# Planning for Sustainability and Climate Change in Mountain Based Resort Municipalities: A Case Study of Whistler and Rossland, British Columbia

**by**

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B.A., University of Lethbridge, 2005

Research Project Submitted in Partial Fulfillment
of the Requirements for the Degree of dfd
Master of Resource Management

in the
School of Resource and Environmental Management

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# Abstract

The Intergovernmental Panel on Climate Change has identified ski and snowboard resorts and mountain-based resort communities as vulnerable to the symptoms of climate change (e.g. receding glaciers and less reliable snow cover), and recommends they develop a response plan. This research adapts Jopp et al.'s (2010) regional adaptation model to learn how the ski and snowboard resort and the local government in Whistler and Rossland, British Columbia are planning for climate change. The findings suggest that in Whistler the ski and snowboard resort, is using its sustainability-based approach to planning to develop a series of *mitigation* strategies, and the local government, is using its comprehensive sustainability plan as a platform to implement a community wide *mitigation* plan. In Rossland the ski and snowboard resort has not developed a response plan; however, the local government is using its sustainability-based approach to planning, to develop a community wide *adaptation* strategy.



**Keywords**: climate change; mitigation; adaptation; mountain-based resort communities; ski industry

*Neo-liberal agendas and the downsizing of governments have led to merged responsibilities for governance between public and private institutions (Gill & Williams, 2011a).*

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## Acknowledgements

I am sincerely indebted to my supervisors – Drs. Peter Williams and Alison Gill – for their support and direction. At every point of this project they encouraged deeper thinking, offered continuous feedback, and facilitated personal and academic growth.

I am very appreciative for the informants who participated in this study, without them my research would not have been possible. Their deep-rooted belief in sustainability planning will help guide mountain-based resort communities and the ski industry through the many challenges and opportunities that climate change may present.

I truly believe that friends are the family you choose. I consider my friends from the REM program to be a part of my family, and I am truly grateful for their tremendous love and support. We have spent a lot of time having late night study sessions, seeking out new adventures, and eating chocolate to make it through it all. I extend this thankfulness to my parents, who have always found a way to support my journey.

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# List of Acronyms or Glossary

| | |
|---|---|
| ACT | Adaptation to Climate Change Team |
| CACCI | Communities Adapting to Climate Change Initiative |
| CBT | Columbia Basing Trust |
| CNK | Carbon Neutral Kootenays |
| CSP | Comprehensive Sustainability Plan |
| EMS | Environmental Management System |
| IPCC | The Intergovernmental Panel on Climate Change |
| NGO | Non Government Organization |
| NRCan | Natural Resource Canada's |
| OCP | Official Community Plan |
| PCIC | Pacific Climate Impacts Consortium |
| PICS | Pacific Institute for Climate Solutions |
| RMOW | Resort Municipality of Whistler |
| SC | Sustainability Commission |
| SSP | Strategic Sustainability Plan |
| TNS | The Natural Step |
| TW | Tourism Whistler |
| UBCM | Union of British Columbia Municipalities |
| UNFCCC | United Nations Framework Convention on Climate Change |
| V2A | Vision to Action |
| WCS | Whistler Centre for Sustainability |

# 1. Introduction

## 1.1. Research Rationale

Tourism plays a crucial role in the province of British Columbia (BC) in Canada. It is the second largest economic sector next to forestry, contributing more than $6.3 billion (approximately 4%) towards BC's gross domestic product (GDP) in 2009 (BC Stats, 2010). It is also an important source of employment, providing around 129,000 jobs for British Columbians, which is the equivalent of one out of every fourteen workers (BC Stats, 2010). To help support the tourism industry, the Government of BC has designated thirteen municipal governments—of tourism destinations—as resort municipalities. The municipalities receive a portion of the provincial hotel room tax to be used for local investments in tourism infrastructure, amenities, and programs designed to strengthen the marketability of the entire community (Government of British Columbia, 2010; Whistler Centre for Sustainability, 2011).

Overall, nine of the thirteen resort municipalities are alpine based and are classified as mountain-based resort communities, which have primarily developed around ski resorts[1] (Government of British Columbia, 2010). This study examines the mountain-based resort communities–Whistler and Rossland, BC.

