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A large wind turbine stands in the foreground against a bright blue sky with a sunburst effect. In the background, several industrial smokestacks are visible, with one emitting a plume of white smoke. The overall scene suggests a contrast between clean energy and fossil fuel emissions.

SHARING THE BURDEN: CANADIAN GHG EMISSIONS

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EXECUTIVE SUMMARY

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- Canada has adopted an ambitious GHG emissions target of 524 million tonnes (Mt) per year by 2030. The current (2013) level of emissions is 726 Mt.
- Under the Canadian Constitution, the responsibility for environmental stewardship is shared by federal and provincial governments.
- The most difficult issue to resolve in structuring any multi-government collaboration to reduce GHG emissions is burden sharing.
- In this paper, we outline the rationales for three alternative approaches to burden sharing: Egalitarian (i.e., based on equal per capita shares of national emissions), Historical (i.e., based on historical provincial/territorial shares of national emissions) and Efficiency (i.e., based on shares of emissions reductions implied by the application of a national carbon price sufficient to achieve a given target).
- Using Canada's 2020 emissions target as an illustration, we show the implications of the three approaches and compare them to existing provincial targets.
- Our illustration shows that while rationales differ substantially, the practical implications of the Historical and Efficiency approaches are closely aligned and roughly consistent with the targets of three of the four largest provincial emitters: BC, Ontario and Quebec.
- This result suggests that some combination of the Historical and Efficiency approaches to burden sharing could form the basis for a federal-provincial collaboration to meet Canada's 2030 GHG emissions target.

INTRODUCTION

There is actually a lot of consensus among policy makers on a number of critical issues related to climate change and GHG reductions. For example, most would agree that the rapid build-up of GHGs in the atmosphere is responsible for the climate changes the world is experiencing. Most would also agree that humans in the last century are largely responsible for the growing concentrations of CO₂ and other GHGs. Further, most would agree that a rapid decrease in GHG emissions is essential to limiting the damage caused by man-made climate change. Finally, there is a growing consensus that an economic policy tool that imposes a price on carbon emissions, such as a carbon tax or cap-and-trade system, has the best chance of tackling the problem in an economically-efficient way.¹

Where the consensus breaks down is on how we should share the burden of climate change action. Indeed, burden sharing has been at the heart of the failure of a number of international meetings on climate change over the last 20 years. However, the latest UNFCCC meeting in Paris involved a new approach. Countries were asked to bring what they could offer to the table (even though, in aggregate, it falls short of what is needed to limit the global temperature rise to 1.5 - 2 degrees Celsius), commit to rigorous monitoring of emission reduction efforts, and to reconvene on a regular basis to strengthen the ambition of national pledges.

In Canada, the same burden sharing dynamic complicates discussions of climate change action between governments and sectors of the economy. These discussions invariably involve competing notions of efficiency and equity. In the first paper in this series, we laid out the simple arithmetic of Canadian GHG emissions and showed the gap

between existing policies and the national target.² A key observation that emerged was the enormous diversity in emissions across provinces and territories.

The diversity is related, in part, to the uneven distribution of resources such as oil and gas reserves and the potential for hydroelectric power generation across the country. The diversity is a particular challenge of the Canadian federation that has tested the ingenuity of Canadian policy makers many times over.

In this paper, we tackle the sensitive issue of burden sharing. We begin by laying out some alternative approaches to burden sharing and their rationales. Using Canada's 2020 target as an illustration, we then show the practical implications of each approach and consider how they might be employed to form the basis of a plan to meet Canada's 2030 GHG emissions target.

ALTERNATIVE APPROACHES TO BURDEN SHARING

Economists considering the problem of burden sharing typically structure their analysis along two dimensions: efficiency and equity. We can think of the efficiency dimension as making the economic burden to be shared as small as possible. The equity dimension is concerned with the fairness of the particular burden assigned to each party. Not surprisingly, different notions of equity exist and one's preferred notion is often aligned with one's own interests. As representatives of their voters, provincial and territorial leaders' notions of fairness are no different in this respect.

