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Who Occupies the Sky? The Distribution of GHGs in Canada

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To create effective policy for reducing greenhouse gas (GHG) emissions, it is important to identify who is emitting. Household emission rates are particularly difficult to examine as most GHG reporting is based on broad economic sectors. To overcome this, we use expenditure data to estimate emissions generated by Canadian families based on their income levels. The distribution of household emissions by income is important to climate justice, and has been explored in a previous CCPA brief for BC specifically. Analyzing differential environmental impacts based on income builds off of a 2008 CCPA study, which found that the ecological footprint of the top 10% of income earners in Canada is almost two and a half times greater than the lowest 10%.[1] Accordingly, this brief highlights policy options for emission reductions based on fairness and equity.

The Distribution of Canada's Emissions

The burning of fossil fuels accounts for almost 80% of Canada's GHG emissions. Household emissions (from fossil fuels used in heating, electricity and transportation) make up one-quarter of Canada's overall GHG emissions.[2] Household spending data allow us to estimate direct emissions from fossil fuels used for homes and personal vehicles.[3] Indirect emission amounts, from the production, transportation and use of goods and services that households consume, can be estimated as well.[4]

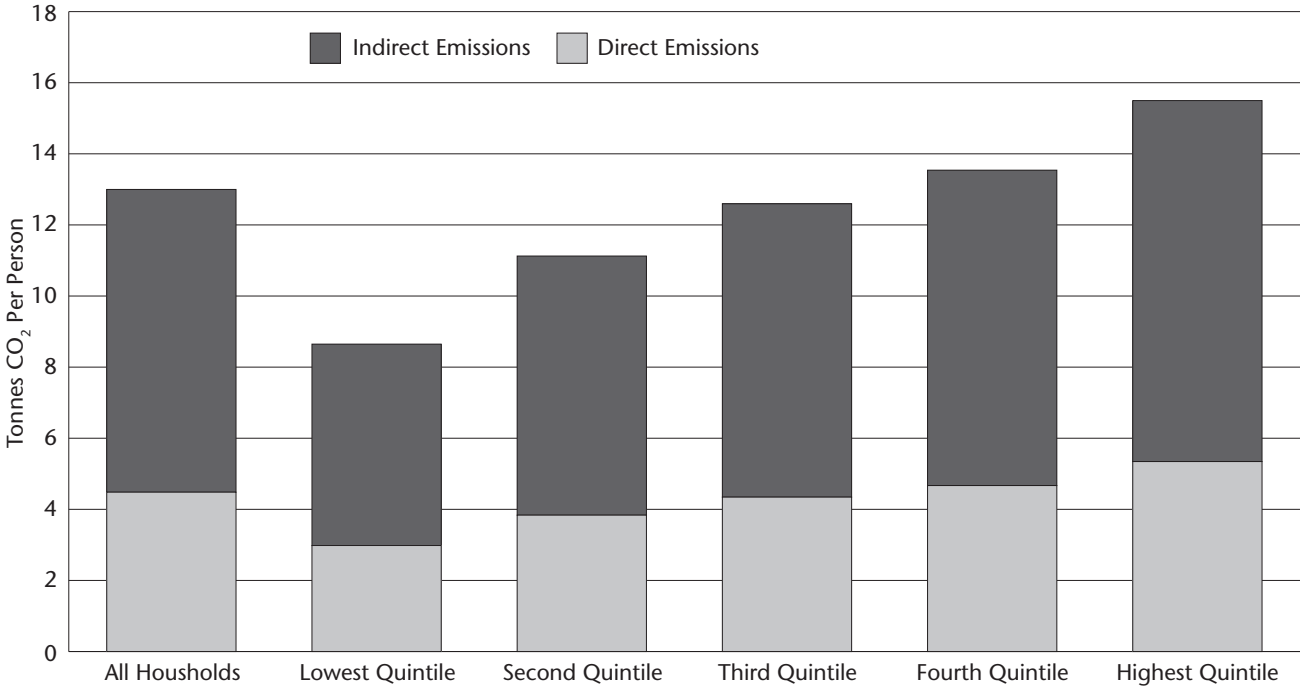
In 2009, individual Canadians generated four and a half tonnes of carbon dioxide equivalent (CO_2e) on average. If indirect emissions are added, the amount increases to thirteen tonnes per person.

