

# **Report of the BC Climate Change Economic Impacts Panel**

**Prepared for:**

**Minister of Water, Land and Air Protection  
Minister of Energy and Mines**

March 25, 2003

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The Hon. Joyce Murray  
Minister of Water, Land and Air Protection

The Hon. Richard Neufeld  
Minister of Energy and Mines

We are pleased to submit this report for your consideration. It is a reflection of work done by the BC Climate Change Economics Impact Panel between October 2002 and March 25, 2003. At this time, the Panel has been asked to pause in its activities in order to provide the Government with an opportunity to review the information and advice we have provided to date.

We would like to thank you for seeking independent advice on such an important issue to British Columbians. Panel members would be pleased to provide additional advice or input on the Government's development of a BC Climate Change Action Plan at any point in the future.

The Panel would also like to take this opportunity to commend the staff of your ministries and their consultants for the dedication they demonstrated in helping us prepare the report. Hopefully, our work will provide a framework for a wide variety of actions that can be taken to strengthen the BC economy, preserve our quality of life, and provide leadership in meeting the challenge of climate change.

Yours sincerely,

Bruce Sampson (Chair), BC Hydro  
Mike Bradley, Canadian Forest Products  
Peter Busby, Busby & Associates, Architects  
Johnny Carline, Greater Vancouver Regional District  
Denis Connor, QuestAir Technologies Inc.  
Rick Hyndman, Canadian Association of Petroleum Producers  
Pat Jacobsen, Greater Vancouver Transportation Authority  
Anne Murray, Vancouver International Airport Authority  
Hugh Porteous, Alcan Inc.  
John Robinson, University of British Columbia  
Wayne Soper, Duke Energy Gas Transmission Canada

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## Executive Summary

British Columbia action to address climate change should not be separated from actions in pursuit of important economic, social, and other environmental benefits. A strategy that propels the province along a sustainable development path can achieve these broader goals while, at the same time, reducing the greenhouse gas (GHG) emissions that contribute to global climate change. Such an expanded policy focus is critical to ensuring the long-term prosperity and well-being of all British Columbians.

An advisory group is preparing a “made-in-BC” approach to climate change action in the context of sustainable development. The BC Climate Change Economic Impacts Panel strongly believes that this can be done in a way that continues to develop the province’s rich resource base, improves the cost-competitiveness of existing sectors, and grows new industries that diversify the economy and take advantage of expanding export markets. To illustrate the possibilities, panel members have composed “word pictures” or descriptions of what key components of the provincial economy could look like by 2030, given a concentrated effort of sectoral and cross-sectoral actions. Together, these pictures convey a sense of the ability to realize not just substantial GHG reductions, but also a highly innovative and resilient economy, large-scale job and wealth creation, cleaner air, more accessible communities, and many other benefits.

It is both prudent and strategic to move now to secure BC’s competitive advantage in areas ranging from forest management to fuel cells to natural gas production. The Panel recommends that the provincial government establish sustainable development targets, identify the emission reductions that would occur under these targets, and set additional targets for GHG-specific actions if needed. It further recommends that a selection of priority policy actions be initiated to launch the province on a sustainability path. Action must be taken without delay in order to make possible more cost-effective emission reductions over the long term, and to secure federal climate change funding that will otherwise go elsewhere.

### PANEL RECOMMENDATIONS

1. The Province should develop an aggregate long-term target for GHG emission reduction that recognizes the potential for extensive technological innovation over time, as well as the considerable synergies among sectors if a sustainable development strategy is adopted. Differentiated sub-targets should be explored, to take account of the varying GHG reduction, economic, and other opportunities in specific sectors and regions of BC.
2. The Province should introduce measures in the following “top ten” areas identified from a wide variety of actions that reduce GHG emissions and advance sustainable development:<sup>1</sup>
  - **Government leadership** – set aggressive GHG reduction targets for provincial facilities and vehicle fleets, supported by “LEED BC Silver” standards for major building projects, an employee trip reduction program, and other enabling policies;
  - **Urban land use** – use tax shifting to discourage sprawl and favour more compact, transit-oriented communities; develop a policy to promote shared energy systems; and work with municipalities to provide incentives and tools for encouraging GHG reduction targets in official community plans and regional strategies by 2005;

<sup>1</sup> Except for certain cross-cutting measures, the policy actions listed here reflect sectors currently represented on the Panel (see Recommendation #3). All suggested measures are incremental to the new provincial energy policy (BC Ministry of Energy and Mines 2002). See Section 3.3 for more detail on the top ten actions and Appendix 1 for an expanded list of potential GHG reduction measures.

- **Transportation** – implement increased funding of transit and strategic road improvements, California-style vehicle emission standards for cars, higher emission standards for light to heavy duty trucks, and incentives to purchase more fuel-efficient vehicles and lower GHG fuels;
  - **Buildings** – establish phased-in energy performance standards, with a revolving fund for energy efficiency upgrades, provincial tax relief for the purchase of sustainable products and equipment, and other supporting policies;
  - **Electricity** – adopt a GHG emission standard and offset requirement for thermal power generation that is coordinated with the federal government and builds on the province’s current energy efficiency and clean energy objectives;
  - **Natural gas** – develop an efficient and harmonized regulatory, fiscal, and land access framework to facilitate expansion of natural gas production consistent with sustainability; and tax or other incentives to reduce fugitive emissions and to promote acid gas reinjection into depleted reservoirs for disposing of CO<sub>2</sub> emissions;
  - **Fuel cells** – prepare a strategic plan to grow BC’s world leading fuel cell cluster; make a long-term provincial commitment to the hydrogen economy; and ensure active government participation in private and public sector fuel cell demonstrations;
  - **Forest products** – establish incentives to encourage energy from biomass; targets and support for afforestation and reforestation projects; and policies to prevent deforestation (all consistent with international carbon accounting protocols); and
  - **Aluminum (and other sectors)** – negotiate voluntary binding agreements for GHG emission reduction with the aluminum smelting and other industry sectors that are harmonized with federal initiatives.
  - **Cross-cutting actions** – implement a revenue generation device to pay for the above measures in keeping with the budget neutrality principle; an aggressive strategy for research, development, and demonstration of new technologies, and the fostering of “sustainability clusters” in BC; tax or other incentives to encourage energy efficiency, recycling, and the accelerated replacement of old buildings and equipment; and cooperation with universities and other organizations on climate change education and public engagement in sustainability decision-making.
3. The Panel should continue its advisory work for the BC Climate Change Action Plan, with a focus on:
- exploring further the potential emission reductions and short-term cost impacts for sectors addressed in this report, and the quantification of a proposed long-term GHG reduction target for BC;
  - refining and elaborating on the list of initial policy actions to be included in the plan;
  - preparing information for other sectors and parts of the province not addressed here (e.g., rural and smaller communities, agriculture, cement, chemicals); and
  - developing recommendations on how to consult with stakeholders and engage the private sector, NGOs, and the general public in developing and implementing the BC Action Plan.

## 1.0 Introduction

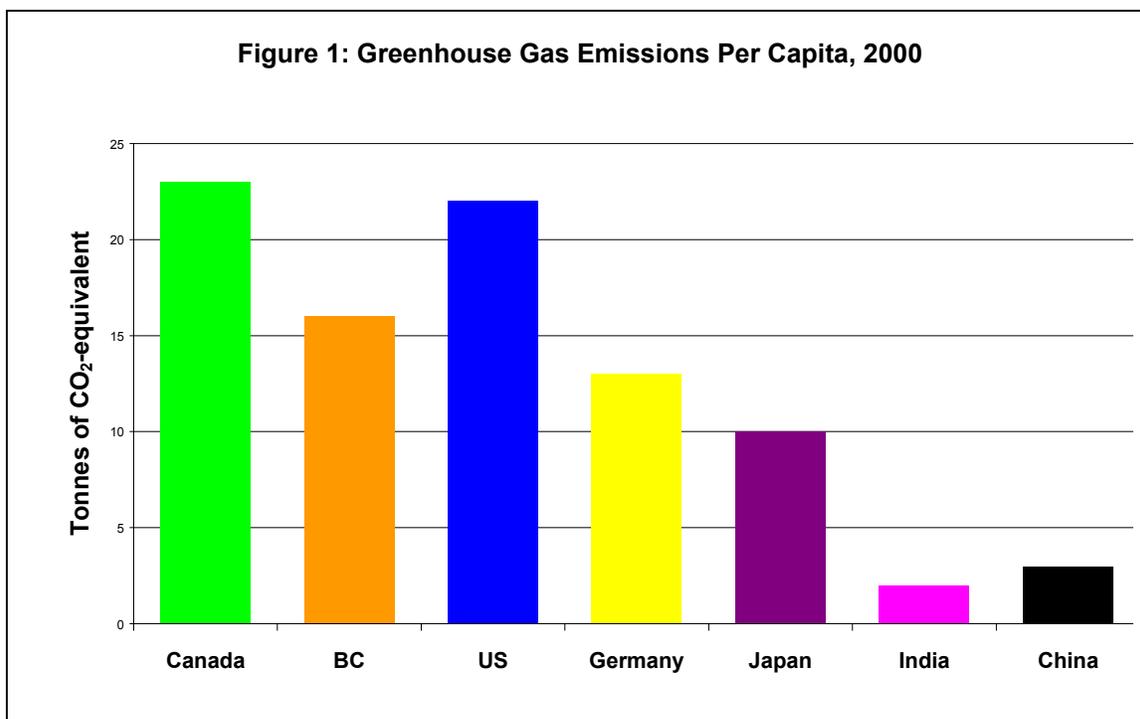
***The Province of British Columbia has committed to developing a long-term action plan to address the serious threat of climate change.***

British Columbia has the third lowest greenhouse gas (GHG) emissions per capita in Canada, and the second best performance in containing emissions growth since 1990. Provincial forests provide a large sink for storing carbon that has been estimated at on the order of 48 megatonnes (MT) of CO<sub>2</sub>-equivalent per year.<sup>2</sup> Industries such as forest products, smelting, and electricity have taken significant steps to improve their energy efficiency and reduce emissions over the past ten years. And, as shown later in this report, the province's major emitting sectors have considerable potential to further reduce emissions in the coming decades.

### BC success story: pulp and paper

Since 1990, the BC pulp and paper industry has switched from heavy fuel oil to natural gas and biomass fuels, and implemented energy conservation and efficiency measures. As a result, total GHG emissions were down 29% in 2000, with emissions intensity down 41%. This was achieved despite a 21% increase in production over the period.

While BC accounts for only about 0.2 percent of global GHG emissions, on a per capita basis we emit significantly more than many other jurisdictions, in particular developing countries (see Figure 1).<sup>3</sup> Despite our opportunities, we also face some challenges to stemming the rise in emissions, given projected population and industrial growth. The largest source (40%) of provincial emissions is transportation, an especially difficult sector for GHG reduction. The continued expansion in upstream oil and gas production will add to provincial emissions, even though our natural gas exports displace higher carbon fuels in the United States. In addition, compared to provinces that rely on thermal power, BC's hydroelectric system offers less scope for reducing emissions, as electricity generation shifts to low-cost natural gas.



<sup>2</sup> To put this sink estimate in perspective, BC's total GHG emissions were 65.5 MT in 2000.

<sup>3</sup> The data in Figure 1 are taken from Environment Canada (2002) and <http://ghg.unfccc.int>.

The BC government is developing a climate change action plan focused on long-term GHG emission reductions that enhance our economic opportunities. With the Kyoto Protocol now ratified, it is time to move forward on a long-term strategy for realizing these opportunities.

***This report outlines a framework for developing the BC Climate Change Action Plan and preliminary recommendations on an emission reduction target and policy actions.***

**BC advantage: electricity**

The BC electricity sector has a low GHG emissions intensity (50 tonnes/GWh), thanks to hydroelectricity and energy from wood residues in the forest sector. Other jurisdictions, including Alberta (800 t/GWh), the US (650 t/GWh), and the UK (400 t/GWh), have much higher emissions intensities.

In September 2002, the Ministers of Water, Land and Air Protection and Energy and Mines appointed a BC Climate Change Economic Impacts Panel to advise on a long-term action plan for the province. The Panel members, drawn from industry, government, and academia, were selected for their expertise rather than to represent specific businesses or organizations. Their role was to give advice on a GHG emission reduction target and target date, on proposed actions to reduce emissions or enhance carbon sinks, and on

further consultations and analysis required to complete the BC Climate Change Action Plan.

The Panel conducted its analysis through a series of meetings from October through January 2002. This report offers preliminary recommendations and suggestions for additional work.

Much of the recent debate around climate change action has focused on the costs of emission reductions and the potential harm they pose to provincial economies. This debate has largely ignored the substantial economic, social, and environmental opportunities that could accrue in BC, if a broader policy approach were to be adopted.

In this report, the Panel suggests an alternative approach that positions climate change policy as part of a broader sustainable development path, resulting in job and wealth creation, local air quality improvement, and other important benefits in addition to GHG emission reduction. Key parts of the report are as follows:

- Section 2 describes a justification for adopting a sustainability path and outlines a vision of what BC could look like in the future if it were to pursue such a path.
- Section 3 makes preliminary recommendations on a policy framework and principles for the BC Climate Change Action Plan, a long-term emission reduction target, and some initial policy actions to be included in the plan.
- Appendix 1 contains a more detailed listing of potential policy measures identified by the Panel, while Appendix 2 provides an example of a sector profile completed by a Panel member to demonstrate the challenges, opportunities, benefits, and outlook for reducing GHG emissions over the long term.<sup>4</sup>

The Panel has provided only an illustrative sample of GHG-emitting sectors in the province.<sup>5</sup> Important sectors for climate change action that are not on the Panel include other industries (e.g., chemicals, cement), the commercial sector, and agriculture. In the time period available, the Panel has not been able to consult with all BC sectors that play a role in climate change, with the result that the scope of its recommendations is limited.

<sup>4</sup> Panel members produced profiles of their sectors as background to the analysis in this report.

<sup>5</sup> Appendix 3 shows the Panel membership.

## 2.0 Climate Change Action in a Broader Context

### 2.1 The Global Perspective

***Global corporate leaders increasingly view climate change action, and sustainable development in general, as sound business practice.***

International companies have made significant commitments to reduce their GHG emissions that in some cases exceed Canada's Kyoto target (6 percent below 1990 levels by 2008-12):

- Oil giants Royal Dutch Shell and BP have pledged to cut their global emissions by 10 percent below 1990 levels by 2002 and 2010, respectively.
- Nike plans to reduce CO<sub>2</sub> emissions from company-owned facilities, services, and business travel by 13 percent below their 1998 baseline by the end of 2005.
- Polaroid has committed to reduce corporate-wide CO<sub>2</sub> emissions 20 percent below 1994 levels by 2005 and 25 percent by 2010.
- DuPont promises to slash its GHG emissions by 65 percent from 1990 levels, flatten energy use, and purchase 10 percent renewable energy by the end of this decade.

#### A note on terminology

*Eco-efficiency* means creating more goods and services with less use of resources, waste, and pollution.

*Corporate social responsibility* means businesses working with employees, their families, the local community, and society at large to improve quality of life.

These commitments are part of a broader change that began in the 1980s, when some of the world's corporate leaders recognized a need to rethink their way of doing business. What started as a response to local and regional environmental pressures evolved in the mid-1990s to a much wider sustainability focus, as multi-nationals came under increased scrutiny for labour practices in developing countries as well as longer-term environmental issues. Smart CEOs wanted to position their companies to take advantage of

emerging global management trends, notably eco-efficiency, corporate social responsibility, transparency, and new partnerships with civil society and government. As a result, sustainable development and its three pillars – economic progress, ecological health, and social well-being – entered the culture and practices of forward-looking corporations.<sup>6</sup>

Today, companies pursue sustainability for a variety of reasons. In the case of Canada's Suncor Energy, the ability to earn stakeholder support, reduce costs, and meet consumer demand for environmentally friendly products is important to building profitability and shareholder value.<sup>7</sup> On a global scale, a sustainable development approach helps companies attract investment, protect existing markets and develop new ones, secure and retain their license to operate, and attract and keep skilled employees.

#### Environment and the bottom line

Innovest Strategic Value Advisors uses its EcoValue21 model to rate companies based on sustainability risks, management quality, and profit opportunity. In a recent survey of 17 electric companies, BC Hydro ranked first in the environmental and social areas, with the comment that "maintaining its leadership position is likely to provide significant competitive benefit" (Innovest 2002).

Appendix 4 lists examples of corporate alliances that have been formed to pursue GHG emission reductions and broader strategies for sustainable development.

<sup>6</sup> Holliday et al. (2002), p. 19.

<sup>7</sup> George (2002).

### What some leaders are saying about sustainability

Philip Watts, Chairman of the Committee of Managing Directors, The Royal Dutch **Shell** Group of Companies. *Why do I value sustainable development as a leader? Quite simply because it is good business. The need to balance economic, social, and environmental considerations makes it a very powerful concept. Businesses sometimes think only about economic considerations. NGOs sometimes think only about the environment, or only about social issues. Sustainable development forces us all to confront the reality of integrating those considerations and making hard choices* (Holliday et al. 2002).

Elmer Derrick, First Nations Hereditary Chief, **Gitsegukla First Nation**. *Adopting a sustainability framework for climate change makes sense and is consistent with the approach to develop aboriginal peoples have traditionally taken. For example, a sustainable forestry program in the North could provide significant economic, environmental, and social benefits.*

John Pepper, CEO, and A.G. Lafley, **Proctor & Gamble**. *Sustainability is an important way for us to leverage the power of innovation and global markets for the benefit of everyone – not just those in the developed world. We cannot condemn developing countries to a life of poverty so those in the developed world can maintain their lifestyles. But neither do we have to presume that the only alternative is for the developed world to reduce its quality of life* (Pepper and Lafley 2001).

Philip Knight, Chairman and CEO, **Nike**. *Global citizenship is important to our company and to our consumer. The performance of Nike and every other global company in the 21<sup>st</sup> century will be measured as much by our impact on quality of life as it is by revenue growth and profit margins. We hope to have a head start* (Nike 2002).