### 1.1.1 Whistler, BC

Whistler, located 120 km north of Vancouver (Figure 1), is a comprehensively planned four-season mountain resort community, and was an official host for the 2010

[1] The use of the term "skiing" in this report includes alpine or downhill skiing and snowboarding

Winter Olympic and Paralympic Games. The Resort Municipality of Whistler (RMOW) is the community's local government, which has an estimated permanent population of 11,000 residents (*Whistler 2020*, 2011). Annually, the destination hosts about two million visitors, and non-residents own about half of all residential properties (Gill & Williams, 2011a). The RMOW was officially designated a resort municipality by the Resort Municipality of Whistler Act in 1975.

The largest employer and biggest business in Whistler is the four season resort corporation Whistler and Blackcomb Holding Inc. (WB), and its operations are primarily located on two mountains abutting the municipality, Whistler and Blackcomb. In the summer, WB's main attraction is downhill-mountain biking and sightseeing, while in the winter the primary draw is its downhill skiing and snowboarding facilities (*Whistler 2020*, 2011). Summer guests are primarily from regional markets and stay for shorter visits, while in the winter a greater portion of tourists originate from destination markets and stay longer. Winter is Whistler's primary tourism season and it generates the largest share of WB's tourism revenues (BC Stats, 2005).

The RMOW and Whistler Blackcomb Inc. are economically dependent on their ability to maintain tourism as a primary economic driver (*Whistler 2020*, 2011). In 2000 the RMOW hired KPMG—an economic consulting company—to determine Whistler's overall contributions to BC's revenue stream. KMPG estimated that Whistler's resort economy generated $1.035 billion in tourism spending which accounted for 11% of the province's total tourism revenue of $9.47 billion. In that same year direct visitor spending in Whistler was estimated at $921 million. Almost a third of this was associated with the food and beverage sector (30%), followed by lodging (25%), recreation and entertainment (15%), retail (14%), grocery (7%) and transportation (7%). Although, the KPMG study needs updating, the proportional share of Whistler's contributions to BC's tourism revenues are still estimated to be in the 11% range. To further illustrate Whistler's economic dependence on tourism, BC Stats (2008) indicates that about 30% of the jobs in Whistler are in the accommodation and food industry sectors; 10% are in entertainment and recreation; another 9% of jobs are in retail; and 9% are in construction.

The RMOW and Whistler Blackcomb Inc. both understand their economic dependence on protecting and conserving the area's natural resources for visitor and resident appreciation, and they have made a strong commitment to developing economic, social and environmental actions that improve the destination's overall sustainability.

In 2000, the RMOW adopted a community-driven form of governance that was guided by the sustainability principles associated with "The Natural Step" (TNS) (Gill & Williams, 2011a; *Whistler 2020*, 2011). Its principles are designed to guide collective community decisions toward actions that: eliminate the progressive buildup of substances extracted from the Earth's crust, eliminate the progressive buildup of chemicals and compounds produced by society, eliminate the progressive physical degradation and destruction of nature and natural processes, and eliminate factors that undermine people's capacity to meet their basic human needs. These objectives are accompanied by the *Whistler 2020* vision "Whistler will be the premier mountain resort community – as we move toward sustainability" (*Whistler 2020*, 2010, para. 1).

Prior to the RMOW's plan, Whistler Blackcomb Inc. (WB) had begun its journey towards sustainability. In 1992 the ski resort developed an environmental management system (EMS) plan, which today complements the RMOW's *Whistler 2020* vision, and includes a zero operating footprint goal associated with waste, carbon, and net emissions.

### 1.1.2 Rossland, BC

Rossland is a smaller-scale four-season mountain-based resort community, located in BC's Southern Interior Mountains, halfway (630km) between Vancouver, BC and Calgary, AB (Figure 1). Rossland City Council is the community's local government, and has an estimated permanent population of approximately 3,500. Rossland exists within a larger economic unit that includes neighbouring municipalities, and two regional districts—the Regional District of East Kootenay (RDKB), and the Regional District of Central Kootenay (RDCK) (The City of Rossland, 2010a). In 2006, approximately 37% of employed residents worked in Rossland while another 60% worked in Trail—a mining

community of approximately 7,300 people, located 10 km to the east (The City of Rossland, 2010a).

Rossland's largest employer is Red Mountain ski and snowboard resort. Red Mountain resort is independently owned and employs 200 seasonal workers and 40 full time staff (Waston, 2010). Rossland's primary tourist draw is the ski resort; however, the destination entices summer tourists with attractions such as Redstone golf resort and extensive mountain biking trails. In 2007 the Government of BC formally designated Rossland City Council as a 'Resort Municipality'.

