MIND the Gap

A BLUEPRINT FOR CLIMATE ACTION IN BRITISH COLUMBIA

Full Report

ALISON BAILIE • MATT HORNE
Karen Campbell • Alison Jamison • Josha MacNab • Ian Picketts • Rich Wong

November 2007

the PEMBINA institute

Mind The Gap

To combat climate change, Premier Gordon Campbell has declared that British Columbia will cut its greenhouse gas emissions by 33% or more below current levels by 2020. With emissions continuing to rise, this challenge is significant if we are to avoid new emissions and decrease current levels. That's at least 36 million tonnes of emissions that we will need to cut.

To date, the details announced in Premier Campbell's proposals will only reduce British Columbia’s emissions by about 5 million tonnes – 31 million tonnes less than needed to meet the goal.

Those 31 million tonnes are the gap.

Mind the Gap explains how to cut the rest.

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"The science is clear. It leaves no room for procrastination. Global warming is real."
British Columbia Speech from the Throne, February 13, 2007

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Mind The Gap Full Report
Published November 2007
Printed in Canada

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Cover Illustration J & W Communications Inc
Cover Photo: David Dodge, Pembina Institute

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About the Pembina Institute

The Pembina Institute creates sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy and environmental governance. More information about the Pembina Institute is available at http://www.pembina.org or by contacting info@pembina.org.

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Acknowledgements

The Pembina Institute is grateful for the support of Vancity, the British Columbia Government and Service Employees Union, and the Oak Foundation for their support in the production of this report. Please note that Vancity's support for this project does not necessarily imply Vancity's endorsement of the findings or contents of this report.

We would also like to thank the following individuals for their feedback and suggestions throughout this project: Nicholas Heap, David Suzuki Foundation; Nic Rivers, MKJA; Kevin Washbrook, Voters Taking Action on Climate Change; Cheeying Ho, Smart Growth B.C.; Sean Nixon, Ecojustice (formerly Sierra Legal); Tom Hackney, B.C. Sustainable Energy Association; and John Robinson, Sustainable Development Research Initiative, University of British Columbia.

Finally, but not least, we thank our Pembina colleagues, Matthew Bramley, Katie Laufenberg, Greg Powell and Laura Fauth for valued advice, edits, research and support in completing this project.

Any errors or omissions remain the responsibility of the authors.

Mind the Gap

A Blueprint for Climate Action in British Columbia

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1. Introduction

"The science is clear. It leaves no room for procrastination. Global warming is real."

B.C. Speech from the Throne, February 13, 2007

To combat climate change, Premier Gordon Campbell has declared that British Columbia will cut its greenhouse gas emissions by 33% or more below current levels by 2020. In 2007, B.C.'s estimated greenhouse gas emissions are 71 million tonnes, and they are projected to rise. Meeting our goal of cutting today's emissions by 33% or more by 2020 means we'll need to cut a total of at least 36 million tonnes of greenhouse gases. Since the Premier's announcement, British Columbians have been asking one question: how do we get there?

The Pembina Institute wanted to help answer this question and determine what it would take for British Columbia to meet or beat this emission reduction target. In Mind the Gap, we look at the actions the B.C. government has announced to date, recognizing that not all of the B.C. government plans can be quantified, and more will be announced soon. Of those that we could count, we estimate that B.C. government commitments will result in almost 5 million tonnes of reductions.

We then looked at strategies for reductions from six different sectors of B.C.'s economy in order to determine where we can further cut our carbon emissions. We have found another 30 to 38 million tonnes of potential reductions, and offer recommendations on the changes needed in order for these reductions to happen.

These changes will not happen without real leadership from the B.C. government, through laws, regulations and policies that will establish economic signals to ensure that polluting our atmosphere with greenhouse gases is no longer free. Mind the Gap is not a comprehensive roadmap to the solution, rather it is a blueprint or guide. The tools we propose have the potential to work. We look forward to some discussion, and even more action, on making it happen.

1.1 The Tipping Point

2007 may be remembered as a tipping point for climate change. It is the year that Al Gore received an Academy Award for his film 'An Inconvenient Truth' and the Nobel Peace Prize for his tireless effort to share the urgency of global warming. 2007 is also the year that the Intergovernmental Panel on Climate Change, a body of hundreds of scientists and other experts from around the world who advise the United Nations, shared in the Nobel Peace Prize. It is also the year that the B.C. government said it would take action on climate change.

In its February Speech from the Throne, the B.C. government said, in order to combat global warming, it would reduce provincial greenhouse gas emissions[1] by at least 33% below the 2007 level by 2020. This announcement represents a major step forward by a provincial government in Canada. But, while some clear commitments have been made, the significant changes needed to achieve those targets and the strong government policies needed to drive those changes are still

[1] Greenhouse gas (or GHG) emissions is used to refer to the six gases covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

far from fully known. There remains a yawning gap between the greenhouse gas emission reduction targets that B.C. has established, and what we are currently on track to achieve. There are many tough actions that will need to be taken for us to not only meet the 2020 target, but also to move further to the deeper reductions that are required. Engaging us all meaningfully in this crisis is British Columbia's big climate challenge. In other words, how does British Columbia 'mind the gap?'

Citizens are supportive of the B.C. government's direction and want to see action, but the nature and extent of the needed change have not been clearly spelled out. Individuals, businesses and organizations have critical roles to play, and will be the ones making the on-the-ground changes to technology and behaviour. Citizen input will be critical to help design and support effective policy change in British Columbia.

However, while there is a role for all of us in bringing about the necessary changes, primary responsibility, leadership and commitment to the tough policies that will be required, must come from the British Columbia government.

The purpose of Mind the Gap is to put the reality of this challenge into perspective. Our goals in undertaking this study are twofold. First, we provide estimates of the reductions that can be achieved based on commitments and opportunities that exist today – recognizing where it is up to us, individuals, businesses and organizations, and where it is up to the British Columbia government. Second, we want to advance a public discussion of the changes that we will all need to make if we are to find the deep emission reductions that are required. To make the societal changes that are needed, the public must understand the problem, participate in the solution, and inspire governments to take necessary action on global warming.

Our findings show that much can be accomplished, but the changes cannot be marginal – they must be substantial. Because of this reality, we want to ensure that British Columbia's climate actions are made in full recognition of the scale of change B.C. is aiming to undertake. By 'minding the gap' we hope our analysis will ultimately inspire and inform the most important question: What will we do to protect our climate?

1.2 How Big is the Gap?

2007 greenhouse gas emissions in B.C. are estimated to be 71 million tonnes of CO_2e[2] (CO_2 equivalence.) If British Columbians do nothing to reduce emissions, it is projected that by 2020, B.C. would be emitting 84 million tonnes, an increase of 18% (see Section 3.1 for description of the Do Nothing projection). For context, greenhouse gas emissions in B.C. have risen approximately 35 percent since 1990. This increase tracks very closely with the growth in British Columbia's population; BC Statistics estimates a 33% increase from 1990 to 2007.[3]

[2] Emissions of the six types of greenhouse gases are presented using a common metric, CO_2 equivalence (CO_2e), which accounts for the relative contribution of each gas to global warming. 2007 estimate is based on 2005 values from Environment Canada. 2007. *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2005*.

[3] BC Statistics - http://www.bcstats.gov.bc.ca/data/pop/pop/project/bctab1.asp

"If we do nothing to reduce emissions, they will continue to rise. If we take into account projected increases, by 2020 we will need to reduce emissions by 36 million tonnes (43%)."

The British Columbia government's reduction target of 33% of 2007 emission levels by 2020 means that B.C. will need to find 23 million tonnes of reductions in annual emissions to meet the target (33% of 71 million tonnes). However, if we do nothing to reduce emissions, they will continue to rise, so relative to Doing Nothing, we need strategies to reduce emissions by at least 36 million tonnes in 2020 (43% of 84 million tonnes). Meeting the 2020 target will mean that B.C. needs to reduce greenhouse gas emissions by 10% below the 1990 level by 2020.

Mind the Gap has found that based on B.C. commitments announced to date, emissions will be reduced by 5 million tonnes from projected 2020 emissions (still leaving our 2020 emissions 11% above the 2007 level). But we estimate that the rapid implementation of new strategies can reduce our emissions from projected 2020 levels by an additional 30 to 38 million tonnes in 2020.

1.3 Global Warming and B.C.

The need to reduce greenhouse gas emissions is clear. According to the Intergovernmental Panel on Climate Change (IPCC) – the United Nations body that governments set up to advise them on Climate Change – the global average surface temperature has risen by about 0.74°C over the past 100 years,[4] and it is more than 90% certain that the past half-century's warming was mostly due to the build-up of greenhouse gas emissions from human activities.[5] The IPCC has concluded that if no explicit action is taken to curb greenhouse gas emissions, the global average surface temperature is likely to increase by a further 1.1 to 6.4°C between 2090 and 2099 compared to 1980 to 1999. [6] For all but the lowest end of this range, many impacts will be devastating and some irreversible. Taking concrete action to achieve our targets in B.C. is part of the global effort that will need to take place.

There is wide agreement that prevention of "dangerous" climate change will require the increase in average global surface temperature, relative to the pre-industrial level, to be kept within 2°C.[7] Studies reviewed by the IPCC show that for the world to have a chance of staying within the 2°C limit,

- global CO_2 emissions must peak by no later than 2015, and then be reduced to about 43 to 83% below the 1990 level by 2050;[8,9] and

[4] Intergovernmental Panel on Climate Change, "Summary for Policymakers," in Solomon et al., eds, *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press, 2007), 2–3. Also available online at http://www.ipcc.ch.

[5] Ibid., 10.

[6] Ibid., 13.

[7] Matthew Bramley, *The Case for Deep Reductions: Canada's Role in Preventing Dangerous Climate Change* (Vancouver, BC and Drayton Valley, AB: The Pembina Institute and David Suzuki Foundation, 2005), 17–18. Also available online at http://climate.pembina.org/pub/536.

[8] Intergovernmental Panel on Climate Change, "Summary for Policymakers," in Metz et al., eds, *Climate change 2007: Mitigation. Contribution of Working group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press, 2007), 23. Also available online at http://www.ipcc.ch.

- industrialized countries' greenhouse gas emissions must fall to 25 to 40% below the 1990 level by 2020 and to 80 to 95% below the 1990 level by 2050.[10,11]

In 2005, the Pembina Institute and the David Suzuki Foundation surveyed similar studies to those reviewed by the IPCC and concluded that we need to see a reduction in Canada's greenhouse gas emissions to 25% below the 1990 level by 2020, and 80% below the 1990 level by 2050.[12] For comparison with the B.C. 2020 target (33% below 2007 levels), the target of 25% below the 1990 level target equates to 46% below the 2007 level by 2020.[13]

If British Columbia and the rest of the world don't succeed in efforts to reduce greenhouse gas emissions, global warming is set to cause enormous disruption. Examples of impacts projected to occur during this century if greenhouse gas emissions are allowed to continue rising unchecked include[14]

- sea level rise sufficient to flood areas inhabited by millions of people
- more intense rainfall events and tropical storms
- tens of millions of additional people at risk from coastal flooding and hunger, hundreds of millions from malaria and billions from water shortage
- a substantial proportion of land-based species "committed to extinction"
- additional annual costs in the tens of billions of dollars for the world's water management, agriculture and forestry sectors
- further dramatic declines in Arctic ice and a threat to the cultural survival of some Arctic communities
- destruction of more than half of the world's coral reefs.

In B.C., we have already started to see some impacts, but much worse is forecast if emissions are not reduced. Some of the province's most defining characteristics are at risk. Salmon populations will be endangered due to warmer water temperatures and changing flow patterns.[15] Glaciers in

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[9] The IPCC concluded that an emissions reduction of 50–85% below the 2000 level by 2050 is needed to limit equilibrium warming to 2.0–2.4°C, relative to the pre-industrial level. We have recalculated this reduction relative to the 1990 level, based on a 13.3% increase in global CO_2 emissions (including international bunkers but not land-use change and forestry) between 1990 and 2000. This increase was calculated from the Climate Analysis Indicators Tool Version 4.0 (Washington, DC, USA: World Resources Institute, 2007), http://cait.wri.org.

[10] Gupta et al., "Policies, Instruments and Co-operative Arrangements," in Metz et al., eds, *Climate change 2007: Mitigation. Contribution of Working group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press, 2007), 776. Also available online at http://www.mnp.nl/ipcc/pages_media/AR4-chapters.html.

[11] These emission reductions are based on stabilizing the atmospheric GHG concentration at 450 parts per million CO_2e, which corresponds to only about a 50% probability of respecting the 2°C limit. See Bramley, *The Case for Deep Reductions*, 20.

[12] Bramley, *The Case for Deep Reductions*, 38.

[13] Calculated based on estimated 2007 greenhouse gas emissions for B.C. that are 38% higher than 1990 levels.

[14] References to sources for each of these items are provided in \Bramley, *The Case for Deep Reductions*, 15–16.

[15] 2007. Nelitz, M., et al. "Helping Pacific Salmon Survive the Impact of Climate Change on Freshwater Habitats". Report prepared for the Pacific Fisheries Resource Conservation Council.

the southern part of the province will continue to retreat due to increased temperatures.[16] Forests will be vulnerable to increased incidences of insect and disease outbreaks, and changing temperature and precipitation patterns will further stress ecosystems.[17]

1.4 Our Approach at a Glance

In this study, we examined more than 30 important strategies to address global warming. We have grouped the strategies into six different sectors:

- business and industry,
- oil and gas,
- personal transportation,
- homes and buildings,
- waste and agriculture, and
- electricity.[18]

These strategies mostly focus on individual and societal action, but their implementation will require government leadership, in particular, policies to place a meaningful cost on greenhouse gas emissions and fully enforced regulations. These strategies fall into two categories:

> **Strategies and Policies**
>
> *Strategies:* Strategies are changes in technologies or behavior that are undertaken by people or businesses in B.C. Examples include installing a more fuel-efficient furnace or other equipment, using teleconferencing rather than flying, or installing specialized equipment to reduce leaks in natural gas pipelines.
>
> *Policies:* Policies are the government rules that lead to the implementation of strategies. Examples include vehicle emission standards, building codes, carbon taxes, and cap-and-trade systems.

1. *B.C. Commitments* are strategies that have been identified by the British Columbia government in 2007 as part of the Speech from the Throne or the Energy Plan. Where possible, we have estimated reductions from these strategies, but in many cases not enough detail has yet to be provided by the B.C. government. Where the government has announced policies (such as buildings codes and vehicle emission standards) in order to achieve strategies, we have evaluated the policy in conjunction with the strategy.
2. *Minding the Gap* includes more strategies, changes in technology and behaviour that go further than, or address sectors not covered by, the B.C. Commitments. Minding the Gap will require even more changes in the way we live our lives and the ways in which our businesses and industries operate. They will also require strong policies from our government to become a reality.

   We have two categories for strategies under Minding the Gap: *New Strategies* are specific actions for which we were able to estimate emission reductions, while *Further Innovation* are non-specific actions for which we weren't. The second category

[16] 2002. BC Ministry of Environment, "Indicators of Climate Change for BC".

[17] 2006. BC Ministry of Forests and Range, "Preparing for Climate Change: Adapting to Impacts on British Columbia's Forests and Ranges".

[18] The Business and Industry sector excludes emissions from both the oil and gas production industry and the electricity industry. Because of their size, these two industries are considered as separate sectors. The Business and Industry sector includes on-road freight transportation, as well as air, marine, rail and off-road transportation. The Electricity sector includes emissions from net imports of electricity. Electricity emissions are shown as a sector here rather than included with Business & Industry and Homes & Buildings to reflect where electricity is consumed.

recognizes that technologies, operations and even behaviour must evolve substantially over the next 12 years and beyond. Under the appropriate government policies, this evolution could lead to innovative solutions to reducing emissions that we cannot yet describe. Some of these solutions exist today, but we did not find sufficient research to estimate their likely effectiveness in B.C. For *Further Innovation* in each sector, we provide a rough range for potential emission reductions, based on our understanding of the emissions remaining after the *New Strategies* have been implemented and the general potential for further reductions. More research is needed to fully understand those strategies.

For each strategy, we describe the actions (for example, adding better insulation and other energy saving improvements to an existing home or reducing leaks in natural gas pipelines), and estimate the reductions in greenhouse gas emissions. Many of the strategies overlap with one another, so we have structured our analysis to ensure that potential emissions reductions are not double counted.

In examining the different strategies, we acknowledge that these are inherently subjective tasks that rely on value judgments and can be perceived differently depending on how one considers action on global warming. We have attempted to make our analysis as transparent as possible. Section 3 includes a discussion of the general approach we used for estimating reductions and all of our data can be made available.

We finish the analysis by recommending possible policies that could help lead to the implementation of the strategies. Due to the large scale and short timeframe of the required reductions, our focus is on regulations and emissions pricing signals. Strong, clear policies are needed to ensure that businesses and individuals can no longer treat the atmosphere as a free waste bin.

2. Overview of Results

If B.C. does nothing to reduce greenhouse gas (GHG) emissions, they could increase from 71 million tonnes in 2007 to 84 million tonnes by 2020, or an increase of 18%. This change is shown by the tops of the two bars in Figure 1. To meet or exceed the B.C. target of reducing emissions to 33% below 2007 levels, 2020 emissions need to be reduced by at least 36 million tonnes compared to the Do Nothing scenario (shown by the red line). If B.C. successfully achieves the strategies put forward in our analysis, that 18% increase could be reversed to a 37% decrease in emissions (the top of the right red bar in Figure 1). This amounts to 39 million tonnes of reduction.

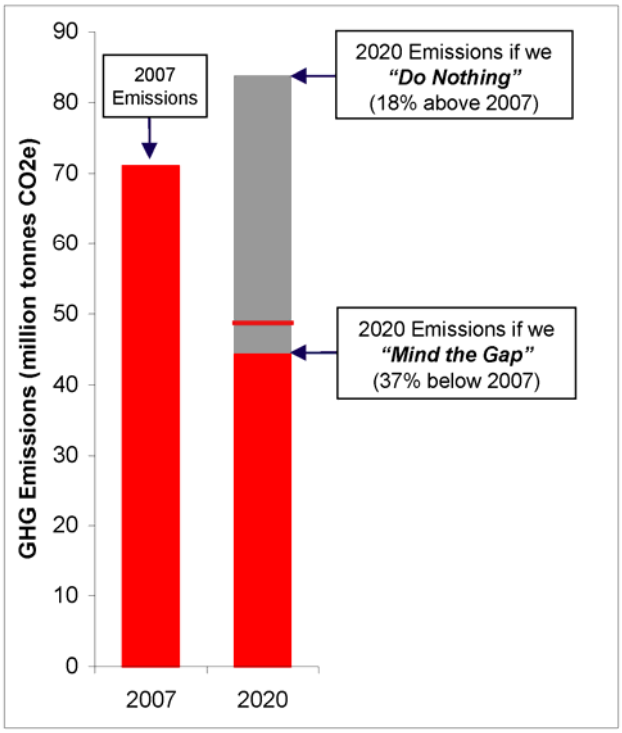


Figure 1: B.C. GHG Emissions, Reduction Targets, and Potential Reductions

Knowing that there is a mix of strategies sufficient to achieve significant reductions in each sector is cause for optimism, but much more than identification is needed to actually achieve those reductions. The types of changes analyzed in our strategies are not marginal in nature and we unfortunately do not have the luxury of picking and choosing the easiest strategies if we are committed to significant GHG reductions. As a result, we will need to ensure that our policies are sufficient to start forcing significant change in all sectors. A mix of policies will clearly be needed, but they must be underpinned by strong pricing and regulation signals that drive GHG reductions.