David Emerson, President and CEO, **Canfor** Corporation. *As a forest company practicing sustainable forestry, we don't try to predict the future; we try to create it. Sustainability for Canfor means a fully functioning environment, a healthy community, and a competitive company, now and in the future.*

Wayne Balta, Vice President, Corporate Environmental Affairs and Product Safety, **IBM**. *Consuming less and less energy is one of the most effective ways IBM contributes to environmental protection. The results of IBM's longstanding efforts clearly demonstrate that aggressive energy conservation makes good environmental sense as well as good business sense* (Margolick and Russell 2001).

Charles Holliday, Chairman and CEO, **DuPont**. *But it's one thing to believe in sustainability yourself and it's another thing to lead others in that direction. I don't spend a lot of time talking about vision; I focus on leadership reality. To me, leadership reality is vision, grounded. Sustainability is such a grand and noble vision that people can subscribe to it and then go about business as usual, never making it a reality. At DuPont we've grounded the vision of sustainability in the reality of real activity and performance measures that tell us whether we're moving in that direction* (Holliday et al. 2002).

Teruyaki Minoura, President, **Toyota** Manufacturing North America. *Our society has become accustomed to believing that we have to sacrifice something to obtain products that are environmentally friendly. At Toyota, we are in a strong position to challenge that notion* (Margolick and Russell 2001).

Joe Mallof, President of Asia and Pacific Consumer Products, **SC Johnson**. *In my experience very few consumers come out and say, "I want products that help the environment." But if we listen hard, we might hear them say, "I want to do more with less. I want my life to be more simple. I don't want to waste." Those words have strong eco-efficiency undertones – and give us the incentive to keep delivering more value with less resource* (Holliday et al. 2002).

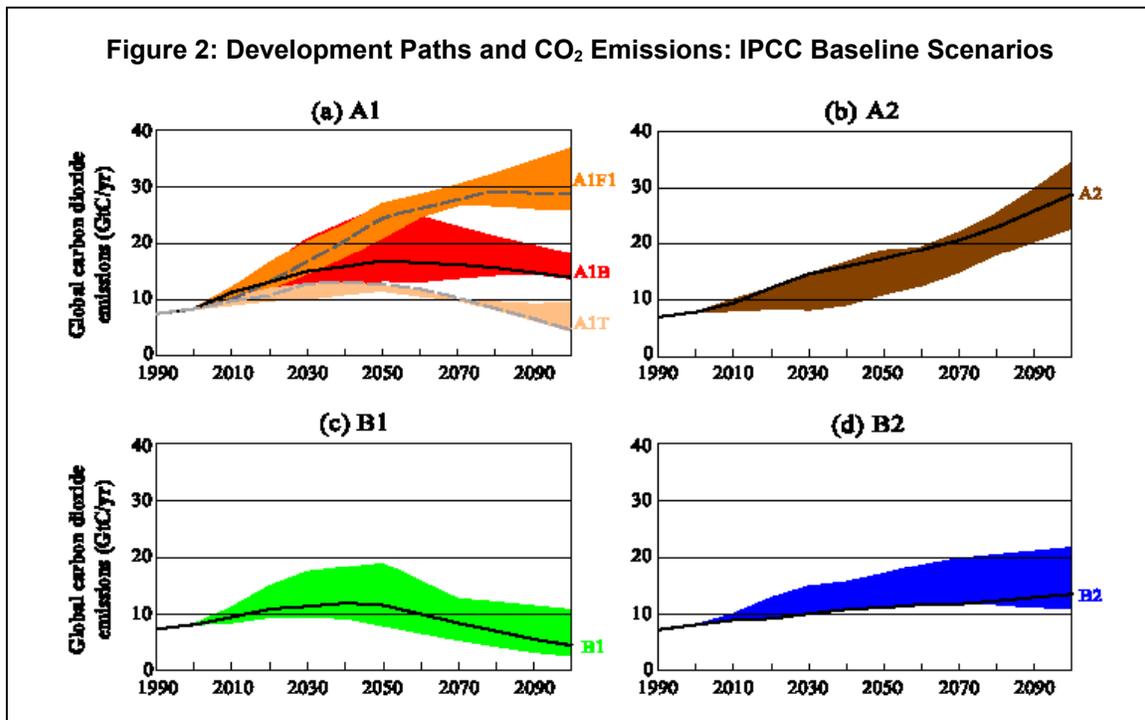
James Wolfensohn, President, **World Bank**. *Corporate sustainability today includes recognition of the leadership role that the private sector must take in ensuring social progress, improved equity, higher living standards and stewardship for the environment. Corporate responsibility is not philanthropy – it is good business* (Holliday et al. 2002).

Scott Stark, Managing Director, **STOXX** Ltd. *Being proactive and innovative with regard to future sustainability challenges is increasingly regarded as a crucial success factor and, thus, as a significant lever to increase long-term shareholder value. A rising number of asset managers therefore seek to invest in sustainability leaders* (Dow Jones Indexes et al. 2001).

***A sustainable development path can result in lower GHG emissions without sacrificing economic growth or requiring major new climate change policies.***

In its Third Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) suggests that promoting sustainability may be the most effective way to address global climate change.<sup>8</sup> A Special Report on Emissions Scenarios (SRES) documents the latest IPCC baseline scenarios that were used to determine further policies for stabilizing carbon dioxide emissions at different levels of atmospheric concentration.<sup>9</sup> These scenarios were constructed from a range of underlying assumptions about future demographic, social, economic, technological, and policy trends.<sup>10</sup>

A striking result from the SRES analysis is that the choice of development path can have a major impact on future emissions. For the six scenario groups modelled, CO<sub>2</sub> emissions in the year 2100 are projected to vary widely, from about five times current levels to less than today's emissions (see Figure 2). For example, two scenario groups with a different focus, A1T (rapid technological change to non-fossil fuel energy) and B1 (environmental quality), both lead to low-emission paths because of their emphasis on clean technologies.<sup>11</sup>



It is important to note that, as baseline scenarios, the CO<sub>2</sub> projections in Figure 2 do not include any additional climate change initiatives associated with implementing the UN Framework Convention on Climate Change or commitments under the Kyoto Protocol. While the A1T and B1 scenarios encompass policy assumptions that act to reduce CO<sub>2</sub> emissions, the assumptions were made for many different reasons other than mitigating climate change. In addition, these two scenarios encompass strong (B1) to rapid (A1T) rates of economic growth. Therefore, the IPCC analysis indicates that, by adopting a sustainable development path such as B1, it is possible to continue growing the economy and stabilize or even lower emissions over the long term, without the need for significant new climate change policies.

<sup>8</sup> Banuri et al. (2001)

<sup>9</sup> Nakicenovic (2000). Figure 3 below is taken from p. 7 of the report.

<sup>10</sup> Appendix 5 outlines the SRES emissions scenarios and how they were developed.

<sup>11</sup> Robinson (2002), pp. 4-5.

## 2.2 BC's Opportunity

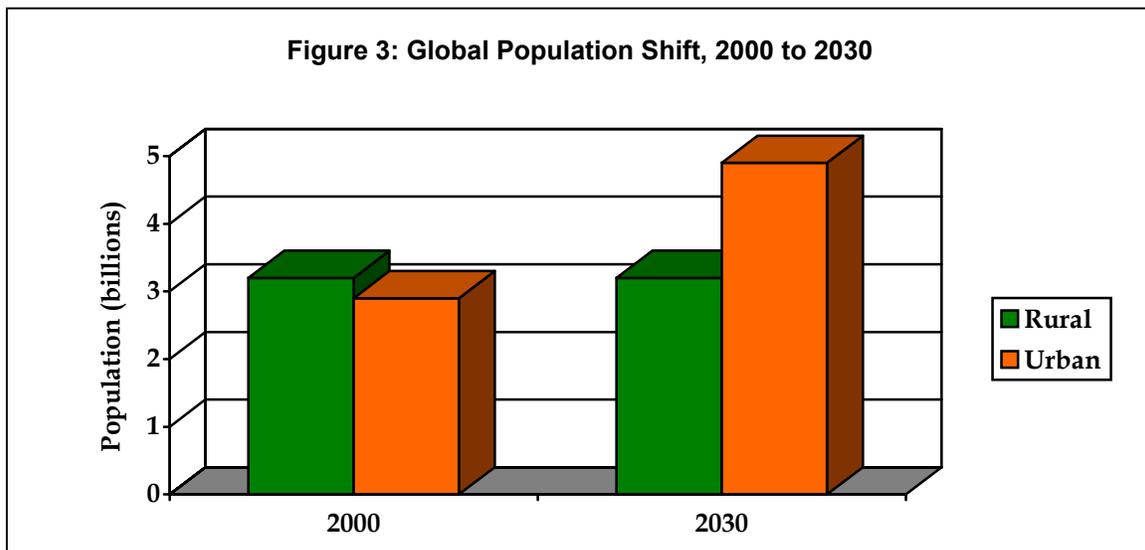
***A sustainable future for BC is one of high innovation and economic opportunity, given the burgeoning global market in sustainability.***

The experience of global companies and the international climate change analysis suggests that a sustainable future will mean significant technological and institutional innovation. To achieve sustainability requires the introduction of clean and resource efficient technologies, reductions in material and energy intensity, and a continued shift toward a service-oriented and information-based economy applying more advanced technology and higher value-added in traditional industries and newly emerging sectors. It also involves improved equity and new forms of governance and collective decision-making.

The UN expects world population to reach around 9.3 billion by 2050.<sup>13</sup> All of the projected growth by 2030 will occur in urban regions, with more than two billion people added to the 2.9 billion in 2000.<sup>14</sup> For many cities already in serious difficulty, this "urban tsunami"<sup>15</sup> poses formidable challenges to the delivery of adequate social, economic, and environmental services. At the same time, the pressing need for new infrastructure investment this decade alone (see Table 1) provides an unprecedented opportunity to achieve sustainable development for the benefit of billions of people.

**Table 1: Urban infrastructure need<sup>12</sup>**

World Bank client countries (2000-10)	\$2.5 trillion
East Asia (1997-2004)	\$1.5 trillion
Asia-Pacific (1996-2005)	\$1.4-1.5 trillion



BC is in a strong position to make real progress on sustainability here at home, and to use this experience as a springboard into world markets. By getting on a sustainable development path now, we can realize important benefits, including:

- significant long-term reductions in GHG and other air emissions;
- healthier, more livable, and attractive local communities;
- a highly innovative and resilient provincial economy;

<sup>12</sup> The three estimates are from: [www.worldbank.hu/about.html](http://www.worldbank.hu/about.html); World Bank 1994; and APEC 1999.

<sup>13</sup> Based on the medium variant of population projections in UN Population Division (2001).

<sup>14</sup> The data here and in Figure 3 are taken from UN Population Division (2002).

\*<sup>15</sup> Harcourt (1999).

### Characteristics of a Sustainable Development Path: Alcan Case Study

*Shift to a service and information economy.* Improved computer controls contributed to a 20% reduction in CO<sub>2</sub>e intensity at Alcan's Kitimat smelting facility since 1998. Globally, the company has invested more than a quarter billion dollars over the past decade to develop sheet applications for automotive bodies, producing the technology for lighter weight cars.

*Reduction in materials and energy intensity.* Alcan has developed progressively thinner aluminum can body stock, which provides an equally effective container but with less use of materials. Design and process improvements have reduced the energy required to produce one kilogram of aluminum from 21 kWh in the 1950s to 13 kWh in today's newer smelters. While Kitimat's technology requires more energy than a modern prebake smelter, energy intensity was reduced by 4% between 1998 and 2001.

*Introduction of clean and resource efficient technologies.* Since 1986, three new prebake smelters have been built in Quebec, replacing 13 older pot lines. Options to improve the technology at Kitimat are under study and have been discussed with the local community.

*Enhanced recyclability and product durability.* Aluminum can be recycled indefinitely, and recycled aluminum requires 5% of the energy of new aluminum. In automobiles, pound for pound aluminum absorbs twice as much crash energy as steel, and can be up to 2.5 times stronger. Aluminum packaging offers a high level of corrosion resistance.

*Increased equity and new forms of governance.* In the past 5 years, Alcan has worked with government, ENGOs, business, and First Nations to develop an open forum of addressing environmental, social, and economic issues, including water use for hydroelectric generation at Kitimat. A public forum has been established to review environmental issues, including the tracking and reporting of GHG emissions.

- huge export potential into the trillion-dollar global sustainability market; and
- international leadership and acclaim in sustainable development.

### ***BC has an advantage in key sustainable development technologies and services:***

*Forestry* – The provincial forest sector has been involved for many years in reforestation, silviculture, and other sustainable management practices. Most major companies are actively pursuing independent third party certification of their forestry practices, with operations representing about 36 percent of the allowable harvest currently certified.<sup>16</sup>

*Conservation and energy efficiency* – Since its debut in the 1980s, BC Hydro's Power Smart has grown into one of the world's foremost demand-side management programs. Together with industry and private energy service companies, BC utilities have amassed considerable expertise in energy efficiency services and technologies that can be used domestically and exported.

#### **BC success story: UBC Retrofit**

Power Smart is contributing incentives to the largest energy retrofit at a Canadian university. Through lighting upgrades in 50 buildings, the University of British Columbia has already reduced its yearly electricity use by 11%, and will save another \$600,000 annually by installing computer controls and other measures.

*Natural gas* – Given expanding production and exploration and development opportunities, the province is well positioned to serve continental markets, as natural gas provides the transitional fuel to a lower carbon world and the hydrogen economy. BC is also home to internationally recognized companies in lower-emitting natural gas vehicles (NGV) and one of the best refuelling infrastructures for NGV in North America.

*Buildings* – Our buildings sector leads the rest of Canada in high-performance green building design and technology. The Ministry of Competition, Science and Enterprise's Green Buildings BC directory lists more than 60 local architects, engineers, environmental consultants, and

<sup>16</sup> Certification Canada Website, [www.certificationcanada.org](http://www.certificationcanada.org).

alternative energy companies, some of which compete internationally in markets from China to Italy.

**BC opportunity: fuel cell markets**

PricewaterhouseCoopers estimates that the global market for fuel cells in various uses could total \$46 billion by 2011 (PWC 2002). By 2021, it could reach \$500 billion to \$2.5 trillion, depending on how fast technologies are adopted.

*Fuel cells* – The Lower Mainland has developed the world’s largest fuel cell industry cluster centred around the pioneering Ballard Power Systems. With a concentration of fuel cell producers, suppliers, and fuelling infrastructure and service providers, BC is poised to capture a significant share of the potentially massive global market for fuel cell technologies.

*Smart growth* – In 1998, BC became the first province to enact growth management legislation. The GVRD was already pursuing its Livable Region Strategic Plan and other efforts now linked under the Sustainable Region Initiative. Separate initiatives such as Smart Growth BC<sup>17</sup> and “cities<sup>PLUS</sup>” are examining ways to control urban sprawl and design more sustainable communities.

**BC success story: TransLink**

The Greater Vancouver Transportation Authority (TransLink) integrates goods and personal transportation planning, roads, and transit as well as vehicle emissions testing within the context of the Livable Region Strategic Plan. This unique institutional model has been studied by several national and international agencies, including the US Federal Highway Administration, which published a report on TransLink as an example for US metropolitan areas to consider.

*Land and water use planning* – The province is widely lauded for its cooperative land use planning, which has successfully brought together government, community, First Nations, industry, and environmental interests. BC Hydro’s ongoing water use planning uses a community-based multi-stakeholder process to reconcile power generation at hydroelectric facilities with fish habitat, recreation, and other competing uses of water resources.

*Vehicle emissions testing* – In 1992, BC implemented Canada’s first vehicle emissions testing and maintenance program. Since then, the province has worked to improve AirCare, which is credited with reducing vehicle emissions in the Lower Fraser Valley by 34 percent during its first eight years of operation.<sup>18</sup>

***We can build on this advantage and a provincial commitment to sustainability with innovative partnerships and collective decision-making.***

**BC opportunity: South East False Creek**

The City of Vancouver plans to redevelop 80 acres of former industrial land into a model sustainable community balancing social equity, livability, ecological health, and economic prosperity. With a planned population of 14,000, this development will complete the ring of high-density residential land use that surrounds False Creek.<sup>19</sup>

The government has already committed conceptually to sustainable development through its strategic goals to ensure a strong and vibrant economy, a supportive social infrastructure, safe and healthy communities, and a sustainable environment.<sup>20</sup> In addition, the *Draft Sustainability Principles*<sup>21</sup> approved by open cabinet in May 2002 call for resource management decisions to integrate economic, environmental, and social considerations.

A sustainability path will require proactive technology development and a focus on collective choice in some strategic areas, including community design, land use planning, transportation

<sup>17</sup> See [www.smartgrowth.bc.ca](http://www.smartgrowth.bc.ca) and [www.citiesplus.ca](http://www.citiesplus.ca).

<sup>18</sup> [www.aircare.ca/faqs/amazing\\_facts.asp](http://www.aircare.ca/faqs/amazing_facts.asp).

<sup>19</sup> [www.gvrd.bc.ca/sustainability/casestudies.htm](http://www.gvrd.bc.ca/sustainability/casestudies.htm).

<sup>20</sup> BC Government (2002).

<sup>21</sup> Ministry of Sustainable Resource Management (2002).

**BC opportunity: cities<sup>PLUS</sup>**

As part of an international competition in 2003, Cities Planning for Long-Term Urban Sustainability (cities<sup>PLUS</sup>) will showcase the GVRD as an example of how a Canadian metropolitan area could achieve sustainability over the next century. This initiative will develop Canada's first 100-year plan for a sustainable urban area, incorporating economic, social, and environmental priorities in a systems approach.<sup>22</sup>

systems, and energy and other infrastructure. Climate change policy that puts an undue burden on certain sectors of the economy, or that "guilt-trips" individuals for their lifestyle choices, is divisive and counterproductive to environmental, social, and economic goals.