Household income quintiles (where the population is grouped in 20% increments, ranked from lowest to highest) are used to investigate the distribution of emissions. To generate per capita estimates we account for increases in family size, which increase in line with income. In Canada, average family size for the bottom quintile is 1.5 persons per household, climbing to 3.4 persons per household in the top quintile.

Figure 1 illustrates direct and indirect emissions per person by income quintile. A person in the bottom quintile produces one-third fewer emissions than the average Canadian, while someone in the top quintile produces almost 20% more emissions than average. Comparing them directly, a person in the top quintile produces nearly 1.8 times more emissions compared to those in the bottom quintile.

This gap would grow even greater if data allowed us to look at narrower income divisions (10% or smaller), where per capita emissions would be even higher for the richest Canadians and correspondingly lower for those with the lowest incomes. Based on modeling of BC's carbon tax, the top 1% of households had emissions three times the average, and almost six times the emissions of households in the bottom decile.

Figure 1: Canada GHG Emissions Per Person



Note: Data are for 2009.
Source: Author's calculations based on Statistics Canada, Survey of Household Spending, Energy Statistics Handbook, and Canada Year Book; Environment Canada, National Inventory Report 1990–2009: Greenhouse Gas Sources and Sinks in Canada

Emissions of the top 1% were also almost double those of the next 4% of households.[5] Much of the inequality in carbon emissions is driven by the very top of the income distribution.

It is important to note that while households have some ability to limit their direct emissions, there are also significant structural factors that are beyond their control. Families can make concerted efforts to lower their thermostats and use vehicles less frequently. However, it is difficult to make significant energy efficiency improvements if you are not a homeowner, or to use alternative transportation in areas with limited service. Policies to reduce GHG emissions need to take into consideration the larger structural context that households operate within.