Emissions Pricing: Cap and Trade Systems and Carbon Taxes

Cap and trade systems and carbon taxes are two key approaches to reducing GHG emissions that take advantage of the private market to control pollution. Both can be effective ways of putting a price on GHG emissions, and both feature prominently in our recommendations. Depending on the design, these approaches could operate independently or in combination.

Cap and Trade Systems

In a 'cap and trade' system, the government would establish a limit on GHG emissions, and then require companies to obtain the *right to emit* greenhouse gases within that limit. Over time, the emissions cap would be lowered to ensure ongoing reductions in emissions. Companies would need to prove their *right to emit* by ownership of emission permits each year. The trading part of the cap and trade refers to the ability of companies to buy or sell those emission permits to each other, so long as all participants ensure that their emissions are at or below their permitted levels. This trading helps companies minimize their compliance costs, and would require a new system to accurately track the permits, revenue, and emissions. Companies view the cost of compliance – either by obtaining permits or reducing emissions – as the price of GHG emissions.

Carbon Taxes

With a carbon tax, the government would directly put a price per tonne on GHG emissions, increasing the cost of processes or activities that produce greenhouse gas emission. The increase in cost would be proportional to the greenhouse gas emissions. For example, an inefficient vehicle would pay more in carbon taxes per kilometre than an efficient vehicle. If a household or company found ways to reduce their GHG emissions, they would pay less tax. Unlike a cap and trade system, the government does not set an absolute cap on GHG emissions, but instead sets the tax rate at a level sufficient to drive investment into low-GHG technologies.

Impacts on Communities, Workers, and Families

This is a complex project, and these types of policies will result in changes that encompass all areas of our economy and significantly transform our society. We can expect to see shifts in the structure of our economy. We will need to redesign our urban communities, our transportation systems, and the ways in which we produce and distribute the goods and services that we all rely on.

This transition will inevitably have deep effects on communities, workers and families, and significant foresight and investment will be required to ensure those impacts are manageable. To maintain broad support for climate action in B.C., we will need to find ways to cushion the effects on those of us who will be disproportionately impacted, and ensure that workers and communities do not bear an unfair share of the burden of change.

There is clearly a key role for the B.C. government in ensuring a just transition for these impacted communities, workers, and families. Workers and communities will need to be meaningfully engaged in the planning and implementation of this transition. From the perspective of workers, there will be a need to support the development of growing sectors and ensure workers have the skills and opportunities to participate in those new opportunities. From the perspective of families (especially those with low incomes), there will be a need to ensure that the potentially regressive impacts of emissions pricing are mitigated. This could include using the revenue generated from a possible carbon tax or carbon cap system to address impacts on workers and their families. Policies will also need to be implemented to ensure that lower income families can afford to reduce their greenhouse gas footprint.

Considerable public funds will be required to support the engagement of workers and communities, and to implement measures to help with the transition. The redesign of our communities will require a skilled workforce to rebuild and administer a new physical infrastructure – everything from new and retrofitted energy efficient buildings and transportation facilities to sewage and water systems. Public funds will also be necessary to support and retrain workers, displaced during the transition, to do the new jobs.

2.1 Emissions Reductions by Strategy

The strategies leading to emissions reductions can be segmented many different ways. One option is to look at the results in terms of our three main types of strategies: those that fall under existing *B.C. Commitments*, the *New Strategies* that help Mind the Gap, and the *Further Innovation* that help Mind the Gap.

Based on the specific strategies committed to in the 2007 Speech from the Throne or Energy Plan, we estimated that emissions will be five million tonnes lower than the Do Nothing scenario (shown by the white bar in Figure 2), which will fall well short of the needed reductions. This amounts to limiting the growth in emissions to 11% instead of 18%. Although these strategies are clearly not enough on their own, they will not be implemented on their own either. Ensuring that they are implemented is our first recommendation.

RECOMMENDATION 1: The B.C. government must enact policies to undertake all its announced strategies. Many initiatives have been announced but most of them lack details on implementation. The B.C. commitments need effective follow through by government policy so that individuals and business can act. We need to know what will be done, how it will be done, how success will be measured and what will be done if initial steps do not succeed.

Of the additional strategies we've identified to Mind the Gap, 22 million tonnes fit within our *New Strategies* category (the light grey bar in Figure 2), while between eight and 16 million tonnes are defined as *Further Innovation* (the dark grey bar in Figure 2).

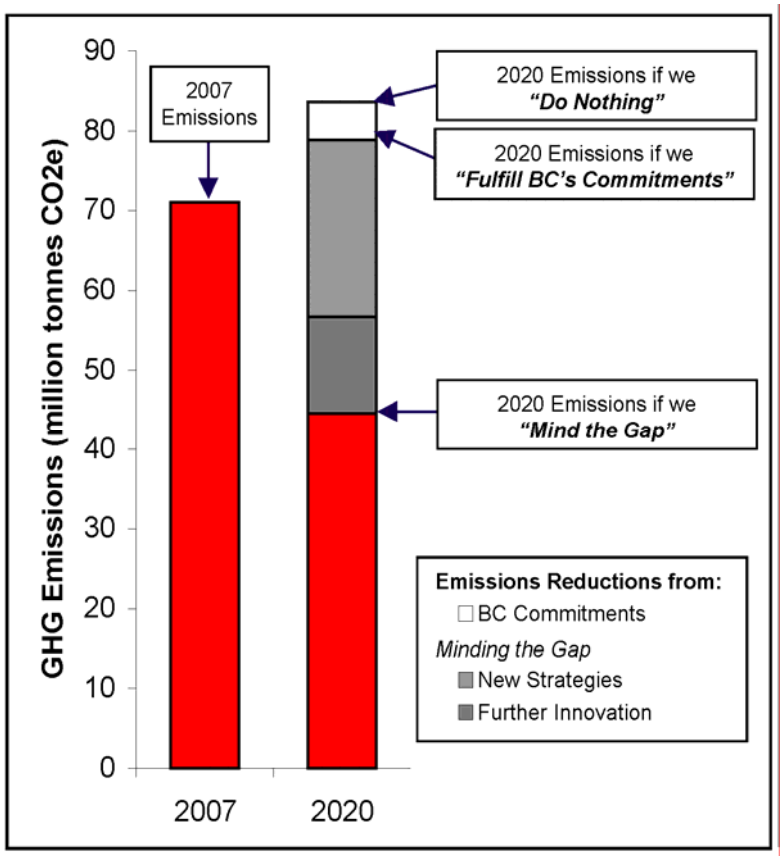


Figure 2: B.C. GHG Emissions Reduction Potential by Strategy

NOTE: "Fulfill B.C.'s Commitments" refers to implementing the B.C. government's announced strategies, based on public information available. "Mind the Gap" refers to implementing the additional strategies identified in this report.

Interpreting the Charts

Charts like the one to the left are used to describe emissions and emissions reductions for all of B.C. and each of the six sectors.

The bar on the left always shows the 2007 emissions, while the bar on the right shows the emissions in 2020 under three scenarios:

- If we *Do Nothing* (the top of the white)
- If we *Fulfill B.C.'s Commitments* (the top of the grey)
- If we Fulfill *B.C.'s Commitments* and *Mind the Gap* by acting on all *New Strategies* and *Further Innovation* (the top of the red).

The charts can also be interpreted in terms of the emissions reductions achieved by:

- Fulfilling *B.C.'s Commitments* (the white block)
- Acting on the *New Strategies* (the light grey block)
- Pursuing *Further Innovation* for reductions (the dark grey block shows the mid-point of the range that we estimated)

2.2 Emissions Reductions by Sector

A second way to categorize the reductions is by sector. The possible reductions, and the challenges associated with each sector, are unique; and all are important. Emissions in British Columbia come from almost every sector of society from our cars, our furnaces and our garbage to small businesses, pulp and paper mills and the mining and oil and gas industries. Reductions will need to be found from all of these sources. No sector can be left behind.

To illustrate, Figure 3 shows how the mix of B.C. Commitments and Minding the Gap strategies leads to lower emissions in each sector, where the difference between the bars in each group is the reduction in emissions from that sector. For example, if all of business and industry strategies are implemented, the sector will reduce emissions from 33 to 22 million tonnes. The strategies we've considered do not produce equal results in each sector, but they are able to generate significant reductions in each – ranging from 19% to 100% below 2007 levels. Note that there are no emissions remaining if we Mind the Gap for the electricity sector – the strategies that we identified in this report can eliminate all the emissions from this sector.

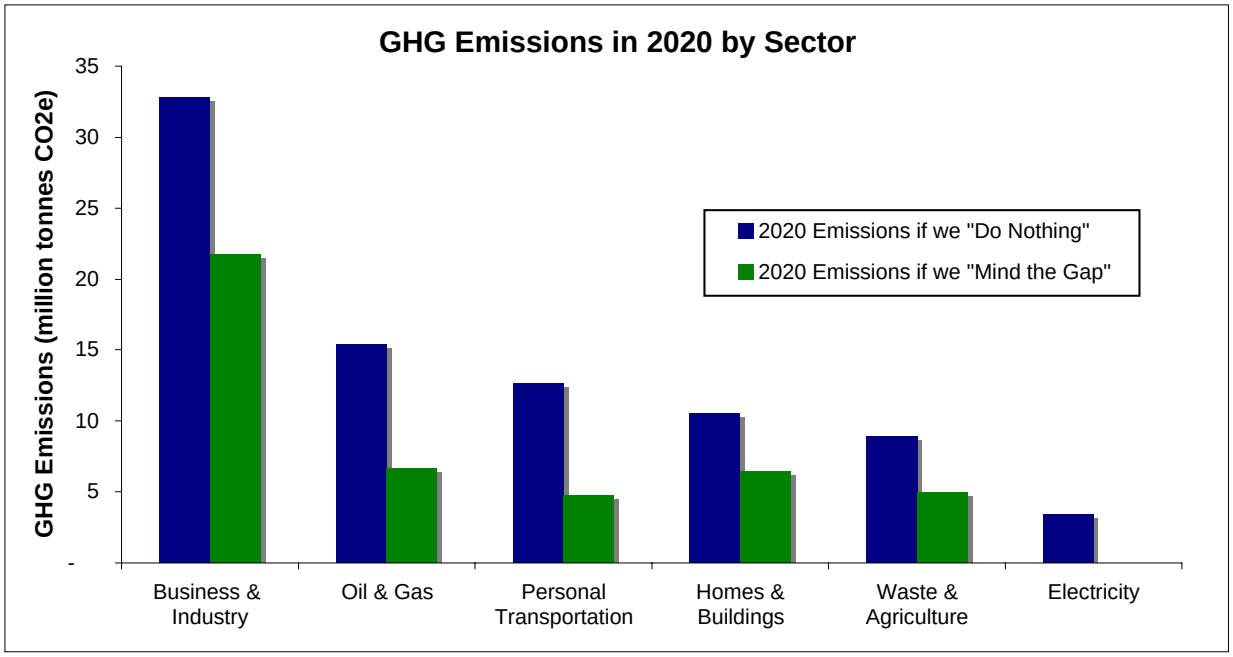


Figure 3: GHG Emissions in 2020 by Sector

Further information on each of the strategies is presented in Sections 4 through 9, grouped by sector. All numeric results are summarized in Appendix 1.

Carbon Neutral Government Operations

The B.C. government has committed to Climate Action in its own operations. The B.C. Throne Speech states the Climate Action Team will "identify practicable options and actions for making the government of British Columbia carbon neutral by 2010." The government followed up on this statement on November 20, 2007 when it introduced Bill 44 to enact the *Greenhouse Gas Reductions Target* act. This act requires, among other provisions, that

- "for 2008 and 2009, the Provincial government to be carbon neutral in relation to greenhouse gas emissions related to business travel by public officials, and
- beginning with 2010, the Provincial government and other public sector organizations to be carbon neutral in relation to their greenhouse gas emissions generally"

In September 2007 at the Union of British Columbia Municipalities conference, the Climate Action Charter was introduced. Signatories of the charter agree to:
Develop strategies and take actions to achieve the following goals:

(i) being carbon neutral in respect of their operations by 2012, recognizing that solid waste facilities regulated under the Environmental Management Act are not included in operations for the purposes of this Charter.
(ii) measuring and reporting on their community's GHG emissions profile; and
(iii) creating complete, compact, more energy efficient rural and urban communities (e.g. foster a built environment that supports a reduction in car dependency and energy use, establish policies and encourage land use patterns that increase density and reduce sprawl.)

The Province and the UBCM will support local governments in pursuing these goals, including developing options and actions for local governments to be carbon neutral in respect of their operations by 2012.
The parties to the charter agree to establish a joint committee and Working Group to develop actions, build local capacity and develop a common approach to determine carbon neutrality.[19]

On September 26, 2007, 62 local governments provided their signed Climate Action Charters to Premier Campbell.

The B.C. government news release notes that: "Carbon neutrality involves measuring the greenhouse gas emissions that come from government operations such as buildings and fleet vehicles and then reducing those emissions to net zero. Governments achieve carbon neutrality by reducing emissions where possible, by purchasing carbon offsets to compensate for its greenhouse gas emissions or by developing projects to offset emissions. Such projects may include converting to energy efficient buildings and replacing old fleet vehicles and buses with hybrids."[20]

19 www.cserv.gov.bc.ca/ministry/docs/climate_action_charter.pdf

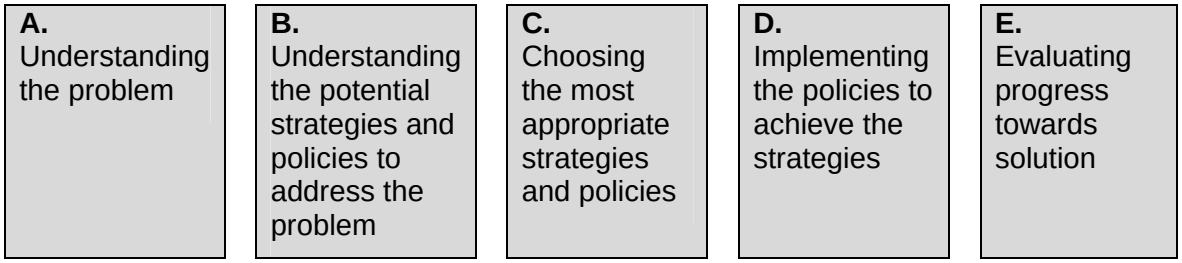
20 *B.C. Communities Commit To Carbon Neutrality By 2012*, News Release, 2007OTP0139-001194, Sept. 26, 2007, Office of the Premier, Ministry of Community Services, Union of BC Municipalities

3. Study Approach

This report examines strategies to reduce GHG emissions from homes, commercial buildings, vehicles, landfills, electricity supply, oil and gas production, and production and transport of goods. It then provides some preliminary policy recommendations that we feel will be capable of achieving those strategies. Our key goals in pursuing this approach are to:

1. Provide estimates of the reductions that can be achieved based on commitments and strategies that exist today
2. Advance a public discussion of the changes that are required, and the effective policies to advance these changes.

The goals of this report are two steps in the much larger objective of addressing climate change in B.C. We can identify at least five major steps in an overall climate action plan



These steps must be adjusted based on new information about the problem and progress to solutions. This report is a piece under step B, and other analyses will also contribute to that step. What this analysis has shown, however, is that we have very limited time and options for step C. All or most strategies that we evaluated will need to be considered and we need to quickly move to steps D. and E.

As described in the sections below, our examination required:

1. Estimating the level of GHG emissions in 2020 if nothing was done to reduce them
2. Grouping the emissions into sectors and identifying strategies to reduce them
3. Estimating the potential reductions from each strategy
4. Recommending policies to achieve those strategies

We describe each of these steps below. We then explain some of the aspects that have been excluded from the current analysis but are very important to be addressed in subsequent considerations of this work.

3.1 Determining the Do Nothing Scenario

Determining a Do Nothing scenario (often called a reference case or business-as-usual scenario) is an important starting point because it indicates many of the trends that will need to be accounted for when assessing potential reduction strategies (e.g. increasing populations). Estimating future emissions if we do nothing requires answers to questions that cannot be answered definitively. How will B.C.'s population, land-use patterns, and economic structure

change over the next 13 years and beyond? What types of buildings, cars, and other energy-consuming equipment will be purchased, and how will they be used?

Our approach for answering these questions is to rely on publicly available estimates of future energy and emissions provided by public agencies, including Environment Canada, Natural Resource Canada, and the B.C. government. These agencies provide information that is widely reviewed and attempts to represent likely future conditions.

We used Environment Canada's information on greenhouse gas emissions for historic emissions from 2000.[21] This report provides GHG emissions by province and major emitting source, following international guidelines for inventory reports. We have expanded on Environment Canada's estimates for the province by including GHG emissions associated with both the use of hydrofluorocarbons and with electricity that is imported into B.C. The first category is currently excluded from Environment Canada's reporting at the provincial level so we included rough estimates based on national GHG emissions from hydrocarbons, scaled by B.C.'s population. The second category, net GHG emissions from electricity trade, is a first step towards capturing emissions associated with B.C.'s overall consumption. The Environment Canada estimates are focused on providing estimates to meet the international reporting requirements and must follow a standard procedure, and these do not include the upstream emissions from imported energy. Our adjustment to include emissions from electricity imports reflects an acknowledgement that our electricity demands can cause GHG emissions in other regions. This is one step in taking responsibility for our GHG emissions associated with our consumption. Future steps, depending on data availability, could account for emissions from imports of fossil fuels and other energy types and possibly from imports of other goods (see Section 3.5.5 for more information on estimating emissions from up stream sources)

For trends in future emissions, we started with projections provided by Natural Resources Canada in the report, *Canada's Energy Outlook: Reference Case 2006*.[22] This report provides estimated projections for greenhouse gas emissions by province and activity (including non-energy related emissions). But, we noted that the assumptions for population growth used by B.C. Statistics differed from those used in Canada's Energy Outlook. [23] So we adjusted the projections in this analysis to be consistent with the B.C.-government assumptions.

The historic and projected GHG emissions are shown in Figure 4. B.C.'s emissions are expected to be about 71 million tonnes of carbon dioxide equivalent ($MtCO_2e$) in 2007 and increase to 84 $MtCO_2e$ in 2020, an 18% increase over 13 years. Individual sectors are projected to grow at varying rates over the period 2007 to 2020, ranging from a 10% decrease in electric sector emissions to a 32% increase in energy consumption in homes and buildings (the emissions reported under Homes and Buildings refer only to emissions produced on-site from fossil fuel consumption and exclude electric sector emissions, which are reported separately).