To build on its competitive advantages, BC should pursue new ways of partnering and engaging the public to leverage the most GHG reduction and other benefits as efficiently as possible:

- *Public-private partnerships* – Consistent with the Province's P3 initiative, there are opportunities for sustainability partnerships among the public, private, research, and NGO sectors. Examples include demonstrations of fuel cell systems, building technologies, and compact community design.
- *Government partnerships* – BC can work with the federal government and other provinces to leverage support for sustainability initiatives, including technology development. For example, there are potential synergies with Alberta and Saskatchewan in geologic storage of CO<sub>2</sub>, clean coal technology, hydrogen production, enhanced oil recovery, and coalbed methane development.
- *Research partnerships* – Provincial universities and research institutions have expertise in areas ranging from climate change modelling to sustainable forestry and biomass fuels. The Province should coordinate with federal funding initiatives to target research support where it makes the most sense for BC.
- *Public engagement* – British Columbians need more say in how to achieve a sustainable future for their communities and the province as a whole. Community-based planning and visioning processes can be useful tools for public engagement.

**BC success story: UVic climate modelling**

The Canadian Climate Change Modelling and Analysis Centre at the University of Victoria develops and applies complex global models of atmospheric and oceanic processes to simulate past and future world climate. A separate Climate Modelling Group in the School of Earth and Ocean Studies uses models of medium complexity to examine in greater detail specific climate-related processes, such as ocean circulation in the North Atlantic.

***Proactive policies are needed now to put BC on a sustainable development path and achieve cost-effective long-term GHG emission reductions.***

**BC success story; Energy Efficiency Act**

The provincial *Energy Efficiency Act* sets minimum energy performance standards for a variety of appliances and equipment. During the 1990s, these standards worked with utility programs to transform markets. Standards removed the worst energy users from the marketplace, while Power Smart rebates motivated consumers to buy more efficient models, ratcheting up energy efficiency levels over time.

According to a recent study for the Pew Center on Global Climate Change, companies do not replace their capital based on a regular cycle.<sup>23</sup> With proper maintenance, equipment can last decades longer than its expected lifetime, and old, inefficient plant is rarely retired because new technology is available. The implication is that policies must be put in place to accelerate turnover of the capital stock (e.g., tax incentives) and shape long-term patterns of capital

<sup>22</sup> [www.citiesplus.ca](http://www.citiesplus.ca).

<sup>23</sup> Lempert et al. (2002).

investment (e.g., government-sponsored R&D on new emissions-reducing technologies).

Provincial policy objectives should aim at reducing BC's GHG footprint: the full cycle emissions associated with what British Columbians consume. Since shifting the location of industry to other countries does not reduce global emissions or the emissions associated with BC consumption, the objective for industries producing internationally traded goods should focus on the energy efficiency and emissions intensity of production. Provincial and Canadian policy on industry emissions should be set in the context of an attempt to develop more global approaches to emissions associated with internationally traded goods.

**BC success story: Technology Park**

The Vancouver Island Technology Park in Victoria is the first project in Canada to achieve a Gold rating under the US Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system. The park provides a showcase of green building and site design, recognizing that technology firms are attracted to areas of higher quality of life.

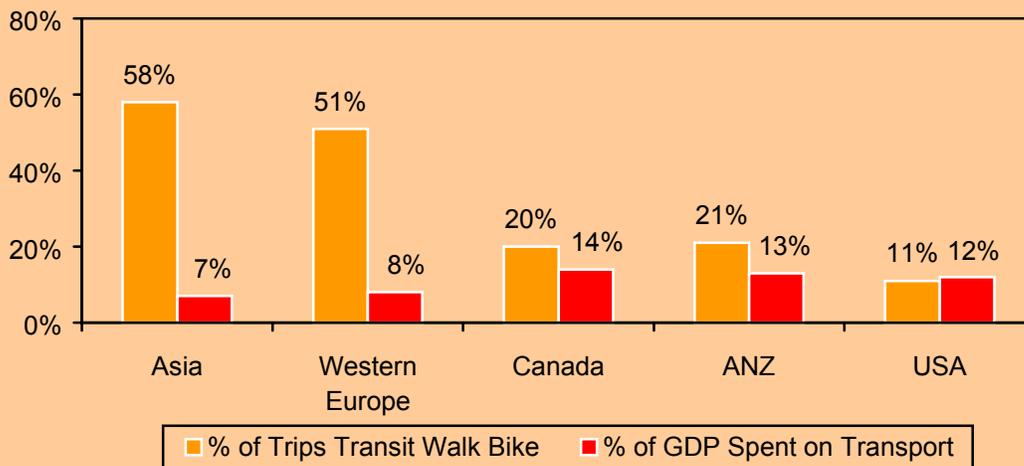
BC needs policies that will ensure long-term emission reductions:

*"The GHG challenge is long term and as such calls for policies that operate on the long-term determinants of emissions... Policies with a long-term focus would instead seek to influence the fundamental character of technological innovation, the forest and agricultural land base, and the gradual evolution of urban form and infrastructure with policies such as research and development support (for efficiency and cleaner fuels), warnings about future higher financial penalties for GHG emissions, and a shifting emphasis in urban planning and infrastructure funding."*<sup>24</sup>

This policy focus is not intended to delay action on climate change. On the contrary, the path to long-term GHG reductions and a sustainable future requires the immediate adoption of an array of incentives, standards and regulations, leadership, and other policy actions (see Section 3.3). An integrated, sustainable development approach offers the potential for larger emission reductions, due to the synergies from combining sustainability measures across sectors. This

**Environmental and Economic Benefits: Urban Transportation**

Regions with transit-oriented transportation networks not only benefit from lower GHG emissions, but also spend a smaller share of their GDP on transport (International Union of Public Transport 2000).



<sup>24</sup> Jaccard et al. (2000), p. 192.

holistic approach can change the fundamental pattern of energy-using activities, rather than focusing on individual energy uses and technologies.

### 2.3 A Sustainability Vision for BC

As part of their sector profiles, Panel members were asked to develop word pictures of what their sectors could look like in 2010, 2020, and 2030 if they were to embark on a sustainable development path today. These "sustainable futures" are presented in Table 2 and integrated below to give a summary vision of the BC economy in 2030. What emerges from this vision is a highly interconnected world of sustainable technologies and practices linking the various sectors.

#### An electronic postcard from the future

In 2030, many more British Columbians are employed in the service and information economies, which are fully integrated into BC's important resource sectors. People live closer to their workplaces, in denser, quieter communities with more parks and green space. They walk or cycle to work, or take an efficient transit system, and on the weekends some drive fuel cell powered cars out into the countryside. Homes are extremely energy-efficient; many are equipped with photovoltaic panels and other distributed energy technologies that allow them to sell power into the grid. Offices and factories take advantage of shared energy systems, reducing waste and energy costs.

In 2030, the BC economy is more diversified and resilient, and highly cost-competitive in the maturing global sustainability market. Freight and passengers are moved over an effective transportation network that includes zero-emission trucks, trains, and ground support equipment. Resource industries have cut their material and energy intensities significantly. The forest products sector is self-sufficient in biomass energy and provides sustainable building products for local construction. Natural gas continues to be a major energy source, helped by the widespread adoption of geological storage and other sustainable practices. The electricity industry has cut its net GHG emissions to zero through clean energy, energy efficiency, and emission offsets.

The transition to a hydrogen economy is well under way, with fuel cells in use in buildings and vehicles. This is spurring the development of renewable energy sources (e.g., wind, solar), creating opportunities throughout the province. These emerging industries, together with the growth of several key sustainability clusters, have catapulted BC into an international leadership position, exporting technologies and expertise worldwide and boosting job creation.

Achieving this sustainable future will mean not only substantial reductions in GHG emissions from today's levels, but also other significant environmental, social, and economic benefits, including:

- more cost-competitive BC businesses through improved resource and energy efficiency and the easier movement of goods;
- major improvements in local air quality from the reduction of smog precursors and particulates;
- healthier and more livable communities for existing citizens and skilled workers from outside the province seeking a place to live;
- greater preservation of BC's unique wilderness and natural areas as a result of more sustainable resource extraction and land use practices;
- increased tourism and business location successes due to a high quality of life;
- enhanced attractiveness for international investment;
- development of the fuel cell industry, with a workforce estimated at more than 50,000 employees by 2030;
- sustained growth in the oil and gas industry, which currently provides \$3.1 billion in capital spending and \$2 billion in provincial revenues;

- long-term sustainability MB) of the BC forest products industry, through narrowing of the competitive gap with Scandinavian countries;
- further expansion of the provincial green building economy, from architects to manufacturers of building products; and
- job creation from energy efficiency and renewable energy projects throughout BC.

### 3.0 Recommendations for the BC Climate Change Action Plan

#### 3.1 Framework and Principles

***Climate change policy should be framed in the context of sustainable development and all government decisions should be screened using a "sustainability lens."***

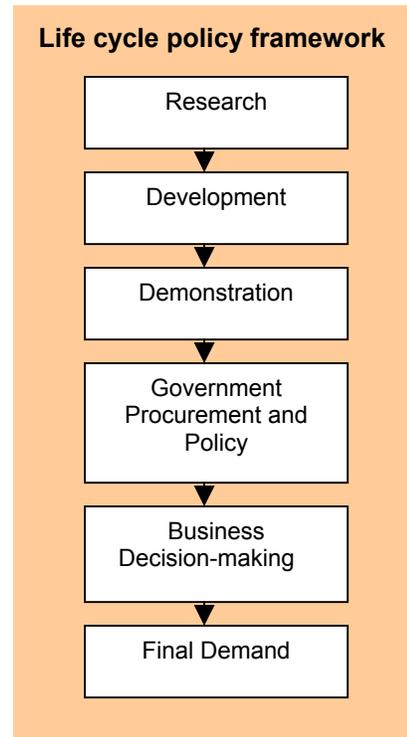
The BC government should continue its commitment to sustainability by adopting a broader approach to climate change policy:

*"Thinking about climate change in a sustainable development framework requires broadening the focus of analysis:*

- *from environmental/energy policy to tax, budget, trade and procurement policies;*
- *from focusing on domestic costs to thinking in terms of global investment opportunities and business plans;*
- *from disciplinary and sectoral analysis to integrated assessment of alternative development paths.*<sup>25</sup>

All government investments, policies, and other decision-making should be screened using a sustainability lens that considers their environmental, social, and economic implications. The Province should avoid investments that do not pass such a screening.

The box to the side presents a conceptual framework for sustainability policy that traces the "life cycle" of policy actions from the R&D phase through to influencing consumer demand. Each phase in the life cycle feeds into the next. For example, government can fund the demonstration of a commercially unproven technology. If the demonstration is successful, a procurement policy can be implemented to develop a market. This leadership can then lead to wider adoption of the technology by the private sector. Examples of how the framework could apply to two different policies, energy performance standards in buildings and certification of forest products, are shown in Table 3.



<sup>25</sup> Robinson (2002), p. 6.

**Table 2: Sector Sustainable Futures**

Sector	2010	2020	2030
<p>Land Use – Urban Planning</p>	<p>GHG emission reduction is a goal within local land use plans and regional strategies. Complementary community energy plans identify emission reduction actions.</p> <p>Land use plans reduce demand for vehicle-based travel. Urban boundaries are maintained, with development fees and taxes shifted to encourage redevelopment and discourage sprawl. This is reinforced by continued strong restrictions on development of the Agricultural Land Reserve. Transit-oriented development plans and high-quality urban design ensures that urban redevelopment is attractive, livable, and affordable. Regional centres capture high proportions of job and housing growth. Cycling and walking routes are well developed.</p> <p>Plans and regulations promote co-location of complementary uses within communities. Shared energy solutions (e.g., district heating, waste heat exchange) are in place in major centres and several major employment areas. One community has adopted a goal of “no waste heat vented to the atmosphere” for its major centre.</p> <p>Many businesses are investing in eco-efficiency improvements, increasing their profitability and competitiveness. The lower demand for energy and resources has ripple effects in reducing energy requirements for utility services, enhancing GHG reductions. Continued emphasis on waste reduction and recycling reduces GHG emissions from waste</p>	<p>Smart growth approaches are paying dividends in many communities, with vitality and livability enhanced and vehicle travel demand reduced. Preferences for housing and employment locations are shifting toward existing urban areas and away from urban fringe locations. Transit-oriented design in urban and neighbourhood centres has improved the competitiveness of transit systems compared to independent vehicle operation, and many people are choosing to participate in car share programs to meet their reduced needs for vehicle use.</p> <p>Land use and community energy plans include servicing plans that require shared energy solutions throughout the community/region. All major centres and employment areas have shared energy systems in place, and are working towards the goal of no waste heated vented to the atmosphere.</p> <p>The majority of businesses are completing their eco-efficiency programs and the economy is benefiting from the cost competitiveness this yields. Some are selling their GHG credits as part of their financing strategies. Region-wide, enhanced materials management produces lower energy intensity in goods-producing activities, and lower disposal rates. Eco-industrial networks are common. All GHG emissions are now captured at disposal facilities.</p> <p>Communities have completed carbon sink projects and are monitoring carbon</p>	<p>Smart growth objectives are realized, with travel demand greatly reduced and most travel now occurring in low and non-GHG emitting travel modes. Businesses prefer to locate in areas that are cost-effective to serve with transit. A network of centres captures most of the job growth.</p> <p>Servicing plans are now leveraging shared energy and waste heat exchange systems to achieve further energy reductions. Buildings are seen as part of the urban infrastructure, and are contributing to energy supply through solar and non-GHG technologies.</p> <p>Businesses are being spurred on to more eco-efficiency and networking as their competitors catch up. Innovation focuses on reducing the carbon intensity of inputs and the embedded energy / GHG content of products.</p> <p>An eco-industrial network is developing a strategy for going ‘off the grid’ for energy and urban services. The waste stream is dramatically reduced and every joule of waste energy is recaptured in disposal processes.</p> <p>Communities are examining ways to get peak performance out of carbon sinks, to increase carbon sequestration. Pilots are underway.</p>

**Table 2: Sector Sustainable Futures**

Sector	2010	2020	2030
Land Use – Urban Planning (cont'd)	<p>disposal. Disposal facilities have emission reduction strategies. Eco-industrial networks are beginning to emerge in several major employment areas.</p> <p>Communities are well underway in implementing projects that increase their carbon sink capacity, including urban forestry initiatives and green roof programs.</p>	<p>sequestration rates. Investment in carbon sink projects came partly from companies seeking offset reductions, thus reducing local tax revenues required.</p>	
Urban Transportation – Greater Vancouver	<p>The bus fleet is now approaching 1,800 vehicles, with many of the new buses being hybrid or low emissions buses. In addition, transit vehicles have been given a much greater priority on roads (bus lanes and signal priority) in congested areas. Two of the three remaining links (Coquitlam, UBC, and Richmond/Vancouver) in the region's rapid transit network are complete and construction has begun on the third. Significant investment is also being directed to improving pedestrian and cycling facilities, safety, and amenity. This is encouraging greater use of these modes as well as public transit.</p> <p>Daily Amtrak services have been expanded to two trips a day between Vancouver and the West Coast of the US.</p> <p>Strategic road improvements are starting to significantly enhance the competitive advantage of the region's port and associated economic benefits.</p> <p>These actions, combined with densification, transit-oriented development, the concentration of employment in key town centres, and improvements to physical design, have</p>	<p>The bus fleet is now in excess of 2,100, comparable to other cities of similar size with mature rail networks. The rapid transit system has been further expanded in line with regional priorities. The SeaBus fleet has been expanded and there is an extensive network of ferry services in the Burrard Inlet, as well as some on the Fraser River. The length of bike lanes and greenways in the region has increased five-fold.</p> <p>Users use a transportation "smartcard" to pay electronically for transit, tolls, parking, and usage-based car insurance. User pay (e.g., tolls) applies on all new major road facilities, and user pay sources are becoming more widely used to fund system improvements. Many drivers now find a distinct financial advantage to using transit.</p> <p>Zero and low emissions vehicle technologies are commercially viable and represent the majority of new vehicle purchases.</p> <p>The effects of better urban planning, transit enhancements, and selected user pay approaches to travel have resulted in a</p>	<p>A rapid transit extension from Whalley to Guildford has been completed and the region's rapid transit network is now fully mature. The bus fleet has expanded since 2020 to keep pace with regional growth, with most of the fleet now being zero or low emission. Between 40% and 50% of all transit trips now involve travel on rail for at least part of the journey. This has led to significant reductions in the levels of congestion that would otherwise prevail.</p> <p>Major gains in walking and cycling have accompanied significant enhancements to facilities, but also densification and quality urban design. Transit mode share is 22% and 80% of the region's residents use the transit system at least once a week. Walking and cycling account for a further 26% of travel. Automobile GHG emissions are down 30% to 40% compared to trend through a combination of reduced demand and better technology.</p>

**Table 2: Sector Sustainable Futures**

Sector	2010	2020	2030
<p>Urban Transportation – Greater Vancouver (cont'd)</p>	<p>assisted in building transit, walking, and cycling usage.</p> <p>Personal daily trips in the GVRD are approaching 71% automobile, 14% transit, and 15% walking and biking. Some town centres have transit mode shares approaching 30%. Automobile GHG emissions are down by 5% to 10% from their trend.</p>	<p>decline in single occupancy vehicle (SOV) use. This has allowed some of the existing road space to be allocated to goods movement, further supporting the region's gateway function.</p> <p>GVRD mode share is now 64% automobile, 17% transit, and 19% walking and biking. Vehicle kilometres traveled and GHG emissions are down 15% compared to trend.</p>	
<p>Truck, Rail, Ship, and Air Transportation</p>	<p>Berthed ships and aircraft use local electrical power. Trucks use ITS. The road network is efficient due to strategic improvements and fewer single occupant vehicles. Trucks use fuel optimization technology and truck operators have fuel-smart driver education and training.</p> <p>Airport ground support equipment is powered by cleaner fuels, such as natural gas, electricity, and hybrid technology, or meets emission standards. Passengers use rapid transit and pre-order duty free goods to pick up at their destination.</p> <p>The cost savings realized from eco-efficiency concepts are reinvested into more modern, productive infrastructure and equipment to attract carriers to call here. A fair, competitive tax framework allows gateway carriers to compete efficiently with other jurisdictions and improve the competitiveness of Canada's export and tourism economies. The interface between railways and marine terminals in the Lower Mainland has improved.</p>	<p>Ships and aircraft are piloted under environmental best practices and use fuel that meets more stringent and harmonized US-Canadian refinement standards. Goods are transferred using support equipment that is non-polluting. Goods are transported according to the most efficient mode practicable.</p> <p>Trucks use diesel alternatives, such as natural gas, bio-diesel, or other lower GHG-emitting fuels. Shuttles serving the hotels and tourist destinations run fully loaded.</p> <p>Transport-related buildings and facilities incorporate green building principles. Three major Foreign Trade Zones serve all of North America.</p>	<p>Cross-border freight and passenger rail services are becoming increasingly important. Five passenger trains a day travel between Vancouver and San Diego.</p> <p>A new rail crossing has been built in New Westminster and track has been upgraded and electrified from Vancouver to Seattle, providing for downtown-to-downtown journey times faster than car or plane. Goods movement has been enhanced between Vancouver and the US West Coast, and there has been a resurgence in the use of rail for local goods movement by through application of Intelligent Transportation Systems (ITS) to make timely and efficient connection between road and rail.</p> <p>Airport and port vehicles and ground support equipment are non-polluting.</p> <p>Arriving and departing eco-tourists assemble or package their bicycles; some take advantage of the bicycle paths that extend to the ferry terminals. The airport</p>

