would "kill jobs" have proven false. More likely, carbon pricing has helped "create green jobs". British Columbia's economy has grown at the

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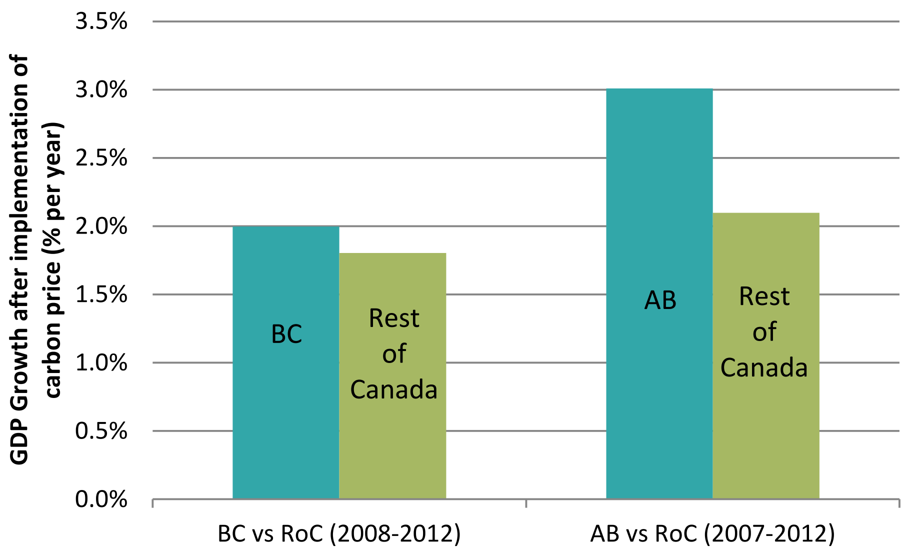
[27] Dunn M, 2014, "Finance minister rips Trudeau's carbon tax plan", *Toronto Sun*; Conservative Party of Canada, 2012, "Another senior liberal calls for job-killing carbon tax".

[28] World Bank, 2014, *State and trends of carbon pricing*. Norway, Finland, Denmark, Sweden and the European Union all implemented

national average since the carbon tax was introduced in 2008 (see Figure 3). The "clean technology" sector has grown even faster: revenues from the cleantech sector have increased by 57% from 2008 to 2011.[29] There is also evidence that households are better off with the implementation of the carbon tax.[30] Alberta's economy has barely skipped a beat since the imposition of its carbon price. These results suggest that economic activity is highly resilient to carbon pricing.

Figure 3: GDP growth after the implementation of carbon pricing in BC and Alberta



One of the biggest advantages with Canadian provinces' early experience with carbon pricing is they establish frameworks for carbon pricing that can copied in other provinces. With three approaches to carbon pricing already established, other provinces can move forward with confidence and knowledge on how to design and implement effective carbon pricing policies. And, while the rhetoric and conjecture about carbon pricing will likely endure, policy makers and the public can be assured it is false.

Leaving no stone unturned: Smaller niches yield big reductions

While some specific policies yield large reductions in GHG emissions, other smaller policies when aggregated yield big reductions. Although these efforts are more difficult to quantify, they are equally important to achieving our climate objectives.

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[29] KPMG, 2011, *Cleantech report card for British Columbia*.

[30] Elgie S and McClay J, 2013, *BC's carbon tax shift after five years: results*, Sustainable Prosperity; Melton N and Peters J, 2013 *Is British Columbia's carbon tax good for household income?* Navius Research.

Some of these small niches offer the advantage of having cheap reductions available. Landfills, for example, only account for 3% of Canada's GHG emissions.[31] However, capturing landfill gas has proven cost effective, and even profitable in some instances. Landfill gas can be upgraded to consumer grade natural gas. In British Columbia, Fortis BC (the natural gas distributor) has undertaken great efforts to market renewable gas, and has the capacity to meet the demands for up to 1,900 homes.[32]

Ontario's *Biogas systems financial assistance program* literally helps produce electricity from manure. The program provides financial assistance to facilities that capture methane emissions from livestock manure and other food waste. The captured biogas is subsequently used to generate renewable electricity. The program enabled the addition of enough electricity capacity to power 10,000 homes.[33]

British Columbia has implemented a regulation requiring a reduction in venting and flaring emissions in the oil and gas industry. The regulations seek a complete elimination of routine flaring of gas from oil wells by 2016.[34] While the reductions achieved by this policy may be small on a national level, they are significant for the sector in British Columbia.