[21] Environment Canada. 2007. *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2005*.
[22] Natural Resources Canada. 2006. *Canada's Energy Outlook: Reference Case 2006.*
[23] BC Statistics - http://www.bcstats.gov.bc.ca/data/pop/pop/project/bctab1.asp

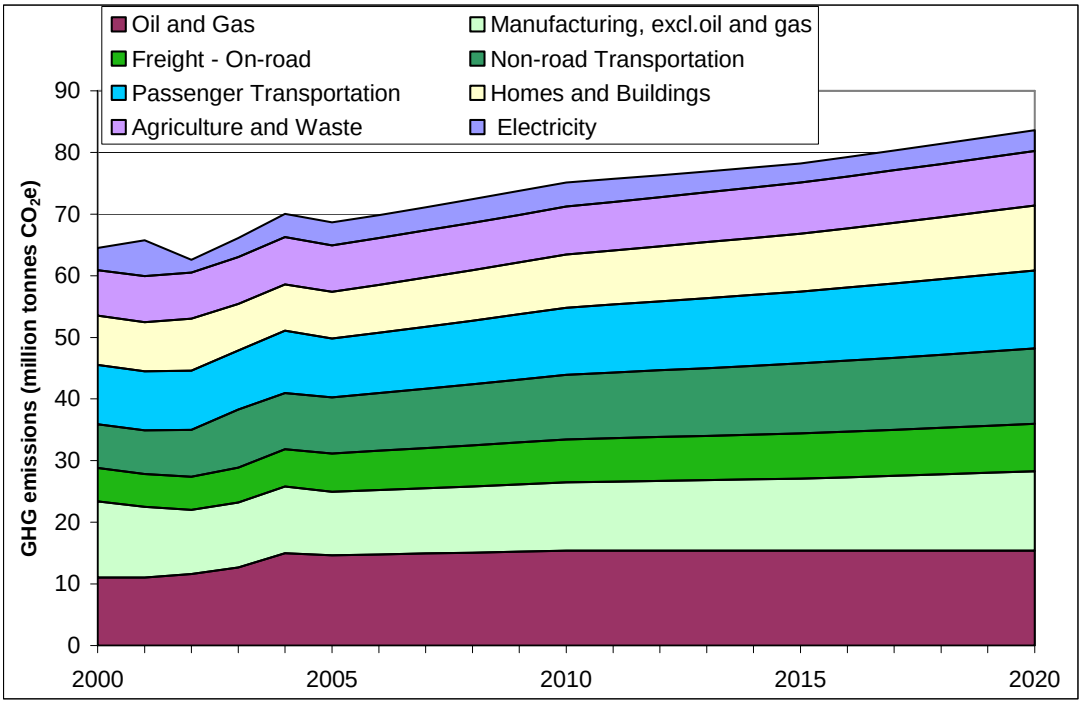


Figure 4: B.C. Historic (2000-2005) and projected (2006-2020) Greenhouse Gas Emissions

Source: Pembina estimates based on Environment Canada (2007) through 2005, Natural Resource Canada (2006) with population growth adjustments, plus estimates of GHG emissions associated with electricity imports from National Energy Board website and GHG intensity from US Energy Information Administration and Environment Canada (2007).

Note: The Business and Industry sector, described below, includes three of the segments in the above chart – the manufacturing industry, non-road transportation (off-road, marine, aviation and rail), and Freight – on-road transportation.

It is useful to put these Do Nothing trends within a context of various targets to reduce greenhouse gas emissions. B.C.'s target is to reduce greenhouse gas emissions by at least 33% below 2007 levels by 2020. Within a Canadian context, the Pembina Institute and the David Suzuki Foundation have advocated the adoption of deep greenhouse gas reduction targets based on best available science.[24] Specifically, we have said that we need to see a reduction in Canada's GHG emissions to 25% below 1990 levels by 2020, and to 80% below 1990 levels by 2050. For comparison with the B.C. 2020 target, the 25% below 1990 levels target equates to 46% below 2007 levels by 2020.[25]

3.2 Identifying the Strategies

Next, we grouped the emissions into the following six sectors to reflect the general groups of people or businesses that are capable of reducing emissions in similar ways:

- Business and Industry

[24] Matthew Bramley, *The Case for Deep Reductions: Canada's Role in Preventing Dangerous Climate Change* (Vancouver, B.C. and Drayton Valley, AB: The Pembina Institute and David Suzuki Foundation, 2005), 15–16. Also available online at http://climate.pembina.org/pub/536.

[25] Calculated based on estimated 2007 greenhouse gas emissions for B.C. that are 38% higher than 1990 levels.

- Oil and Gas
- Personal Transportation
- Homes and Buildings
- Agriculture and Wastes
- Electricity

We then identified more than 30 strategies that could be used in B.C. to decrease GHG emissions in each sector. These strategies mostly focus on individual and societal action, but their implementation will require government leadership, in particular, policies to place a meaningful cost on greenhouse gas emissions and fully enforced regulations. These strategies fall into two categories:

- *B.C. Commitments* are strategies that have been identified by the British Columbia government in 2007 as part of the Speech from the Throne or the Energy Plan. Where possible, we have estimated reductions from these strategies, but in many cases not enough detail has yet to be provided by the B.C. government. Where the government has announced policies (such as buildings codes and vehicle emission standards) in order to achieve strategies, we have evaluated the policy in conjunction with the strategy.
- *Minding the Gap* includes more strategies, changes in technology and behaviour that go further than, or address sectors not covered by, the B.C. Commitments. Minding the Gap will require even more changes in the way we live our lives and the ways in which our businesses and industries operate. They will also require strong policies from our government to become a reality.

We have two categories for strategies under Minding the Gap: *New Strategies* are specific actions for which we were able to estimate emission reductions, while *Further Innovation* are non-specific actions for which we weren't. The second category recognizes that technologies, operations and even behaviour must evolve substantially over the next 12 years and beyond. Under the appropriate government policies, this evolution could lead to innovative solutions to reducing emissions that we cannot yet describe. Some of these solutions exist today, but we did not find sufficient research to estimate their likely effectiveness in B.C. For *Further Innovation* in each sector, we provide a rough range for potential emission reductions, based on our understanding of the emissions remaining after the *New Strategies* have been implemented and the general potential for further reductions. More research is needed to fully understand those strategies.

For each strategy, we describe the actions (for example, adding better insulation and other energy saving improvements to an existing home or reducing leaks in natural gas pipelines), and estimate the reductions in greenhouse gas emissions. In examining the different strategies, we acknowledge that these are inherently subjective tasks that rely on value judgments and can be perceived differently depending on how one considers action on climate change. In making these decisions, we have used the following guidelines:

- We have used existing government commitments as a starting point to give the government credit for initiatives they have taken and provide a frame of reference for future action.
- We have selected strategies that are deemed to be achievable based on experience in B.C., successes in other jurisdictions, and peer suggestions. We have also attempted to ensure that

in addition to being achievable, the strategies are aggressive and consistent with the scale of the climate change challenge.

- We have focused on strategies that will deliver results within the 2020 timeframe, and have also included some longer-term strategies that could make more significant contribution post-2020 in recognition of the need for much greater emission reductions after 2020.
- We have attempted to ensure that our strategies cover a wide range of sectors. We initially chose this guideline to demonstrate the potential that B.C. could realize greenhouse gas reductions in all areas of the economy. However, the results of our analysis quickly showed that reductions would be needed from all sectors – we can't focus on only a few sectors and ignore the others, if we are serious about meeting the targets.

3.3 Estimating Reductions

For each of the *B.C. Commitments* and *Minding the Gap* strategies, we describe the technologies or behavioural changes and estimate the reductions in greenhouse gas emissions. We consider what will happen if large numbers of people and businesses use these technologies or undertake the changes. Substantive changes in government policy, business investments and personal decisions will be required for these new strategies to occur. In terms of estimating the tonnage of greenhouse gas emission reductions, we used the following general approach:

- First, we reviewed literature to find examples of how technologies and actions can change the Do Nothing scenario to reduce greenhouse gas emissions. As with the Do Nothing estimates, this entailed some value judgments, such as how many people or businesses will participate in a strategy and how much will their GHG emissions change?
- Second, we set up simple and transparent spreadsheets to show how quickly these new technologies and actions could replace or alter our course from Doing Nothing and then calculated the estimated emissions reductions based on the difference. Some strategies will overlap, so we had to be careful that we did not introduce errors by double counting the emission reductions.[26] For the *Further Innovation* strategies, we used our understanding of the sector and the other strategies already evaluated to estimate a range for the total reduction potential available from the package of strategies. For all of the other strategies, we were able to produce single point estimates for the emissions reduction potential. This is not to imply that there is no uncertainty in those estimates, but we have greater confidence than the strategies under Further Innovation.
- Third, we asked experts to review our estimates and revised them based on the feedback from the experts.

A key underlying pillar of our approach is to provide all assumptions and calculations for estimating GHG reductions through clearly documented spreadsheets. Our spreadsheets are available by request. This allows the analysis to be updated by anyone, based on new information or alternative assumptions about effectiveness of strategies. This has been done to help others understand the specific strategies and be more informed when discussing how we make each strategy a reality.

[26] To illustrate the potential to double count emissions reductions, consider two strategies: increasing the average fuel efficiency of vehicles by 10% and decreasing the GHG intensity of vehicle fuels by 10%. On their own, both of these strategies would reduce emissions from vehicles by 10%, but because they both influence the same fuels, their combined effect would not be a 20% reduction. The actual combined reduction in this example would be 19%.

3.4 Selecting Recommendations

Although this report is not a detailed policy analysis, one of our goals was to ensure that B.C.'s policy discussions are held with a focus on the types of policies capable of driving the scale of change that B.C. is aiming to undertake. There is no point wasting time debating the specifics of policies that are incapable of driving the scale of change required. To accomplish this goal, we finish our analysis by recommending key policies that to implement the strategies in each sector.

The types of changes analyzed in our strategies are not marginal in nature and we unfortunately do not have the luxury of picking and choosing the easiest strategies if we are committed to significant GHG reductions. As a result, our recommendations are focused on policies that regulate allowable GHG emissions or put a price on those emissions. Where possible, we suggest policies that are not technology-specific, but instead can be met through different means depending on circumstances. This encourages individuals and businesses to focus on the objective (finding the best method for reducing their own GHG emissions) rather than having others prescribe specific technologies or behaviors. We also focus on policy opportunities that mesh with existing government announcements where it would be effective.

This differs from the typical approach to market transformation, which has typically relied on a relatively slow transition from research and development, training, and information, to financial incentives, to regulation. This full breadth of policy types will still be needed to minimize the disruption caused by this scale of change, but it is abundantly clear that B.C. (and other jurisdictions) will need to be using strong regulatory and pricing signals to initiate the market transformation. They cannot simply be relied upon towards the end of the process. The B.C. government acknowledged this point in the 2007 Throne Speech, where the Premier said: *"Since 1997, greenhouse gas emissions have continued to grow here in British Columbia and across Canada. Voluntary regimes have not worked."*

3.5 What Is Excluded

While this study focuses on what can be done in B.C. to reduce GHG emissions, it does not address the following key areas: detailed policy design, complementary policy selection, costs of action and inaction, emissions and strategies from forestry and agricultural practices, emissions and strategies from up and down stream emission sources, and issues related to a just transition.

3.5.1 Detailed Policy Design

Detailed policy design is the choice of specifically what policies will be used (a regulation versus a carbon tax for example), and selection of each policy's characteristics (a $50 versus a $100 carbon tax for example). This study has introduced some policy recommendations that attempt to focus discussion on the types of instruments that are capable of achieving the scale of change needed, but detailed design questions have not been explored. We have excluded these questions from this report because we feel that the most effective decisions on policies will occur when a diverse group of informed citizens can participate in discussions.

The urgent next steps for B.C. must focus on deciding on the best policies to implement the strategies needed to significantly reduce GHG emissions by 2020 and even greater reductions beyond that time. The discussion and decisions on policy design *are critical and must be undertaken promptly.* The strategies identified in this report will not occur without strong leadership and policies, especially from the provincial government. But the most effective

policies will also need participation from individuals, businesses, and communities throughout the Province.

3.5.2 Complementary Policy Selection

The policy recommendations made in our analysis are intended to focus on the core tools capable of driving the scale of change that B.C. is aiming to undertake. These policies that focus on putting a price on GHG emissions and regulating GHG emissions can be viewed as a foundation, but they are not comprehensive. B.C. will also need complementary policies that help to guide the change that needs to happen and smooth the transition for households, workers, and businesses. An example would be energy performance labeling requirements for homes and buildings to help consumers understand how they can minimize their GHG footprint. Policies such as these can be hugely beneficial in building and maintaining support for GHG reduction efforts, but they are not capable of driving GHG reductions on their own.

We encourage the provincial government and others to implement complementary policies. To be effective however, they must be built on a foundation of GHG pricing and regulations – not the other way around.

3.5.3 Costs of Action and Inaction

We have not attempted a detailed evaluation of the cost of achieving these emission reductions. Our focus has been to quantify potential reductions from strategies and identify possible policies. Without knowing which policies will be implemented, costs cannot be estimated. But significant investments, by government, households, businesses, and organizations will be required.

It is clear that many of these investments will lead to savings over time – for example, using more energy efficient cars means that drivers will pay less at the gas pump. Some policies could also result in additional government revenue that could be used to invest in deeper greenhouse gas reduction strategies.

Even more importantly, not investing in strategies to reduce emissions will guarantee major costs, the mountain pine beetle epidemic being one example. These costs will escalate over time. A number of prominent economists have provided estimates of the costs to our societies if significant actions to limit climate change are not taken. These studies indicate that the cost of inaction is likely to be higher than the cost of implementing strong policies and strategies to reduce GHG emissions.[27]

Progressive companies are now changing their operations to reduce financial risks related to greenhouse gas emissions. B.C. Hydro is a local example. If other B.C. businesses do not account for the costs of GHG emissions, their bottom line, and ultimately, jobs in the province, will be put at risk as other companies engage in a market place that recognizes these costs.

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[27] The most prominent study is Nicholas Stern. 2007. *Stern Review: The Economics of Climate Change* (Cambridge Press) – this report estimated the costs to global GDP of not acting to avoid the worst impacts of climate change. The author notes both "The costs of stabilizing the climate are significant but manageable; delay would be dangerous and much more costly" and "A range of options exist to cut emissions; strong, deliberate policy action is required to motivate their take up." http://hm-treasury.gov.uk/media/9/9/closed_short_executive_summary.pdf Another recent study for the United States reports similar findings. M. Ruth, D. Coelho, D. Karetnikov. October 2007. *The US Economic Impacts of Climate Change and the Costs of Inaction* Center for Integrative Environmental Research, University of Maryland. http://www.cier.umd.edu/climateadaptation/

3.5.4 Impacts and Strategies from Forestry and Agricultural Practices

In this analysis, we have not included estimates of impacts of biological sinks, such as CO_2 that is stored and released in trees, other plants, and soils, on B.C.'s net GHG emissions. Human activities such as rate of harvest, type of crops and agricultural practices will affect the GHG emissions. Other factors such as forest fires and age of forest stands also determine the CO_2 uptake or release. Compared to the emissions and strategies in this report, there is greater uncertainty associated with estimating the carbon dioxide associated with biological sources. Much research is underway, by the Canadian Forest Service of Natural Resources Canada, Forest Ethics and Agriculture and Agri-Foods Canada on these areas. Much international research is also being focused on this area and, as one example, the California Air Resource Board has recently adopted forestry protocols that will provide foundation for measuring greenhouse gas emission reductions from strategies that change forestry activities.[28]

Preliminary results indicate that the capacity of B.C.'s forests and agricultural lands in B.C. are decreasing (which increases the challenge that we face in reducing our overall emissions).[29] However, strategies such as changes in agricultural soil management, increased conservation of intact and old growth forests, longer rotation time and increased retention in managed forests could help reverse the reduction in biological sinks and should be considered as potential strategies for B.C.. As the results of research in this area become available, we look forward to including them in next steps for our work.

3.5.5 Emissions and Strategies from Up and Down Stream Sources

The GHG emissions for B.C. included in this report are based on the standard reporting protocols followed by Environment Canada that focus on GHG emissions that occur within our borders. We have expanded on Environment Canada's estimates for the province by including GHG emissions associated with electricity that is imported into B.C. This is a first step towards capturing upstream emissions associated with B.C.'s overall consumption.

This initial step focused on one aspect of B.C. consumption – electricity – we chose to estimate these emissions following reporting procedures being developed by California, Washington, Oregon and B.C.'s other potential GHG trading partners[30] (see section 4.1.4 on the Western Climate Initiative that B.C. has joined). Next steps could focus on net trade of fossil fuel energy by linking the GHG emissions from the production of natural gas, gasoline and diesel with the region that consumes these fuels. In fact, protocols could be developed top potentially expand to GHG emissions associated with net trade of goods and materials, if this proves useful for policy development.

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[28] http://www.arb.ca.gov/newsrel/nr102507b.htm

[29] See page 184 in Environment Canada. 2007. *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2005.*

[30] For example, in August 2007 the Western Climate Initiative developed a goal for emission reductions for the region covered by the participants at the time, (Arizona, British Columbia, California, Manitoba, New Mexico, Oregon, and Washington). This regional goal was based on "consumption-based (or "load-based") emissions estimates for the electricity sector, except where such estimates are currently unavailable" such as British Columbia. We expect that as part of this process the B.C. government will develop load-based emissions estimates for the electricity sector, which can be used to replace our preliminary estimate. *Western Climate Initiative, Statement of Regional Goal August 22, 2007* http://www.westernclimateinitiative.org/ewebeditpro/items/O104F13006.pdf

An alternative accounting approach is to include emissions associated with the eventual use of our exports – for example, GHG emissions from consumption of B.C.'s exported natural gas. These downstream emissions are important and the choice of accounting approach will need to be reviewed as we gain greater experience with climate policies and increasing sophistication can be employed, as needed.

Other emissions that are excluded from international GHG emission reporting protocols are GHG emissions from international air and marine transportation. We did not develop alternative estimates for these values for this analysis but anticipate future changes in protocols to account for these potentially significant GHG emissions.

Carbon Offsets: Short Term Steps Toward Longer Term Solutions

In some cases, it is unlikely that a GHG emitter can find all of the desired reductions from changes in their own emissions. A good example of this is the B.C. government which has committed to become "carbon neutral" by 2010, or Vancity, who have also committed to being carbon neutral. These organizations will first need to reduce emissions as much as possible from their own operations. Then the remaining emissions will need to be "offset". A GHG offset allows a government, individual, business, or organization to cancel out, or 'offset', a portion of their emissions. By paying for the offset, the purchaser provides investment for a project that will reduce emissions elsewhere. For example, an individual, company, or government can offset the emissions from its travel by investing in energy efficiency projects that will reduce GHG emissions somewhere else. Where offsets are acquired, the purchaser will need to meet high standards to ensure that the money invested leads to *real, additional* emission reductions that can be verified by a third party.

The B.C. government has committed to developing an GHG offset system in B.C.. The credibility of this system will directly impact the credibility of B.C.'s efforts to reduce GHG emissions because the system will be utilized by the provincial government (and their municipal counterparts) seeking to meet their own climate commitments, and by business and industry involved in the Western Climate Initiative's (WCI) cap and trade system.

A GHG offset allows an individual, business, or organization to cancel out, or 'offset', a portion of their GHG emissions. By paying for the offset, the purchaser provides a means of financing a project that reduces GHG emissions that would not have otherwise been economically viable. Common uses of offsets include: businesses purchasing offsets to meet voluntary or mandatory emission reduction targets, countries purchasing offsets to meet international reduction obligations, and individuals using offsets to counter emissions associated with their air travel. GHG offsets can be generated from any type of project that reduces (or removes) GHG emissions, including renewable energy, energy efficiency, methane destruction projects, as well as forestry and agricultural projects.