**Table 2: Sector Sustainable Futures**

Sector	2010	2020	2030
Truck, Rail, Ship, and Air Transportation (cont'd)	Funding has already been put aside for past and future Gateway infrastructure and equipment, benefiting commuters, local business, exporters, importers, and tourists.		<p>gas station has been replaced with clean, renewable powered hydrogen dispensing equipment and other alternative power sources.</p> <p>Key transportation infrastructure has been upgraded to allow the most resource- and cost-efficient method to be used. Global fuel standards are in place and allow international marine vessels, aircraft, trucks, and locomotives to take advantage of the newest transportation technologies.</p> <p>Canadian companies continue to work with other countries, both developed and developing, on a bilateral and multilateral basis to share experiences, expertise, and resources, such that all countries continue to pursue a more sustainable global transportation system.</p>
Buildings	<p>Newly constructed buildings are very energy efficient, averaging half the consumption of buildings in 2002. This performance level is achieved with limited capital cost implications, developed architectural ideas, and much greater levels of insulation.</p> <p>Most buildings are designed to LEED<sup>26</sup> Gold standards, so there are widespread reductions in typical water consumption and sewage discharge, both also 50% less than in 2002. Through developments in materials intensity</p>	<p>Well over 60% of all buildings have been renovated to new energy efficient standards. The latest in new construction are net zero emissions buildings with photovoltaic skins and fuel cell plants. A recent fuel cell furnace for retrofit of residences is selling well, with a payback of 5 years, marking the significant emergence of the hydrogen economy.</p> <p>Total GHG emissions from buildings are 75% below 2002 levels. The LEED standard has been replaced with energy consumption</p>	<p>Most new buildings are GHG neutral and many are net energy generators, sharing into the grid. Almost all existing buildings have been renovated to high performance energy criteria.</p> <p>BC Building Code limits are 40 kWh per sq m for residences and 100 kWh per sq m for offices. There are fuel cells in all new buildings and all renovations built in BC. Solar harvesting touches every aspect of buildings operations, for lighting, power,</p>

<sup>26</sup> LEED (Leadership in Energy and Environmental Design) is a rating system designed by the US Green Building Council that evaluates building performance based on scientific standards for sustainable site development, energy and water efficiency, materials selection, and indoor air quality. It is being customized to BC requirements with the support of the GVRD, City of Vancouver, BC Buildings Corporation, the Ministry of Competition, Science and Enterprise, BC Hydro, and BC Gas.

**Table 2: Sector Sustainable futures**

Sector	2010	2020	2030
Buildings (cont'd)	<p>and operations improvements, total GHGs per capita for buildings have been reduced 60%.</p> <p>BC is host to a vibrant sustainable design and engineering sector, exporting expertise international.</p>	<p>performance criteria in the BC Building Code.</p> <p>All forestry companies are developing new sustainable building products, as part of a move to realize maximum value and employment from our natural bounty.</p>	<p>and heating.</p> <p>The BC forest products industry is a sophisticated supplier of value-added sustainable building products with international reach, based on a managed resource, which has grown greatly in size and importance in the economy.</p>
Electricity	<p>New meter technology coupled with complementary rate design, an aggressive Power Smart campaign, and the focus on sustainable development has dramatically cut load growth.</p> <p>The 50% clean energy goal succeeded in encouraging a wide range of renewable projects, including small hydro, cogeneration, biomass, wind, and demonstration wave, tidal, and solar projects.</p>	<p>Demand for renewable energy has grown dramatically, stimulated by continuous efficiency improvements, rising prices for fossil fuel alternatives, and widespread public support for sustainable development.</p> <p>Distributed generation from a range of technologies, including fuel cells, is beginning to have a significant impact on load growth. A widespread focus on Power Smart and conservation and energy efficiency continues to significantly limit overall growth in demand.</p>	<p>The transition to a hydrogen economy has begun in earnest and distributed generation accounts for a significant proportion of incremental load growth. All energy projects must be either zero-emitting or fully offset or sequestered.</p> <p>By 2030, the province has achieved its target of zero emissions from the electricity sector and is seen around the world as a model for the transition to a sustainable economy, with a strong demand for BC products and expertise.</p>
Natural Gas	<p>Sector-specific policy changes and incentives have fostered an increase in the use of cleaner hydrogen fuels, thereby increasing the demand for natural gas.</p> <p>Natural gas companies have well-established GHG management systems and maintained emissions per unit throughput in accordance with covenant agreements. This has been primarily accomplished through cost-effective energy optimization in processing and pipeline systems, reduced fugitives and flaring, and extension of acid gas reinjection.</p>	<p>The demand for natural gas continues to increase as additional sectors switch to cleaner burning fuel sources and fuel cell technology moves forward utilizing natural gas as a hydrogen source. In addition, a large percentage of urban transportation, in particular, commercial fleets, have transitioned to natural gas vehicles.</p> <p>Natural gas companies continue to lower emission levels through GHG management, technological advances, capital stock replacement, carbon sequestration, and offsets.</p>	<p>BC's primary energy source is natural gas, which continues to provide the province with a key source of provincial revenue.</p> <p>The province moves forward to low emission technologies, GHG management, and a hydrogen based fuel economy powered by hydrogen from natural gas.</p> <p>Use of carbon sequestration technologies and geological storage is fully developed and in use. Sustainable exploration, development, and recovery of natural gas reserves are underway.</p>

**Table 2: Sector Sustainable Futures**

Sector	2010	2020	2030
Natural Gas (cont'd)	Regulated GHG inventory and reporting systems are clearly outlined and harmonized (provincial and federal) and a system of large industrial emitter intensity targets with emissions trading as part of the flexible compliance options. As a result, companies have implemented accurate GHG inventory, reporting, and audit systems and begin to utilize offset opportunities. R&D projects have further enhanced the feasibility, safety, and acceptability of carbon sequestration and storage technologies.	Continued R&D has facilitated additional opportunities for geological storage and carbon sequestration and addressed outstanding environmental, safety, and technical issues for the sustainable exploration and recovery of natural gas reserves. There is a greater use and development of new and existing acid gas reinjection facilities.	
Fuel Cells and Hydrogen	<p>BC fuel cell companies have over \$3 billion in sales and employ 10,000 people.</p> <p>The BC Hydro-sponsored Hydrogen Highway provides a showcase for BC's commitment and leadership in the initial stages of the global transition to a hydrogen economy.</p> <p>Over 20,000 fuel cell vehicles are in operation worldwide. Over 2 gigawatts of stationary power systems are supplying power with much lower CO<sub>2</sub> and no criteria emissions.</p>	<p>Over 30,000 people are employed in the BC fuel cell industry.</p> <p>More than 25% of all vehicles are fuel cell powered, with 50% to 100% CO<sub>2</sub> reductions depending on the source of the hydrogen – 50% if from natural gas, or 100% if from the renewable or carbon sequestered sources that are coming on stream.</p> <p>Natural gas and gasified coal, sewage and garbage feed the high temperature fuel cell systems that provide half of the new and replacement power for the highly distributed power grid.</p> <p>Vehicles parked at home and at work, controlled by the worldwide General Hydrogen arbitrage system, provide a massive new source of distributed power, substantially reducing power system investments.</p>	<p>More than 50,000 people are employed by the BC fuel cell cluster and the renewable energy industry it has enabled.</p> <p>The rolling stock of vehicles in BC is largely fuel cell powered, as are stationary power systems. Both use either hydrogen pipelined from carbon sequestered fossil fuel sources, or electrolytic hydrogen generated from renewable power sources.</p> <p>Renewable energy sources, such as wind and solar, begin to grow rapidly now that fuel cells can use stored hydrogen to provide power to the grid when these intermittent sources are not available.</p> <p>GHG emissions from all transportation and stationary power sources are declining dramatically.</p>
Forest Products	Several BC forest products companies have now completed certifying all of their forestry operations under credible and internationally	All provincial forestry operations are certified as sustainable under credible and internationally recognized, third party certification standards.	By 2030, wood residue has completely replaced natural gas for heat energy within the sector, self-generation of energy and

**Table 2: Sector Sustainable Futures**

Sector	2010	2020	2030
<p>Forest Products (cont'd)</p>	<p>recognized third party certification standards. Supplemental verification of their forest carbon balances is included in the certification process. The provincially managed small-business program wood harvests are being included under the certification process too.</p> <p>Ecosystem based management of forestry operations is widespread and total ecosystem carbon is one of the attributes being managed for (i.e., coarse woody debris etc). The BC forest products sector is fully complying with the sectoral covenants developed to meet the Kyoto obligations. These covenants recognize the early achievements made by the sector. Some sawmills are now using wood residue gasification and/or bio-oil to heat their kilns.</p> <p>Energy efficiency initiatives, Power Smart, etc., have resulted in significant energy savings and reduced the sector's dependency on purchased energy.</p> <p>Afforestation of marginal farmland to native HW species has been underway for 7 years already and Kyoto ARD<sup>27</sup> credits are being earned. All carbon accounting is conducted in accordance with IPCC protocols.</p> <p>GHG sequestered under article 3.3: 1 MT CO<sub>2</sub>e</p> <p>GHG emissions in 2010:3.0 MT CO<sub>2</sub>e</p>	<p>All forestry operations respect the principles of ecosystem based forest management. Installation of more efficient chemical recovery systems in 2 kraft pulp mills has occurred. Some kraft pulp mills are virtually energy self-sufficient.</p> <p>Some innovative wood residue based bio-fuels are being used to fuel lime kilns at pulp mills and all sawmill drying kilns have now been converted to use the mills own wood residues.</p> <p>Marginal farmland afforestation has been expanded and the new forests are now producing wood and fibre for industrial use in facilities that rely on this source of fibre.</p> <p>Kyoto credits are being earned for the newly forested areas, as the forestry is certified as sustainable under credible, internationally recognized, third party certification standards.</p> <p>GHG sequestered under article 3.3: 2 MT CO<sub>2</sub>e</p> <p>GHG emissions in 2020:1.7 MT CO<sub>2</sub>e</p>	<p>power from wood residue and bio-fuels has replaced purchased electricity. Most of BCs pulp mills are energy neutral, and some actually export energy to the grid. Total emissions are down 90%, with GHG intensity down 93% from 1990.</p> <p>Marginal farmland afforestation is complete and carbon credits are being earned and traded.</p> <p>The BC forest sector is recognized globally for its positive contributions to the mitigation of climate change through its processes and through its sustainable forest management.</p> <p>GHG sequestered under article 3.3: 2 MT CO<sub>2</sub>e</p> <p>GHG emissions in 2030:0.4 MT CO<sub>2</sub>e</p>

<sup>27</sup> Afforestation Reforestation Deforestation.

**Table 3: Application of Life Cycle Policy Framework**

Example/ Policy phase	Buildings Sector: Energy Performance Standards	Forest Sector: Sustainable Forest Products
Research	<ul style="list-style-type: none"> <li>• Funding for building education</li> <li>• Forest sector conducts research for sustainable building materials</li> <li>• Research on building system technologies and their behavioural and regulatory dimensions</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct research on markets and environmental, social (local/global), and economic impacts</li> <li>• Research on new products and new forms of production</li> <li>• Identify critical social license issues associated with the use of a primary resource</li> </ul>
Development	<ul style="list-style-type: none"> <li>• LEED BC rating system is completed</li> <li>• Energy performance goals are established for residential and commercial buildings</li> <li>• Design and engineering BC centre of excellence is supported</li> </ul>	<ul style="list-style-type: none"> <li>• Select independent, credible, 3<sup>rd</sup> party audited, sustainable forest management systems appropriate to the local resource</li> <li>• Local companies establish certification arms to meet demand</li> </ul>
Demonstration	<ul style="list-style-type: none"> <li>• Sustainable research facility (CIRS) is built and supported for the commercial/institutional sector, and attracts industry and researchers</li> <li>• A BC Zero Energy Development project is built for the residential sector, a North American first</li> </ul>	<ul style="list-style-type: none"> <li>• The certification systems are applied widely throughout BC. They are also applied to supply chains, to verify “chains of custody”</li> <li>• For a province with publicly owned forest lands, this is also an example of corporate social responsibility</li> </ul>
Government Procurement and Policy	<ul style="list-style-type: none"> <li>• All construction projects and major renovations for facilities used by provincial public sector agencies meet LEED BC Silver standards</li> <li>• Government conducts a 20-year program to renovate all existing government buildings to higher performance levels and indoor air quality (IAQ)</li> </ul>	<ul style="list-style-type: none"> <li>• Government starts to require compliance with these certification systems for all its purchasing</li> <li>• Government applies certification to its own “small business program” wood, a major wood source to industry in BC, and necessary to close a chain of custody gap</li> </ul>
Business decision-making	<ul style="list-style-type: none"> <li>• Developers adopt LEED BC Silver standard</li> <li>• Commercial workplaces are renovated to higher performance levels and healthier IAQ</li> </ul>	<ul style="list-style-type: none"> <li>• Companies adopt a timetable requiring 100% certified content in their products within 5 years, with incremental levels along the way</li> <li>• Sustainable forestry equates to carbon neutrality</li> </ul>
Final Demand	<ul style="list-style-type: none"> <li>• Municipalities provide implementation level support to change consumption preferences through education</li> <li>• Energy performance standards are entrenched in the BC Building Code at the LEED BC Silver level</li> <li>• Consumers choose more efficient housing because of its many advantages; sustainable buildings become common in residential and commercial applications</li> </ul>	<ul style="list-style-type: none"> <li>• International customers flock to purchase these products, helping to establish BC’s reputation as a leader in sustainability</li> <li>• Government promotes this BC advantage</li> <li>• Government encourages the demand in its own procurement policies</li> </ul>

Government policy has been set for some of the key aspects of a BC Climate Change Action Plan. The plan is to have a long-term focus and to enhance economic opportunities in the province. It should also use principles of sustainable resource management and apply other criteria related to overall budget neutrality, alignment with other jurisdictions, and a preference for market-based policy instruments. The Panel recommends that the plan and its individual actions also be screened against the provincial *Draft Sustainability Principles*.<sup>28</sup> These draft principles include a number of important criteria, such as accountability, shared responsibility, continual improvement, and science-based decision-making, that can help ensure an effective plan in the broader context of sustainable development.<sup>29</sup>

### 3.2 Emission Reduction Target

***The Province should develop an aggregate long-term target for GHG reduction, along with differentiated sectoral and regional targets, that recognize technological innovation and synergies across sectors if a sustainability path is adopted now.***

The Province has committed to develop a long-term emission reduction target for the BC Climate Change Action Plan. A target could take several forms, including a reduction in the absolute level of emissions or emissions intensity (i.e., emissions per capita or per dollar of GDP), or a ranking relative to other jurisdictions.

It appears from the word pictures in Table 2 that, by taking a sustainable development path, some key GHG-emitting sectors (e.g., buildings, electricity, pulp and paper) should be able to reduce their emissions in absolute terms relative to current levels by 2030. In some cases, the possibility of zero net emissions is even envisaged. In other sectors (e.g., oil and gas) where production is growing rapidly, it may be more feasible to make major reductions in emissions intensity. For the province as a whole, however, indications are that a substantial absolute reduction in GHG emissions could be achieved over the longer term, assuming the development and adoption of zero and low-emitting technologies (e.g., fuel cells, carbon sequestration) and the synergies across sectors as a result of sustainability actions.<sup>30</sup> Moreover, this environmental improvement can be achieved along with rising population and healthy economic growth.

#### Examples of long-term GHG targets

The Eastern provinces (Quebec and the Maritimes) and New England states have committed to reduce emissions by 10% below 1990 levels by 2020. Alberta is targeting a 50% reduction in GHG emissions per \$GDP by 2020, which equates to 27% above 1990 emissions.

#### BC opportunity: LEDs on landing strips

The Vancouver Airport Authority is investigating high efficiency LED lights for aircraft maneuvering areas. With better visibility and longer lives, these lights use 90% less energy. They could make Vancouver International Airport a North American leader in LED lighting.

To date, the Panel has not undertaken the quantitative analysis necessary to recommend a long-term target for the BC Action Plan. In fact, it is extremely difficult to determine what the level of provincial GHG emissions could be three decades from now, given the myriad of technological, behavioural, and infrastructure-related changes that could occur in the interim. At this time, the Panel recommends that, on an aggregate level, the Province consider setting an aggressive “aspirational” target, with differentiated sectoral and regional targets to reflect the varying opportunities

<sup>28</sup> Ministry of Sustainable Resource Management (2002).

<sup>29</sup> See Appendix 6 for a listing of the principles.

<sup>30</sup> This result is substantiated by the IPCC modelling work, which shows that for a majority of low-emission (A1T and B1) scenarios OECD countries end up reducing their absolute CO<sub>2</sub> emissions to below 2000 levels by 2030, and very substantially by the end of the century.

for emission reduction. The Panel proposes to work further on quantifying the potential long-term emission reductions for specific sectors, and on identifying a preliminary GHG reduction target for BC.