Rossland City Council uses commercial accommodations as a primary tourism indicator. In 2010 its commercial accommodation revenues approximated $2.6 million, which was 18% higher than in 2009 (Tourism Rossland, 2011). However, Rossland is considered a relatively small-scale destination, for example the mountain tourism community of Revelstoke, located 300 km's north of Rossland, earns more than $16 million in accommodation revenue each year (Tourism Rossland, 2011).

Similar to the RMOW, Rossland City Council recognizes its economic dependence on the natural environment, and has committed to developing economic, social and environmental actions that improve the destination's overall sustainability. In 2007, Rossland City Council began working on a long-term sustainability initiative titled Vision to Action (V2A), which engaged the community in conversations about how to shape a more sustainable future (The City of Rossland, 2008). Through the V2A process a community Strategic Sustainability Plan (SSP) was developed containing *Rossland's 2030* vision, "…Rossland is a resilient alpine community and a leader in balancing social, environmental, and economic sustainability" (The City of Rossland, 2010b, p. 10).


Figure 1. Map of British Columbia (Province of British Columbia, 2012)

### 1.1.3 Climate Change and Mountain Based Resort Communities

Mountain-based resort communities and their associated ski resorts rely on favourable alpine weather and climate conditions, and accessible natural resources to attract tourists and retain/ increase resident populations (Scott, 2003; Williams, Dossa, & Hunt, 1997). However, the Intergovernmental Panel on Climate Change (IPCC) confirms that the stability of the global climate and the availability of snow cover for many alpine winter tourism activities are threatened by anthropogenic greenhouse gas (GHG) emissions (IPCC, 2007a).

In Canada, since the late 1940s the mean annual temperature has increased by 1.1$^{o}$C with winters experiencing the greatest amount of warming—on average they are 1.9$^{o}$C warmer (Bruce, 2009). Specific to BC, during the past century the province warmed significantly across all seasons and changes in the amount and type of

precipitation—mainly more rain and less snow—are evident (Walker & Sydneysmith, 2008). These impacts are affecting the natural winter setting of BC's mountain regions (e.g. receding glaciers, reduced snow pack, and less reliable snow cover), which may diminish the draw of ski tourism operations located in these areas (Walker & Sydneysmith, 2008). This creates the need for local governments and ski resorts to both implement climate change response strategies in combination with sustainable development goals (Scott, 2010; UNWTO & UNEP, 2008).

In a case study method of Whistler and Rossland, BC, this research employs a climate change response frame, adapted from Jopp et al. (2010), to understand how the Resort Municipality of Whistler (RMOW), Whistler Blackcomb Inc. (WB), Rossland City Council, and Red Mountain resort (Table 1), are developing climate change management initiatives alongside sustainability strategies. The results are intended to be instructive for the local governments of mountain-based resort communities' and ski resorts.

***Table 1. Municipal Government and Associated Ski Resort in Whistler and Rossland, BC.***

| Mountain-Based Resort Community | Municipal Government | Ski Resorts |
|---|---|---|
| Whistler, BC | Resort Municipality of Whistler (RMOW) | Whistler Blackcomb Inc. (WB) |
| Rossland, BC | Rossland City Council (City Council) | Red Mountain Ski and Snow Board Resort |

## 1.2 Research Objective and Questions

The overarching objective of this research is to determine the extent **municipal governments** and **ski resorts** in mountain-based resort communities are planning for climate change. Four guiding questions focus the research associated with the overriding objective. They are:

1. What governance approaches is the municipal government and ski resort in Whistler and Rossland, BC using to plan for climate change?
2. What are the climate change risks and opportunities facing the municipal government and ski resort in Whistler and Rossland, BC?
3. What is the climate change response capacity of the municipal government and ski resort in Whistler and Rossland, BC?
4. To what extent has the municipal government and ski resort in Whistler and Rossland, BC identified, assessed, implemented, and evaluated climate change response strategies?

## 1.3 Research Approach

### 1.3.1 Literature Review

A literature review provides the theoretical foundation and guiding frame for the examination of this study's research objective and questions. The review discusses the relationship between: climate change and tourism; planning for climate change in mountain-based resort communities; and assessing planning regimes.

### 1.3.2 Case Study

Based on an adaptation of Jopp et al.'s (2010) regional adaptation model, this research assesses how the municipal government and the associated ski resort in Whistler and Rossland, BC are planning for climate change. A semi-structured active interview was the primary investigative tool used (see Chapter 3). Respondents included local elected officials, representatives from the municipalities (e.g. city planners), non-government organizations (NGOs), and ski resort operators, and other tourism operators. The empirical results of the case study were systematically interpreted and

reported on according to themes in the adaptation of Jopp et al.'s (2010) regional adaptation model.