Efforts for afforestation, improved agricultural tillage practices among others will work towards our climate goals, even if their individual contributions are small.

Following the leader: If all provinces or the federal government had implemented "Best-in-Country" policies we would be close to achieving our target for emissions

This report shows how provinces across the country have shown leadership to reduce greenhouse gas emissions. However, it should also be acknowledged that leadership has been uneven across the country. Some provinces have become global leaders in climate policy, while others of lagged. The federal government has lead in some areas, but not in others.

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[31] Environment Canada, 2013, *National inventory report: 1990-2011*.

[32] Forits BC, 2014, *Renewable natural gas*.

[33] Government of Ontario, 2008, *Biogas financial assistance program*.

[34] Canadian Association of Petroleum Producers, 2014, *Flaring and Venting*.

This raises the question: what would have happened if the federal or provincial governments would have followed the leaders and implemented the policies that have been most effective at transforming the energy system and reducing GHG emissions?

Two tasks are required to answer this question:

1. Define the “best-in-country” policies to reduce GHG emissions;
2. Conduct original modeling with the CIMS energy-economy model to estimate the impact of best-in-country policies.

What are the best-in-country policies?

The government of Ontario has undertaken the greatest effort to reduce emissions from coal plants in Canada. Over seven years from 2008 to 2014, the province closed the equivalent to 17% of their expected electricity capacity needs for 2020. This is an annual decline of 2.4%.

Again, the government of Ontario has lead with the adoption of renewable energy. Ontario will not have the highest share of renewables in Canada as a result of their efforts (the share electricity generated from renewables sources in British Columbia, Québec, Manitoba and Newfoundland will exceed 90%). However, Ontario has supported renewables in a region that is not as richly endowed with the renewables resources as these other provinces. By 2020, non-hydro renewables will represent about 25% of Ontario’s capacity, up from 2% in 2007.

If other provinces had undertaken similar efforts to Ontario, Canada’s electricity system would be significantly cleaner than it is today. In total, these efforts would have achieved about an additional 38 Mt of reductions by 2020.

British Columbia has established the strongest carbon price in the country. In 2008, the province introduced a $10 per tonne CO2e price, which rose in $5 per tonne increments until it reached $30 in 2012. The key rationale for not raising the carbon tax beyond 2012 was the province was concerned about competitiveness impacts if it became “too much of a leader”. However, if other provinces and countries had followed with carbon prices of equivalent strengths, this concern would have been alleviated.

To examine the effect of “best-in-country” carbon pricing, all provinces would have implemented an equivalent carbon price to British Columbia’s starting in 2008. This price would continue to rise after 2012 until it reaches $70 per tonne in 2020.

This analysis examines the effect of increasing the carbon price and also acknowledges Alberta's leadership in carbon pricing. Therefore, Alberta keeps its Specified Gas Emitters Regulation, but strengthens the price for the policy to $70 by 2020.

British Columbia also established the most stringent building standards in the country, while the government of Alberta and Saskatchewan have demonstrated the strongest commitments to carbon capture and storage.

Table 1 summarizes the key best-in-country policies and the rationale for selecting these policies.

Table 1: Key best-in-country policies

Policy	Best-in-country
Eliminating emissions from coal	Ontario's coal phase out, which closed the equivalent of 2.4% of their expected electric capacity needs by 2020 on an annual basis. Ontario's coal phase out started in 2008 and was complete by 2014. In the analysis, other provinces have the option of closing or retrofitting their existing coal plants with carbon capture and storage. The outcome of the provinces' decision should be equivalent to closing 2.4% of the expected capacity needs on an annual basis. Like Ontario, the policy in other provinces is assumed to start in 2008.
Commitments to electric generation from renewable sources	By 2020, non-hydroelectric resources will account for 25% of total electric capacity, up from 2% in 2007. In the analysis, other provinces increase the share of capacity from renewable resources by up to 23% from 2007 to 2020.
Carbon pricing	British Columbia's carbon tax rose in $5 per tonne increments to $30 per tonne in 2012. For the analysis, we assume other jurisdictions also implement the same pricing schedule. This would reduce competitiveness concerns and enable the pricing schedule to continue rising to $70 per tonne by 2020. Acknowledging Alberta's leadership in carbon pricing, the analysis examines the effect of Alberta keeping the SGER, but strengthening it to reflect the more aggressive pricing schedule.