Rigorous rules governing offset creation, quantification and accounting and regulation are critical to ensure an offset is credible. With these rules in place, offsets can be an important strategy for meeting GHG reduction targets in B.C.. Without them, any reliance on offsets to meet those targets will compromise the credibility of the target. Specifically, a credible GHG offset project must be:

- Additional, meaning that the emission reductions or removals go beyond what would have occurred in the absence of the possibility of earning and selling offset credits (The Clean Development Mechanism's Additionality Tool is a standard additionality test used under the Kyoto Protocol as well as for Gold Standard projects);
- Rigorously quantified through third party validation and verification in accordance with recognized standards;
- Claimed by a single individual/organization and not double-counted;
- Transparent with full information on project details and credit quantification accessible to the public;
- Re-evaluated every seven to eight years to ensure determine how much of an offset can still be credibly claimed;
- Evaluated based on other environmental/social impacts;
- Compatible with the world's major carbon trading systems, which are currently the European Union's Emissions Trading Scheme (EU ETS) and the Kyoto Protocol's Clean Development Mechanism (CDM).

The 'additionality' requirement is fundamental to offset credibility. Granting offsets for non-additional projects amounts to giving the purchaser credit for a reduction that would have occurred even if the offset had not been sold. Counting such offsets towards voluntary or mandatory emission reduction targets is a form of 'emissions fraud.' It is important to note that additionality means the scope for GHG offsets will be limited in a jurisdiction where the government is applying aggressive GHG-reduction policies to all major sources of emissions. This is because only emission reductions that go beyond the results of those policies can qualify as offsets.

4. Business and Industry

'No Pain, No Gain'

Business and Industry activities[31] are expected to account for almost 28 million tonnes of carbon dioxide equivalent ($MtCO_2e$) in 2007, approximately 38% of the provincial total. The activities and entities covered by this sector are highly diverse – from large multi-national pulp and paper companies to freight delivery companies with one or two employees. In 2006, 47% of all jobs in B.C. were in small businesses (less than 50 employees), compared with 35% of jobs in large business and 18% in the public sector.[32] The connection between all these entities is that they make decisions largely based on seeking competitive advantage within the private market. This sector encompasses all of the emissions associated with extraction, manufacturing, production and transportation of products to markets. Because the oil and gas industry is the largest of all of the industrial emitters, we have considered its impacts as a separate sector.

The top 10 point source polluters in B.C. collectively emitted nearly 8 $MtCO_2e$ in 2006. The highest GHG polluting facilities are owned by Spectra Energy (5 facilities), Alcan, Lehigh Northwest Cement, Lafarge Canada, Chevron, and Calpine Canada.[33] These ten facilities accounted for 11% of B.C.'s total emissions in 2006 and therefore focused reductions at these facilities represent a significant opportunity for reducing GHG emissions in the province.

The B.C. government has announced several initiatives to work with these entities and with other jurisdictions to develop policies to reduce GHG emissions. The GHG reductions from these initiatives will depend heavily on how they are designed, and in most cases we have been unable to estimate the reductions from the B.C. commitments. We have identified strategies, which we estimate could reduce GHG emissions by between 10 and 12 $MtCO_2e$ in 2020, relative to the Do Nothing emissions in that year. These reductions would bring emissions from Business and Industry down to about 21 to 21 $MtCO_2e$ in 2020, a reduction of 14 to 21 percent compared with 2007 levels.

We have confidence that many opportunities will be developed as businesses focus on finding solutions. The biggest challenge for achieving GHG reductions is for the government to provide clear and sufficient signals that will encourage the private sector to apply its impressive ingenuity to find solutions but allow flexibility to adjust the signals depending on the results. We recommend that the B.C. businesses and the B.C. government move quickly to define GHG reduction targets and begin implementation of fiscal policies – this may entail moving more quickly and including more types of businesses than are being considered by other jurisdictions in the region.

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[31] Including transportation, other than personal vehicles, which are included in Section 6. Road freight and all non-road transportation are included in this section. Emissions from the Oil and Gas industry are considered separately in Section 5.

[32] BC Statistics. Small Business Profile 2007: Small Business in British Columbia, http://www.bcstats.gov.bc.ca/data/bus_stat/busind/sm_bus/SBP2007.pdf

[33] As reported to Environment Canada, Facility GHG Reporting, 2005 data.

Activities covered by this group of strategies include fossil fuel consumption from industrial sector (excluding oil and gas), processes such as metal, cement, and mining production that produce fugitive GHG emissions, hydrofluorocarbon use, and fossil fuel consumption in freight vehicles. This group also includes GHG emissions from aviation, marine and other non-road transportation. For simplicity, we have excluded the oil and gas production industry from this group and instead examine those activities in detail under Section 5.

Estimates of growth in these activities, if no additional action is taken to constrain GHG emissions, would lead to emissions of 32.8 $MtCO_2e$ in 2020

The biggest sources identified for GHG emission reduction in these activities are improved energy efficiency of equipment and vehicles, reduced GHG intensity of fuels, and changes to operations and maintenance. Other potential reductions, which have not been estimated here, include changes in system design for manufacturing and delivering goods.

4.1 Business and Industry Strategies

The B.C. government has made some commitments in this area, but these are few relative to the size of emissions in this sector and to announcements in other areas. As well, they have yet to provide enough details for us to estimate the reductions, as noted in Figure 5. In terms of new strategies, we estimated reductions from four specific strategies for freight, business travel, off-road transportation and the manufacturing industry. Our analysis assumes that the government will implement strong regulations or pricing policies to achieve these strategies. Yet we see a large potential for innovation by progressive companies to lead to further reductions, spurred by appropriate policy signals.

Strategy	Reductions in Annual GHG Emissions Relative to *Do Nothing* in 2020 (million tonnes CO_2e)
B.C. Commitments	
Port and truck stop electrification	Less than 0.1
Low-GHG fuel standards for Freight Vehicles	0.4
Industrial Energy Efficiency Plan	Policy details have not been provided, potential reductions included below in Manufacturing Industry
Minding the Gap	
Road Freight Technology and Practices	1.5
Business Travel Management	0.1
Off-road transportation Efficiency Improvements	1.0
Manufacturing Industry – energy efficiency and GHG reductions	4.5
Further Innovation	2.6 - 4.6
Total Reductions	*10.1 – 12.1*
Total Emissions remaining in 2020	*20.7 – 22.7*

Reductions in 2020 of 15% to 22% relative to 2007. Province-wide target is to "reduce by 33% or more, relative to 2007".

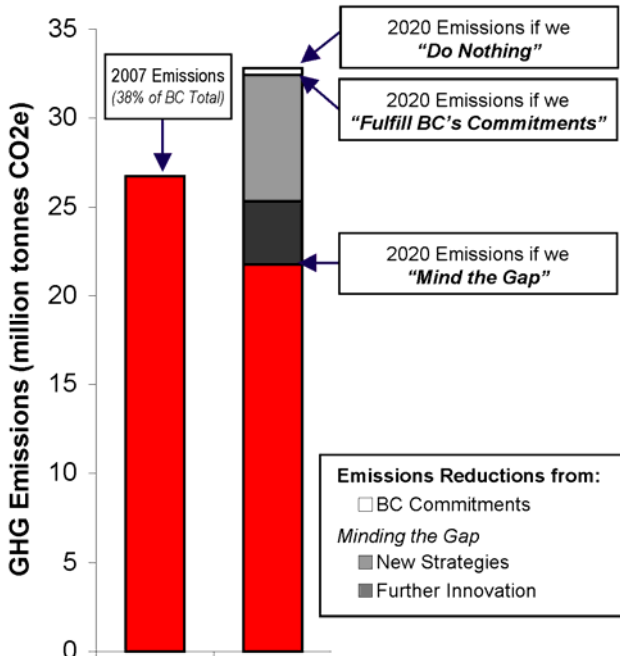

Figure 5: Results for the Business and Industry Sector

NOTE: 'Fulfill B.C.'s Commitments' refers to implementing the B.C. government's announced strategies, based on public information available. "Mind the Gap" refers to implementing the additional strategies identified in this report.

4.1.1 Port and truck stop electrification

The B.C. Throne Speech (2007) announced that "Your government will seek federal co-operation to electrify our ports and reduce container ships' carbon emissions in all of Canada's ports." The government has not yet announced the policy initiatives for this strategy but has estimated GHG emission reductions from electrification to be relatively low, less than 0.02% of current Provincial GHG emissions.

4.1.2 Low-GHG fuel standards for Freight Vehicles

This strategy, based on announcements in the B.C. Throne Speech (2007), applies to fuel used in freight vehicles and light duty vehicles. Greenhouse gas reduction potential from freight vehicles are reported in Figure 5, but the details of the strategy are described in Section 6.1.1.

4.1.3 Industrial Energy Efficiency plan for B.C.

The B.C. Energy Plan 2007 states the B.C. "Government will establish an Industrial Energy Efficiency Program for British Columbia to address challenges and issues faced by the B.C. industrial sector and support the Canada wide industrial energy efficiency initiatives." This strategy covers all industries except Oil and Gas Operations, which are covered by strategies in Section 8.

The specifics of the Industrial Energy Efficiency program have not been announced (as of September 28, 2007) but the B.C. Energy Plan indicates that it will:

- promote self generation of power;
- promote the generation of renewable energy within the industrial sector;
- reduce funding barriers that discourage energy efficiency in the industrial sector; and
- develop a results based pilot program with industry

Additionally in September 2007, Premier Campbell announced that "A Climate Action Team will also be announced next month, consisting of a "blue ribbon" team of leaders from environmental organizations, private enterprise, the scientific community, First Nations and academia. The Climate Action Team will determine the most credible, aggressive and economically viable sector targets possible for 2012 and 2016. That work will be completed by July 31, 2008. The targets identified for 2012 and 2016 must be scientifically supported with viable emission reduction strategies that are economically and fiscally achievable. Those targets will be put out for public review, either accepted or amended, and legally mandated through regulation by the end of 2008."[34]

While work on target setting is underway, the Industrial Energy Efficiency program will likely be on hold and we are unable to estimate GHG emissions reductions associated with this particular program. Estimated GHG reductions from the actions that could be part of the Industrial Energy Efficiency plan are included in the Manufacturing Industry strategy below.

4.1.4 Regional Market-based Mechanism to Reduce GHG Emissions

In April 2007, the B.C. government announced that it would begin working with western US states and Manitoba as part of the Western Regional Climate Action Initiative (WCI) to reduce GHG emissions.[35] By August 2008, the state and provincial governments will develop a design for a regional market-based multi-sector mechanism to reduce GHG emissions from multiple sectors. This mechanism is likely to be either a Cap and Trade system or GHG taxes. Details on the design may not be provided to the public until next summer, so we were unable to estimate potential GHG emission reductions.

4.1.5 Road Freight Technologies and Practices

GHG emissions can be reduced from road freight through installation of more energy efficient technologies (either as add-on technology to existing trucks or as part of new trucks brought on

[34] http://www2.news.gov.bc.ca/news_releases_2005-2009/2007OTP0141-001209.htm

[35] BC Government Press Release April 24, 2007. http://www2.news.gov.bc.ca/news_releases_2005-2009/2007OTP0053-000509.htm

through routine or accelerated scrappage). Changes to operating practices (such as reductions in idling of engines or reductions in excess travel speeds) can be controlled by installation of equipment in trucks.

The emission reductions identified here for large trucks are based on analysis by the Canadian Trucking Alliance (CTA).[36] The CTA analysis considered options such as installing speed-limiters, anti-idling devices, wide-based tires and aerodynamic improvements. We estimated reductions by assuming that by 2020 such equipment would be installed on all large trucks, leading to a 16% reduction, relative to Do Nothing in 2020.

Reductions from medium trucks are based on estimates by MetroVancouver of replacing these trucks at the end of their useful lifetimes with trucks using hybrid fuel-electricity technologies.[37] These replacements are estimated to reduce emissions by 28%, relative to Do Nothing in 2020.

4.1.6 Business Travel Management

The aviation industry appears to have limited opportunity to reduce emissions through changes to technology or operating practices. One promising area for GHG reductions is encouraging alternatives to air travel – including increased use of videoconferencing by businesses and increased trip linking (combining individual trips into one) or mode-switching to less GHG intensive option by individuals. We included this strategy under Business and Industry since about 2/3 of passenger trips[38] are for business travel. However, the same strategy could also be applied to personal airline travel.

We estimated the GHG reductions for this strategy by assuming that 5% of domestic aviation travel is replaced with options that do not emit any GHG emissions (a similar amount of GHG reductions can be achieved by assuming that airline trips are replaced by on-road modes, but a larger percentage of trips would need to change).

4.1.7 Off-road transportation

Off-road transportation includes mobile transportation that occurs on-site, such as at airports or industrial sites. Emissions from these activities are significant in B.C., accounting for almost 7% of total Provincial GHG emissions in 2007 – more than twice the emissions from domestic aviation. Opportunities for reductions will be specific to the individual site and include fuel efficiency improvements, increased maintenances, ensuring that the vehicle or equipment used is the appropriate size, and using fuels with lower GHG emissions. The emission reductions for this strategy reflect potential savings estimated by MetroVancouver (17% of emissions in 2020, relative to Do Nothing), but scaled to the entire province.[39]

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[36] *Trucking & A Made in Canada "Clean Air Act" Recommendations of the Canadian Trucking Alliance* June 2006 http://www.cantruck.com/news/news/2006/ctapr_2006_06_30_110544_i.php3

[37] Greater Vancouver Regional District. 2006. *Developing a Greenhouse Gas Reduction Strategy for Greater Vancouver*. http://www.gvrd.bc.ca/pdfs/GreenhouseGasReductionStrategy.pdf

[38] Based on 2002 data on Canadians traveling in Canada, http://www.tc.gc.ca/pol/en/T-Facts3/main.asp?id=42&table=05-Table42&file=air&Lang=&title=AIR%20-%20Passenger%20Traffic

[39] Greater Vancouver Regional District. 2006. *Developing a Greenhouse Gas Reduction Strategy for Greater Vancouver*. http://www.gvrd.bc.ca/pdfs/GreenhouseGasReductionStrategy.pdf

4.1.8 Increased Energy Efficiency and Decreased GHG Emissions through Technology, Process, and Management Changes in Manufacturing

Manufacturing businesses have many opportunities to reduce GHG emissions through changing equipment and/or operating, maintenance, and management practices. Some opportunities are highly cost-effective to individual businesses and the main barriers are access to information or capital for the improvements. Even with appropriate information and financing, many of these opportunities are missed due to business decisions on where to focus limited resources and which risks will be accepted. Other energy efficiency opportunities require extra financial incentives (or disincentives for the inefficient choices) to be cost-effective for businesses.

We used information from recent analysis for the National Round Table on Energy and the Environment.[40] The analysis used a GHG pricing signal, such as a tax, that ranged from \$15/tonne of CO_2e in 2011 (this would be the same as a 7.5 percent increase compared to current prices of natural gas) to a \$200/tonne of CO_2e in 2020 (100 percent increase in the price of natural gas, so the price including tax would be double the current prices) with further increases expected beyond 2020. This is an ambitious option – both in terms of the total reductions achieved and the feasibility of the policy to achieve the reductions. The estimated GHG reductions in 2020 are almost 50% of the projected emissions in that year, if we Do Nothing.

4.1.9 Further Innovation

There may be large opportunities for innovation by progressive companies to lead to further reductions, spurred by appropriate policy signals and entrepreneurial ingenuity to develop the business case. Some ideas include

- *Reduced leaks and other emissions of hydrofluorocarbons.* We did not analyze the potential for reductions in B.C. from technologies and practices to limit the release of hydrofluorocarbons (hydrofluorocarbons are released from refrigeration and air conditioning equipment and from foam blowing, aerosols, solvents and fire suppression). Emissions of hydrofluorocarbons are expected to experience large increases by 2020 and efforts are occurring world-wide to investigate reduction potentials, with some countries calling f. Companies will benefit from participating in the research and leading the way on trial and development of the solutions.
- *Reductions from Marine and Rail operations.* We also did not embark on detailed analysis for the potential reductions in B.C. from marine and rail operations. Ideas for reductions include low-GHG fuel and more energy efficient equipment. Further input from the industry will be needed to better understand the size of the reduction potential in B.C..
- *Increased focus on developing the market for local food.* This might result in lower GHG emissions in food transportation
- *Co-ordinated freight management through efficient transport centers.* The centers would seek to integrate the best transportation technology, with "smart" systems to quickly communicate the demand and supply of products and determine the lowest GHG delivery route. This could include transfer of road freight to barge or rail, if these alternatives have lower GHG emissions. Companies such as Mountain Equipment Co-op are researching such

[40] Personal Communication from Nic Rivers, MKJA. August 2007.

improvements in their own operations, but the transport centers could also be developed to service many companies.

- *Enhanced Services for Foot Passengers on B.C. Ferries* – GHG emissions will be saved by not having to transport vehicles, but this opportunity will only happen if the service is more convenient than private vehicles. B.C. Ferries can continue to work closely with bus systems and car-sharing companies and further adjust pricing and loading priority to encourage alternative modes.
- *Deceased use of new materials in manufacturing and packaging* – Lessons can be learned from other countries with stronger environmental regulations and higher resource costs to help local companies make the transition. This opportunity could be enhanced by consumer demand for products with small GHG footprints (see also Market Niche through Low GHG products).
- *Market Niche through Low GHG products* – Companies in B.C., such as Catalyst Paper, SPUD, and Salt Spring Coffee, are already carefully reviewing the GHG emissions from their own operations and seeking ways to reduce their own emissions. A major advantage for these companies is being able to develop their market niche for consumers who are concerned about climate change and will purchase goods that reflect this concern.

Many more opportunities exist and will develop. The challenge is to alter the current business environment to encourage companies, industries and systems that can lead the economy under increasing GHG constraints

4.2 Recommendations

To take advantage of ingenuity, the real opportunities for Business and Industry can be found in emissions pricing policies such as a carbon tax and/or a cap-and-trade system. In targeted areas or if emissions pricing gets delayed or weakened, the B.C. government should also consider regulations for this sector. The most effective policies for business operations provide clear long-term signals to the market about future requirements (in this context that could include expected GHG reductions in various years and consequences of not meeting the reductions). The challenge with developing these policies is that significant reductions in emissions are needed in the timeframes that are relatively short. Fortunately, B.C. businesses have adjusted to many forms of unexpected external events in the past, such as changing energy costs, high construction costs, and changing consumer demands. Additionally, many businesses have already started to consider how the future business environment will change under GHG emissions constraints.

We recommend that the B.C. government continue to work with businesses to define GHG reduction targets – accounting for existing business concerns and the need for significant GHG emission reductions. Once initial GHG targets are set, the blue ribbon team will need to quickly design and implement a mix of market mechanisms (such as GHG cap and trade or GHG taxes), combined with targeted technical assistance, regulations and financial incentives. The aim of the mix will be to provide a sufficiently strong signal to stimulate business decisions that will reduce GHG emissions to the extent required by the 2020 targets.

The urgency to begin implementation stems from both the need to start GHG reductions as soon as possible and the acknowledgement that the mix of policies will need to be adjusted.

Experiences with GHG Trading System in the European Union[41] and with cap and trade program for SO_2 in the U.S.[42] have shown that the analyses conducted prior to implementation of the policies did not fully account for the reduction opportunities that were undertaken by industry to meet the emission targets. Assuming that similar opportunities may exist in B.C., the best course of action is to start implementation early, monitor and learn from those experiences, and adjust the policies to more effectively meet the reduction targets and encourage the adjustments needed by businesses.

We encourage the B.C. government to continue its key co-operation and leadership with the WCI partners in developing a design for regional policies for GHG reductions. But both government and businesses may need to move more comprehensively or more quickly than the region and provisional planning for such action needs to be considered now.