## 1.4 Research Significance

At a theoretical level, the synthesis of the literature ultimately informs the development of an assessment model to understand how local governments and ski resorts in mountain-based resort communities can plan for climate change.

At an applied level this work catalogues how the local government and ski resorts in Whistler and Rossland, BC are integrating climate change response strategies into their management regimes. As such, the research may be instructive for these case study communities, as well as other mountain-based resort communities concerned with climate change.

## 1.5 Report Project Structure

This introduction is the first of six chapters. Chapter Two reviews and discusses the relevant literature to the study and informs the development of an assessment model guiding the primary research pursued. Chapter Three outlines the design and research methods employed, and identifies the research limitations. Chapter Four reports the findings emerging from the case study. Chapter Five places the project's findings in the context of the broader climate change and planning related literature, and discusses key lessons learned. Chapter Six offers conclusions and provides recommendations for further research.

# 2 Review of the Literature

## 2.1 Introduction

This literature review considers three topics that have influenced this study. The first explores the impacts climate change may have on tourism, mountain-based resort communities, and ski resorts. The second situates the study objective within the context of planning for climate change in mountain-based resort communities, governance, and response strategies. The third identifies a regional climate change adaptation-planning model.

## 2.2 Tourism and Climate Change

### 2.2.1 Tourism

Tourism has been defined as:

> "the activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited" (WTO, 2008, p. 181).

Over the past several decades' global tourism has experienced strong growth. From 1950 to 2008 the number of global international tourist arrivals has climbed from about 25 million to 922 million and revenues rose from US$2.1 billion to US$856 billion in 2007(UNWTO, 2009). Tourism currently accounts for about 9.1% of the global GDP (US$5.9 billion) and is expected to rise to 9.6% (US$9.9 billion) by 2021(WTTC, 2011).

Canada makes significant contributions to the global tourism industry. In 2007 about 17.9 million tourists visited the country, and it ranked 14$^{th}$ amongst the 50 most

visited countries in the world (UNWTO, 2008). Tourism contributes significantly to the Canadian economy, with tourist activities accounting for 2% of Canada's GDP (Industry Canada, 2010). Mountain-based winter activities have shaped a considerable portion of Canada's tourism performance and continue to make important contributions to the income of many urban and rural communities. Canada's ski sector boasts more than 250 ski resorts (Scott & Jones, 2006), and winter tourism for downhill skiing and snowboarding generates about $839 million annually (Bruce, 2009). BC's winter tourism sector and ski resorts attract a portion of this market, hosting local, national, and international visitors ever year. The Canadian Ski Council (CSC) estimates that roughly 5.8 million skiers and snowboarders visited ski resorts throughout BC during the 2008/09 season; making significant contributions to the provincial economy (specific dollar amounts are unavailable) (BC Stats, 2010). For the remainder of the paper the term 'skiing' will include both alpine and downhill skiing and snow boarding activities.

### 2.2.2 Climate Change

Weather and climate are key resources for mountain-based resort communities. In most cases weather and climate define the length and quality of a tourist season, and play major roles in shaping destination choices and tourist spending. Overall, projected changes in climate are expected to have significant implications for Canada's tourism industry and for winter based resort communities in particular (UNWTO & UNEP, 2008).

Weather refers to the fluctuating state of the atmosphere and is characterized by daily changes in temperature, wind, precipitation, and cloud cover. Climate reflects average weather for a specified area over a relatively long time period, usually decades or centuries, but sometimes even millennia (IPCC, 2001a). It is typically described in terms of averages and extremes in air temperature, precipitation, humidity, sunshine, and storm frequency (British Columbia Ministry of Water, Land and Air Protection, 2002). Climate varies from place to place, depending on latitude, distance to the sea, vegetation, and presence or absence of mountains or other geographical factors. Climate also varies from season to season, year-to-year, decade to decade or on much longer time-scales. Climate variability involves relatively short-term changes and can occur as a result of natural alterations in some aspect of the climate system (British Columbia Ministry of Water, Land and Air Protection, 2002). Statistically significant

variations of the mean state of the climate or of its variability, typically persisting for decades or longer, are referred to as 'climate change' (IPCC, 2001a).