The textbook solution to ensuring economic efficiency is to equate the marginal price of carbon (i.e., the price of the last unit) across regions and sectors. This is to ensure that the cheaper opportunities for reductions are adopted first in order to minimize the overall cost of adjustment. Operationalizing this notion in policy is usually done by setting an economy-wide carbon price through a tax on emissions, or setting up an auction-based, economy-wide

1. In certain cases, regulatory approaches can complement explicit carbon pricing policies. Examples include vehicle regulations and a ban on coal-fired electricity generation, both of which have high implicit carbon prices.

2. Boothe, Paul and Félix Boudreault. *By the Numbers: Canadian GHG Emissions*. Lawrence National Centre for Policy and Management: London, ON, 2016. Available at: <http://www.ivey.uwo.ca/cmsmedia/2112500/4462-ghg-emissions-report-v03f.pdf>

cap and trade system that allows the market to determine a common carbon price. In the practical world of policy such policies ignore the lumpiness of emissions and the fact that the capital that produces emissions is sometimes long lived and will only be replaced periodically.

In contrast, there is no single textbook approach to establishing equity in allocating the emissions reduction burden. Approaches include egalitarian notions of fairness, i.e., all citizens having equal claims on allowable emissions, or consideration of relative ability-to-pay, as is the case with income taxes, or historical shares of emissions per jurisdiction. Each of these approaches has weaknesses. Equal per capita allocations ignore the different circumstances of provinces and territories with respect to the structure and GHG-intensity of their economies. The ability-to-pay approach ignores the feedback between emission reductions and provincial-territorial income levels that may differ across jurisdictions or sectors. Historical shares ignore past actions to reduce emissions and investment decisions made in good faith in previous climate policy regimes.

Complexities arising from differing notions of equity are not unique to Canada. For instance, the European Union (EU) acts as a Party to the UNFCCC and makes commitments on behalf of all of EU members. The EU then shares the burden among member countries. For its Kyoto target, the EU committed to reducing its emissions by 8 percent for the period 2008-2012 from 1990 levels. A political Burden Sharing Agreement (BSA) was then agreed in 1997 to ensure accountability by each member state (Phylipsen and Blok, 2013).³

The EU BSA was based on a so-called Triptych approach to burden sharing in which three major factors played in the allocation of the emissions

reduction burden: (1) differences in economic structure, (2) differences in energy sector structure and renewable energy potential, and (3) differences between member states' standards of living. The BSA was revised for the 2020 commitments, though the principles remained the same. In the end, this burden sharing approach resulted in explicit recognition of equity based on ability-to-pay principles, using relative GDP per capita levels of member states. For example, Bulgaria was assigned a +20 percent emissions target as they had the lowest GDP per capita, while Ireland and Luxembourg received the most stringent target with -12 percent given their high GDP per capita at the time (2008). Ability-to-pay equity principles were also reflected in the allocation approach for the EU Emissions Trading Scheme (ETS) for industrial and power-related emissions, where 90 percent of allowances were to be auctioned and the remaining allowances were to be distributed from countries with high GDP per capita to those countries with low GDP per capita.

BURDEN SHARING IN PRACTICE

None of the approaches to burden sharing we consider are immune to criticism and governments with different interests are likely to favour different ones. No single approach has a rationale so compelling that all governments would likely support it. In particular, provinces with relatively high emissions per capita are likely to favour allocations based on historical levels, while those with relatively low emissions per capita are likely to favour allocations based on equal per capita shares. Assuming that the federal government's interest is to minimize the overall economic burden of meeting the target, its preferred choice would be based on a common carbon price across jurisdictions.

3. Phylipsen, D, and K. Blok (2013). European experiences with burden sharing in climate change. Phylipsen Climate Change Consulting.

However, the fact that different governments have different rationales motivating their approach to burden sharing does not mean that agreement on how to achieve Canada's 2030 GHG emissions target is impossible. In practice, what matters is how much the allocations based on these rationales differ and how much they differ from what provinces have already pledged to do.

To investigate the practical implications of some of the different approaches, we build on the results presented by Bohringer et.al. (2014)⁴ for Canada's

2020 emissions target set by Prime Minister Harper in Copenhagen in 2009. Our analysis is summarized in Table 1 and Figure 1.