RECOMMENDATION 2: **The B.C. government should establish a strong emissions pricing mechanism, such as a carbon tax and/or cap and trade system to address GHG emissions across the wide range of business and industry activities in B.C.** This mechanism must be applied broadly across the economy; in particular for B.C. it will need to cover emissions from small or medium sized companies, as well as from the large ones. The price will need to be sufficiently strong to motivate major change, and include funding to help with transitions for those most vulnerable.

These emissions pricing policies provide companies with clear market signals to inspire innovation in finding and implementing the changes needed for large emission reductions. The B.C. government, along with some neighbouring state and provincial governments, has recognized this need and has begun to design such policies (see section 4.1.4 above). It is essential that these policies include as many businesses and industries as possible and with sufficiently strong market signals. For example, the emission reductions that we estimated in Figure 5 are based on taxes that lead to doubling of natural gas prices by 2020 or emission caps that limit emissions to 65% or less of current levels for each company. The government will also need to signal that such taxes or caps will grow more stringent beyond 2020.

The government will also need to ensure that revenue that is generated from any emissions pricing policy must be used in the best way possible. The revenue, which could be significant, should fund both additional emission reduction strategies and support a just transition for those most vulnerable to the negative impacts of the changes. This will ensure that workers can be trained to participate in new businesses, and to ensure that small businesses, as well as households, are not at risk of energy poverty.

RECOMMENDATION 3: **The B.C. government should implement regulations to achieve specific actions to reduce emissions; these will drive companies to make changes in advance of, or as a complement to, emissions pricing.**

[41] Personal communication Jill Duggan, United Kingdom, Department for Environment, Food and Regional Affairs

[42] Hadi Dowlatabadi, David R. Boyd, and Jamie MacDonald. 2004. *Model, Model on the Screen, What's the Cost of Going Green?* Resources for the Future. Discussion Paper. http://www.rff.org/Documents/RFF-DP-04-17.pdf

Regulations will also be an important measure to achieve the reductions for business and industry. Regulations are particularly important to address areas where the effectiveness of emissions pricing is limited, or to ensure that industries produce products that result in lower emissions by consumers. Regulations such as the low GHG-fuel standard are already being developed. Other regulations might focus on specific technologies, such as anti-idling devices in freight trucks, and drive companies to start making changes in advance of the implementation of the emission pricing.

5. Oil and Gas Production

'The Biggest Single Source – And Solution'

Emissions from oil and gas development are considered as a separate category because this industry is the largest single contributor in the province, accounting for 21% of emissions in 2007. This sector includes emissions from exploration and production, and the transport of natural gas and oil to our homes, buildings, workplaces and cars.

Although the B.C. government is developing numerous initiatives to decrease GHG emissions, some aspects of its plans will likely lead to significant increases in emissions. In particular the B.C. Energy Plan state the government will strive to:

- Continue to work to lift the federal moratorium on offshore exploration and development
- Pursue regulatory and fiscal competitiveness in support of being amount the most competitive oil and gas jurisdictions in North America
- Encourage the development of conventional and unconventional gases
- Promote Exploration and development of the interior basis with a priority focus on the Nechako Basin
- Assess and promote the development of additional gas processing facilities in B.C.[43]

The Do Nothing scenario that we have used does not include the opening up of new basins. If new oil and gas basins are explored and developed between now and 2020, the projected emissions will be significantly higher than estimated here. Even with technologies such as carbon dioxide capture and storage, additional development of this industry will lead to additional GHG emissions in the province. While there may be reasons to encourage such development, the government must account for the GHG emissions increases by implementing significant policies for additional GHG reductions.

5.1 Oil and Gas Strategies

Oil and gas emissions have been identified by the B.C. government as a key issue. It has said that it will reduce emissions from oil and gas down to the 2000 level by 2016, approximately a 4.4 $MtCO_2e$ of reduction in annual emissions by our calculations. And while the B.C. government has announced some strategies for this sector, we have found that there are more opportunities to achieve short term reductions than have been named by the B.C. government so far, as shown in Figure 6. This industry's potential for additional reductions is increased if technologies to capture and store CO_2 emissions can be commercialized in the next ten years. These potential reductions are included under the estimate for Further Innovation below.

We estimate that eight to ten million tonnes of reduction in annual GHG emissions can be achieved through actions in this sector. Less than 0.2 million tonnes of reductions is estimated to result from B.C. Commitments announced to date, based on available information. Our research into New Strategies reveals that 4.5 million tonnes of reductions would come from the specific

[43] www.bcenergyplan.ca

new strategies that we have identified. Finally, we expect that further innovation could lead to another three to five million tonnes of reductions through actions such as capture and storage of carbon dioxide and further improvements on energy efficiency.

Strategy	Reductions in Annual GHG Emissions Relative to *Do Nothing* in 2020 (million tonnes CO_2e)
B.C. Commitments	
Eliminate all routine flaring	0.1
Reduce flaring at test sites, well sites, and gas gathering	0.1
Reduce venting of fugitive gases	Govt. policy not available, reductions included under venting strategy below
Sequestration and Compressor Technologies and Policies	Details on announcement not available, potential reductions included with energy efficiency and venting strategies below.
Minding the Gap	
Reduce venting of fugitive gases	3.5
Energy Efficiency Improvements in Oil and Gas Plants	1.0
Further Innovation	3.0 – 5.0
Total Reductions	*7.7 – 9.7*
Total Emissions remaining in 2020	*5.7 - 7.7*

Reductions in 2020 of 49% to 62% relative to 2007. Province-wide target is to "reduce by 33% or more, relative to 2007".

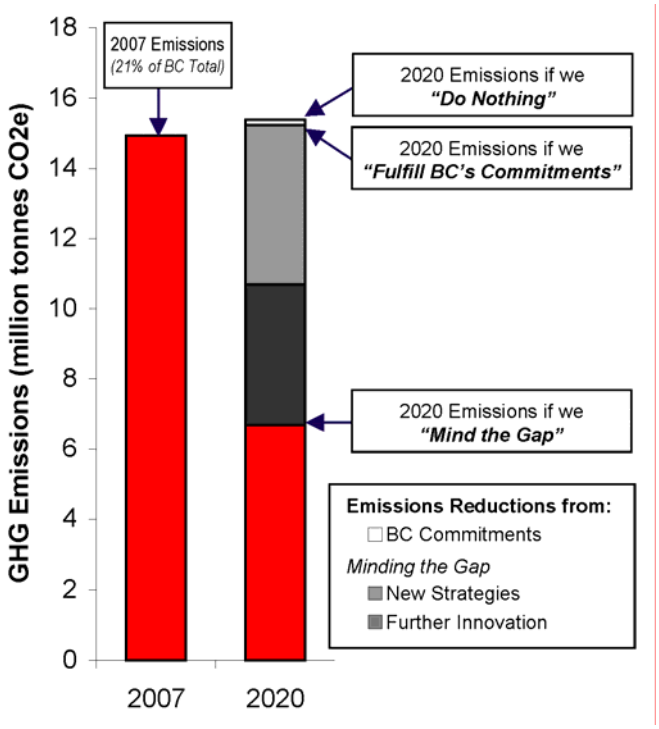

Figure 6: Results for the Oil and Gas Sector

NOTE: 'Fulfill B.C.'s Commitments' refers to implementing the B.C. government's announced strategies, based on public information available. 'Mind the Gap' refers to implementing the additional strategies identified in this report.

5.1.1 Eliminate all routine flaring and reduce non-routine flaring

The B.C. Energy Plan includes the following initiatives regarding flaring in this sector:

1. 1. Eliminate all routine flaring at oil and gas producing wells and production facilities by 2016 with an interim goal to reduce flaring by half (50%) by 2011.
2. Reduce the flaring and venting of natural gas at test sites, well sites, and on pipelines, and eliminate the growth of fugitive gases

To estimate the potential reductions for flaring, we considered recent events in Alberta. Concerns about flaring in Alberta led the Clean Air Strategic Alliance (CASA) to establish a flaring project team in 1997. The work of this team led to the first edition of the EUB's Directive 60 in 1999 (although at this time it was called Guide 60). Directive 60 includes mandatory reporting of

flaring and venting volumes and requires operators to eliminate routine associated gas flaring wherever possible.[44] Between 2000 and 2006, total flaring from all upstream gas sources in Alberta has decreased by 39%, even with increased production.[45] Note that based on the BC Energy Plan's definition, routine flaring is the fraction of total flaring that is generally the most cost-effective to reduce.[46]

Based on Alberta's experience, we assume that B.C. can readily meet the routine flaring initiative in the timeframe specified. Additional flaring reductions (beyond routine) also appear to be feasible. We estimated these additional reductions based on Alberta's reductions at gas plants, wells, and gas gathering; but accounting for B.C. conditions. (Venting is included in section 5.1.2 below)

5.1.2 Reduce Venting of Fugitive Gases

As mentioned in 5.1.1, the B.C. Energy Plan includes a goal to "Reduce the flaring and venting of natural gas at test sites, well sites, and on pipelines, and eliminate the growth of fugitive gases." Environment Canada does not provide details on the sources of fugitive emissions in the oil and gas sector but based on information from the B.C. Energy Plan, we estimate that flaring accounted for less than 6% of total oil and gas fugitive emissions in 2004. Other sources for fugitive emissions include venting (and leaks) from site and pipelines, spills, storage losses, off-gas, and migration from production, processing, and transportation of oil and natural gas products. Recently the industry has focused on developing operations and technologies to significantly reduce these fugitive emissions for economic (fugitive emissions are loss of marketable product) and environmental reasons.

The estimated emission reductions are based on analyses conducted for the US Environmental Protection Agency and can likely be achieved at relatively low cost. Since further information on the design of the provincial policies was not yet available, we have allocated all emission reductions to New Strategies.

5.1.3 Sequestration and Compressor Technologies and Policies

The B.C. Energy Plan also states that the Government will:

- Explore opportunities and new technologies to develop underground disposal of carbon dioxide (sequestration or carbon capture and storage).
- Working with International Partners on Carbon Capture
- Create policy to help improve compressor station efficiency and reduce emissions.

With limited information on the policies and technologies being considered, we were unable to estimate the emission reductions from these specific Energy Plan initiatives. Improvements to

[44] www.methanetomarkets.org/resources/oil-gas/docs/canada_flaring2.pdf

[45] Upstream Petroleum Industry Flaring and Venting Report. June 2007, Alberta Energy and Utilities Board: http://www.eub.ca/docs/products/STs/st60b_current.pdf.

[46] As noted in the BC Energy Plan "Routine associated gas flaring is considered gas that meets an economic threshold for conservation. Operators will be required to perform an economic analysis of all sources of continuous solution gas flaring and subsequently tie in any gas that shows a net present value greater than zero." http://www.bcenergyplan.ca/

compressors are included within section 5.1.4 below and sequestration is a key component of our estimated emission reductions under Further Innovation.

5.1.4 Energy Efficiency Improvements in Oil and Gas Plants

This new strategy focuses directly on the energy consumed by this industry. Like the strategy, *Increased Energy efficiency and Process Changes in Manufacturing* (see Section 4.1.8), this action involves replacing aging equipment with high-efficiency models and ensuring that maintenance and operations of existing equipment implements energy conservation options. Our estimates for emission reductions reflect savings identified from audits of existing upstream oil and gas facilities in Alberta.[47]

5.1.5 Further Innovation

Several potential technologies have been identified that could provide significant additional opportunities for GHG emission reductions, in particular CO_2 sequestration technologies might be used as part of gas processing plants. Another opportunity to consider is avoidance of expansion of this industry.

As noted above, the provincial government has initiatives to explore the technical, legal and economic aspects of underground long-term storage of CO_2 emissions (sequestration). Since natural gas processing plants generate large amounts of CO_2 from burning fuel at a single site, these plants could be some of the best opportunities for sequestration in B.C.[48] It may be possible to capture about 3 million tonnes of CO_2 through sequestration technologies applied to B.C.'s gas processing plants. This capture and storage technologies have not yet been commercialized and the timing is uncertain. At this time, we have not included these potential emission reductions in the oil and gas operations sector.

5.2 Recommendations

The natural gas industry is highly competitive and the most effective policies for reducing GHG emissions will take advantage of market conditions. Our recommendations are focused on emissions pricing policies, with regulations to support.

RECOMMENDATION 4: The B.C. government needs to establish a strong emissions pricing mechanism, such as a carbon tax and/or cap and trade system to address GHG emissions from oil and gas operations.

The B.C. government must ensure that any emissions pricing policies, such as carbon tax or cap-and-trade, includes oil and gas operations. In particular, the design of any such policy must include GHG emissions from fugitive sources. Also, to the extent possible, the policy must seek to encompass all components of oil and gas operations, even emissions from smaller facilities and leaks throughout the operations.

[47] http://www.cetacwest.com/library/EcoEfficiencyFinalReport2.pdf

[48] It will be less costly to recover CO_2 from a single concentrated source than from a large number of spread out sources, such as from BC's homes and buildings.

RECOMMENDATION 5: The B.C. government should implement and enforce regulations to achieve actions to reduce emissions from oil and gas operations in advance of, or as a complement to, emissions pricing.

The government and natural gas industry need to acknowledge the likely delays in implementation of pricing policies and the challenge of overcoming market failures in this particular industry. Regulations may be necessary for limiting leaks from processing and transportation and other activities that are less responsive to pricing policies. The B.C. government will also need to invest in staff and other resources to ensure that strict and transparent enforcement of these policies occurs.

6. Personal Transportation

'On The Road To Breaking Even'

Personal transportation includes all personal road and air travel in B.C., accounting for 14% of emissions in 2007.[49] Almost all of these emissions come from personal vehicles; and, even though particular classes of vehicles are becoming more efficient, emissions continue to rise. If B.C. does nothing to reduce GHG emissions from personal transportation, they could increase from 10 million tonnes in 2007 to 13 $MtCO_2e$ by 2020, or an increase of 26%.

This anticipated increase in emissions is due to three key trends. First, British Columbia's increasing population means more cars on the road. Second, an increasing demand for larger and more powerful vehicles is working against the trend to make specific classes of vehicle more efficient. Third, the average distances driven per year have been increasing and are expected to increase, which means each vehicle on the road will be responsible for more GHG emissions.

6.1 Personal Transportation Strategies

In general, reducing the greenhouse gas emissions from personal vehicles can be achieved by making vehicles that use less energy (either through decreased size, decreased power, or improved technologies) and switching to energy sources that produce fewer greenhouse gas emissions (e.g. using a plug-in hybrid or a blend of bio-diesel). We estimated emission reductions from five strategies (see Figure 7), two of which were announced by the Province in 2007.

The B.C. government has already committed to adopt California's clean car vehicle efficiency legislation and low carbon fuel standard. These are positive steps which will slow the increase in emissions, but these measures are incapable of reversing the trends described above and will represent a false start if B.C. does not enact policies to ensure deep cuts in emissions. Even with full implementation of the vehicle efficiency standard and the low carbon fuel standard, emissions from personal transportation will rise by one million tonnes from 2007 levels (a 10% increase) by 2020. Highway expansion plans, such as those proposed in the B.C. government's Gateway Program, will likely cause average driving distances (and emissions) to rise even faster, thereby offsetting some of the gains.[50]

Our research reveals that five million tonnes of reductions would come from the new strategies that we have identified. In addition, we expect that further innovation could lead to another 0.5 to 2.5 $MtCO_2e$ of reductions. In combination, the implementation of these strategies in addition to

[49] Emissions from on-road freight transportation, marine, rail and aviation are all included under the Business and Industry sector.

[50] A study conducted for the Ministry of Transportation (RWDI Inc. (2006) South Fraser Perimeter Road Regional Air Quality Impact Assessment: Technical Volume 1) showed that the Gateway project would increase GHG emissions by 0.1 $MtCO_2e$.

the existing commitments could reduce emissions from personal transportation by between 43% and 63% from 2007 levels.

Strategy	Reductions in Annual GHG Emissions Relative to *Do Nothing* in 2020 (million tonnes CO_2e)
B.C. Commitments	
Low-GHG fuel standards for light duty vehicles	0.3
California standards for light duty vehicles	1.3
Minding the Gap	
Going beyond CA standards	2.6
Sustainable Communities	2.2
Further Innovation	0.5 – 2.5
Total Reductions	6.9 – 8.9
Total Emissions remaining in 2020	*3.7 - 5.7*

Reductions in 2020 of 43% to 63% relative to 2007. Province-wide target is to "reduce by 33% or more, relative to 2007".

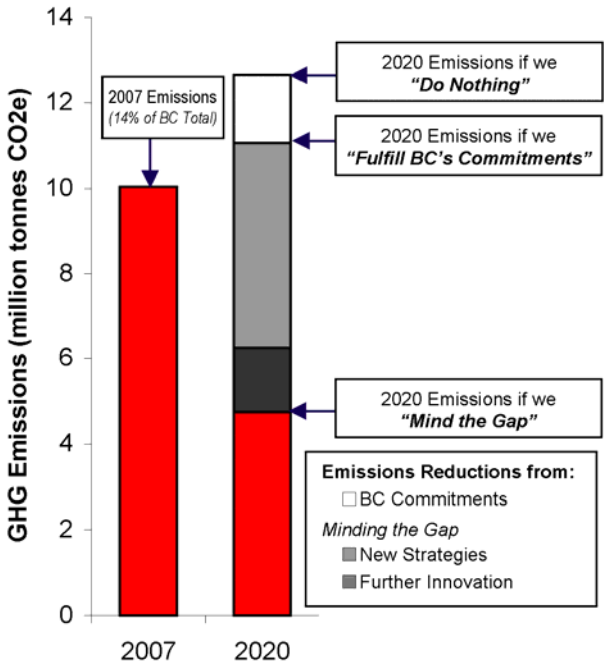

Figure 7: Results for the Personal Transportation Sector

NOTE: 'Fulfill B.C.'s Commitments' refers to implementing the B.C. government's announced strategies, based on public information available. 'Mind the Gap' refers to implementing the additional strategies identified in this report.

6.1.1 Low GHG fuel standard

The B.C. government has committed to adopting California's low carbon fuel standard which promises to reduce the GHG intensity of vehicle fuels by 20% by 2020. They have also committed to requiring all gasoline or diesel sold to have a 10% blend of ethanol or bio-diesel by 2010. In estimating the reductions from this policy, we have assumed that the 2010 commitment would increase to 20% by 2020. The low carbon fuel standard is still in development and it is not clear where in the fuel refining supply chain the reductions in emissions intensity will be achieved. As a result, we've endeavored to avoid any potential double counting of emissions reductions by using conservative estimates of the GHG savings from ethanol and biodiesel. Each litre of biodiesel is assumed to be 60% less greenhouse gas intensive than a litre of diesel, and each litre of ethanol is assumed to be 25% less greenhouse gas intensive than a litre of gasoline.[51] By 2020, these strategies are projected to reduce emissions by 0.3 $MtCO_2e$ compared to the Do Nothing scenario.[52]

[51] (S&T)2 Consultants Inc. (2006). *Sensitivity Analysis of GHG Emissions from Biofuels in Canada*. Report prepared for Natural Resources Canada.

[52] This does not include the GHG reductions that would accrue from the use of biofuels in freight transportation. These are discussed in Section 4.