Air temperature and precipitation are the two most commonly measured and widely studied variables in relation to climate change. Over the last century (between 1906 and 2005) scientists have recorded an increase in the average global surface temperatures by about 0.74°C, but with regional variations (IPCC, 2007a). Precipitation has increased over land at mid and high latitudes of the Northern Hemisphere, especially during winter and early spring, and over most Southern Hemisphere land areas. It is unlikely that climate change will be a homogenous force. Its consequences may vary among different locations depending on the magnitude and speed of change, and the characteristics of existing biological and human systems (Belle & Bramwell, 2005).

### 2.2.3 Mountain Regions

Mountainous regions are sensitive to climate change. Evidence can be seen in less snow, receding glaciers, more extreme events like landslides, and a shift in mountain flora and fauna—particularly at lower to mid elevations (~1,600 m), when compared to higher elevations (~2,600 m) (Scott, 2003). Future climate change predictions for mountain regions include: increased mean winter temperatures, increased mixed precipitation during the winter, rising reliable snowlines, higher elevation freezing levels, an increased number of extreme winter storms events, increased snow avalanche risks, and an increased length of fall and spring seasons (Beniston, 2006; Bürki, Elsasser, & Abegg, 2003; IPCC, 2001b, 2007a; Reynolds, 2010).

## 2.2.4 BC's Mountain Regions

The province of BC is divided into ten eco-provinces (areas with consistent climatic conditions processes, oceanography, and regional landforms) (Figure 2). In relation to this research, Whistler is located within the Coast Mountains, while Rossland is located in the Southern Interior Mountains.


Figure 2. Ecoprovinces of BC (Province of British Columbia, 2012)

These mountain regions are a part of the Canadian cordillera—the series of mountain ranges in Alberta and BC, bordered on the east by the Canadian Rockies in Alberta, westward through BC to the Coastal Mountains—adjacent to the Pacific Ocean on the west.

There is a limited amount of scholarly literature available for BC and the Canadian Cordillera; however, the available data provides sufficient context to understand how the changing climate may impact BC's mountain-based resort communities. Currently, BC is experiencing a pattern of warming consent with broader North American trends.

Generally cold days and nights have become less frequent, while hot days and nights and heat waves have become more common (British Columbia Ministry of Water, Land and Air Protection, 2002). The overall pattern suggests that most regions of BC are warming because night time minimum temperatures are increasing, not because daytime maximum temperatures are increasing. The strong increasing trends in minimum temperature, especially during the spring and summer, have likely made the greatest contribution to the general warming trends across the province (British Columbia Ministry of Water, Land and Air Protection, 2002). In terms of precipitation, data collected at climate stations throughout the province show that since 1950 winters have become drier, while spring and summer seasons are wetter (Walker & Sydneysmith, 2008). However, variations in these fluctuating weather patterns have occurred throughout the different regions of the province.

In the Coast Mountains during the 20$^{th}$ century the region warmed at a rate equivalent to 0.5$^{o}$C to 0.6$^{o}$C per century, or at roughly the same rate as the global average (Walker & Sydneysmith, 2008). Specific to the Southern Interior Mountains the region warmed at a rate equivalent to 1.1$^{o}$C per century, or at twice the global average (Walker & Sydneysmith, 2008). These temperature trends are based on 101 years and almost certainly reflect climate change (British Columbia Ministry of Water, Land and Air Protection, 2002).

Precipitation increased in the Coast Mountains by two percent per decade and by four percent per decade in the Southern Interior Mountains. These trends are based on 70 years of data and likely reflect the influence of climate change (British Columbia Ministry of Water, Land and Air Protection, 2002).

For much of BC, future projections suggest a likely warming by 2-7 $^{o}$C by 2080 for all seasons with wetter conditions in winter and spring, but drier conditions during summer in the south and on the coast (Walker & Sydneysmith, 2008). Table 2 and 3 summarizes the historical temperature and precipitation trends throughout BC, Southern BC, and Coastal BC.