Table 1 shows the different allocations of GHG emissions by province for three approaches to burden sharing: Egalitarian, Historical and Efficiency.⁵ Canada's 2020 target is 17 percent below the benchmark 2005 level, representing 622 Mt of CO₂, which translates to 19 percent below 768 Mt - Environment Canada's estimate of business-as-usual (BAU) emissions in 2020.⁶

TABLE 1: DIFFERENT ALLOCATION SCENARIOS FOR 2020

	BAU (2020)	Targets		Egalitarian			Historical (2013)			Efficiency		
	Mt	Mt	% of BAU	Allocation (Mt)	Δ with Target	% of BAU	Allocation (Mt)	Δ with Target	% of BAU	Allocation (Mt)	Δ with Target	% of BAU
NFLD	9	9	98%	9	1	104%	7	-1	82%	8	-1	84%
PEI	2	2	90%	3	1	129%	2	0	77%	2	0	75%
NS	15	18	121%	17	-1	111%	16	-3	104%	11	-7	76%
NB	17	15	87%	13	-1	79%	13	-1	79%	14	-1	81%
QC	85	72	85%	144	72	170%	71	-1	83%	75	3	88%
ON	171	155	90%	240	85	140%	146	-8	86%	151	-4	88%
MB	22	18	80%	22	5	102%	18	1	83%	20	3	92%
SK	75	56	74%	20	-36	26%	64	9	85%	57	1	75%
AB	297	277	93%	71	-206	24%	229	-48	77%	221	-56	75%
BC	72	43	60%	81	38	113%	54	10	75%	62	19	87%
Territories	3	3	104%	2	-1	68%	2	-1	58%	2	-1	75%
Total	768	667	87%	622	-45	81%	622	-45	81%	622	-45	81%
<i>Column</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>

Sources: Authors' calculations and Environment Canada (2016), Boothe and Boudreault (2016) and Bohringer et.al. (2014).

4. Böhringer, Christoph and Rivers, Nicholas and Rutherford, Thomas F. and Wigle, Randall, Sharing the Burden for Climate Change Mitigation in the Canadian Federation (July 6, 2014). ZenTra Working Paper in Transnational Studies No. 30 / 2014. Available at: SSRN: <http://ssrn.com/abstract=2386508> or <http://dx.doi.org/10.2139/ssrn.2386508>. We are grateful to Nicholas Rivers for giving us access to some unpublished results related to the paper.

5. We omit the Ability-to-Pay approach, since provincial redistribution in Canada is done via the federal Equalization Program.

6. Canada's Second Biennial Report on Climate Change (February, 2016). Available at: <https://www.ec.gc.ca/GES-GHG/default.asp?lang=En&n=02D095CB-1>

Columns 2 and 3 correspond to emission targets pledged by the individual provinces.⁷ We see that they sum to 667Mt – 45 Mt more than the national target set in Copenhagen. Thus, even if every province achieved their target level of emissions in 2020 (which, given current progress, is not likely),⁸ Canada would be substantially over its national pledge of 622 Mt.

Columns 4 to 6 present the allocations implied by the Egalitarian approach to burden sharing, i.e., the distribution of the reduction burden in proportion to each province's population. By construction, allocations sum to the national 2020 target. Column 5 compares the allocation with the provincial targets. We see that for the Atlantic Provinces and the Territories, per capita shares and provincial targets are well aligned. The pledges of Quebec, Ontario and BC are substantially lower than their per capita shares while the pledges of Saskatchewan and Alberta are substantially higher than their per capita shares. In other words, under the Egalitarian approach, Quebec, Ontario and BC would receive far more emissions allowances than would be needed to meet their targets while Alberta and Saskatchewan would receive substantially fewer than needed to meet their targets.

Columns 7 to 9 correspond to the Historical approach to burden sharing. In this approach, shares of the national target are allocated based on a historical standard. In our illustration, we use the most recently available data (2013) published by Environment Canada.⁹ From column 8 we see that, with some notable exceptions, historical allocations and provincial pledges are well aligned. The outliers are Ontario, whose allocation is 8 Mt below its pledge, Saskatchewan whose allocation is 9 Mt

above its pledge, Alberta whose allocation is 48 Mt below its pledge and BC whose allocation is 10 Mt above its pledge.