6.1.2 More efficient light duty vehicles

California standards for light duty vehicles

The B.C. government has already committed to adopt California's clean cars legislation, which will set fleet average efficiency requirements for cars and light trucks. An interesting aspect about the policy is that although it is a regulation, it provides manufacturers with flexibility to determine how they will meet the required average. They could choose to make all of their vehicles more efficient, or they could attempt to increase the relative market share of vehicles that are already more efficient. The standards maintain separate classifications for cars and light trucks (which includes SUVs and minivans), so the trend to larger vehicles would likely still be an upward pressure on emissions.

The standards come into place in 2009 and become more stringent each year until 2016. In 2009, the standards won't actually be any more efficient than the projections for new vehicles in B.C., but by 2016, they standards will have resulted in new vehicles being 15% more efficient than they would have otherwise been. We have made an assumption that the stringency of the standards will continue to increase between 2016 and 2020 at the same rate specified between 2013 and 2016 (2.7%). By 2020, this strategy is projected to reduce emissions by 1.3 $MtCO_2e$ compared to the Do Nothing scenario.

Going Beyond California standards

Although California is often lauded as a leader in clean vehicles, there is nothing stopping B.C. from moving beyond the California standards using a combination of more stringent regulation and emissions pricing policies. This objective could be achieved by an increase in the market share of high-efficiency technologies (e.g. hybrid vehicles), a shift to smaller, lighter, and less powerful vehicles, or a combined approach.

There is a strong rationale to strive for a higher level of efficiency than the proposed California model. California's standards are selected on the basis that they will be cost-effective (not including any price for GHG emissions) and they will not limit customer choice. Given the scale of reductions demanded from all sectors and the high costs that GHG emissions are beginning to impose on the environment, there is no reason why B.C. needs to operate under these same constraints. Without the constraints, British Columbians might end up paying more for their vehicles than they otherwise would have, and they might be unable to purchase some of the most inefficient vehicles.

If B.C. did want to have vehicles more efficient than what would be achieved under the California standards there are other jurisdictions to look towards for inspiration. Japan and the European Union have adopted or in the process of adopting efficiency standards that are more stringent than the California standards.[53] By 2016, both the EU and Japanese fleets will be approximately 20% more efficient than new vehicles being sold in California. We have assumed

[53] The European Union's standards are not yet legally binding, but the European Commission recently expressed "growing concerns regarding the progress made by the industry under [the current] voluntary approach" and concluded that it should be replaced by legislation. See European Commission, *Results Of The Review Of The Community Strategy To Reduce CO_2 Emissions From Passenger Cars And Light-Commercial Vehicles* (Brussels, Belgium: European Commission, 2007), 5. Also available online at http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0019en01.pdf.

that B.C. could adopt a mix of regulatory and pricing policies to achieve levels of vehicle efficiency that are comparable to the projected European Union standards. Under this scenario, GHG emissions reductions from this strategy are projected to be 2.6 $MtCO_2e$ in addition to what would have been achieved by the California standards.

6.1.3 Sustainable Communities

B.C. should pursue strategies to reduce the demand for driving. These include building communities in a way that the goods and services we need are closer to our homes and offices. It also means providing higher quality alternatives to the private vehicle, notably, improvements in public transit and other alternative transportation infrastructure. Developing sustainable communities will entail a variety of actions intended to decrease resource use in cities, districts and towns. These actions, which have general goals of decreased energy use in buildings, homes, businesses and transportation, benefit from an integrated approach to planning. Examples of actions include land-use that minimizes distance traveled between work and home, enhanced public transportation service to decrease the need for vehicle travel, and developing neighborhood areas that combine both residential and commercial space. Mixed residential and commercial development leads to lower greenhouse gas emissions by both decreasing travel and decreasing energy consumed to meet heating and cooling needs.

For this strategy, we estimated emission reductions from an integrated package of changes to land-use development and transportation system operations. These changes are designed to reduce vehicle travel and decrease energy use in buildings. The estimated emissions reductions assume that communities are developed that have a smaller “footprint” with smaller dimensions and less distance between buildings. Complementing this development is increased use of public transit, plus pedestrian, bicycle and shared vehicle travel. The combined effect of this package of strategies in 2020 is estimated to be GHG reductions of $MtCO_2e$ million tonnes.

6.1.4 Further Innovation

Looking beyond these core strategies, there are several areas that may offer potential for further reductions:

- New drive-train technologies that make a shift to near zero-emissions vehicles possible. Examples would include electric vehicles and hydrogen powered vehicles (depending on the source of hydrogen).
- Both of the biofuels considered in the analysis achieve relatively low levels of GHG reduction in part due to the fact that their GHG intensity is only 25% to 60% lower than gasoline or diesel respectively. Advances in the processing of biofuels from other feedstocks (e.g. cellulistic ethanol) could offer the potential of gaining better reductions from biofuels.
- This analysis has not pushed beyond the low carbon fuel commitments already promised by the government due to unresolved concerns with the large scale development of biofuels. If sufficient supply can be developed without compromising other environmental criteria while still providing GHG benefits, it may be possible to push for even greater percentages of renewable fuels.

6.2 Recommendations

For most people, personal transportation decisions – what type of car to buy, whether to drive or take the bus, where to live – are not simply based on the cost. Many other factors influence these decisions – including availability of options and prestige. Our personal transportation recommendations are focused on regulations that ensure the availability of efficient vehicles, low GHG-fuels, and alternatives to driving. Price rebates and charges will play a role, as discussed below, but we emphasize regulations for this sector.

RECOMMENDATION 6: The B.C. government needs to enact energy performance standards for light duty vehicles that will take B.C. beyond the California vehicle standards.

California is often cited as a leader in North America on clean vehicles, so it will take even stronger leadership from B.C.'s government to push beyond the standards already established – but this is clearly needed to help achieve the 2020 provincial reduction target. Specific ways of extending California's standards would be to impose a higher average efficiency requirement or re-classify SUVs and minivans as cars so that they fall under a more stringent standard (pick-up trucks would likely still be excepted). Vehicle manufactures would continue to have flexibility in determining the best way to meet the more stringent standards. As mentioned above, this is a feasible course of action in B.C., and the European Union and Japan have already established, or are in the process of establishing stronger standards, that set a precedent for action in B.C.

RECOMMENDATION 7: The B.C. government, working with federal and industry partners, should establish a strong system of rebates and extra charges on all personal vehicles, based on their energy efficiency.

Although we support B.C. adopting more stringent light duty vehicle regulations than California, we also recognize that B.C. is unlikely to be able to achieve all of the required reductions through regulation alone. As such, we support additional policies that can help encourage consumer demand for those vehicles and help the province exceed the standards. The policies that are most effective and affordable to the public purse will provide incentives for the least polluting cars, coupled with disincentives for the worst performers. This is the type of mechanism that Japan has primarily relied upon to encourage vehicle manufacturers to exceed already stringent efficiency standards.

Since car buyers tend to look at many different aspects when purchasing – including perceived prestige, fun, and safety – fuel costs (and environmental implications) tend to be only minor considerations in the decision making process. By concentrating these costs at the point of purchase, the rebates and extra charges will have a greatest possible influence on consumer choice. A recent study for the National Round Table on Environment and the Economy showed that charging $1,000 for every L/100 km a mid point efficiency and rebating $1,000 for every L/100 km below that threshold could improve new vehicle efficiency by 0.5 L / 100 km.[54]

[54] Marbek Resource Consultants (2005). Development of Options for a Vehicle Feebate in Canada. Report prepared for the National Round Table on Environment and the Economy.

RECOMMENDATION 8: The B.C. and local governments need to aggressively encourage sustainable community growth by requiring that new developments minimize greenhouse gas impacts, and developing alternatives to car travel.

The climate benefits of new energy efficient cars will be lost if people end up driving these cars more. And there is still the issue of addressing GHG emissions from the cars that are already on the road. To achieve reductions in the use of all personal vehicles, we recommend a two-pronged approach – developing alternatives to car travel and providing financial benefits to drive less that are complemented with higher costs for driving more.

Developing alternatives to car travel is daunting but we have many examples to learn from both in B.C. and beyond. To do this will require increased resources for coordinated community planning and transit patterns, as well as investments in alternative choices – more public transit, more safe and enjoyable bicycle and pedestrian trails, and more opportunities for car-pooling. The need for deep emission reductions means that 'out of the box' approaches should be considered, such as making all public transit fare free.

One first step toward sustainable communities would be for the B.C. government to require that new proposals for land-use development assess future GHG emissions, and where the lowest GHG option is not pursued, provide reasons for the other choice.

RECOMMENDATION 9: A system of charges based on gasoline consumption and/or distance traveled should be developed.

Another means to reduce car use and encourage more efficient vehicles is, unfortunately, through people's wallets. This can also be thought of as including currently-ignored environmental costs in market prices. A system of pay-as-you-drive car insurance could be instituted with the Insurance Corporation of B.C. (ICBC), or a carbon tax on gasoline could be introduced, or road/congestion pricing could be implemented. These tax and insurance options could also be implemented as a combined system. The initial goals of such a system would be to educate drivers on the connection between filling up at the pump and global warming, as well as providing revenue to fund alternatives to car travel, as described above.

Although a carbon tax on gasoline or changes in insurance rates could motivate drivers to drive less, recent research indicates that a very high carbon tax (relative to that we recommend for Business and Industry) would be required to motivate any change. Thus we focus on initiating a small but highly-visible charge for education and revenue generation, along with careful evaluation of the behavioural changes that result from such a charge.

7. Homes and Buildings

'Just Scratching the Surface'

This sector accounts for 11% of B.C. emissions in 2007. It includes emissions from natural gas and oil used in homes, apartments, commercial and retail buildings.[55] While the B.C. government has made a number of commitments to be achieved by 2010, particularly regarding the B.C. Building Code, there is still much more that can be done to make buildings a major source of emission reductions.

If B.C. does nothing to reduce GHG emissions from homes and buildings, they could increase from 8 million tonnes in 2007 to 11 $MtCO_2e$ by 2020, or an increase of 32%. The main trend driving this increase is an increasing population (improvements in efficiency are expected to be approximately cancelled out by increases in housing size).

7.1 Homes and Buildings Strategies

In general, reducing the greenhouse gas emissions from homes and buildings is accomplished by making them more efficient (e.g. installing a more efficient furnace or building a home with thicker and better insulated walls) and switching to energy sources that produce fewer greenhouse gas emissions (e.g. using a solar system to pre-heat domestic hot water). We estimated emission reductions from five strategies (see Figure 8), two of which were announced by the Province in 2007 - the Green Building Code and new incentives for home and building retrofits.

Based on the B.C. commitments, we estimated that emissions will be 1.1 $MtCO_2e$ lower than the Do Nothing scenario. This amounts to limiting the growth in emissions to 18% instead of 32%. The commitments announced to date, however, only scratch the surface of GHG reduction opportunities available in this sector – even accounting for the slow turnover in building stock. There is much greater opportunity to lower the 'emissions footprint' of our homes and buildings, both individually and through neighborhood design. In particular, we need to make renewable energy a part of our everyday world in our homes and workplaces. New designs and innovation can lead to even more emission reductions through changes in the size of homes and buildings in the future, before they are built.

We estimate that an additional three to four million tonnes of reductions in annual GHG emissions can be achieved through actions in this sector – two million tonnes of reductions would come from the new strategies and we expect that further innovation could lead to another 0.5 to 1.5 $MtCO_2e$ of reductions. The combined result of all strategies is a reduction in emissions from the homes and buildings sector of 3.6 to 4.6 $MtCO_2e$ compared to 2020 levels. This is equivalent to 13% to 26% below 2007 levels.

[55] The greenhouse gas emission attributed to homes and buildings do not include any emissions associated with electricity production. Those emissions are covered in section 9.

Strategy	Reductions in Annual GHG Emissions Relative to *Do Nothing* in 2020 (million tonnes CO_2e)
B.C. Commitments	
B.C. Green Building Code	0.9
Incentives for retrofits of existing homes and buildings	0.2
Minding the Gap	
Enhanced efficiency in new homes and buildings	0.4
Enhanced retrofits of existing homes and buildings	1.2
Solar hot water systems in homes and buildings	0.2
Sustainable communities[56]	0.2
Further Innovation	0.5-1.5
Total Reductions	***3.6 - 4.6***
Total Emissions remaining in 2020	***5.9 - 6.9***

Reductions in 2020 of 13% to 26% relative to 2007. Province-wide target is to "reduce by 33% or more, relative to 2007".

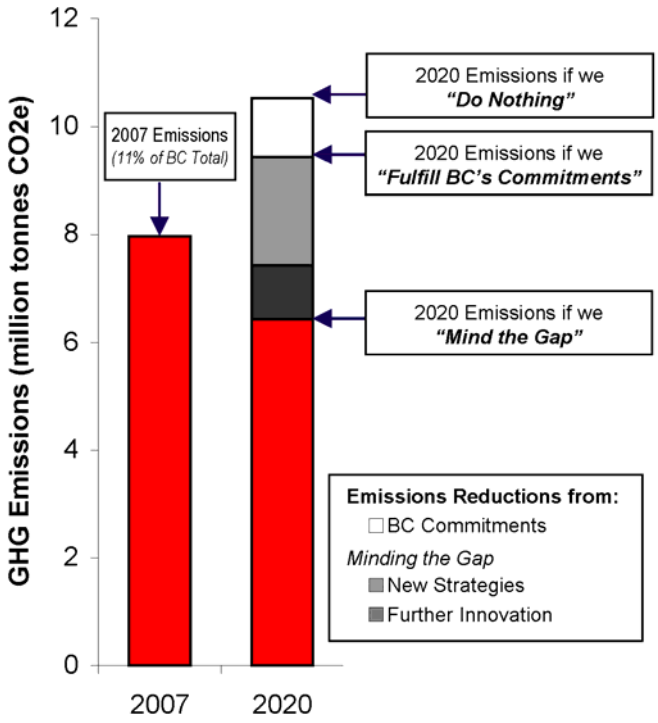

Figure 8: Results for the Homes and Buildings Sector

NOTE: 'Fulfill B.C.'s Commitments' refers to implementing the B.C. government's announced strategies, based on public information available. 'Mind the Gap' refers to implementing the additional strategies identified in this report.

7.1.1 Improved Energy Efficiency for New Homes and Buildings

B.C. Green Building Code

The province committed to implementing a new Green building code by 2008 and energy efficiency standards for all new buildings by 2010. Specific information on what these energy standards will be has not been finalized, so we have assumed that the 2010 targets in the province's 2005 buildings strategy will form the basis for the new code. Depending on the building type, these requirements represent an improvement of between 20% and 32% compared

[56] The Sustainable Communities strategies lead to reductions in greenhouse gas emissions by having more compact housing and a shift to multi-unit housing. The emissions reductions are shown in this section, but recommendations are discussed with Personal Transportation.

to standard practices. The net result of these improvements would be a reduction of 0.9 $MtCO_2e$ in 2020 compared to doing nothing.[57]

Enhanced Efficiency in New Homes and Buildings

Making homes and buildings more efficient than the improvements discussed in the previous strategy is not only possible, but it has already been done in a number of B.C. homes and buildings. For example, the federal government Commercial Building Incentive Program supported the development of 84 buildings in B.C. between 2000 and 2006 that were on average 35% better than the model national code – and ranging up to 65% more efficient (the comparable value used for the B.C. Green Building Code strategy is 25%). There are also numerous examples of how jurisdictions and organizations intend to advance building efficiency beyond our assumptions about the B.C. Green Building Code. For example:

- The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) are developing a new standard for green buildings that will be approximately 30% more efficient that the existing standard. Once developed, this will be almost 50% more efficient than the Canadian model national code.[58]
- The California Public Utilities commission has proposed a long-term buildings strategy that would see all new residential buildings consuming zero net energy by 2020.[59] The same proposed target for commercial buildings is 2030.[60]
- The United Kingdom has adopted a strategy of having all new homes be zero carbon developments by 2016.[61]

Achieving these higher levels of energy efficiency will typically increase development costs and require designers, builders, and inspectors to continually refreshing their skills to adapt to new technologies and techniques. At the upper extent of improvements, it will also likely require tradeoffs in building design – for example, reducing the percentage of glazing (windows) on buildings will dramatically reducing heating losses. That said, if B.C. can achieve substantial and ongoing improvements in energy efficiency in B.C., the potential for greenhouse gas reductions is significant. If the energy efficiency of our homes and buildings improves by 5% per year between 2010 and 2020, they will be more than 50% more efficient than current construction in 2020 and emit 0.4 fewer $MtCO_2e$.

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[57] In addition to the improvement in 2010, it is assumed that the energy performance standards in the green building code improve by 1% per year between 2010 and 2020.

[58] Accessed at http://www.iccsafe.org/news/bsj/0807_ASHRAE.pdf.

[59] Zero net energy means that the renewable systems at the home supply enough energy over the course of a year to meet the energy required by homes for lighting, heating and other demands. Zero net homes usually focus first on energy efficiency improvements to decrease the energy needs then on installing sufficient renewable energy systems.

[60] Accessed at http://www.cpuc.ca.gov/EFILE/PD/72819.pdf.

[61] Accessed at http://www.communities.gov.uk/archived/publications/planningandbuilding/buildinggreener.

7.1.2 Improved Energy Efficiency for Existing Homes and Buildings

Incentives for retrofits of existing homes and buildings

The throne speech committed to several measures that will likely improve the efficiency of existing buildings. The most significant of these are:

- Incentives to encourage energy efficiency retrofits on homes and buildings.
- Measures to help homeowners undertake energy audits.

Specifics on these programs have not yet been made available, so we've made assumptions on the percentage of stock retrofitted each year and the average savings achieved per retrofit based on the 2005 B.C. Building Strategy. The specific scenario we've looked at included retrofitting 5% of homes retrofitted per year at an average energy savings of 10%. If these results are achieved, greenhouse gas emissions will be reduced by 0.2 $MtCO_2e$ in 2020 compared to doing nothing.

Enhanced retrofits of existing homes and buildings

The potential to achieve greater energy savings from existing buildings depends on the rate at which buildings can be improved and the amount by which they can be improved. If B.C. is willing to explore policies beyond the proposals announced to date, then the anticipated reductions could also be exceeded. We have modeled a scenario in which 7.5% of the home and building stock is retrofitted every year with achieved energy savings of 30% for homes and 20% for buildings.[62] Based on this more aggressive retrofit scenario, greenhouse gas emission from homes and buildings could be reduced by 1.2 $MtCO_2e$ in 2020.

7.1.3 Increased Renewable Energy in Homes and Buildings

Solar Hot Water Systems in Homes and Buildings

Government commitments to date have not included initiatives intended to increase renewable energy in buildings, but technologies such as solar hot water heaters and geothermal heatpumps can reduce greenhouse gas emissions from homes and buildings beyond what can be achieved through efficiency improvements. This analysis quantifies the potential benefits of solar hot water systems assuming that by 2020, B.C. is able to install solar systems that capture 20% of the water heating potential identified in B.C. [63] In comparison with efficiency improvements, which are often cost-effective, investments in renewable energy are typically more expensive ways of reducing greenhouse gas emissions. If achieved however, greenhouse gas emissions from homes and buildings could be reduced by 0.2 $MtCO_2e$.

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[62] *The EnerGuide for Existing Houses* program helped homeowners achieve average reductions in energy consumption of 33% in 2005/06, and the Natural Resources Canada estimates that a comprehensive building retrofit can achieve 20% savings in energy consumption on average.

[63] The total potential for residential and commercial have been taken from a 2007 study completed by Pembina for the BC Sustainable Energy Association.