***Table 2. Historical (1900-2004) temperature trends throughout BC, Southern BC, and Coastal BC***

| Region | Extremes | Seasonal |
|---|---|---|
| BC | Increased warm temperature extremes; fewer extreme cold days and nights; fewer frost days and more extreme warm nights and days; longer frost-free period. | Daily minimum and maximum temperatures higher in all seasons; greatest warming in spring and winter. |
| Southern BC | Interior warmed more than the coast. | Warming in spring, fall and winter, but not summer. |
| Coastal BC | Coast warmed less than interior. | Warmer in spring and fall. |

Source: Walker & Sydneysmith (2008)

***Table 3. Historical (1900-2004) trends in precipitation throughout BC, Southern BC, and Costal BC***

| Region | Extremes | Snow/Rain | Total annual precipitation | Total seasonal precipitation |
|---|---|---|---|---|
| BC | More precipitation days; decreased consecutive dry days, decreased mean daily precipitation; no consistent changes in extremes. | Decreased snow to total precipitation ratio (more rain, less snow during cold season) | Slightly wetter for the period 1950-2003 | N/A |
| Southern BC | Wetter winter wet periods | Less annual snowfall in last 50 years; ratio of rain to snow increased (more rain, less snow) in Okanagan; decreased snowpack in spring and at lower elevations | Wetter in 20th century, with majority of increase before 1945 | Wetter in spring, summer, fall; drier in winter, wetter in summer in Okanagan; drier in winter in interior |
| Coastal BC | | Less snow throughout, more than 40% less at some sites; greatest loss of snow in Pacific Northwest on south coast; more locations with no snow in April | | Wetter in winter (more rain), except Georgia Basin (no trend November to March) |

Source: Walker & Sydneysmith (2008)

### 2.2.5 Climate Change Impacts on Mountain Communities

Winter tourism and climate research has been undertaken in various countries such as Canada, the U.S.A., Australia, New Zealand, Austria, Switzerland, France and the U.K. (Scott, 2003). This research suggests changes in climate may have significant implications on mountain tourism destinations throughout all seasons. The UNWTO & UNEP (2008) provides a general overview of these implications (see Table 4).

***Table 4. The Major Climate Change Impacts and Implications for Mountain Tourism Communities***

| Climate Change Symptoms | Potential Destination Implications |
|---|---|
| Increased duration and frequency of higher temperatures | Altered seasonality; changes in plant-wildlife-insect populations and distribution; and an increase in invasive species. |
| Decreased duration of reliable snow cover, snowpack, glacier coverage | Decreased winter sport season, snow cover length, availability, and quality; increased snowmaking and snow-retention costs; increased avalanche management costs; decreased winter landscape attractiveness. |
| Increased frequency and duration of 'extreme storm' conditions | Increased risk insurance costs and business interruption costs. |
| Increased frequency of heavy precipitation | Damaged tourism and community infrastructure; altered lengths of winter, summer and shoulder seasons. |
| Decreased availability of reliable water supplies | Increased water shortages, increased competition over water between tourism and other sectors; desertification; increased wildfires threatening infrastructure and affecting demand. |
| Changed character of terrestrial biodiversity | Loss of natural attractions and species from destinations, and higher risk of invasive species i.e. mountain pine beetle. |
| Increased frequency, intensity and extent of forest fires | Loss of natural attractions; damage to tourism. |

Source: Adapted from UNWTO & UNEP (2008)

From a strategic management perspective four broad categories of climate change impacts have been identified that may affect the market competitiveness and the overall sustainability of mountain tourism activities and the hosting regions. They are:

- Direct climate impacts - geographic and seasonal redistribution of climate resources for tourism, and changes in operating costs.
- Indirect climate change impacts –water shortages, biodiversity loss, decline of landscape aesthetic, increase in vector-borne disease, and damage to infrastructure.
- Impacts of mitigation policies on tourist mobility - changes in tourist flow due to increased prices, alterations to aviation routes, changes in the proportions of short-haul and long haul flights.
- Indirect societal change impacts – changes in economic growth, development patterns, social-political stability and personal safety in some regions (UNWTO & UNEP, 2008).

### 2.2.6 Climate Change Vulnerability and Ski Resorts

Much of literature on mountain-based resort communities and climate change is centred on the vulnerability of its associated ski resorts. The vulnerability of a ski resort is determined by several geographic and built environmental factors that include: elevation, snow reliability, glacial cover, and the degree of base developments. The impacts to the natural and built environment are predicted to reduce the quality and appeal of ski resorts, resulting in reduced visitation levels, which in turn may have negative impacts on resort revenues and local economies.

**Elevation:**

Elevation determines whether precipitation falls as rain, mixed precipitation, or snow, and it defines the initial reliable snowline on the mountain slopes (Beniston, 2006; Bürki et al., 2003; IPCC, 2001b, 2007a; Reynolds, 2010).The overall elevation of a ski resort is one of the most important geographic factors because the greatest effects of climate change are expected to be felt at lower to mid elevations (~1,600 m), when compared to higher elevations (~2,600 m) (Beniston, 2003, 2006; Bŭrki et al., 2003). Modeling indicates that at 2,000 m a warming of 2$^{o}$C does not seem problematic for snow cover, and ski resorts with good prospects will be those that provide access to altitudes higher than 2,000 m by the 2050s (Scott, 2003).