Columns 10 to 12 correspond to the Efficiency approach to burden sharing, i.e., the allocation obtained using a common carbon price across the country, assuming inter-provincial transfers.¹⁰ Looking at column 11 we see that once again allocations are well aligned with provincial pledges with two notable exceptions. Alberta's allocation is 56 Mt below its pledge and BC's allocation is 19 Mt above its pledge.

A proxy measure for the amount of adjustment necessary for each province to meet its target or allocation under the three burden sharing approaches is given in the columns headed "Percent of BAU". The percentages presented in columns 3, 6, 9 and 12 are normalized by the forecast of provincial emissions in 2020 in a business-as-usual (BAU) scenario.

The Canadian BAU aggregate for 2020 is forecast to be 768 Mt (column 1). We focus on the four largest emitters who, in aggregate, represent about 80 percent of total emissions. Looking first at the estimated adjustments required to meet their targets (column 3), we see that they range from 40 percent in BC to 7 percent in Alberta.¹¹ This can be interpreted as the level of each province's climate change 'ambition' in the jargon of GHG reductions.

Turning to the amount of adjustment needed under the Egalitarian approach (column 6), the allowable emission levels in 2020 range from 170 percent in Quebec to 24 percent in Alberta relative to BAU. Under this approach Quebec, Ontario and BC are

7. Manitoba does not have a 2020 target so its 2012 target of 6% below 1990 is used as a proxy.

8. Boothe, Paul and Félix Boudreault. *By the Numbers: Canadian GHG Emissions*. Lawrence National Centre for Policy and Management: London, ON, 2016. Available at: <http://www.ivey.uwo.ca/cmsmedia/2112500/4462-ghg-emissions-report-v03f.pdf>

9. Canada's Second Biennial Report on Climate Change (February, 2016). Available at: <https://www.ec.gc.ca/GES-GHG/default.asp?lang=En&n=02D095CB-1>

10. Bohringer et.al. (2014) estimate a common permit price of roughly \$50/t CO₂e to achieve Canada's Copenhagen target. Unpublished data was provided by Nicholas Rivers to the authors in order to compile column 12.

11. We calculate the level of ambition as 100 minus the 'percent of BAU'.

allocated emissions that are greater than their estimated BAU emissions. In contrast, Alberta has an allocation that is 76 percent less than its estimated BAU emissions. In aggregate, Canada’s 2020 target requires a reduction of 19 percent from BAU.