### 3.3 Immediate Policy Actions

***BC's Climate Change Action Plan should present some significant policies that can be implemented immediately to start the province on a sustainable development path.***

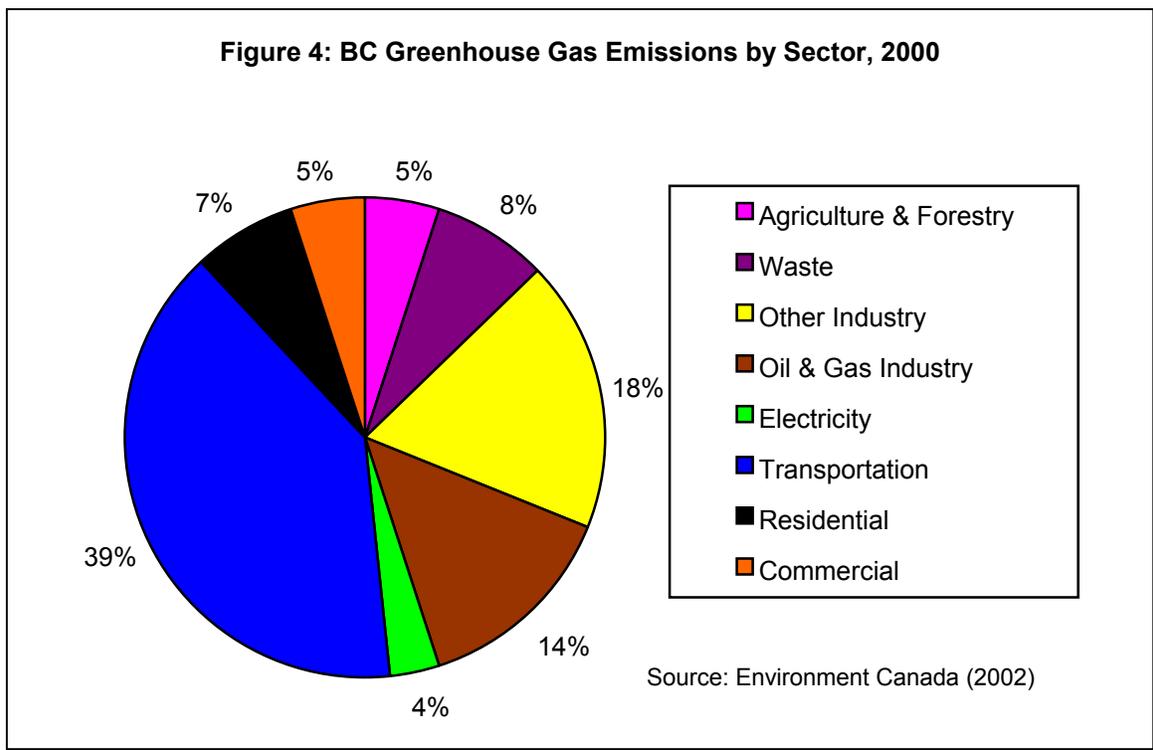
Appendix 1 contains a detailed listing of policy actions identified by Panel members for specific sectors and the economy as a whole. From this list, a selection of "top-ten" areas of crosscutting and sector-specific measures are profiled below as action that could be initiated right away to reduce emissions and provide economic benefits, while moving toward a sustainable future. It is important to implement some significant measures as soon as possible, and to demonstrate a commitment to climate change action, in order to access federal funding and leverage greater investment. Crosscutting Actions

Four areas requiring multi-sector action are:

*Revenue generation.* To achieve budget neutrality, the BC Action Plan will have to include provisions for raising the funds required to cover its costs. There are various options for taxes or fees that could be used to generate the necessary revenues. Although the Panel has not conducted an analysis of these options, it is suggested that a relatively modest tax or fee could be designed to help raise funds for the Action Plan without attempting to use the tax/fee to directly reduce GHG emissions to a significant extent. The Province's tax policy specialists should be consulted to explore the best mechanism(s) for revenue generation.

**UK climate change levy**

In April 2001, the UK introduced a tax on non-residential energy use to help meet its Kyoto commitment of a 12.5% GHG reduction from 1990 levels. For the 44 energy-intensive sectors that signed climate change agreements with the government, an 80% exemption from the levy was provided.



### Industrial clusters and R&D in Finland

In 1996, the Finnish government set a goal for national research funding to be 2.9% of GDP by 1999. To improve the country's innovation system, seven industrial clusters were established, including forest, transport, telecommunications, and environmental clusters. Research is now planned, financed, and implemented jointly by government agencies, industry, universities, and research institutions. In preparing the forest research program, the aim has been to identify the research areas suitable for each financing body so that together they form a continuous chain from the market to the forest.

The forest cluster is the largest industrial cluster in Finland and has the most extensive R&D program, investing some EUR 250 million (\$400 million CDN) annually. It contributes 30% of industrial production and 40% of net export revenue. Finnish pulp and paper machines, equipment, and components account for 30% of the world market. On a per capita basis, R&D in the Canadian forest sector is roughly 1/6 the level in Finland.

*Technological innovation.* A cornerstone of sustainability is the development of clean, zero and low-emitting technologies. Panel members identified the need for R&D support in areas ranging from fuel cells to ethanol from biomass, bio-fuels, and biomass gasification. The Province needs to work with research institutions, industry, and the federal government on strategies and funding mechanisms for encouraging innovation. BC should consider setting an aggressive R&D target and adopting a technological approach similar to the Finnish sector clusters, in which a government-enabled and industry-led R&D program is carried out as a cooperative effort among government, industry, academia, and service organizations.<sup>31</sup> This cluster model could be sector-based (e.g., forestry, energy) or broadened to include all sustainability technologies.

*Energy efficiency, capital stock replacement, and recycling.* For most sectors, energy efficiency improvement is expected to remain a key source of emission reductions for the future. Likewise, the replacement of old, inefficient buildings and equipment with less GHG-intensive stock is an important long-term reduction strategy. Energy performance standards for appliances, equipment, and buildings are a key measure for securing GHG reductions as capital is replaced. Incentives such as tax credits, accelerated depreciation, and Power Smart assistance are also needed across sectors to encourage efficient energy use and capital stock turnover, as are other incentives to promote recycling (see below under Aluminum Smelting).

*Education.* Education on climate change, GHG reduction, and sustainability can have a role in influencing behaviour. The Panel has identified policy actions ranging from truck driver training programs to innovative tools for involving the public in sustainability decisions. The Province should work with the universities, NGOs, the federal government, and others to develop a long-term initiative for public education and involvement in sustainable development.

### GOVERNMENT LEADERSHIP: AGGRESSIVE GHG REDUCTION TARGET AND ACTIONS

#### BC success story: GVRD Incinerator

By mid-2003, a new turbo-generator at the GVRD waste-to-energy facility will use excess steam to generate electricity for sale to the BC Hydro grid. Using steam to replace fossil fuels will reduce GHG emissions by an estimated 59,000 tonnes per year.

Leadership by all levels of government is critical to demonstrating emission reductions and motivating action by the private sector and individual citizens. In the broader sustainability context, key areas for leadership are innovation and research, development, and demonstration of GHG-reducing technologies. It is important to consider sustainability throughout government operations from

procurement of office supplies and equipment to employee travel.

The BC government should adopt an aggressive target for GHG reduction in its facilities and vehicle fleet. In the Panel's estimation, the existing target of a 16 percent reduction in emissions

<sup>31</sup> <http://english.forestindustries.fi/finance/significance/cluster.html>.

by 2005 represents an underachievement. Meeting a tougher target will require a comprehensive package of policy actions, including:

- LEED Silver certification for all new construction and major retrofits of facilities used by provincial public sector agencies;
- an aggressive employee trip reduction program, with incentives for transit, parking policies, telecommuting, etc.;
- a requirement for all purchases or leases of supplies and equipment to be of leading environmentally beneficial products (e.g., Energy Star computers, hybrid vehicles); and
- the acquisition of 20 percent of internal electricity needs from BC Clean sources by 2005 and 50 percent by 2010.

**BC opportunity: LEED buildings**

Adopting LEED Silver standards for new public buildings and retrofits can lead to healthier workplaces and increased employee productivity, as well as GHG and other emission reductions. The incremental capital cost to meet LEED BC Silver requirements is estimated at only 1% to 3% per building.

The Province should also work with other levels of government in areas such as support for R&D (federal) and the development of landfill gas and local clean energy projects (municipalities).

**URBAN LAND USE: TAX SHIFTING AND GHG REDUCTION TARGETS/PLANS**

**BC success story: WindSong Cohousing**

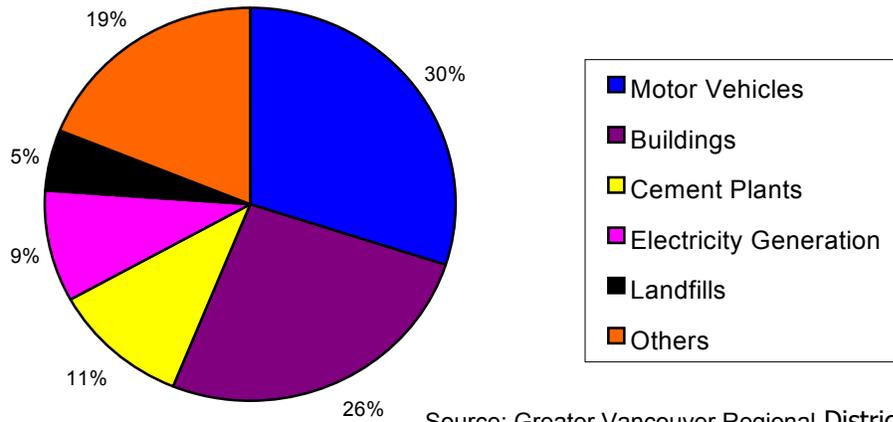
The WindSong Cohousing Community, an intentional neighbourhood in Langley, has won awards for environmental and urban development excellence. The 25% smaller-than-average homes are designed to minimize energy and resource waste. Density clustering, resource sharing, and preservation of habitat are all exceptional

More efficient land development that emphasizes multiple uses and higher densities can amplify the impact of GHG reduction actions in key emitting sectors, such as transportation, energy, and buildings. Over the long term, much higher reductions can be realized by integrating better development practices with transportation efficiencies, high-performance buildings, and local energy planning.

Municipalities collect development cost charges (DCCs) to help fund water, sewerage, highway, and other projects necessary for growth. DCCs could be changed to provide discounts to multi-use, higher-density development and higher charges for development that contributes to urban sprawl. In addition, various systems for pooling tax bases could be examined to remove incentives for sprawl and encourage balanced residential and employment development. The Province could also provide incentives and tools to encourage local governments to implement GHG reduction targets in official community plans (OCPs) and regional strategies by 2005. In the near term, an initiative to develop a framework for shared energy systems in urban contexts, including waste heat exchanges and district heating systems, would open doors to the opportunities for waste heat recovery and smooth the way for making the regulatory and other changes that will be needed to achieve these systems.

Point sources make up 28 percent of GHG emissions in the Greater Vancouver area, the largest sources being cement plants and the Burrard Thermal Generating Station. Under the *Waste Management Act*, the Province has authority to regulate all air emissions and to delegate emissions permitting to the GVRD. Industrial emitters could be required to prepare GHG reduction plans, backed by a system of waste permit fees and rebates for compliance.

**Figure 6: Greenhouse Gas Emissions in the GVRD, 2000**



Source: Greater Vancouver Regional District

**TRANSPORTATION: INCREASED TRANSIT AND VEHICLE EMISSION STANDARDS**

One of the areas where the greatest emission reductions can be achieved is urban passenger transportation, particularly in larger centres and especially in Greater Vancouver. Motor vehicles account for about 30 percent of GHG emissions in the GVRD, and 28 percent of total emissions for the province as a whole. To substantially reduce emissions in urban transportation will require offering a greater choice of how to travel as well as incentives to create a modal shift away from personal vehicles to public transit, walking, and cycling. While Greater Vancouver was one of the few Canadian cities to grow its transit ridership in the 1990s, per capita ridership is still typically around 70 percent of that of Toronto or Montreal. At present, transit investment in BC’s urban areas is not proceeding at a pace or to the extent required to allow a significant modal shift.

While transit can be a viable option for metropolitan areas, in many suburbs and smaller communities transit is not an alternative for a large share of trips due to the nature of the low density urban development and dispersed employment and other activity centres. As a result, in addition to transit expansion, it will still be necessary to implement strategic investments in road

**California vehicle emission standards**

California VES have spurred the development of new propulsion technologies, such as gasoline-electric hybrid, battery-electric, and fuel cell vehicles. Some 24 manufacturers now compete to sell LEV, including Ford, General Motors, Honda, and Toyota. Although California’s current standards address only local air pollutants, a new law will see the first US tailpipe standards for CO<sub>2</sub> emissions by 2006.

improvements at ‘choke’ points that can also benefit goods movement. Both transit and road systems can be improved, as well, through the use of Intelligent Transportation Systems (ITS) to maximize the effectiveness of existing facilities and services.

The federal government has committed \$450 million for a ten-year infrastructure program focused on environmentally responsible transportation systems and urban transit. While this amount may seem substantial, it is a fraction of the level of investment needed.<sup>32</sup> Nonetheless, to access federal funding,

provinces must make significant financial commitments of their own to sustainable transportation. BC could target a 50 percent increase in the capacity of the Greater Vancouver transit system, with more rapid transit and bus fleet expansion, by 2012. This would require a

<sup>32</sup> The estimated cost of replacing the GVRD’s existing electric trolley fleet alone is around \$250 million.

major funding initiative across the federal, provincial, and regional governments, as well as the increased use of user pay to fund transportation improvements.

The Province could also implement vehicle emission standards (VES) comparable to those pioneered in California and now being adopted in other states. VES require automobile manufacturers to guarantee a minimum percentage of new sales for low and zero emission vehicles (LEV and ZEV), with a phase-in period of increasingly stringent standards to allow for technological innovation and commercialization. BC's fuel cell industry is a key beneficiary of these technology-driving standards. While VES would impose some costs on manufacturers, qualifying vehicles are already being produced for larger US markets.<sup>33</sup> Compared to other policies, such as higher fuel taxes, emission standards have greater potential to effect the profound technological change that is necessary to tackle local air pollution and climate change.<sup>34</sup>

A variety of policy measures are available for the transportation modes of trucking, marine, rail, aviation, and off-road vehicles (see Appendix 1). Trucking accounts for more than half of the GHG emissions from freight transport in BC. Given concerns about traffic congestion as well as air emissions, the movement of goods in urban areas has been identified as a focus for policy action.

Measures to improve urban transportation efficiency and reduce emissions could include:

- tax or other incentives to encourage the use of lower-carbon fuels in light, medium, and heavy-duty vehicles;<sup>35</sup>
- the use of intelligent transportation systems, such as signal synchronization, road condition information, and satellite tracking of vehicles, for more efficient goods movement; and
- driver training, reduced idling, and vehicle maintenance programs to change vehicle operating practices and improve fleet fuel economy.

**BC success story: NGV engines**

Cummins Westport produces natural gas engines for medium and heavy-duty vehicles. Westport Innovations' high pressure direct injection (HPDI) technology uses 5% diesel and 95% methane, for a CO<sub>2</sub>e reduction of about 17% over diesel in the case of medium-duty vehicles.<sup>36</sup>

**BUILDINGS: ENERGY PERFORMANCE STANDARDS AND SUPPORTING POLICIES**

Construction industry practices have widespread implications for GHGs, from the upstream emissions produced in the manufacture of building products to the downstream emissions from the disposal of demolition waste in landfills. Correspondingly, there are substantial opportunities to reduce these emissions using know-ledge and technologies available today. An association of Canadian architects and engineers estimates that by reducing emissions by 25 percent, the building industry could achieve approximately 40 percent of Canada's Kyoto commitment.

**BC success story: Telus Building**

The decision to recycle materials from the Telus Office Building in Vancouver avoided 18,000 tonnes of solid waste going to landfill. The completed renovation saved 15,600 tonnes of CO<sub>2</sub> emissions from demolition and landfill.

To provide the impetus for significant GHG reductions in buildings, the provincial government could develop and phase in energy performance standards for the BC Building Code. In particular, it could work towards long-term (e.g., 2030) limits of 30 kWh per square metre for

<sup>33</sup> The standards could be combined with incentives to car dealers and perhaps even salespersons.

<sup>34</sup> Jaccard (2002).

<sup>35</sup> Examples of light and medium-duty vehicles are courier vans and garbage trucks, respectively.

<sup>36</sup> Westport Innovations (2000).

residences and 80 kWh per square metre for offices. These limits are roughly 75 percent below current energy performance practice in BC buildings. They can be achieved at minimal additional cost if appropriate supporting policies are put in place, such as:

- the development and application of world class, high-performance envelope standards (e.g., R60/R70, as used in Switzerland and Sweden);
- government leadership (see above) in the implementation of LEED BC Silver requirements and voluntary adoption of these standards by the private sector;
- the establishment of a \$100 million borrowing facility for energy efficiency upgrades in all BC buildings, with repayment out of energy savings;
- provincial sales tax relief for the purchase of Energy Star appliances, dual flush and ultra low flow fixtures, and other sustainable products and equipment; and
- legislation requiring all regional and municipal development cost charges to provide rewards and penalties (on a revenue-neutral basis) related to building sustainability.

**Revolving funds for energy upgrades**

Edmonton and Calgary both operate \$5 million revolving funds to support energy retrofits in municipal buildings. The GVRD is considering this and other innovative financing mechanisms as part of its Better Buildings Partnership being developed for municipal and commercial eco-efficiency retrofits.

**ELECTRICITY: EMISSION STANDARD AND OFFSETS**

The new provincial energy policy<sup>37</sup> contains a number of measures that will help control the growth in GHG emissions from BC’s electricity sector. In particular, electric utilities will pursue a goal to meet at least 50 percent of incremental demand through 2002 from “BC Clean” energy resources.<sup>38</sup> Other policies acting to reduce emissions growth include new rate structures (stepped and time-of-use rates) to encourage conservation and energy efficiency, and upgraded energy efficiency standards for appliances and equipment.

Even with these and additional policy changes over the next decade, electricity emissions are expected to grow due to the addition to the hydroelectric base of natural gas-fired generation. The Province could provide an incentive to curb this emissions growth by adopting an emission standard and offset requirement to supplement the 50 percent clean energy goal, Power Smart, and other efforts. Under such a policy, all new thermal power plants would be required to offset emissions down to a percentage of the GHGs produced by the most efficient natural gas-fired generating plant – a combined cycle gas turbine (CCGT).