**Snow Reliability:**

Snow reliability is defined as sufficient snow cover of at least 30 to 50 cm, for a minimum of 100 days during the ski season (between December 1 and April 15) in seven of every ten winters (Bruce, 2009). A high quality skiing experience depends on at least 30 cm of packed snow cover at the base elevation and 70 cm or more to sufficiently cover slopes and hazards at mid and summit elevations (Bruce, 2009).

Currently the average elevation of reliable snow is 1,200 m. The warming effects of climate change on snow and temperature conditions are causing the reliable snowline to gradually rise in elevation (Reynolds, 2010). General estimates indicate that the snowline will rise by 150 m per 1$^{o}$C. Furthermore, models project a 75 cm to 125 cm reduction in average winter snow depth and estimated upward shift in the snowline from 900 m to 1,250 m in Western North America (Scott, 2003).

**Base Development:**

An attractive base development can help diversify ski resorts' product offerings and significantly reduce their vulnerability to climate change (Scott & McBoyle, 2007). Base developments provide services beyond the facilities necessary to support skiing activities, including on-hill accommodations, and food and beverage facilities. Some ski resorts have diversified by becoming four season operations with amenities such as golf courses, conference facilities, permanent residences, staff residences, grocery stores, service stations, and private real estate development aimed at time-share and ownership for part-time residence (Reynolds, 2010).

Despite the many potentially negative impacts climate change may have on winter tourism operations, this phenomenon may have positive impacts for some mountain activities. For instance, the summer season may be lengthened and generate an increase in summer market demands (Scott & Jones, 2006). However, the negative impacts are predicted to outweigh the positive effects (Jopp, DeLacy, & Mair, 2010).

### 2.2.7 Mountain-Based Resort Communities and Ski Resorts Climate Change Influence

Municipal governments in mountain-based resort communities and the associated ski resorts are mostly concerned with the economic impacts climate change may have on the ski tourism industry, yet they directly and indirectly consume large amounts of GHG emissions (Kelly & Williams, 2007). Direct emissions are associated with providing amenities and supporting facilities within the community, while indirect emissions are related to energy needed to transport travellers. The majority of energy used by mountain communities comes from:

- Internal destination energy consumption, which includes energy consumption for all buildings, infrastructure, and transportation internal to the destination.
- Employees commuting to and from the destination, which includes traveling by automobile, car-pooling, or public transportation.
- Visitor travel to and from the destination, which includes traveling by automobile, bus or airplane (Kelly & Williams, 2007).

From the above sources, energy needed to facilitate the transportation of travellers and employee's represents the greatest amount of GHG emission (Reilly, Williams, & Haider, 2010). The UNWTO & UNEP (2008) estimates that tourism transportation, accommodation, and activities contribute up to 5% of global GHG emissions; with 90% related to transportation. These numbers align with a study conducted by Kelly & Williams (2007) on energy consumption and GHG emissions in Whistler, BC which found:

> if external travel energy consumption and GHGs (including employee commuting) is included in Whistler's total energy inventory, it would account for approximately 80% of the destination's overall energy consumption and about 86% of their GHG emissions. The contribution from airplane travel alone would account for about 72% of total energy consumption and 78% of GHG emissions (p. 81).

Energy needed to facilitate the transportation of travellers and operate mountain-communities, while contributing to global GHG emissions, illustrates the need for the industry to implement strategic climate change response strategies.

## 2.3 Planning for Climate Change in Mountain-Based Resort Communities

### 2.3.1 Governance

Governance encompasses the values, rules, institutions and processes through which public and private stakeholders seek to achieve common objectives and make decisions (Beritelli, Bieger, & Laesser, 2008). Historically, governance in mountain-based resort communities has followed a path of dependence, defined by structural, cognitive, and political lock-in (Gill & Williams, 2011a). Structural lock-in is dependency on increasing returns on investments. For example, in the mountain resort context such as Whistler, the long-term benefits accruing from the high initial cost of investment in mountain lift systems are intricately tied to escalated returns on the sale of real estate developed in close proximity to the slopes (Gill & Williams, 2011a). Cognitive lock-in relates to institutional embeddedness and the structure of social relationships that link people to institutional environments, whereas political lock-in has much to do with power relationships (Gill & Williams, 2011a).