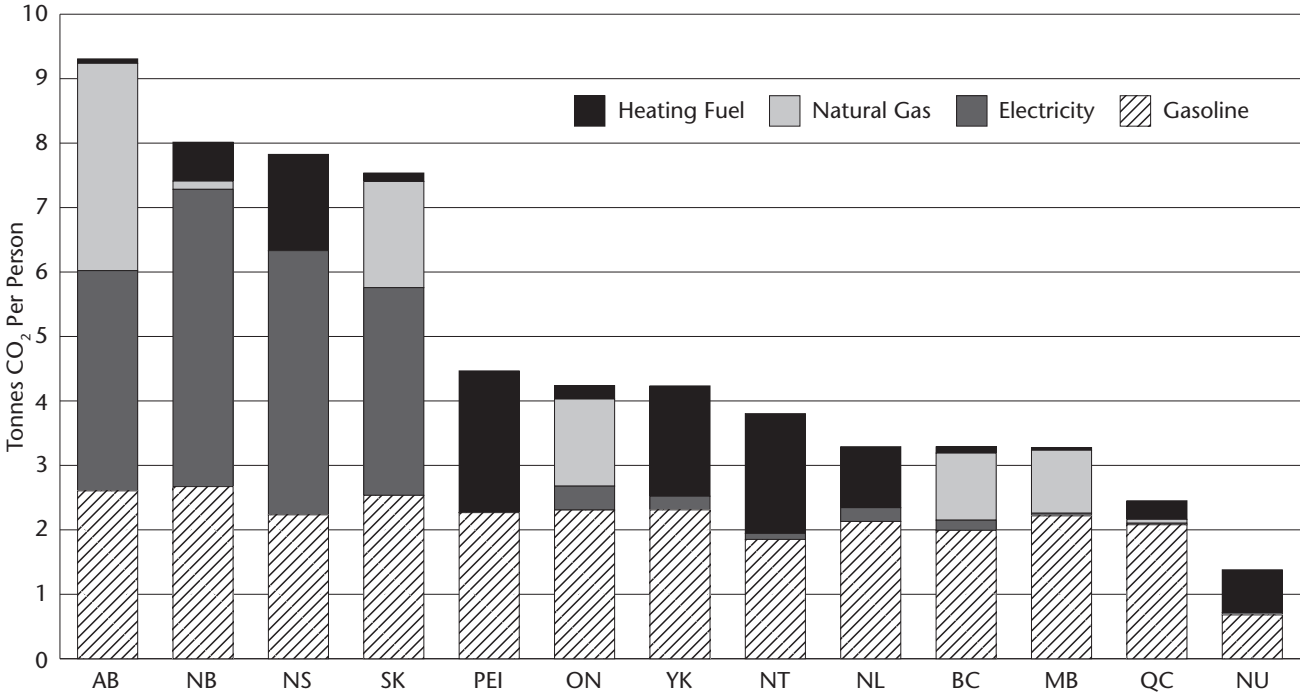
Provincial Discrepancies

Another factor in Canada's distribution of GHG emission is the significant differences in sources of electricity generation. The availability and use of varied energy resources for electricity has major impacts on GHG emissions for Canadians living in different provinces. Though less significantly, there is also provincial variation based on household heating source and average temperatures.

As Figure 2 illustrates, electricity makes up a huge proportion of direct emissions for those living in Alberta, New Brunswick, Nova Scotia and Saskatchewan. In all of these provinces, a majority of electricity generation comes from fossil fuels. Alternatively, provinces such as Quebec and B.C. are able to draw on extensive hydroelectric resources with minimal emissions. Ontario fares well, on average, because over half of the province's electricity comes from nuclear energy. While nuclear energy has low emissions, other environmental concerns with nuclear power were made apparent in the wake of Japan's recent disaster (Germany, for example, has committed to phasing out its nuclear power).

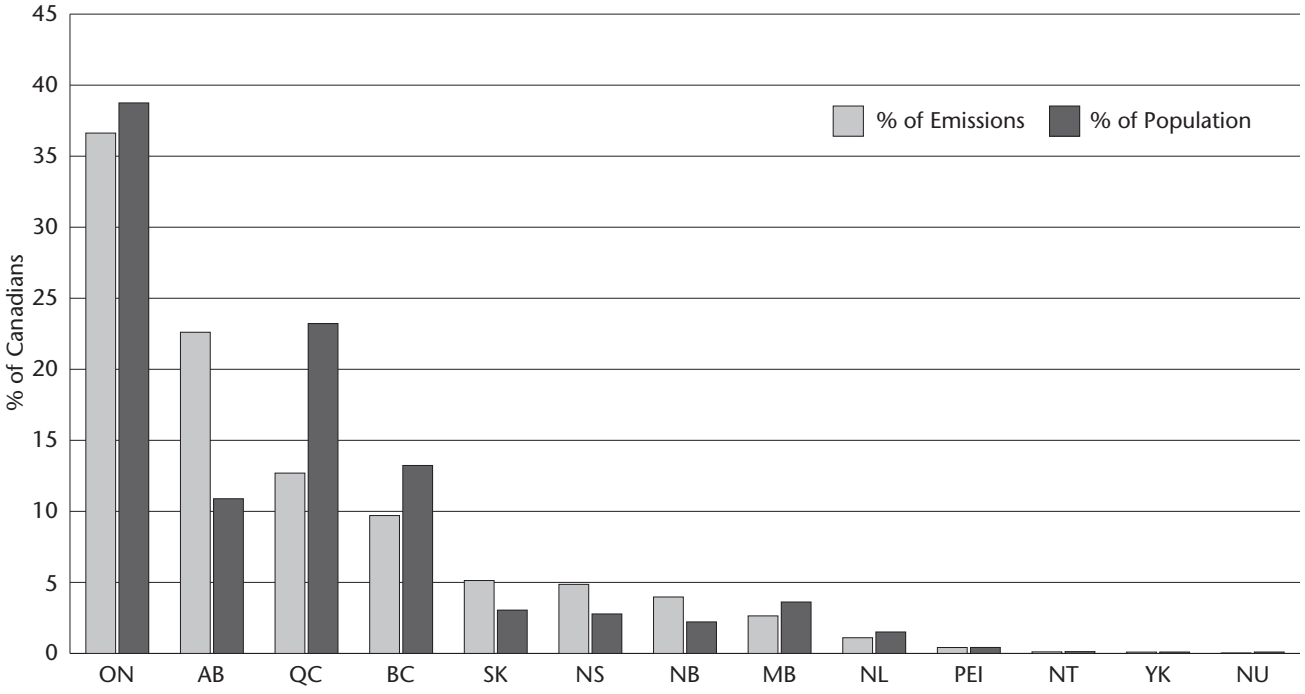
Figure 3 compares population shares with GHG emissions for each province. We can see that Quebec produces 13% of GHG emissions with 23% of Canada's population, while Alberta generates 23% of GHG emissions with only 11% of Canada's population.