7.1.4 Sustainable Communities

The sustainable community development strategies discussed in the Personal Transportation section will also result in more compact development that leads to reduced greenhouse gas emissions in the homes and buildings sector. The reductions are reported in this section, but the strategy is described in 6.1.3.

7.1.5 Further Innovation

The combined result of the above strategies is a potential to reduce greenhouse gas emissions by 3.1 million tonnes. All of the strategies that we looked at could be pushed further to achieve greater reductions. This would entail:

- Moving even faster towards highly efficient homes and buildings (e.g. following the UK's lead of trying to achieve zero carbon homes by 2016).
- Increasing the rate at which homes and buildings are retrofitted and going further on the amount of energy saved per retrofit.
- Exploring additional opportunities for renewable energy systems, with a particular focus on heat pumps and district energy systems.

Several additional opportunities to further reduce emissions outside of what has currently been explored include:

- Changing societal expectations around how much energy we consider necessary in our homes and buildings. This would entail homes and buildings with less heating and air conditioning for example.
- Accelerating the rate at which we demolish existing homes and buildings so that more efficient ones can be put in their place sooner.
- Switching energy sources to less greenhouse gas intensive fuels.
- Shifting to smaller homes and workspaces.

Our estimate for the reduction potential from these further innovations is 0.5 to 1.5 million tonnes by 2020.

7.2 Recommendations

The strategies discussed in the Homes and Buildings involve improvements in energy efficiency and renewable energy at a significantly accelerated rate compared to the Do Nothing scenario. As such, we recommend a mix of strategies – regulation, price rebates and charges, and information. In all cases, these actions must provide strong signals for developers, real-estate agents, owners, and tenants.

RECOMMENDATION 10: The B.C. government should work with the building industry, plus natural gas and electricity companies utilities and Municipalities to implement and enforce leading-edge energy efficiency and renewable energy performance standards for all new and existing homes and buildings.

The B.C. government has stated that, "The new green building code will implement the highest energy efficiency standards in Canada." This is a promising start, but we note that being the best

in Canada still leaves much room for improvement. There are examples in Europe and the United States of building standards with more stringent requirements for energy efficiency, than are currently found in Canada. Standards must be improved in several key ways.

First, the standards for new homes and buildings need to be increased on a frequent basis (i.e. every three years) so that even greater reductions are achieved. As part of this ongoing improvement, developers and contractors should be given clear signals about where the code is heading on a longer term basis (i.e. 2020) so that they can develop the necessary skills to meet new energy efficiency requirements, while still providing comfortable and healthy homes and buildings.

Second, creative policies that extend performance standards to existing homes and buildings need to be developed. For example, energy-efficiency renovations could be required whenever homes and buildings are bought or sold to ensure they meet an acceptable minimum standard. Older buildings cannot be allowed to avoid contributing to our GHG reduction targets.

Third, standards for new and existing buildings will need to begin to incorporate requirements for minimum percentages of energy needs being met with on-site renewable energy sources (solar, biomass, waste heat, and ground source heat-pumps for example). These standards should also be increased up over time. These types of policies were pioneered in Merton, UK, and have been adopted across the UK, and they have also been integrated into the current drafts of the ASHRAE 189 standard.

RECOMMENDATION 11: The B.C. government should investigate and implement a system of targeted price rebates and charges aimed at building construction and renovation.

Often the people designing and building B.C.'s homes and buildings do not install energy efficient or renewable energy options because of the higher costs of those choices, even if the costs will be entirely recouped by energy bill savings for the future tenants or owners. This recommendation targets the upfront costs to encourage the construction industry to implement these options. For example, developers could be charged a penalty for less efficient buildings (i.e. only slightly better than code), and be given a rebate or other incentive for very efficient buildings.[64] Once implemented these types of policies will provide the market signals that help spur highly efficient and net-zero buildings. They also make it easier to continue advancing the building code requirements by encouraging the building industry to gain experience with any code changes, prior to implementation of the regulations.

RECOMMENDATION 12: A modest carbon tax should be applied to home and building energy bills, levied in proportion to the emissions generated from heating, cooling and all other services in the building.

A highly visible but modest carbon tax (compared with our Business and Industry recommendations) on GHG emissions will complement the previous recommendation by

[64] US cities such as Portland OR, Seattle WA, and Arlington VA all have similar policies.

providing an ongoing price signal to building occupants and owners. The revenue from such a tax could be used to educate home and building owners on small steps that could be taken to further reduce emissions, fund programs that directly work with owners to audit and upgrade existing buildings.

These two goals – education and revenue generation – could be achieved with relatively low charges (similar to public benefits charges that are added to electricity bills in many U.S. states). As with personal transportation, research to date has shown that a very high tax would need to be charged to provide sufficient rationale for significant improvements in energy efficiency or increased use of renewable energy.

Mandatory Energy Performance Labeling for Homes and Buildings

Although not one of our core recommendations for homes and buildings, it will be important for the B.C. government to require performance labels on all new and existing homes and buildings. Understanding the energy efficiency and GHG emissions from existing homes and buildings is a key step in identifying further reductions. It will also help ensure that the benefits of improvements are known over time and provide consumers with a tool to evaluate and demand better buildings. Natural Resources Canada has developed a rating system for residential buildings and is researching a similar system for commercial buildings, and B.C. has already committed to a pilot program for new building labeling.

8. Waste and Agriculture

‘Good News – Simple Measures Can Yield Big Results’

Greenhouse gas emissions from waste and agricultural operations account for 11% of provincial emissions in 2007 – about two-thirds of these emissions are methane release from landfills, and remainder come from animals and agricultural soils.

Activities that emit greenhouse gases from waste and agriculture include solid waste disposal at landfills (almost 66% of the emissions from waste and agriculture), enteric fermentation from animals (17%), manure management (6%), fertilizers and other practices on agricultural soils leading to nitrous oxide (N_2O) emissions (9%), and wastewater handling and waste incineration (the remaining 2%).[65]

8.1 Waste and Agriculture Strategies

The B.C. government has indicated that landfill regulations to require additional methane capture will be forthcoming.[66] This commitment could be significant and achievable; but we have not calculated its impact on emissions because the regulation details have not yet been provided. We have estimated potential reductions from methane capture at landfills, but we can not currently estimate the extent that the future regulation will capture this potential. We have also estimated the reductions that would result from decreasing the amount of methane-generating waste that is sent to landfills. These results are summarized in Figure 9.

We do not have specific reduction estimates for strategies to reduce emissions from agriculture, although work is underway on such strategies elsewhere. For example, research being conducted in Washington state indicates large potential for reductions, often with associated financial benefits to farms by converting waste products to energy. These waste-to-energy opportunities could provide energy for farms or, where possible, it could be sold into the B.C. grid for profit.

Reducing greenhouse gases from waste and agriculture will require the design and, most importantly, enforcement of strict regulations. Regulations can reduce the amount of waste that we send to landfills and ensure that methane gas capture technologies are installed and operated correctly.

We estimate that three to four million tonnes of reductions in annual GHG emissions can be achieved through actions in this sector - two million tonnes of reductions would come from the new strategies for waste operations. Further innovation, such as biocovers for small landfills and processes that convert agricultural emissions to produce energy (waste-to-energy), could lead to additional reductions of roughly two to three million tonnes.

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[65] Environment Canada. 2007. *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2005*.

[66] Existing regulations require that large landfills capture methane; these could be extended to medium and small landfills.

Strategy	Reductions in Annual GHG Emissions Relative to *Do Nothing* in 2020 (million tonnes CO_2e)
B.C. Commitments	
New requirements for methane capture at landfills	Policy details have not been provided, reductions included under methane capture strategy below
Minding the Gap	
Methane capture at landfills	0.8
Reductions of Waste sent to landfills	1.0
Further Innovation	1.6 – 2.6
Total Reductions	*3.4 – 4.4*
Total Emissions remaining in 2020	*4.4 – 5.4*

Reductions in 2020 of 29% to 42% relative to 2007. Province-wide target is to "reduce by 33% or more, relative to 2007".

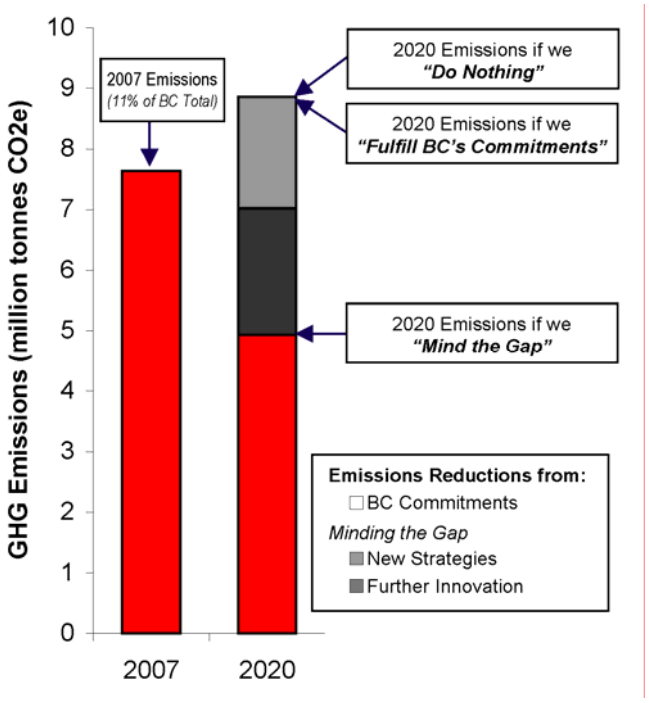

Figure 9: Results for the Waste and Agriculture Sector

NOTE: "Fulfill B.C.'s Commitments" refers to implementing the B.C. government's announced strategies, based on public information available. "Mind the Gap" refers to implementing the additional strategies identified in this report.

8.1.1 Methane Capture at Landfills

The B.C. government highlighted landfill operations as a key area for GHG emissions, noting that *"Legislation will be developed over the next year to phase in new requirements for methane capture in our landfills."*[67] Current regulations require facilities with a filling rate of over 100,000 tonnes of waste per year to be audited for emissions. If the methane emissions exceed 150 tonnes per year, they must capture some of their landfill gases. This legislation could be changed to increase the amount of landfill gas that must be captured.

The emission reductions estimated here are based on the assumption that small landfills will achieve a 60% efficiency in landfill gas capture and there will be an increase in capture efficiency of 15% at medium and large landfills.

8.1.2 Reductions of Waste sent to Landfills

Another strategy for reducing emissions is to decrease the amount of waste that is sent to landfills, such as by increasing backyard (or other) composting of organic waste and by using woodwaste that is currently sent to landfills for energy or other uses. The provincial government may be considering these actions as part of its policies. Emission reduction estimates for waste diversion are based on projections that 50% of the waste stream could be diverted from landfills and composted or incinerated without emissions.

[67] *BC Throne Speech, 2007*

8.1.3 Further Innovation

Each of the above two strategies could likely be implemented more comprehensively than estimated here. Extending these strategies will likely require advances in both the efficiency of methane capture and the use of methane capture technologies for use at smaller landfills. One upcoming practice in this area is the use of biocovers at small closed landfills.[68]

Although we did not focus directly on reductions from agricultural emissions, many opportunities have been identified in nearby regions. An expert group convened by Washington State is considering emissions reductions from manure digestors, agricultural carbon and nutrient management, and preservation of agricultural land. Most of these strategies could likely be used to reduce GHG emissions in B.C.[69]

8.2 Recommendations

We recommend regulation as the most effective means to deal with landfill waste emissions - there are relatively few landfills to regulate and the B.C. government has experience with regulations. We have less certainty about the types of solutions for the agricultural sector, so our recommendations for policies are less specific.

RECOMMENDATION 13: B.C. and local governments need to advance zero waste goals by expanding regulations that ban certain materials in landfills, require composting and recycling to be offered, and require Extended Producer Responsibility[70] programs.

MetroVancouver has taken steps in advancing zero waste goals – reducing the amount of waste generated and sent to landfills – often by combining technology and regulation. Such efforts need to be strengthened and expanded to other areas of the province. B.C. can learn from advances in other parts of Canada and the world to further limit waste sent to landfills – many communities provide curb-side collection of compostable materials and Sweden, for example, bans organic material in its solid waste.

In addition, the government should set targets to reduce wood waste in landfills, and enforce the use of landfill gas recovery and flaring systems in existing medium and large wood waste landfills, as per its Wood Residue Management Strategy.

RECOMMENDATION 14: B.C. and local governments must also commit to significantly increase tipping fees to encourage materials recovery.

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[68] http://www.swlf.ait.ac.th/IntlConf/Data/ICSSWM%20web/FullPaper/Session%20I/1_02%20_Invited%20Talk_Dr.Patrick%20Hettiaratchi.pdf

[69] Washington Climate Advisory Team, Policy Options from the Agriculture Technical Working Group. http://www.ecy.wa.gov/climatechange/cat_twg_agr.htm, accessed October 2007.

[70] Extended Producer Responsibility (EFR) policy extends the traditional responsibility of manufacturers of products (i.e. worker and environmental protection during production) to include responsibility of the product and packaging after it has been used. Examples include reducing the amount packaging that is used and manufacturers that will take-back and recycle items after use by consumers.

In addition to regulations that ban materials, rebates and charges can be used to further limit waste. Increasing tipping fees[71] can help encourage alternatives that focus on recovering and using materials that otherwise would compost in the landfill.

RECOMMENDATION 15: The B.C. government should work with the agriculture sector to develop a system of incentives and future regulations to capture emissions from agricultural activities.

Agricultural activities were not examined extensively in Mind the Gap, though we should note that the potential emission reductions from this sector could be significant. Some ideas, such as waste-to-energy technologies, can provide additional business opportunities by selling any excess energy produced. As with other sectors, once the opportunities are understood, the B.C. government will need to move quickly to develop effective incentives and regulations to encourage action. One way to do so would be to make agricultural projects eligible for 'offset' credits under a cap and trade or carbon tax system. See box, *Carbon Offsets: Short Term Steps Toward Longer Term Solutions*, on Page 54.

[71] A tipping fee is a charge for the unloading or dumping of waste at a recycling facility, composting facility, landfill, or transfer station. These fees are usually set as dollars per tonne unloaded, but a variable rate can be used, for example, to discourage compostable materials from being sent to landfills.

9. The Electric Sector

'Looks Good But Size Matters'

Greenhouse gas emissions from electricity account for five per cent of provincial emissions, but all of those emissions could be eliminated. This sector includes all electricity production and use in the province, including hydro electric power generation, natural gas power generation and the emissions from power that we import from other places such as Alberta and Washington State.

Electricity generation emits greenhouse gases when fuels are combusted to generate power. While much of British Columbia's electricity is provided by hydro dams and other low-emitting sources, more of our electricity is coming from fossil fuels.[72] Following the Do Nothing scenario, our GHG emissions would decrease slightly by 2020. While the closure of the Burrard Thermal Plant (a significant source of greenhouse gas emissions in the lower mainland) would mean that emissions from electricity sources should decrease, there are other new fossil fuel power generation sources being contemplated in B.C. which will lead to increases in emissions.

In addition to electricity production, B.C. imports electricity, often generated from coal, from both Alberta and the United States. We estimated a value for the GHG emissions associated with electricity trade for both historic and future imports and exports. While including emissions from electricity trade is not conventional practice at the federal level, many sub-national jurisdictions are starting to acknowledge responsibility for greenhouse gases that are emitted outside of their boundaries.[73] Many would argue that we should be consistent and also account for GHG emissions from oil and natural gas net imports plus our net imports of manufactured goods. We acknowledge B.C.'s responsibility for such emissions and that accounting for electricity trade is one step in that direction. Electricity generation, including the net GHG emissions associated with our electricity trade, is estimated to be 3.8 million tonnes of CO_2e in 2007, decreasing slightly to 3.4 $MtCO_2e$ in 2020. Approximately half of the emissions are from natural gas-fired plants located in B.C. with the other half from electricity imports (a mix of natural gas, coal and other generation).

There are several ways to reduce emissions from electricity generation – such as encouraging conservation, increasing the amount of renewables and low-emitting sources of electricity generation, and capturing then storing the GHG emissions from fuel combustion at power plants.

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[72] Hydro accounted for 97% of electricity generation in 2005, natural gas-fired sources accounted for 2%, biomass and other sources provided the remaining 1%. Natural Resources Canada. 2006. *Canada's Energy Outlook: Reference Case 2006.*

[73] For example, in August 2007 the Western Climate Initiative developed a goal for emission reductions for the region covered by the participants at the time, (Arizona, British Columbia, California, Manitoba, New Mexico, Oregon, and Washington). This regional goal was based on "consumption-based (or "load-based") emissions estimates for the electricity sector, except where such estimates are currently unavailable" such as British Columbia. We expect that as part of this process the B.C. government will develop load-based emissions estimates for the electricity sector, which can be used to replace our preliminary estimate. *Western Climate Initiative, Statement of Regional Goal August 22, 2007* http://www.westernclimateinitiative.org/ewebeditpro/items/O104F13006.pdf

9.1 Electricity Strategies

The B.C. government has announced a number of strategies to reduce emissions from electricity production – more so than for other sectors. While this potential to reduce all emissions associated with electricity production and net imports in B.C. is good, overall, these reductions won't be particularly large, given the relatively small GHG contribution that electricity makes in B.C. As shown in Figure 10, the government has committed to specific targets to electricity conservation and renewable generation. It has also announced that all new and existing electricity produced in B.C. will be required to have net zero greenhouse gas emissions by 2016, and we additionally suggest similar standards for any electricity imports.

Although the government announcements and the estimated GHG reductions indicate that the electricity sector is well in hand, we note that strong policies are still required to implement the announced strategies and pursue the new strategy. Most of our recommendations focus on additional design details to ensure effective implementation of the existing B.C. commitments.

Electricity imports represent an additional imperative that must also be considered given that we are increasing the amounts of electricity imported from other places. We have therefore included recommendations to specifically address the GHG impacts of our electricity imports as well as our own production.

We estimate that 3.4 million tonnes of reductions in annual GHG emissions can be achieved through actions in this sector – 1.5 million tonnes of reductions would come from B.C. commitments announced to date, and 1.9 million tonnes of reductions would come from the new strategies that we have identified.

Strategy	Reductions in Annual GHG Emissions Relative to *Do Nothing* in 2020 (million tonnes CO_2e)
B.C. Commitments	
Meet 50% of new electricity needs with conservation	0.3
At least 90% of Electricity Generation will be clean or renewable	0.3
Net Zero GHG from Electricity Generation	0.9
Minding the Gap	
Reduce GHG emissions from electricity imports	1.9
Total Reductions	*3.4*
Total Emissions remaining in 2020	*0*

Reductions in 2020 of 100% relative to 2007. Province-wide target is to "reduce by 33% or more, relative to 2007".