**Oregon CO<sub>2</sub> standard**

In 1997, Oregon became the first jurisdiction to implement a CO<sub>2</sub> standard for new thermal generation. Power plant developers can meet the standard, currently set at 17% below a CCGT’s emissions, by making a payment for excess emissions to the not-for-profit Climate Trust, which purchases offsets.

BC Hydro is already voluntarily offsetting half of the net GHGs produced by new gas-fired plants on Vancouver Island, and is seeking purchases of emission offsets (GHG reductions at another location) domestically and abroad. In setting the level of an emission standard, it is important to recognize the tradeoff between meeting GHG targets and investing in local technological innovation. If the standard is made too stringent, then electric utilities will be forced

<sup>37</sup> BC Ministry of Energy and Mines (2002).

<sup>38</sup> BC Clean electricity is defined as any generation source that results in a net environmental improvement (e.g., reduced emissions) over existing supply. It includes small hydro, wind, solar, and biomass energy, as well as cogeneration of heat and power and energy from fuel cells, municipal solid waste, and landfill gas.

to acquire more international offsets, which will divert resources away from clean energy investments in BC.

It is also important to recognize the need to ensure offset requirements are applied fairly across the Canadian economy. In other words, electricity consumers in BC should not be required to pay a disproportionate share of emission reduction costs relative to consumers in other jurisdictions. Finally, provincial offset requirements must be harmonized with other policy mechanisms, such as domestic emissions trading, which is currently being developed as par to the federal government's Kyoto implementation plan.

Given these consideration, it is proposed that the Province develop an emission offset standard in concert with the federal government that builds on BC's current energy efficiency and clean energy objectives. This could include GHG offset credits for "BC Clean Energy" developments beyond a national clean energy standard, as well as energy efficiency improvements. Both activities could be enabled through trading certificates. Since it may take several years to fully develop and implement such a system, the provincial government should encourage owners of stationary emission sources to voluntarily offset emissions from their facilities.

### **NATURAL GAS: SUPPORT FOR INCREASED PRODUCTION, REDUCED FUGITIVE EMISSIONS, AND ACID GAS REINJECTION**

Expanded natural gas production is part of the North American and global solution to reduced GHG emissions. Natural gas serves as a transitional fuel in the shift from higher carbon intensity coal and oil products, en route to even lower-emission future energy supplies, including zero emission hydrocarbons. While pursuing initiatives to reduce production-related emissions as outlined below, the main contribution of provincial policy for the natural gas industry will be facilitating the expansion of BC natural gas production to meet domestic needs and growing exports. The key issues are resolving land access difficulties, continuing to improve the efficiency of the regulatory process, and tuning the fiscal regime to the resource base.

In the natural gas sector, approximately 9 percent of BC's GHG emissions come from fuel gas use, transmission, and other direct emissions. A further 8 percent of provincial emissions are classified as "fugitives". Fugitive emissions, as defined by the Ministry of Water, Land and Air Protection Climate Change Branch, are largely from the CO<sub>2</sub> component of gas in reservoirs and stripped from raw gas during processing, from flaring, and to a lesser extent, from small leaks in natural gas equipment, lines, and storage tanks. Each of these processes requires different methods to reduce GHG emissions. In particular, leak detection is a costly and labour-intensive exercise, and increased emissions abatement is currently subject to very marginal returns. Provincial tax credits or other incentives are needed to support the identification and reduction of fugitive emissions, especially in transmission and distribution.

#### **BC success story: acid gas reinjection**

Duke Energy operates acid gas reinjection facilities at its Jedney II (~20 kilotonnes per year CO<sub>2</sub> reduction) and Kwoen (~100 kilotonnes per year reduction) gas plants in northeastern BC. These facilities also work to improve local air quality by reducing sulphur dioxide emissions.

The BC government advocates the injection of acid gas into depleted reservoirs as an effective strategy for disposing of hydrogen sulphide and CO<sub>2</sub> extracted in the processing of raw gas. Carbon storage in this manner is the most promising means to maintain a downward trend in GHG intensity at the processing stage while the demand for natural gas continues to grow in domestic and export markets. Acid gas reinjection is proven both technically and economically,

with 38 projects now operating in Alberta and 10 in BC.<sup>39</sup> At the same time, the capital costs of these projects discourage their wider adoption here.

The Province could provide incentives, such as refundable investment tax credits, to promote the development of acid gas reinjection facilities. Alternatively, it could lobby the federal government for tax credits and policy changes to enable accelerated depreciation through the Capital Cost Allowance (CCA). Provincial support could also help develop a CO<sub>2</sub> market in BC, issue credits for CO<sub>2</sub> injection, and cover marginal differences that might arise between the price of carbon credits and the cost of emission reduction technology. In addition, there is a need for more information on the costs and liabilities associated with acid gas pipelines and reinjection facilities.

## **FUEL CELLS: SUPPORT FOR THE TRANSITION TO A HYDROGEN ECONOMY**

One of the critical dimensions of a sustainable development path is the successful transition to hydrogen-based energy and transportation systems. The provincial fuel cell industry and

### **BC opportunity: hydrogen highway**

BC Hydro, Methanex, and the National Research Council are proposing to build up to 10 hydrogen fuelling stations in southeastern BC. This “hydrogen highway” would include a hydrogen production and dispensing facility in south Burnaby that would sell “green” hydrogen to Ballard Power Systems.

supporting sectors, including natural gas and electricity, are well positioned to make that transition and to secure a sizable share of the global market once technologies reach full-scale commercialization. However, market competition will be fierce and BC producers face several ongoing challenges, including access to capital for R&D to resolve technical issues. The industry believes that the economic, environmental, and social benefits of fuel cells are not widely understood, effectively hindering investment and support. However,

President Bush’s recent announcement of \$1.2 billion (\$US) to support the transition to hydrogen vehicles and the necessary refueling infrastructure indicates that situation is changing, at least in the US.

The Province should work with industry to develop a strategic plan for the growth of BC’s world leading fuel cell industry cluster. A key element of that plan would see the government make a long-term commitment to the hydrogen economy and develop a plan for enabling transition. As a first step in implementation, the government could participate actively in fuel cell demonstration programs in the public and private sectors. These programs would encompass both mobile and stationary fuel cell applications. There are currently a number of demonstration opportunities available, such as the BC Hydro-led Hydrogen Highway, the Burnaby hydrogen and fuel cell cluster, and other infrastructure projects.

Once the demonstration programs have helped commercialize technologies, the government could initiate a targeted procurement policy to acquire fuel cell vehicles and stationary power systems for its own use. It could also offer tax or other incentives to private purchasers of fuel cells, and to providers of hydrogen refuelling infrastructure. This combination of government leadership toward a hydrogen economy, support for demonstrations, and active public and private sector procurement would put BC well on the way to achieving the sustainable 2030 future in Table 2 above.

## **FOREST PRODUCTS: ENERGY FROM WOOD RESIDUE AND FOREST SINKS**

BC’s forest products sector currently produces an estimated two million dry tonnes of surplus wood residue (bark, sawdust, shavings, etc.) that is disposed of, typically in beehive or silo

<sup>39</sup> Wong et al. (2002), p. 1.

burners, with no beneficial use. This wood residue could provide sufficient energy to replace most of the natural gas presently used in pulp and paper mills. In sawmills, wood residues could displace natural gas for lumber drying. With innovation to develop efficient small-scale cogeneration plants, wood residues could also displace purchased electricity through the self-generation of power. This biomass energy could yield substantial GHG reductions, since it is considered carbon-neutral under international rules, while at the same time improving air quality for local communities.<sup>40</sup>

Although energy self-sufficiency offers significant cost savings over the long term, the up-front cost of biomass energy projects is an obstacle to their development, given the sector's capital constraints. The Province should provide investment tax credits or other incentives to make these projects more commercially attractive to companies. As another option, the federal CCA could be changed to allow for a faster write-off of expenditures for appropriate energy asset projects (presently 30% for Class 43.1 and 4% and 5%, respectively, for Classes 1 and 2). The BC government could also continue the leadership it demonstrated in abolishing the provincial capital tax by encouraging Ottawa to eliminate the large corporation tax that is now applied to GHG reduction investments.

#### Energy self-sufficiency in pulp mills

In Scandinavia, strategic investments in energy recovery systems have resulted in many kraft pulp mills becoming net energy producers. The US industry estimates that it could shift from being a 6 GW energy user to a 22 GW net producer in the next 20 years (TAPPI 1999).

Article 3.3 of the Kyoto Protocol requires the reporting of all deforestation, reforestation, and afforestation (the planting of new forests on previously unforested land) activities since 1990. Since this requirement is clear and non-controversial, the Province should do all it can to discourage deforestation, as an emissions source, and encourage reforestation and afforestation to enhance carbon sinks. This could consist of specific targets and support for afforestation and reforestation projects, and policies to prevent deforestation, consistent with IPCC carbon accounting protocols. If sink projects were started immediately, with fast growing native species on marginal agricultural land, BC could earn carbon credits even during the first Kyoto commitment period.

### ALUMINUM SMELTING: VOLUNTARY BINDING AGREEMENTS

The federal government, Quebec, and Alberta are all pursuing negotiated agreements (or covenants) with industry that will set binding targets for GHG reduction. Voluntary binding agreements (VBAs) have been used extensively in Europe to encourage energy efficiency and climate change action.<sup>41</sup> In January 2002, the Quebec aluminum industry signed North America's first such agreement for reductions totalling 200,000 tonnes CO<sub>2</sub>e by 2007. The Quebec framework agreement provides considerable flexibility for government and industry alike, including third party verification of emission reductions and the ability of companies to earn credits for reductions in excess of their targets.

#### Quebec aluminum agreements

Since signing of the Quebec framework agreement, two aluminum producers have committed to GHG reduction targets. By 2003, Alcan Ltd. will reduce emissions from its Quebec facilities by an average 285,000 tonnes annually from 1999 levels. Alcoa Inc. targets an annual 200,000 tonne reduction by the end of 2004. A third agreement with Aluminerie Alouette is imminent.

The Province could negotiate an agreement and binding target with Alcan that would recognize GHG reductions since 1990 (or a mutually agreed year

<sup>40</sup> IPCC rules treat biomass energy as contributing zero net emissions to the atmosphere.

<sup>41</sup> Although VBAs are voluntary in nature, the presumption is that the regulator will issue backstop regulations (i.e., GHG emission limits) for non-participants.

between 1990 and 2000, company growth, technological potential, and best practices with existing technology, while continually reducing emissions intensity. The VBA would contain incentives to exceed the target (e.g., credit creation) and penalties for non-compliance. Any provincial agreement would have to be consistent with, and complementary to, the federal government's planned VBA with the aluminum industry. It should also be coordinated with domestic emissions trading, with incentives for increased recycling and less GHG-intensive consumer products.

The VBA approach could be extended to other industry sectors, such as forest products, oil and gas, cement and chemicals. Targets and other provisions could be renegotiated over time as technology and emission reduction potential evolve. While an aluminum agreement could serve as the prototype, the sooner BC acts on other industry VBAs the better its chances for influencing negotiations at the federal level. Should the Province decide to adopt this approach for industry sectors, it must take care to rationalize any covenant with other provincial (e.g., taxation) and federal policies and initiatives.

This section has described only a selection of policy actions that could be implemented immediately to start on a sustainable path. A much broader suite of sustainability measures will be required to achieve the word picture scenarios in Table 2.

### 3.4 Next Steps

#### ***The Panel will continue its advisory work as directed by the Ministers.***

With this report, members of the BC Climate Change Economic Impacts Panel believe they have made a contribution to framing a broader environmental, economic, and social context for climate change action, and to suggesting some measures that can be implemented quickly to help put the province on a sustainable development path. The Panel awaits provincial comment and direction. In the meantime, the following are some possible next steps for its work:

- Host a meeting with a broad-based group of climate change stakeholders, including representatives from industry, government, and ENGOs, to solicit their feedback on this report.
- Refine the sector profiles prepared by Panel members (see the example in Appendix 2) and advise provincial government staff in working with other sectors and developing sector profiles for key sectors not addressed in the report.
- Further explore potential emission reductions and policy measures identified herein, to refine the recommendations for a long-term GHG reduction target and action plan.
- Advise the government about developing a plan to engage the private sector and the public in the implementation of the BC Climate Change Action Plan, especially with regard to the sustainable development context for the plan.

If asked by the government, the Panel would be interested in playing an ongoing role in overseeing the development and implementation of a sustainability strategy for BC. The Panel recommends that a multi-stakeholder BC Council for Sustainable Development be established to fulfill that role, with representation from the business, government, ENGO, and research sectors. The Council would develop business plans, policies, and research in key areas of competitive advantage, as identified in Section 2.2. The goal would be to implement sustainable development on the ground in BC as a springboard into the export market. The Council could be linked to the BC Progress Board to develop accountability mechanisms for the sustainability strategy.

### 3.5 Summary Recommendations

Panel recommendations are summarized as follows:

1. The Province should develop an aggregate long-term target for GHG emission reduction recognizing the potential for extensive technological innovation over time, as well as the considerable synergies among sectors (e.g., buildings, transportation, energy, forest products) if a sustainable development strategy is adopted. Set differentiated “sub-targets” to take account of the varying emission reduction, economic, and other opportunities in specific sectors and regions of the province.
- BC Opportunity: CIRS Proposal**

UBC’s Sustainable Development Research Initiative is spearheading a proposal for a next-generation facility to serve as a laboratory for sustainable building practices, with interactive visioning tools for involving partners and the public in sustainability decision-making. The GVRD, BC Hydro, technology companies, and the Ministry of Water, Land and Air Protection are backing the \$15-million Centre for Interactive Research on Sustainability (CIRS).
2. The Province should promptly introduce measures in the following “top ten” areas identified by the Panel from a wide variety of actions that reduce GHG emissions and advance sustainable development:
    - **Government leadership** – set aggressive GHG reduction targets for provincial facilities and vehicle fleets, supported by LEED BC Silver standards for major building projects, an employee trip reduction program, and other enabling policies;
    - **Urban land use** – use tax shifting to discourage sprawl and favour more compact, transit-oriented communities; develop a policy to promote shared energy systems; and work with municipalities to provide incentives and tools for encouraging GHG reduction targets in official community plans and regional strategies by 2005;
    - **Transportation** – implement increased funding of transit and strategic road improvements; California-style vehicle emission standards for cars; higher emission standards for light to heavy-duty trucks; and incentives to purchase more fuel-efficient vehicles and lower-GHG fuels;
    - **Buildings** – establish phased-in energy performance standards, with a revolving fund for energy efficiency upgrades, provincial tax relief for the purchase of sustainable products and equipment, and other supporting policies;
    - **Electricity** – adopt a GHG emission standard and offset requirement for thermal power generation that is coordinated with the federal government and builds on the province’s current energy efficiency and clean energy objectives;
    - **Natural gas** – develop an efficient regulatory, fiscal, and land access framework to facilitate expansion of natural gas production consistent with sustainability; and tax or other incentives to reduce fugitive emissions and to promote acid gas reinjection into depleted reservoirs as a strategy for disposing of CO<sub>2</sub> emissions;
    - **Fuel cells** – prepare a strategic plan with industry to grow BC’s world leading fuel cell cluster; make a long-term provincial commitment to the hydrogen economy; and ensure active government participation in private and public sector fuel cell demonstrations;

- **Forest products** – establish incentives to encourage energy from biomass; targets and support for afforestation and reforestation projects; and policies to prevent deforestation (all consistent with international carbon accounting protocols); and
- **Aluminum (and other sectors)** – negotiate voluntary binding agreements for GHG emission reduction with the aluminum smelting and other industry sectors that are harmonized with federal initiatives.
- **Cross-cutting actions** – implement a revenue generation device to pay for the above measures consistent with the budget neutrality principle; an aggressive strategy for research, development, and demonstration of new technologies, and the fostering of sustainability clusters in BC; tax or other incentives to encourage energy efficiency, recycling, and the accelerated replacement of old buildings and equipment; and cooperation with universities and other organizations on climate change education and public engagement in sustainability decision-making.

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## Appendix 1: Potential Policy Measures

Following is an expanded list of potential policy measures prepared by Panel members. The measures are grouped into five categories of policy instruments: incentives; taxes and fees; regulation and planning; education, information, and voluntary agreements; and demonstration and leadership. Within each category, measures are further organized by affected sector. The list is preliminary; further analysis by the Panel will assess the feasibility of the measures, describe possible conflicts between and across sectors, and identify synergies between measures.

### INCENTIVES

#### General

- Establish an aggressive target for R&D funding devoted to sustainability issues and technologies.
- Provide tax or other incentives to establish a sustainability cluster similar to the Finnish Sector Cluster model where industry, academia, service organizations, and government cooperate to research and develop new and existing technology opportunities.
- Provide incentives (e.g., PST exemptions) to private sector purchasers of fuel cell vehicles and stationary power systems, and to hydrogen refueling infrastructure providers.
- Establish a common liability fund or other form of insurance among municipalities and provincial government agencies to spread out the risk associated with innovative infrastructure solutions.
- Establish an "Innovative Technologies Fund" to complement the Green Municipal Enabling and Green Municipal Investment Funds now available from the Federation of Canadian Municipalities to support green infrastructure demonstration projects.

#### Land Use Planning

- Provide incentives such as development cost charge (DCC) discounts to encourage denser, multi-use land development patterns. A revenue-neutral DCC system could charge higher fees for land use development that contributes to urban sprawl.
- Work with municipalities to provide incentives and tools to encourage GHG reduction targets in Official Community Plans (OCPs) and regional strategies by 2005.
- Consider incentives or tax reduction for living close to work and/or major transit arteries that works for both property owners and tenants.
- Examine tax base pooling systems to remove incentives for sprawl and encourage balanced residential/employment development.
- Shift tax system to favour urban redevelopment and transit-oriented developments.

#### Buildings

- Provide support such as Power Smart incentives and tax policy changes (e.g., accelerated depreciation) to encourage energy efficiency improvements in new and existing facilities and equipment.
- Provide tax relief for the purchase of Energy Star appliances, funded through Power Smart payments.