Figure 2: Direct GHG Emissions Per Capita By Province



Note: Data are for 2009.
Source: Author's calculations based on Statistics Canada, Survey of Household Spending, and Energy Statistics Handbook; Environment Canada, National Inventory Report 1990–2009: Greenhouse Gas Sources and Sinks in Canada.

Figure 3: Percentage of Canada's GHG Emissions and Population, By Province



Note: Data are for 2009.
Source: Author's calculations based on Statistics Canada, Survey of Household Spending, Energy Statistics Handbook, and Canada Year Book; Environment Canada, National Inventory Report 1990–2009: Greenhouse Gas Sources and Sinks in Canada

The small population of Canada's territories makes their contribution less than a quarter of a percentage altogether. These discrepancies in provincial and territorial distributions also need to factor into emission reduction policies.

How Should Emission Reductions Be Distributed?

Fairness has been a major concern in the international debates around climate action, particularly because there can be many different perspectives of what a fair solution might be. Drawing on international analyses of climate justice, UBC's Sonja Klinsky and Hadi Dowlatabati cite five principles of fairness to be considered in developing our approach for reducing emissions:

- *Causal responsibility*—those responsible for the problem should have the greatest burden to fix it. This is also reflective of the "polluter pays" principle in environmental law.

- *Equal entitlement*—every person has the right to emit a certain amount of greenhouse gases per year consistent with a sustainable outcome in the aggregate (that is, total emissions are less than the "sink" functions of the earth to process them naturally).

- *Protection of the most vulnerable*—resources should be transferred to those who bear the greatest risks, or that policies need to ensure they do not leave the least well-off in worse shape.

- *Equal burden-sharing*—countries, regions, industries or people with different circumstances can be treated differently.

- *Procedural justice*—those who are adversely affected should have a meaningful say in decision-making.[6]

These international principles have a national implication with respect to Canada's distribution of household emissions. Approaches for reducing emissions need to consider such concepts of fairness if they are to be successful in implementation. Creating policies that take into account disproportionate emitting behaviours, often resultant from income, would be a step towards a longer-term ideal of equal per person emission rights.

Emissions Targets

Canada's current GHG target was set in December 2009 with the signing of the Copenhagen Accord. The Government of Canada committed to reduce emissions to 17% below 2005 levels by 2020, which translates to 607 Megatonnes (Mt). In 2009, Canada produced 690 Mt of CO_2 equivalent. Estimates suggest that current federal and provincial programs should reduce emissions by 65 Mt in 2020. However, based on business-as-usual projections for 2020, this reduction is only one-quarter of the amount necessary to meet Canada's target. A further 178 Mt will need to be eliminated to meet the target.[7]

The Government of Canada's target does not meet an important threshold determined by the Intergovernmental Panel on Climate Change (IPCC). The IPCC indicates that an increase of more than 2°C of average global temperatures could result in runaway climate change, where human actions to reduce GHG emissions are swamped by feedback loops that put ever more GHGs into the atmosphere. To not exceed that limit, industrialized countries would need to reduce emissions to 25–40 percent below 1990 levels by 2020. The Pembina Institute and the David Suzuki Foundation commissioned a study modelling Canada meeting an alternative target of 25% below 1990 levels by 2020 (consistent with other global action to keep temperature increase below 2°C).[8]

For this brief, emissions reductions by quintile will be analyzed for both the official Government of Canada's target and the alternative 2°C target. Action to meet either target requires careful consideration of how the burden should be shared across all Canadians, given that emissions are unequally distributed. Policy makers must also be aware that some reduction strategies could potentially make conditions worse for the most vulnerable.