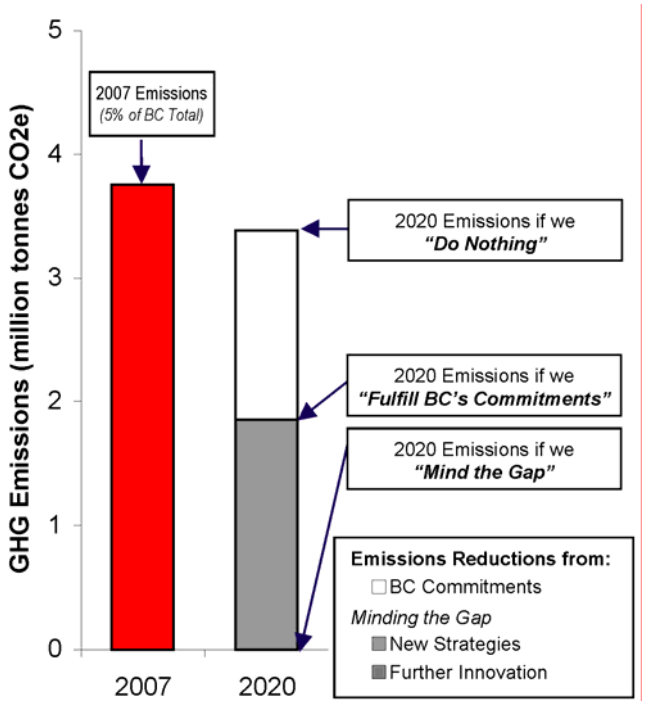

Figure 10: Results for the Electric Sector

NOTE: "Fulfill B.C.'s Commitments" refers to implementing the B.C. government's announced strategies, based on public information available. "Mind the Gap" refers to implementing the additional strategies identified in this report.

9.1.1 Meet 50% of new electricity needs with conservation

For many years, B.C. utilities have included energy conservation as part of electricity planning. In 2007, the B.C. Energy Plan indicates the government's added focus on this issue by setting "an ambitious conservation target, to acquire 50% of B.C. Hydro's incremental resource needs through conservation by 2020."[74] The B.C. Energy Plan notes several policy initiatives that could help reach this target, such as new rate structures, education, and regulations such as codes and standards. One example is the government's proposed Green Building Code standard is described in section 7.1.1. Although not included in the Energy Plan target, Fortis B.C. is also exploring energy conservation opportunities to meet the 50% target. The challenge of this target is that it will be achieved by a combination of many programs and several regulations. Evaluation will be required to ensure that the utilities are on-track to meet the targets.

9.1.2 At least 90 percent of electricity generation will be generated from clean sources

The B.C. Energy Plan includes a goal to "Ensure clean or renewable electricity generation continues to account for at least 90 percent of total generation." The government will need to work with B.C. Hydro, Fortis B.C., the B.C. Utilities Commission, independent power producers, and other key stakeholders to ensure that this goal is met. B.C. currently meets this generation standard, mostly due to our existing hydro facilities, and has excellent potential for developing new electricity generation from wind, low-impact hydro, solar, biomass and geothermal.[75]

9.1.3 Net Zero GHG emissions from All Electricity Generation

The B.C. Energy Plan states that "All new electricity generation projects will have zero net greenhouse gas emissions" and requires "Zero net greenhouse gas emissions from existing thermal generation power plants by 2016." In addition to replacing fossil-fueled generation with renewable sources, the B.C. Energy Plan suggests the following policy initiatives:

- the proponents of these generation projects would have to invest in other initiatives that would completely offset the GHG emissions generated by these projects, unless the technology was available to eliminate or capture and store the emissions from the plant.
- The Ministry of Environment, in consultation with MEMPR, will be responsible for leading the development of the offset policy, as well as all necessary regulatory and legislative changes. The policy may include the option of contributing to the Innovative Clean Energy Fund as an alternative to investing in offset projects."

Both offsets and technologies to capture and store greenhouse gas emissions are new areas for the B.C. government – and both practices have been potential pitfalls. Offsets are a means for

[74] The BC Energy Plan: A Vision for Clean Energy Leadership. 2007. http://www.energyplan.gov.bc.ca/PDF/BC_Energy_Plan.pdf

[75] David Suzuki Foundation Briefing Note. 2006. *Issue: Clear direction from Province needed to attain B.C.'s electricity generation potential of 100% clean, renewable energy*. http://www.davidsuzuki.org/files/climate/BC_Clean_Electricity_Future.pdf

power plants to cancel out, or 'offset', a portion of their GHG emissions by financing other projects that reduce GHG emissions but would not have otherwise been economically viable.[76] To be effective, the reductions from offset projects must be carefully verified to ensure that they did occur. Storing greenhouse gas emissions will also require careful checking to determine that emissions do not "leak" back into the atmosphere over time. Since independent producers, consumers and the government will all invest in and rely on the systems of offsets or emission capture technologies, it will be necessary to clearly assign responsibility for the systems and consider alternatives for obtaining emission reductions if the systems fail.

9.1.4 Reduce GHG emissions from electricity imports

A new strategy, beyond those already announced by the government, is to consider reductions in emissions from electricity imports. Several jurisdictions, including California, Washington and Oregon, are accepting responsibility for emissions that occur outside their borders as a result of electricity trade. While electricity trade provides benefits, such as lower prices and reducing the amount of unused capacity, the emissions associated with imports have been ignored. Limiting the GHG emissions from imports will provide incentives for clean generation outside B.C.'s borders that can be used to meet our electricity needs. This strategy could be met through:

(i) A "load-based" cap and trade system for GHG emissions, as is being discussed through the Western Regional Climate Action Initiative[77] or

(ii) Generation Performance Standards (GPS) for electricity trade, which set maximum GHG emission rates per unit of electricity purchased. Washington, Oregon and California have each implemented generation performance standards for long-term electricity contracts in their states. Note that these two policies could complement each other with the GPS being used for regions that are outside of the cap-and-trade system.

9.1.5 Further Innovation

Since the strategies considered for the electricity sector are sufficient to avoid all emissions associated with electricity consumption in B.C., we recognize that additional reductions may be impossible. One potential opportunity is to consider the emissions avoided in other regions by export of B.C.'s GHG-free electricity. The main concern with this opportunity is possibility of double-counting the emission reductions. If jurisdictions that are importing B.C.'s electricity have requirements that limit GHG emissions or require renewable energy, it is imperative to have systems that correctly account for, and do not double-count, the reductions. The major importers of B.C. electricity – Alberta and the west coast US states – are developing GHG requirements for electric generators but have not determined the accounting systems. To avoid the potential double-counting while these systems are developed and to be consistent with counting emissions avoided by requiring GHG reductions from imports, we have not estimated any GHG reductions from electricity exports.

[76] Standards for GHG offsets have been established in Oregon since 1997 http://www.newrules.org/electricity/climateor.html.

[77] http://www2.news.gov.bc.ca/news_releases_2005-2009/2007OTP0053-000509.htm

9.2 Recommendations

Although the government announcements have provided direction for the electricity sector, we recommend specific steps to ensure that each of the initiatives are effective. Most of our recommendations focus on regulation – we feel this approach allows the B.C. government to take advantage of its existing relationships with companies in this sector.

RECOMMENDATION 16: The B.C. government, working with B.C. Hydro, Fortis B.C., and the B.C. Utilities Commission, need to establish interim targets (every 2 to 3 years) for electricity conservation. Responsibility for meeting these targets must be clearly defined, and penalties for non-compliance must be enforced.

The interim targets will focus on meeting the B.C. government's commitment to meet 50% of new electricity needs with conservation.

RECOMMENDATION 17: B.C. Hydro and the B.C. Utilities Commissions need to revise the design of the B.C. Hydro Standing Offer Program to expand clean generation opportunities. Revisions include: i) remove the size limits (currently limited to systems that are between 0.05 MW and 10 MW), ii) increase the prices that will be paid for low-impact renewable generation, and iii) include transparent information on the pricing structure and the length of contracts under this program.

The goal of the B.C. Hydro Standing Offer Program is to expand the use of renewable generation in B.C. and to meet the B.C. government's commitment that at least 90 percent of generation in the province be clean or renewable. Proposed revisions would ensure that the standing offer will be effective in encouraging investment in new low-impact renewable generation. In addition to the provisions in the recommendation above, the B.C. government could consider using targeted pricing for the Standard Offer. For example, offering higher prices for the technologies that face higher barriers to commercialization in B.C. but offer longer-term benefits.

RECOMMENDATION 18: The B.C. government needs to define a policy on carbon offsets, particularly addressing additionality, rigorous quantification through third-party verification, double-counting concerns, and transparency.

The B.C. government has committed that by 2016, all electricity generation in the province will have net zero GHG emissions. Since it is likely that some natural gas-fired power plants will still be operating then, these plants will need support in becoming net zero GHG emitters. The most common approach used in other jurisdictions, such as Oregon, is to allow power plants that use natural gas or coal to purchase offsets to counter their own emissions.

A strict policy on offsets is required to ensure that the offset purchases reflect real emission reductions. This policy will also potentially have implications for any cap-and-trade system and government commitment to be carbon neutral, which will likely require offsets. See box, *Carbon Offsets: Short Term Steps Toward Longer Term Solutions.*

RECOMMENDATION 19: The B.C. government needs to engage the public to develop clear guidelines for the technical and legal requirements regarding the potential future use of technologies to capture and dispose of GHG emissions.

Another option for power plants that use natural gas or coal is to reduce GHG emissions by capturing the emissions and disposing of them underground. These technologies are still under development and many questions remain. The key questions include: will the technology capture the emissions as expected, will there be unplanned consequences – environmental or other, and will emissions that are stored underground remain there permanently or will they leak? Faced with these uncertainties the B.C. government will need to propose standards for responsibilities then engage with the public in implementing a satisfactory approach.

RECOMMENDATION 20: The B.C. government must move quickly to determine the most effective policy for moving toward elimination of the GHG emissions associated with electricity imports. To aid this, the B.C. government needs to work with all companies that import electricity to develop a tracking system for these emissions.

The B.C. government has committed to being self-sufficient in electricity by 2016. However this does not mean that we will stop importing electricity from Alberta or the United States. It means that we will export more electricity than we import. The hydro dams in B.C. provide us with valuable electricity but due to changing water flows, the amount of electricity provided throughout the year varies. During low water periods or for other economic reasons, B.C. will continue to import electricity but will try to balance this with greater exports at other times. This recommendation ensures that our imported electricity will not add to global GHG emissions.

10. Conclusion

‘No Sector Can Be Left Behind!’

It is possible to both meet, and exceed, the B.C. government’s GHG emission reduction target – or find the required 36 million tonnes in annual emissions of greenhouse gases. In order to meet this challenge, the change required will encompass all areas of our economy and will significantly transform our society – no sector can be left behind.

The need for innovation underlies all of this work. Not only will we need to innovate in the technologies we use to achieve GHG emission reductions, we will also need to innovate in the way we live our lives, travel to our workplaces and purchase goods and services. Above all, we need innovations in the ambition and scale of government policies that must drive these changes.

While the B.C. government’s commitment to take action on climate change has been a major step forward in 2007, the true accomplishment remains to be seen – when the actual reductions are being measured, year by year, between now and 2020 and beyond.

To date, the B.C. government announcements add up to five million tonnes of the 36 million tonnes of reductions that need to be found. This is a good start. We look forward to giving more credit as real reductions can be measured and counted over time. Bold government leadership will be essential to help us ‘mind the gap’ through policies to ensure we achieve the additional millions of tonnes of reductions that we have identified. This will be no small feat.

In this report, we have estimated a possible 22 million tonnes of reductions in new strategies, and the additional possibility of eight to 16 million tonnes available through further innovations. Reductions of this magnitude will be necessary to achieve our goal. We believe that our recommendations for additional government policies are an important first step not only to help us ‘mind the gap,’ but close the gap between the unsustainable world we humans have created and the increasingly taxed limits of our natural world.

Appendix 1 – Results

Table 1 summarizes the emissions reductions by sector and type of strategy. B.C.'s GHG emissions in 2020 are also shown for the scenarios where we Do Nothing and if all strategies are implemented. All results are reported in terms of $MtCO_2e$. Table 2 lists all the strategies that were considered in this report, along with their emission reductions in 2020, relative to the Do Nothing case (also presented in terms of $MtCO_2e$).

Table 1: Emissions Reductions in 2020 by Strategy

	B.C. Emissions in 2020 if we Do Nothing (MtCO2e)	Emissions Reductions in 2020 by Strategy Type (MtCO2e)				B.C. Emissions in 2020 if all strategies are implemented (MtCO2e)
		B.C. Commitments	Mind the Gap		Total	
			New Strategies	Further Innovation		
Business & Industry	32.8	0.4	7.1	2.6 to 4.6	10.1 to 12.1	20.7 to 22.7
Oil & Gas	15.4	0.2	4.5	3.0 to 5.0	7.7 to 9.7	5.7 to 7.7
Personal Transportation	12.6	1.6	4.8	0.5 to 2.5	6.9 to 8.9	3.7 to 5.7
Homes & Buildings	10.5	1.1	2.0	0.5 to 1.5	3.6 to 4.6	5.9 to 6.9
Waste & Agriculture	8.9	0.0	1.8	1.6 to 2.6	3.4 to 4.4	4.4 to 5.4
Electricity	3.4	1.5	1.9	0	3.4	0
Total	83.6	4.8	22.1	8.2 to 16.2	35.1 to 43.1	40.5 to 48.5

Table 2: Annual GHG Reductions Relative to *Do Nothing* in 2020

	Annual GHG Reductions Relative to *Do Nothing* in 2020 (million tonnes CO_2e)
Business and Industry	
B.C. Commitments	*0.4*
Port and truck stop electrification	0.0
Low-GHG fuel standards for Freight Vehicles	0.4
Industrial Energy Efficiency Plan	Not estimated[1]
Regional Market-based Mechanism to Reduce Emissions	Not estimated[2]
New Strategies	*7.1*
Road Freight Technologies and Practices	1.5
Business Travel Management	0.1
Off-road transportation Efficiency Improvements	1.0
Manufacturing Industry – energy efficiency and GHG reductions	4.5
Further Innovation	*2.6 – 4.6*
Oil and Gas	
B.C. Commitments	*0.2*
Eliminate all routine flaring	0.1
Reduce flaring at test sites, well sites, and gas gathering	0.1
Reduce venting of fugitive gases	Not estimated[3]
Sequestration and Compressor Technologies and Policies	Not esimated[4]
New Strategies	*4.5*
Reduce venting of fugitive gases	3.5

Energy Efficiency Improvements in Oil and Gas Plants	1.0
Further Innovation	*3.0 – 5.0*
Personal Transportation	
B.C. Commitments	*1.6*
Low-GHG fuel standards for light duty vehicles	0.3
California standards for light duty vehicles	1.3
New Strategies	*4.8*
Going beyond CA standards	2.6
Sustainable Communities	2.2
Further Innovation	*0.5 – 2.5*
Home and Buildings	
B.C. Commitments	*1.1*
B.C. Green Building Code	0.9
Incentives for retrofits of existing homes and buildings	0.2
New Strategies	*2.0*
Enhanced efficiency in new homes and buildings	0.4
Enhanced retrofits of existing homes and buildings	1.2
Solar hot water systems in homes and buildings	0.2
Sustainable Communities	0.2
Further Innovation	*0.5 – 1.5*
Waste and Agriculture	
B.C. Commitments	*Not estimated*
New requirements for methane capture at landfills	Not estimated[5]
New Strategies	*1.8*
Methane capture at landfills	1.0
Reductions of Waste sent to landfills	0.8
Further Innovation	*1.6 – 2.6*
Electricity	
B.C. Commitments	*1.5*
Meet 50% of new electricity needs with conservation	0.3
At least 90% of generation will be clean or renewable	0.3
Net Zero GHG from Electricity Generation	0.9
New Strategies	*1.9*
Reduce GHG emissions from electricity imports	1.9
Further Innovation	*0.00*

Notes: For the B.C. commitments that were not estimated because of insufficient information on the likely results of the government policy, we have included the potential emission reduction within some of the New Strategies as noted below.

1. Potential reductions included within Manufacturing industry – energy efficiency and GHG reductions
2. Potential reductions included within Manufacturing industry, also within the oil and gas strategies, and within other Business and Industry new strategies, depending on the design and comprehensiveness of the Market-based mechanism
3. Potential reductions included within Venting reductions under New Strategies
4. Potential reductions included within energy efficiency improvements in oil and gas plants (compressors) and Further Innovation for oil and gas (sequestration)
5. Potential reductions included within methane capture, under New Strategies

Appendix 2 – Recommendations

The research that we completed for ***Mind the Gap*** strongly demonstrates that major changes are needed – and we know that strong policies must be deployed for major changes to occur. Our first over-riding recommendation is

RECOMMENDATION 1: The B.C. government must enact policies to undertake all its stated commitments to climate action for our province.

But we still need to go further. We have included recommendations throughout the report, summarized below.

Business and Industry

RECOMMENDATION 2: The B.C. government should establish a strong emissions pricing mechanism, such as a carbon tax and/or cap and trade system to address

RECOMMENDATION 3: The B.C. government should implement regulations to achieve specific actions to reduce emissions; these will drive companies to make changes in advance of, or as a complement to, emissions pricing.

Oil and Gas Production

RECOMMENDATION 4: The B.C. government needs to establish a strong emissions pricing mechanism, such as a carbon tax and/or cap and trade system to address GHG emissions from oil and gas operations.

RECOMMENDATION 5: The B.C. government should implement and enforce regulations to achieve actions to reduce emissions from oil and gas operations in advance of, or as a complement to, emissions pricing.

Personal Transportation

RECOMMENDATION 6: The B.C. government needs to enact energy performance standards for light duty vehicles that will take B.C. beyond the California vehicle standards.

RECOMMENDATION 7: The B.C. government, working with federal and industry partners, should establish a strong system of rebates and extra charges on all personal vehicles, based on their energy efficiency.

RECOMMENDATION 8: The B.C. and local governments need to aggressively encourage sustainable community growth by requiring that new developments minimize greenhouse gas impacts, and developing alternatives to car travel.

RECOMMENDATION 9: A system of charges based on gasoline consumption and/or distance traveled should be developed.

Homes and Buildings

RECOMMENDATION 10: The B.C. government should work with the building industry, plus natural gas and electricity companies, utilities and Municipalities to implement and enforce leading-edge energy efficiency and renewable energy performance standards for all new and existing homes and buildings.

RECOMMENDATION 11: The B.C. government should investigate and implement a system of targeted price rebates and charges aimed at building construction and renovation.

RECOMMENDATION 12: A modest carbon tax should be applied to home and building energy bills, levied in proportion to the emissions generated from heating, cooling and all other services in the building.

Waste and Agriculture

RECOMMENDATION 13: B.C. and local governments need to advance zero waste goals by expanding regulations that ban certain materials in landfills, require composting and recycling to be offered, and require Extended Producer Responsibility programs.

RECOMMENDATION 14: B.C. and local governments must also commit to significantly increase tipping fees to encourage materials recovery.

RECOMMENDATION 15: The B.C. government should work with the agriculture sector to develop a system of incentives and future regulations to capture emissions from agricultural activities.

Electricity

RECOMMENDATION 16: The B.C. government, working with B.C. Hydro, Fortis B.C., and the B.C. Utilities Commission, need to establish interim targets (every 2 to 3 years) for electricity conservation.

RECOMMENDATION 17: B.C. Hydro and the B.C. Utilities Commissions need to revise the design of the B.C. Hydro Standing Offer Program to expand clean generation opportunities.

RECOMMENDATION 18: The B.C. government needs to define a policy on carbon offsets, particularly addressing additionality, rigorous quantification through third party verification, double-counting concerns, and transparency.

RECOMMENDATION 19: The B.C. government needs to engage the public to develop clear guidelines for the technical and legal requirements regarding the potential future use of technologies to capture and dispose of GHG emissions.

RECOMMENDATION 20: The B.C. government must move quickly to determine the most effective policy for moving toward elimination of the GHG emissions associated with electricity imports.