- Provide provincial tax relief for the purchase of dual flush and ultra low flow fixtures for toilets, funded with a small tax on Development Cost Charges (DCCs).
- Work with financial institutions to develop location-specific mortgages.
- Adapt the DCC formula to provide incentives for green roofs (with an average of 50% canopy cover).

#### Transportation

- Introduce federal, provincial, and regional/municipal mechanisms for increased funding of urban transportation (principally transit). Target a major expansion of urban transit systems, including rapid transit and other rail, as well as bus and marine transit in Greater Vancouver (e.g., 50% increase in GVRD transit capacity by 2012). This should include strategic road infrastructure improvements to address congestion points for goods movement.
- Use incentives (e.g., a PST exemption or revenue-neutral “feebates”) to encourage the purchase of lower-emitting vehicles and fuels (e.g., hybrids, NGV, lighter and more fuel-efficient vehicles, biomass ethanol).
- Urge the federal government to treat transit passes as non-taxable benefits and tax employer-provided parking benefits.
- Provide incentives for the development of alternative fuelling infrastructure (e.g., for NGV) for light, medium, and heavy-duty vehicles.
- Encourage the use of high-pressure direct injection (HPDI) technology in medium and heavy-duty compression ignition engines.
- Develop a buyback program (e.g., Scrap-It) to encourage the replacement of old, inefficient trucks and off-road vehicles. To be successful, continual improvement should be built into the program.
- Provide incentives for accelerated fleet renewal for freight and ferry transport.
- Support the use of compressed natural gas (CNG) for short haul ferries, with up to 10 diesel-powered ferries replaced by CNG-powered ferries on short-haul routes. Safety concerns over new technologies will need to be addressed.
- Support a shore power program for marine freighters and ferries. Implementation of a prototype national program could generate information needed for site-specific business cases.
- Provide incentives for R&D on alternative fuels and higher efficiency engines, including fuel cells, for heavy-duty vehicles.
- Use incentives and/or penalties to promote a modal shift for freight transport from highway to rail (five times more fuel-efficient than trucking). Funds would be required for additional railway infrastructure maintenance.
- Support the electrification of some railway corridors and the use of natural gas and battery locomotives.
- Set minimum emission standards for stationary generators (gen-sets) at the manufacturer level.
- Encourage electrical power plug-ins for airplanes.
- Provide incentives for alternative fuels in off-road vehicles, including mining and agricultural equipment and ground support equipment at airports.

- Encourage (e.g., through accelerated depreciation) the replacement of older, less efficient rail locomotives and lower-capacity freight cars. Improved operating efficiencies may assist a modal shift from trucking.

#### Oil and Gas

- Fund and coordinate tools and programs that assist in the identification and management of fugitive emissions in the natural gas sector.
- Provide support (e.g., tax credits, accelerated depreciation) to encourage the development of acid gas reinjection facilities.
- Provide support for a CO<sub>2</sub> market and for marginal price differences between the price of carbon and the cost of sequestration at acid gas reinjection facilities.

#### Forestry

- Establish targets and support for increased utilization of surplus wood residues in the forest sector. Among the options for using these wood residues are: to offset natural gas consumed in sawmills and pulp mills, to cogenerate electricity as an alternative to combined cycle gas turbines (CCGTs), and to produce fuels such as pyrolysis oil.
- Establish specific targets and support for afforestation and reforestation activities on marginal land to earn carbon credits.
- Use investment tax credits or other incentives to promote R&D on ethanol from biomass, bio-fuels, pyrolysis oil, biomass gasification, and carbon-neutral wood extractives such as resins and adhesives.
- Fund the Canadian Standards Association (CSA) to pursue mutual recognition among the various credible, independent, third party sustainability forest management systems of interest to BC companies: CSA, Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI, with 3<sup>rd</sup> party certification), and Pan European Forest Certification (PEFC). Work with the forestry sector to implement certification and brand BC forests as a sustainably managed resource.
- Work with the forest products industry to understand and develop opportunities offered by a sustainably managed forest sector, and to establish a leading sustainable building products industry. Support research to remove regulatory barriers to the use of wood products and changes to the BC Building Code.

#### Energy

- Implement a rate structure to promote distributed renewable energy generation or high efficiency combined heat and power generation.

#### Waste Management and Recycling

- Work with municipalities and industry to improve recycling infrastructure, with incentives to maximize participation.
- Use incentives and fees (i.e., waste permit fees and discounts) to achieve GHG reductions in industries requiring permits under the *Waste Management Act*.

## **TAXES AND FEES**

- Implement a modest carbon tax on upstream energy use to fund the BC Climate Change Action Plan measures.
- Implement a modest waste permit fee to fund the Action Plan. Ensure consistency with federally initiated GHG targets.
- Introduce a targeted gasoline consumption tax on the purchase of SUVs and other heavy emission vehicles at the point of purchase.
- Amend tax structure to accelerate the write-down of capital improvements for energy and resource efficiency upgrades.
- Provide preferential tax treatment to operators of zero-emission refuelling, recharging and bicycle parking infrastructure.
- Remove the property tax inequity that discriminates against biomass projects.

## **REGULATION AND PLANNING**

### Land Use/Planning

- Remove regulatory barriers to shared energy systems, including waste heat exchange.
- Substantially disallow or eliminate new greenfield development to control urban sprawl.
- Eliminate large-scale single use zoning (move to more efficient, multi-use land development).
- Remove regulatory barriers to secondary suites.
- Revise the provincial framework for DCCs to enable municipalities to respond to servicing plans and individual building performance that exceed standards for energy and resource efficiency.
- Establish pre-servicing guidelines for industrial areas based on principles of eco-efficiency.
- Promote/require incorporation of building solar energy devices.
- Encourage local governments to develop urban forestry plans to increase carbon sequestration capacity.
- Require municipal development regulations to comply with GHG reduction targets in OCPs by 2008.
- Require regional servicing plans to comply with GHG reduction targets in regional strategies by 2008.
- Require all municipalities to put in place growth management plans with their next development plan renewal. The emphasis should be on minimizing infrastructure requirements and expenditures.
- Encourage local governments to prepare and implement community energy plans that deliver greenhouse gas reductions.
- Remove regulatory barriers to co-location of uses, a key prerequisite for waste heat exchange.

## Buildings

- Develop energy performance criteria for the BC Building Code and a plan for their phased implementation.
- Develop world class high-performance envelope standards for BC, resolving leaky envelope issues and energy consumption issues at the same time.
- Implement legislation requiring all regional and municipal DCCs to reflect building utilization factors. A revenue-neutral levy system could reward sustainable projects.
- Eliminate regulatory barriers to green building design (coordinate with the *Municipal Act*).
- Incorporate energy efficiency outcomes into the provincial building code. Provide the opportunity for municipalities to exceed those province-wide standards. Establish equivalencies for meeting the outcomes to enable industry flexibility and to encourage innovation.
- Require new buildings to have heating or cooling systems that can be coupled to low temperature sources of heating (e.g., 70°C supply with 40°C return) to facilitate renewable energy use (solar or ground source heat pumps), waste heat (heat from eco-industrial parks, combined heat and power plants) or heat rejected from buildings that are cooled (buy and sell heat or cooling between buildings). Specifically, change building code requirements to allow only mechanical heating and cooling systems that are compatible with renewable energy use, low temperature heat pumps, local district energy systems, local combined heat and power systems, industrial waste heat, etc. (e.g., North Vancouver City's regulations for buildings in their Lower Lonsdale development).

## Transportation

- Introduce an aggressive program of giving transit vehicles a higher traffic priority on urban roads through measures such as bus lanes and signals, with a target to speed buses by 5% to 10% in congested areas by 2013.
- Develop and phase in a non-residential, off-street parking plan for Greater Vancouver that addresses the supply, regulation, and pricing of parking.
- Recommend that the federal government implement California-style vehicle emission standards.
- Require life-cycle evaluations of GHG emissions on all new transportation infrastructure to fully assess GHG impacts.
- Limit heavy-duty vehicle speeds to 90 km/hr and implement wider use of vehicle monitoring and control systems.
- Use the *Motor Vehicle Safety Act* or provincial statutes to introduce central tire inflation monitoring technology and lower rolling resistance tires. Alternatively, provide tax incentives as operating savings might not be sufficient for carriers to invest in this technology.
- Introduce minimum emission standards for all off-road vehicles (e.g., lawn mowers, gas-powered recreational vehicles). Develop and implement a vehicle emissions testing program (AirCare) for existing, large off-road vehicles (e.g., major agricultural and mining equipment and trucks.)
- Require all new transit systems and system upgrades to accommodate multi-modal integration – e.g., bicycles on buses, ferries, and trains (including SkyTrain).
- Require facilities for sheltered and safe storage of bicycles at major transit end-point and transfer points (e.g., BC Ferries and Seabus terminals, SkyTrain stations, WestCoast Express terminus stations). Note that such facilities should exceed a bike-rack and include either a

supervised area or a caged area or locker system where users can pay for secure bike lock-up.

#### Oil and Gas

- Streamline project approvals for new facilities resulting in emission reductions (e.g., acid gas reinjection in the natural gas industry).
- Clarify the liability for acid gas reinjection facilities.

#### Energy/Electricity

- Require the offset of thermal electricity generation down to 85% of a CCGT by 2010, falling to 75% by 2020 and 50% by 2030.
- Establish aggressive targets for BC Hydro's Power Smart and Resource Smart programs to reduce electricity load growth.
- Set an efficiency standard for any generation of power within the province (or urban areas, such as the GVRD) at 75%, of which at least 30% must be electric.

#### Forestry

- Maintain the neutrality of biomass in all national and international climate change negotiations.

#### Waste Management and Recycling

- Revise and enforce local industrial waste bylaws to incorporate eco-efficiency and GHG reduction requirements.
- Adopt minimum recycled content standards for products sold in BC. Preferably this would be done in a Canada-wide initiative.
- Set targets for waste heat reductions in major municipalities.
- Regulate GHG emissions under the *Waste Management Act*.

### **EDUCATION, INFORMATION, AND VOLUNTARY AGREEMENTS**

#### General

- Support the development and use of innovative tools for engaging the public in sustainability decision-making.
- Establish best practices guidelines/standards for evaluating, accrediting, and auditing emission reductions.
- Establish best practices guidelines/standards for GHG monitoring, calculation, and reporting.
- Establish a clear and flexible framework for domestic emissions trading. Develop GHG reduction registry to facilitate GHG credit trading.
- Focus future product stewardship programs on GHG-reducing opportunities.

### Buildings

- Support the BC-based Canada Green Buildings Council (CAGBC) as a centre of excellence for the industry.

### Transportation

- Promote and endorse taxi services and car co-ops.
- Introduce residence-based trip reduction programs to provide information, support, and incentives to households amenable to modal shift (modeled after the highly successful Perth Travel Smart program).
- Encourage and promote greater use of non-motorized transportation (e.g., walking and cycling) through events, programs, and promotion.
- Implement driver training, reduced idling, and vehicle maintenance programs to improve vehicle operating practices and fleet fuel economy. Alternatively, mandate truck driver training education and certification.
- Develop and implement marine codes of practice to improve operating efficiencies (e.g., for ferries), such as reduced vessel speeds. This would require strong corporate or government leadership, since decision-making about vessel running speeds is decentralized, particularly in the freight sector.
- Develop and implement industry codes of practice to promote environmental best practices in marine transportation (freight and ferries), including fuel minimization techniques.

### Industry

- Negotiate voluntary binding agreements with the aluminum industry and other industry sectors that include emission reduction targets, incentives for participation, and penalties for non-compliance.

## **DEMONSTRATION AND LEADERSHIP**

### General

- Integrate local industries with local residential, commercial and other developments to use waste energy.
- Apply a broader "sustainability lens" to all relevant government decisions and processes.
- Develop a Sustainable Province Initiative similar to the GVRD's Sustainable Region Initiative.
- Develop a comprehensive education program on sustainability and climate change for government employees.
- Increase government (federal/provincial) support for R&D on GHG-reducing technologies.
- Work with the tourism industry to develop eco-tourism opportunities, supporting sustainable planning policies. For example, fund improved cycling access to the airport and egress to Vancouver, Fraser Delta, ferries, mountains, Sunshine Coast, Vancouver Island, the Trans-Canada Trail, the Pacific Coast and border crossings.
- Actively participate in fuel cell vehicle and stationary power demonstration programs in both the private and public sectors.

### Fuel Cells and the Hydrogen Economy

- Jointly with industry, develop a strategy for growing BC's world leading fuel cell industry cluster. Use that model for establishing other sustainability clusters in the province.
- Conduct a study to assess the best method of supporting other sustainability industry clusters (e.g., forestry, energy efficiency).
- Commit to achieving a sustainable economy in the long term, with a transition to hydrogen-based energy and transportation systems as a key element of realizing that goal.
- Actively participate in fuel cell vehicle and stationary power demonstration programs in both the private and public sectors.
- Develop and implement a targeted government procurement policy for acquiring fuel cell vehicles and stationary power systems even where they are more expensive than conventional alternatives.

### Buildings

- Implement LEED BC Silver requirements for all projects with provincial funding, requiring also 6 credits in the energy performance component and relaxation of the wood credit to allow CSA Standard Z809 as well as the FSC standard.
- Support a BC Zero Energy Development (ZED) demonstration project for residential housing.
- Create a \$100-million borrowing facility for energy efficiency upgrades in provincial buildings, based on a 12-year payback criterion, with all funding paid by energy savings.
- For every BC purchasing authority, require all carpets, paints, and furniture, floor, and wall finishes to immediately meet LEED indoor air quality and volatile organic compound requirements. This action can be done at no additional cost.
- Require 50 percent fly ash content for all concrete in provincially funded buildings, roads, and other construction projects.
- Work with the construction industry to establish a Web-based recycled materials inventory. This could be organized by the BC Buildings Corporation's Green Buildings group, paid for by users, and then sold to the private sector for a profit.

### Transportation

- Implement a staff vehicle commute trip reduction program, including incentives for alternative transportation, a parking policy, telecommuting, and compressed work weeks.
- Make all new vehicle acquisitions for the provincial fleet alternative fuel vehicles, preferably hybrids.
- Convert diesel fleets to 20% bio-diesel. The US General Services Administration (GSA) has approved a 20% standard, which would be easily transferable to BC.
- Adopt intelligent transportation systems, such as signal synchronization, HOV lane enhancement, speed limit enforcement, road condition information, route optimization, and satellite tracking for vehicles.
- Provide infrastructure for servicing electric and fuel cell vehicles as soon as is justified.
- Manage airport operations to minimize fuel consumption, such as from idling aircraft engines and taxiing aircraft.

#### Forestry

- Introduce independent third party certification of all forest operations taking place under the provincial small business program.

#### Energy

- Promote and operate neighbourhood combined heat and power centres, distributed energy networks and/or district energy systems.
- Increase local clean energy production (e.g., hydroelectric generation through local water system, bio-reactor landfills, solar and wind power facilities).
- Support advanced development initiatives for wind power, fuel cells, LED lighting, native vegetation, sustainable communities, Power Smart, water smart, and sewer smart programs.

#### Waste Management and Recycling

- Investigate potential for bio-fuels to use urban organic wastes as a key feedstock.

#### Government Procurement and Operations

- Purchase only Energy Star electrical equipment for government offices.
- Undertake a review of the government supply chain to identify opportunities for emission reduction.
- Pilot energy management systems for government ministries and agencies. Develop landfill gas collection and energy projects.
- Use more clean energy in public sector operations (e.g., vehicle fleets).
- Put in place a procurement policy that will lead to the renovation of all government buildings within 20 years (5% of the building stock per year) to LEED Silver standards. Include all buildings that depend on BC government operational budgets (universities, school boards, community centres, hospitals, libraries, etc.).
- Set an aggressive target for GHG emission reduction in provincial operations.
- Set a target for government to acquire 20 percent of its energy from BC Clean sources by 2005 and 50 percent by 2010.
- Bid out and contract with the private sector for "green procurement" implementation across the entire government sector. Pay for this plan through energy and cost savings (as UBC does).

## Appendix 2: Illustrative Sectoral Template – Pulp and Paper Sector

This appendix, which deals with GHG reduction opportunities in the pulp and paper sector, is provided to illustrate the format and contents of the summary sectoral templates that will be completed by Panel members for a number of sectors of the BC economy. These templates will identify sector-specific challenges, competitive environments, opportunities, strategies and benefits. They are intended to supplement the more general economic analyses and recommendations that have been prepared by the Panel to date.

### Profile: Pulp and Paper Sector

- *Outline of the sector's socioeconomic importance to BC – GDP, employment, government revenues, community presence, etc. (based on 1999 data; to be updated with 2001 data)*

Direct employment in sector = 90,000+  
 Indirect employment = 181,000+  
 270 communities involved, in 31 local areas of BC  
 Contribution to provincial GDP = 16%  
 Contribution to provincial revenues = 20%  
 Taxes paid (provincial and federal) = \$4 billion

- *Brief description of the sector's emissions path and actions taken to date.*

Since 1990 the BC pulp and paper sector has switched from heavy fuel oil use to natural gas and biomass fuels and has implemented energy conservation measures, with consequent GHG benefits. As a result, by 2000 GHG emissions within the sector were down 29% and intensity was down 41%, despite an increase in overall production. Similar trends can be seen within the pulp and paper industry across Canada.

British Columbia		
	1990	2000
Production (t)	7,081,588	8,560,071
Emissions (t CO <sub>2</sub> )	3,923,200	2,784,500
Intensity (CO <sub>2</sub> kg/t of product)	554	325
Energy efficiency (combined) (GJ/t)	36.7	33.8

(Aggregate GHG emissions data is less readily available for the sawmilling and forestry sector (but is being generated currently). However, its magnitude is only a small proportion of that of the pulp and paper sector.)

### Challenges:

- *Description of the economic, social, and environmental challenges facing the sector as it attempts to reduce emissions over the next 30 years or so.*

The sustainable development path is second nature to the forest products sector. Ecosystem functions are maintained, communities are supported and economic well-being is provided. Most major companies are actively pursuing independent third party certifications of their forestry

activities. In 2006, membership in the Forest Products Association of Canada (FPAC) will become conditional on having all company forestry operations certified under CSA, SFI or FSC standards.