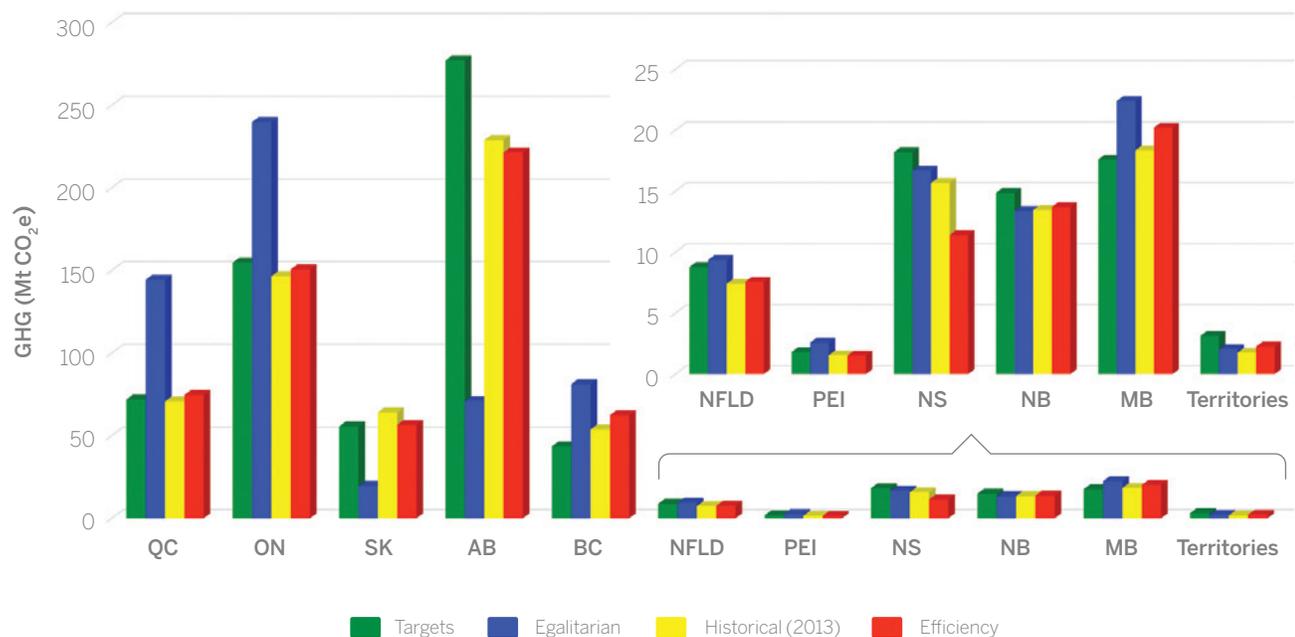
Looking next at the amount of adjustment required by the four largest emitters under the Historical approach (column 9), we see that allowable emission levels in 2020 range from 86 percent in Ontario to 75 percent in BC. In this case, the required adjustments are grouped quite closely relative to the Egalitarian approach.

Finally, we turn to the amount of adjustment needed by the four largest emitters under the Efficiency approach to burden sharing (column 12).¹² With this approach, allowable emission levels in 2020 range from 88 percent in Ontario and Quebec to 75

percent in AB. Once again the required adjustments are grouped quite closely relative to the Egalitarian approach, although Alberta and BC switch places when compared with the Historical approach.

Figure 1 gives a graphical depiction of how targets and burden sharing allocations compare across provinces. Focusing again on the four largest emitters, we see that the Egalitarian approach is the clear outlier when compared both with provincial targets and with the Historical and Efficiency approaches. In the cases of BC, Ontario and Quebec, the targets and Historical and Efficiency approaches are relatively close, although BC’s target is relatively more ambitious than its allocation under the two burden sharing approaches. Alberta is the outlier, largely because of the lack of ambition in the 2020 target set by its previous government.

FIGURE 1 – DIFFERENT ALLOCATION SCENARIOS FOR 2020



12. This approach assumes carbon trading between provinces to achieve a uniform price across the country.

CONCLUSIONS

Canadian policy makers will have to tackle the sensitive question of burden sharing if any real progress is to be made in meeting Canada's 2030 emissions target set in Paris. In this paper we looked at the rationales for three approaches to burden sharing: Egalitarian, Historical and Efficiency. All three approaches have flaws and no one can be said to conceptually dominate the others. We then looked at the practical implications of the three approaches for Canada, using Canada's 2020 emissions target and provincial emissions pledges as an illustration.

While the Egalitarian approach is a clear outlier, the results from the Historical and Efficiency approaches are similar and align well with the pledges from three of the four largest emitters. The exception is Alberta, largely because of the lack of ambition in the target set by its previous government.

The fact that the Historical and Efficiency approaches yield similar results, despite having very different rationales is both interesting and

promising. It suggests that a lack of agreement on the principles underlying burden sharing may not be an insurmountable obstacle to progress. If "where you stand depends on where you sit" we would expect that BC, Ontario and Quebec would all prefer the Egalitarian approach. Yet they all made significantly more ambitious pledges for GHG reductions by 2020. With the heavy burden implied by the Egalitarian approach, Alberta is much more likely to support a Historical or Efficiency approach. This suggests that if consensus is to emerge, it will most likely be based on some combination of the Historical and Efficiency approaches to burden sharing.

The hard work of negotiating a federal-provincial collaboration on meeting Canada's 2030 GHG emissions target is just beginning. It is encouraging that while the conceptual underpinnings of some key approaches to burden sharing differ substantially, the practical implications do not.