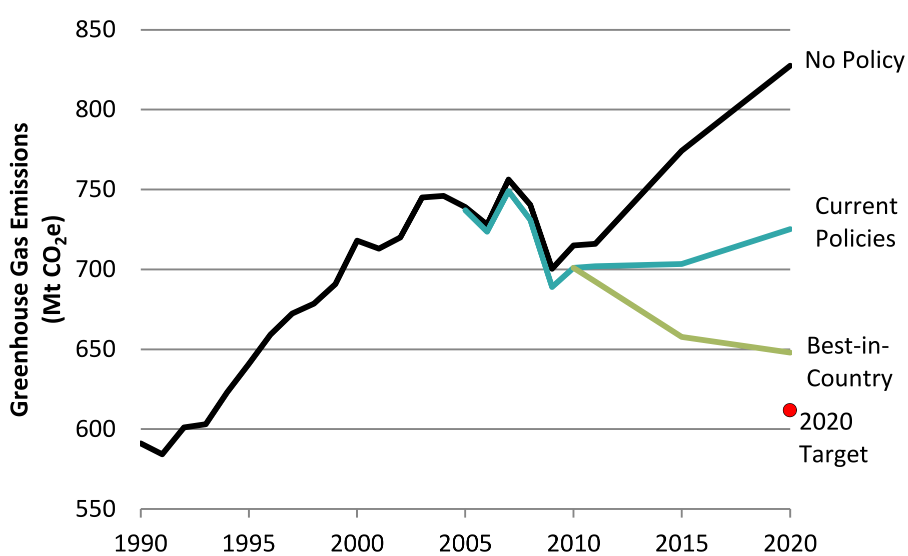
Where are we going? And where could we have gone?

Figure 4 shows where Canada's greenhouse gas emissions are currently headed, and two projections of where Canada's emissions could have gone. The figure also shows Canada's existing target for greenhouse gas emissions, made at the UN climate summit in Copenhagen. Without existing policies ("no policy" in Figure 4), emissions would continue rising to about 830 Mt by 2020 and Canada would miss its target by over 200 Mt or 35%.

Leadership through "current policies" will stem this rise and reduce emissions from no policies by about 100 Mt. However, emissions continue growing and exceed Canada's climate goal for 2020 by over 100 Mt or 19%.

Finally by implementing best-in-country, Canada could have been close to achieving its existing target – missing the target by only 6%. This shows that leadership can have a huge impact on Canada's emissions, however this leadership needs to occur early enough to influence how firms, utilities and households make investment decisions. While the policies examined here would have begun in 2008, had they begun earlier Canada would have likely closed the gap to its target.

Figure 4: Canada's greenhouse gas emissions to 2020 [35]



The leadership of Canadian provinces is clearly demonstrated in Figure 5. For every region, the blue wedge in the pie chart represents the reductions achieved through current policies while the light green wedge represents the additional reductions that