Two major challenges face the industry as it tries to reduce pulp and paper sector GHG emissions further:

- Since significant reductions have already been made through a combination of fuel switching and efficiency improvements, further improvements will be more difficult and more expensive - the "low hanging fruit" has already been harvested.
- The fact that for current energy or emissions reduction related projects the capital cost involved in implementing further improvements usually fails to meet corporate internal rate of return (IRR) hurdles. This is a common issue with most companies in the sector. It is compounded by the fact that most companies in the sector have been trying in recent years to deliver more attractive returns on capital employed, creating a further hurdle to investment.

### **Opportunities:**

- *Provision of a "word picture" of where the sector could be in 2010, 2020, and 2030 under a low-emissions sustainable development path.*
- *Description of the actions that will put the sector on that path – reductions in energy and materials intensity, clean technologies, etc.*

The forest products sector in BC currently produces approx. 2 million dry tonnes of surplus wood residue in the form of sawdust, shavings, bark etc., which are disposed of (typically burned in beehive or silo burners) with no beneficial use. This material is a by-product of the processing of wood obtained from the province's sustainably managed forests. It is carbon neutral under the IPCC definitions.

The total heat energy value of this wood residue material is close to the heat energy which the pulp and paper sector obtains today through the consumption of natural gas (45,000 TJ). In theory, then, wood residue could replace much of the natural gas used in BC pulp or paper mills. This could be done either directly, by initiatives to increase the use of wood residue at the mills, or indirectly, through the creation of fuels such as Pyrolysis oil from the wood residue. Some of these changes would involve major capital outlay (new power boilers and co-generation facilities). Since the capital already invested in boilers and related facilities is significant and not yet retired, the process could require one or two decades to complete. The GHG reductions could exceed 2 MT per annum. The result would be a sector responsible for very few GHG emissions.

In addition, the recovery boilers at many kraft mills will need refurbishing or replacing over the next 20 years or so, and more efficient recovery systems would be installed. These improvements would have the potential to further increase the energy self-sufficiency of the pulp sector. In other regions, notably Scandinavia, strategic investments in appropriate technology have resulted in many kraft pulp mills becoming net energy producers. The US industry estimates that it has the potential to shift from being a 6 GW energy user to being a 22 GW energy producer in the next 20 years. BC has a similar, but proportionately smaller, opportunity.

The sawmill sector has a much more modest energy use profile. However, where fossil fuels such as natural gas are used for lumber drying and electricity is purchased from the local utility, there is potential to generate heat from wood residues and to displace purchased electricity with self-generated power. Based on current wood residue quantities, a sawmill could be energy self-sufficient, with substantial wood residue remaining for other potential uses. Whether we replace

natural gas with energy from wood residue at pulp mills, paper mills or sawmills matters little, so long as we replace it! The GHG benefits will still accrue to the sector and to BC.

IPCC and the Kyoto protocol both recognized that storing carbon in permanently forested areas was desirable from the perspective of stabilizing climate. Thus, deforestation should be avoided and reforestation encouraged. In BC we have large areas of marginally productive farm land, (some of the Agricultural Land Lease areas, for example), that once were forests and could be reforested again. These would qualify as carbon sinks, and once established could easily generate 6MT+ per annum of credits.

### **BC Benefits:**

- *Outline of the benefits to BC businesses, workers, and citizens from the sustainable development path – homegrown technology industries, innovation, jobs, exports, etc.*
- *Case studies of specific applications to demonstrate these benefits.*

Finding a beneficial use for existing wood residuals will improve air quality by reducing particulate emissions.

Increasing the dependency of the sector on a truly renewable source of energy and more fully utilizing the harvested tree would be an important stride on the path to environmental sustainability.

Wise investment in the efficient use of renewable energy will allow the BC industry to narrow the competitive gap with other northern forest regions i.e. Scandinavia, assuring the long term survival of the industry.

BC is already well equipped with forest products research capacity (PAPRICAN, FERIC, FORINTEK) that would be utilized in sustainable development-focused research into climate change mitigation. Joint projects between the Province and the laboratories could be considered.

Research within an existing research program, the Advanced Papermaking Initiative (UBC, BCIT, UNBC), could be directed at more energy efficient refining of mechanical pulps. UBC already has an internationally recognized expertise in the area of refining. By combining disciplines (i.e. chemical engineering & bio-tech) the possibility of making a radical improvement in refining energy is a real one. Such expertise could be commercialized.

As the concept of sustainable development is embraced by mainstream science, a new discipline, the science of sustainability - "Industrial Ecology" – has emerged. (The forest products cycle is perhaps one of the closest industrial systems to a natural eco-system, but non-renewable systems are studied too). Initiatives such as increasing the sector's dependency on renewable energy are examples of moving closer to the characteristics of a natural ecosystem with resultant eco-efficiencies.

This new field has only a few centres of excellence globally today, including one at Yale and one in the Netherlands. BC could and should develop a center of excellence equal to or better than these two world leaders. With a provincial focus on sustainable development, major industries based on renewable resources, and others heavily involved in recycling, such a centre of excellence would fit well within BC's academic and industrial framework.

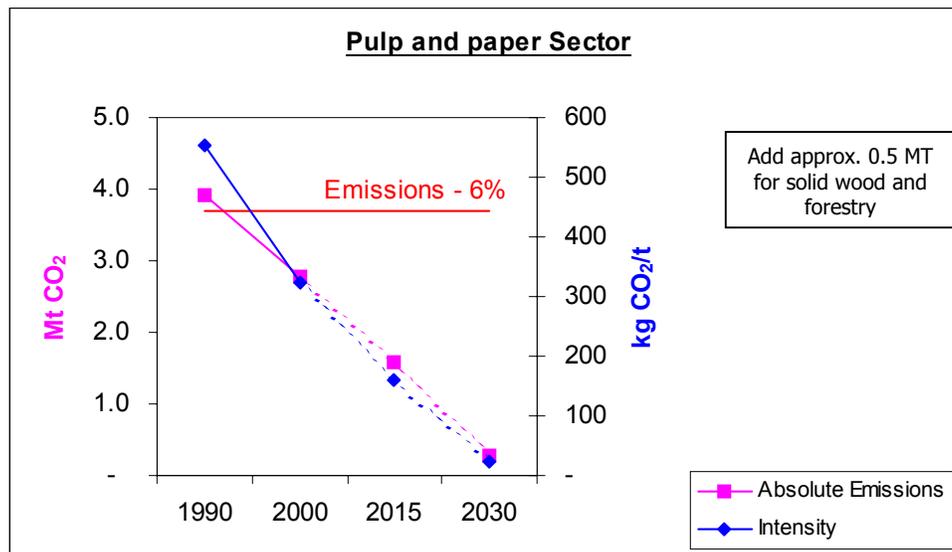
There may also be opportunities for blending forestry expertise with other BC high tech sector expertise. For example, the province already has a world-wide reputation in the areas of fuel

cells and hydrogen. Research into generating fuels from renewables has come a long way recently. Note in particular the work of Dynamotive, UBC/Alcell and Ethanol BC. What would happen, for example, if a fuel cell could be fed with pulp mill black liquor?

Graphics:

- *GHG emissions 1990-2000 and projected under "business-as-usual" and the sustainable development path*

**Potential GHG Reductions from BC Pulp and Paper Sector**



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## Appendix 3: BC Climate Change Economic Impacts Panel

### PANEL MEMBERS

Mike Bradley  
Director, Technology  
Canadian Forest Products (Canfor)

Peter Busby  
Architect  
Busby & Associates, Architects

Johnny Carline  
Chief Administrative Officer  
Greater Vancouver Regional District

Denis Connor  
Executive Chairman  
QuestAir Technologies Inc.

Rick Hyndman  
Senior Policy Advisor  
Climate Change  
Canadian Association of  
Petroleum Producers

Pat Jacobsen  
Chief Executive Officer  
Greater Vancouver Transportation  
Authority

Anne Murray  
Vice President  
Community & Environmental Affairs  
Vancouver International Airport Authority

Hugh Porteous  
Director, Research and Corporate Relations  
Alcan Inc.

John Robinson  
Professor  
Sustainable Development Research  
Initiative (SDRI)  
University of British Columbia

Bruce Sampson (Chair)  
Vice-President, Sustainability  
BC Hydro

Wayne Soper  
Senior Vice-President  
Duke Energy Gas Transmission Canada

### PANEL ALTERNATES

Ted Ferguson  
Environmental Research Coordinator  
BC Hydro

Alison Grigg  
Environmental Analyst  
Vancouver International Airport Authority

Nancy Knight  
Division Manager  
Demand Side Management Policy and  
Planning Department  
Greater Vancouver Regional District

Richard Prokopanko  
Director of Corporate Affairs  
Alcan – BC

Clive Rock  
Director of Strategic Planning  
Greater Vancouver Transportation Authority

Leigh Ann Shoji-lee  
Director  
Environment, Health & Safety Canada  
Duke Energy

## Appendix 4: Corporate Alliances on Climate Change and Sustainability

Global companies have formed various alliances and new business ventures to reduce their GHG emissions and pursue a sustainable development agenda. Examples include:<sup>42</sup>

- The World Business Council for Sustainable Development (WBCSD) ([www.wbcsd.ch](http://www.wbcsd.ch)) was created in 1995 to provide business leadership in sustainability and promote eco-efficiency, innovation, and corporate responsibility. Its membership includes more than 160 companies (e.g., 3M, Alcan, BC Hydro, Dow Chemical, General Motors, Nestle, Sony, Proctor & Gamble) with a combined capitalization of about \$2 trillion.
- Since fall 2001, the Dow Jones STOXX Sustainability Indexes ([www.sustainability-index.com](http://www.sustainability-index.com)) have tracked the economic, environmental, and social performance of the top 20 percent of sustainability-driven companies in the Dow Jones STOXX 600 index. Over 300 of the world's leading corporations are rated using more than 30 criteria groups.
- The Pew Center on Global Climate Change established the Business Environmental Leadership Council ([www.pewclimate.org/belc](http://www.pewclimate.org/belc)) that encourages voluntary action on GHG emission reduction. Alcoa, DuPont, IBM, Intel, and Ontario Power Generation are among the 35 companies represented on the council.
- The Climate Savers Program ([www.cool-companies.org/targets](http://www.cool-companies.org/targets)), a joint initiative of World Wildlife Fund and the Center for Energy & Climate Solutions, works with selected companies to develop business plans for reducing GHG emissions. Members such as IBM, Johnson & Johnson, Nike, and Kodak have committed to emission reduction targets and actions under the program.
- The Oregon-based Climate Neutral Network ([www.climateneutral.com](http://www.climateneutral.com)) is an alliance of companies and other organizations dedicated to commercializing products that involve little or no GHG impact. Corporate members include BP Amoco, Chevron, Nike, The Saunders Hotel Group, Philips Lighting, Sunoco, and Toyota.
- General Motors, BP, Monsanto, and the World Resources Institute (WRI) collaborate on "Safe Climate, Sound Business" ([www.wri.org/wri/climate/scsb.html](http://www.wri.org/wri/climate/scsb.html)), which addresses climate change through emission reductions, sequestration, and support for climate research.
- WRI and WBCSD operate a GHG Protocol Initiative ([www.ghgprotocol.org](http://www.ghgprotocol.org)) that brings together international businesses, NGOs, and governments in the development of corporate standards for emissions accounting and reporting.
- A group of senior executives in the US natural gas, energy efficiency, electric utility, and renewable energy industries participate in the Business Council for Sustainable Energy ([www.bcse.org](http://www.bcse.org)), which also supports climate change action. Members include the Alliance to Save Energy, Honeywell, Los Angeles Department of Water and Power, Maytag, and the Solar Energy Industries Association.

<sup>42</sup> Rocky Mountain Institute (2002), p. 10.

## Appendix 5: IPCC Emissions Scenarios<sup>43</sup>

In its Special Report on Emissions Scenarios (SRES), the Intergovernmental Panel on Climate Change documents the most recent set of baseline emissions scenarios to be used as inputs into climate model runs and to analyze GHG emission reduction scenarios.<sup>44</sup> The basic approach of the SRES writing team was to construct scenarios that were both qualitative and quantitative.

The SRES writing team developed four scenario “families”. Each family has as a unifying theme in the form of a “storyline” or narrative that describes future demographic, social, economic, technological, and policy trends. Four storylines were developed that identified driving forces, key uncertainties, possible scenario families, and their logic (see box). The “A” scenarios were more focused on economic development, while the “B” scenarios were more focused on environmental quality. Cutting across this dimension, the “1” scenarios assumed a greater degree of global integration, while the “2” scenarios described a greater regional orientation.

Six global modelling teams then quantified the storylines. The quantification consisted of first translating the storylines into a set of quantitative assumptions about the driving forces of emissions (e.g., rates of change of population and size of the economy, rates of technological change). Next, these assumptions were input to six integrated, global models that computed GHG and sulphur dioxide emissions. As a result, a total of 40 scenarios were produced for the

### IPCC Emission Scenario Families

*A1.* The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1F1), non-fossil energy sources (A1T), or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).

*A2.* The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

*B1.* The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

*B2.* The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

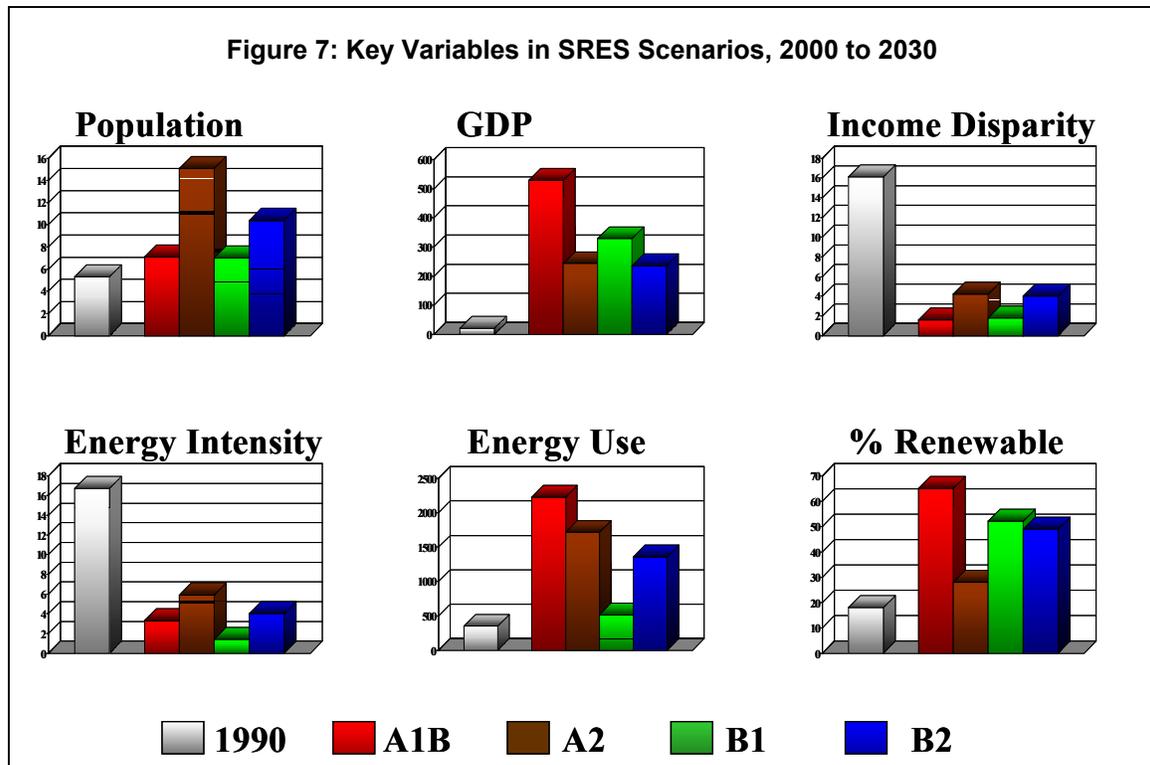
Source: Nakicenovic and Swart (2000).

<sup>43</sup> This discussion is largely excerpted from Robinson (2002), pp. 4-5.

<sup>44</sup> Nakicenovic and Swart (2000).

four storylines, grouped into six scenario groups (the A1 family was split into three groups, emphasizing respectively fossil fuels, a balance of sources, rapid technological change).

While a detailed discussion of the SRES scenarios is beyond the scope of this paper, it is instructive to look briefly at the differences among the scenario groups. Figure 7 shows the values of some of the key scenario variables in four of the six groups. It can be seen that, except in the A2 family, population growth is relatively modest, but economic growth is high, especially in the A1 group. In all scenario families, both global income disparities and energy intensities are substantially reduced. However, energy use and the proportion of zero carbon fuels vary widely among scenarios.



## **Appendix 6: Provincial Draft Sustainability Principles**

The following are the Ministry of Sustainable Resource Management's draft sustainability principles:

- **Accountability:** Setting performance-based standards and indicators and implementing mechanisms for compliance, auditing and reporting on progress towards sustainable resource management. An effective enforcement regime is a key part of accountability.
- **Certainty:** Making timely and clear resource management decisions within a predictable and understandable regulatory framework.
- **Competitiveness:** Ensuring that British Columbia remains internationally competitive by removing barriers to investment and promoting open trade.
- **Continual improvement:** Learning from the past and looking for new and improved approaches to resource management.
- **Efficiency:** Maximizing the net benefits arising from the allocation, development and use of natural resources.
- **Innovation:** Encouraging innovative approaches, technologies and skills to ensure the sustainability of natural resources.
- **Integration:** Ensuring that resource management decisions integrate economic, environmental and social considerations for the benefit of present and future generations.
- **Science-based decision-making:** Making justifiable decisions informed by science-based information and risk assessment.
- **Shared responsibility:** Encouraging co-operation among First Nations; federal, provincial and local governments; industry and non-governmental organizations in developing and implementing resource management policies.
- **Transparency:** Establishing open and understandable decision-making processes including consulting with key interests prior to making decisions. Transparency also includes the public release of monitoring and compliance records, and tracking of sustainability indicators.