Emission Reductions For Canadian Households

Applying Canada's 2020 target (17% below 2005 levels, or 607 Mt) to emissions generated by quintile (Figure 1), emissions must fall to 10.5 tonnes per person on average, once we adjust for population growth to 2020.[9] Here we consider two ways to allocate reductions across groups. One approach (A) is to have each household reduce their emissions by the

Table 1: Canada GHG Emissions Reductions with Population Growth (Tonnes CO_2 equivalent)

	All households	Lowest quintile	Second quintile	Third quintile	Fourth quintile	Highest quintile
Carbon emissions per capita, 2009	13.0	8.6	11.1	12.6	13.5	15.5
Government of Canada 2020 target (17% below 2005 level)						
A: Across the board percentage cut	10.5	7.0	8.9	10.1	10.9	12.5
B: Equal per capita amount	10.5	10.5	10.5	10.5	10.5	10.5
Reduction to per capita amount (tonnes)		(1.8)	0.7	2.1	3.1	5.0
Percentage reduction to meet equal per capita amount		-20.9%	6.1%	17.0%	22.8%	32.6%
2° Celsius 2020 target (25% below 1990 level)						
A: Across the board percentage cut	7.6	5.1	6.5	7.4	7.9	9.1
B: Equal per capita amount	7.6	7.6	7.6	7.6	7.6	7.6
Reduction to per capita amount (tonnes)		1.0	3.5	5.0	5.9	7.9
Percentage reduction to meet equal per capita amount		12.1%	31.7%	39.7%	43.9%	51.0%

Note: Table includes direct and indirect emissions. Calculations may not add up due to rounding.
Source: Authors' calculations based on statistics from Figure 1.

same percentage. From 2009, this would mean a 12% reduction to meet the 2020 target. Total emissions per person for those at the top would drop to 12.5 tonnes, while the bottom quintile would be required to reduce emissions to 7.0 tonnes per person (Table 1).

This method is problematic because it would mean that *after reductions* the top 20% would still be able to emit almost four tonnes more per capita than the bottom quintile were emitting *before reductions*. Additionally, it would have a significantly greater impact on families that have lower emissions to begin with. Those in lower quintiles spend most of their income on necessities, which they would have to consume less of to reduce their emissions. Conversely, those with higher incomes would be able to minimize GHG-producing consumption habits (associated with more and larger vehicles, larger homes and vacation properities) without reducing their necessities. In other words, high-income families can more easily reduce their emissions than low-income families, without affecting their basic needs.

Table 1 also presents a second approach (B), based on the principle of equal per capita emissions. This fairer proposal would reduce the emissions of all Canadians to the target of 10.5 tonnes per person. For the Government of Canada's 2020 target, the bottom quintile has already surpassed the target. The highest quintile would be required to reduce emissions by nearly a third, or by 5.0 tonnes per capita. However, as discussed above, these targets do not reflect reductions specified by the leading climate scientists to avoid dangerous levels of climate change. There is potential for Canadian reductions to make a greater impact, especially considering that those in the lowest quintiles are already below target levels.

The target from the IPCC to avoid global warming above 2°C involves dropping to 25% below 1990 levels (to 444 Mt) by 2020. This would mean a 36% reduction in average emissions, or a drop to 7.6 tonnes per person, when adjusted for population growth. Applying this reduction across the board would allow those in the highest quintile to still produce half a tonnes more per person than the lowest quintile produce *currently.* By applying fairer equal per capita reductions, the bottom quintile will have to decrease emissions by 1 tonne, or 12%, per person. Those in the highest quintile will need to cut their emissions by 7.9 tonnes, or 51%, per person.

Implications For Climate Policy

It is important to develop an approach to reduce emissions that does not have an unequal impact on families with lower incomes who have lower emissions to begin with. A national carbon tax (similar to BC

or Quebec) might seem an effective policy option, but it can have an inequitable impact if implemented without other measures. The highest income families that produce the most emissions have an even greater share of the income in Canada. This means that a carbon tax on its own will be regressive—it will take up a larger share of income for low-income families than high-income families.[10] A carbon tax must include measures for redistribution to ensure that it does not disproportionately affect low-income families.