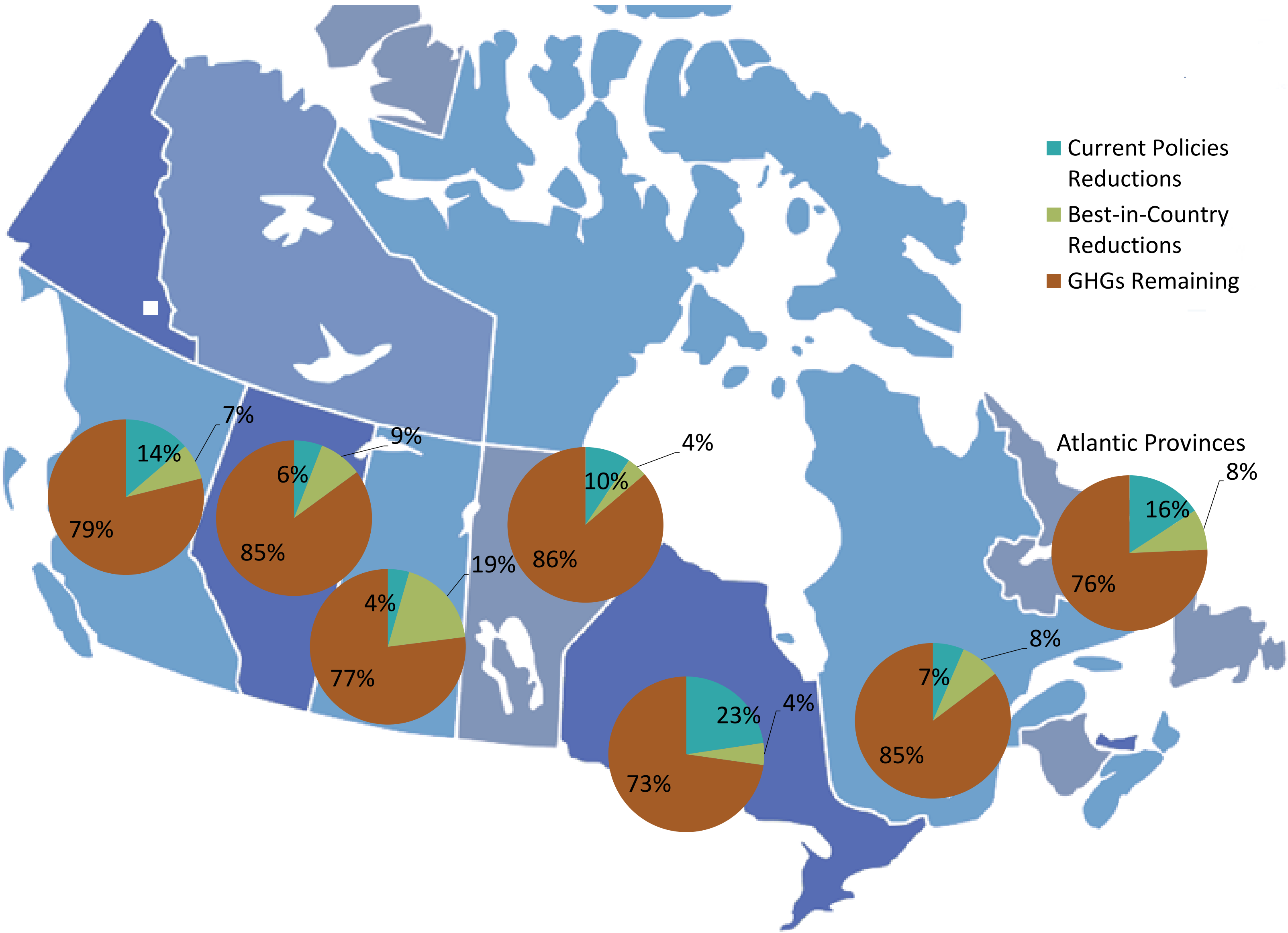
[35] Navius Research, 2014, CIMS model; Environment Canada, 2014, *Canada's sixth national report on climate change*.

could have been achieved with best-in-country policy. The green wedge represents the emissions that would have remained had best-in-country policies been implemented.

Leadership is partially demonstrated by achieving the greatest reductions through current policies (i.e., largest blue wedge). Each province must develop and adapt policies to their unique circumstances which is demonstrated by achieving the greatest level of reductions. Here Ontario's leadership is most noticeable, but leadership in the Atlantic provinces (e.g., Nova Scotia's efforts to close coal plants) and British Columbia are also significant.

Leadership is also demonstrated by having the fewest reductions available from moving to best-in-country policies (i.e., the smallest light green wedge). These are the provinces that are closest to having the strongest climate policies in Canada. Again, Ontario's leadership is noticeable, but other provinces are closely behind.

Figure 5: GHG reductions achieved by province



Finally, Figure 6 shows that the reductions from current policies as well as best-in-country policy are concentrated in the electricity sector. In both scenarios, the electricity sector achieves most of its reductions by closing existing coal plants and generating greater amounts of electricity from renewable energy sources. The electricity sector accounts for over 50% of the reductions due to both current and best-in-country policies. In total, the electricity sector reduces its emissions by 39% with current policies and it would reduce its emissions by 68% with best-in-country policies.

The figure also shows that there is room to strengthen or implement new policies in other sectors of the economy. Emissions in these sectors are reduced by a maximum of 14% under current policies and by a maximum of 17% with best-in-country policies (both in the building sector).

Figure 6: GHG reductions achieved by sector