An intriguing policy option, consistent with equal per capita emissions, is a "personal carbon trading" system. Such a system would set per person emission limits, but enable the lowest emitters to sell "excess" emissions to the highest emitters, a feature that would alleviate income inequalities. The UK government has engaged in some research on this option.[11] Alternatively, auctioned permits to point-source industrial emitters, or carbon taxes, could be redistributed on a per capita basis (called "cap-and-dividend"). Further detail and analysis of these options will be the focus of future Climate Justice research.

Policy options must take into consideration the structural barriers that impact the ability of Canadian families to reduce household emissions. Building complete communities, where people can better access jobs, services and amenities by walking, biking or public transit, would significantly decreases transportation emissions. Making retrofitting programs accessible for low-income households would help improve energy efficiency. Policies that encourage businesses to reduce emissions in production, transport and delivery of goods and services can help reduce indirect emissions. And while reducing energy consumption is essential to decrease emissions, significant gains could also be made if provinces reliant on fossil fuels for electricity are able to switch to renewable resources.

Political resistance to the principle of greater equality is a key challenge for moving ahead with such policy options. It will be difficult to get approval for equal per capita emissions targets from those who are the highest emitters. Climate justice entails that reductions in GHG emissions must simultaneously reduce inequality, and equal per capita emissions could be a step in this direction. And ultimately, for everyone's sake, we must strive for the elimination of fossil fuel use and zero emission households for Canada in the near future.

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Notes

1 Mackenzie, H., H. Messinger and R. Smith. (2008) *Size Matters: Canada's Ecological Footprint by Income*. Ottawa: Canadian Centre for Policy Alternatives.

2 Environment Canada. (2011) *National Inventory Report 1990–2009: Greenhouse Gas Sources and Sinks in Canada.* www.ec.gc.ca/ges_ghg/default.asp?lang=En&n=72E6D4E2-1

3 Direct emissions are estimated by drawing on 2009 data on household expenditures for all provincial quintiles, from Statistics Canada's *Survey of Household Spending*, which include estimates of fuel used in principal residence and motor vehicles. Average 2009 fuel prices reported in Statistics Canada's *Energy Statistics Handbook* were used to determine consumption in volumes. This amount was then multiplied by emission factors from Environment Canada's *National Inventory Report 1990–2009* to estimate direct emissions.

4 Indirect emissions are estimated from Statistics Canada, *Direct and Indirect Household Greenhouse Gas Emissions*, *1990–2007*. Indirect emissions for domestic sources are 1.9 times direct emissions, and we apply this multiple to each quintile. This calculation is for all of Canada, and does not include indirect emissions from imports; doing so would increase the multiple to 2.8 times direct emissions.

5 M. Lee (2011). *Fair and Effective Carbon Pricing: Lessons from BC.* Vancouver: Canadian Centre for Policy Alternatives.

6 S Klinsky and H Dowlatabati (2009). "Conceptions of justice in climate policy" in *Climate Policy*, 9, p 88–108.

7 Government of Canada. *Canada's Action on Climate Change, Canada's Greenhouse Gas Target and Emissions Projections.* www.climatechange.gc.ca

8 Pembina Institute and David Suzuki Foundation. (2009). *Climate Leadership, Economic Prosperity: Final Report on An Economic Study of Greenhouse Gas Targets and Policies for Canada*. http://pubs.pembina.org/reports/climate-leadership-report-en.pdf

9 Statistics Canada. *Population Projections for Canada, Provinces and Territories* http://www.statcan.gc.ca/pub/91-520-x/2010001/t133-eng.htm

10 M. Lee (2011). *Fair and Effective Carbon Pricing: Lessons from BC.* Vancouver: Canadian Centre for Policy Alternatives.

11 Joshua Thumim and Vicki White, Centre for Sustainable Energy (2008). *Distributional Impacts of Personal Carbon Trading: A report to the Department for Environment, Food and Rural Affairs*. Defra, London. 14 March 2008.