Global changes are expected to influence the historical governance structure of mountain-based resort communities, and new paths of governance may be created. The components of path creation include endogenous (limits to growth and changing local values), and exogenous forces (global socio-economic and environmental change), critical change events (mega sports events) and human agency (entreasures) (Gill & Williams, 2011a). Global changes are classified as economic, political, environmental, technological, demographic, and social (Gill & Williams, 2011a).

To conceptualize changes in mountain-based resort community governance, Gill & Williams (2011b) developed a model that employs components of path dependence and path creation (Figure 3).

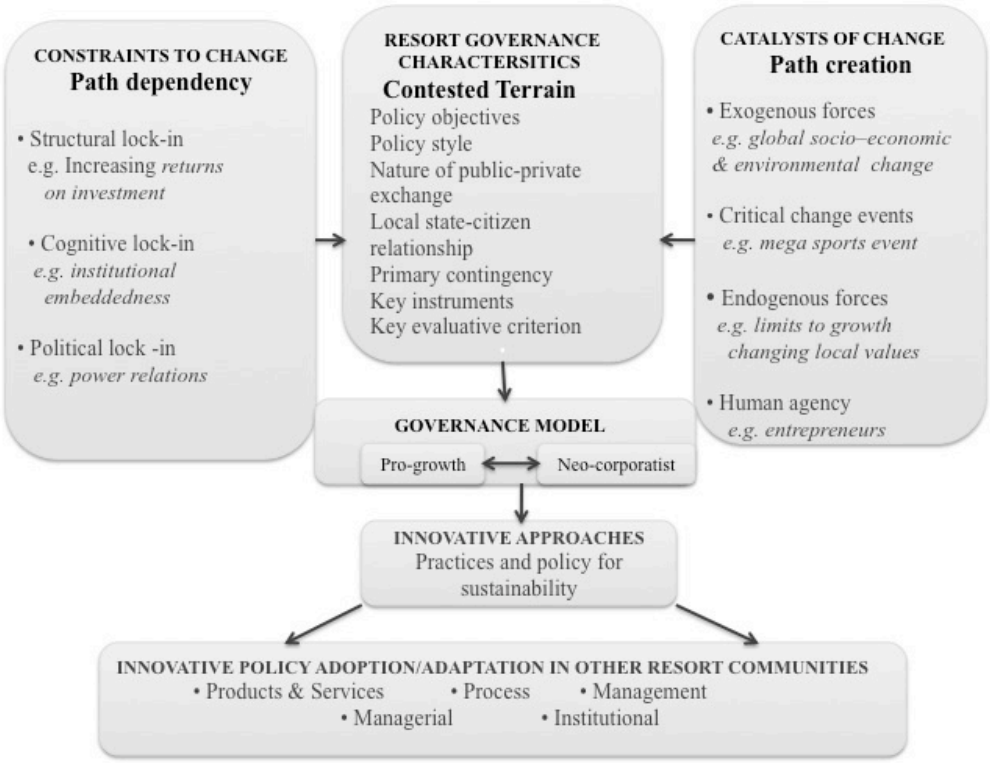


Figure 3. A conceptual model of change in resort governance (Gill & Williams, 2011b).

According to Gill & Williams (2011a) “in recent years, neo-liberal agendas and the downsizing of governments have led to merged responsibilities for governance between public and private institutions” (p.631). In the context of this research, the ability of local governments and ski resorts to create new paths of governance and collaboratively plan for climate change is expected to influence the long term sustainability of mountain-based resort communities (Scott, 2010).

### 2.3.2 Climate Change Response Strategies

Interventions or responses designed to reduce climate-related risks are categorized as mitigation or adaptation. Mitigation “is the promotion of policy, regulatory and project based measures that contribute to the stabilization or reduction of greenhouse gas concentrations in the atmosphere” (IPCC, 2007b, p. 818). Adaptation is an “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2007b, p.809).

**Mitigation**

The overall mitigation objective for most communities is to achieve 'carbon neutrality' (Simpson, Gössling, Scott, Hall, & Gladin, 2008). Carbon neutrality can be defined by the entire set of polices that an institution or business uses when it estimates its known GHG emissions, takes measures to reduce them, and purchases carbon offsets to 'neutralize' remaining emissions (Simpson et al., 2008). Four main strategies are typically considered foundations to achieving carbon neutrality; they include: reducing energy use, improving energy efficiency, increasing the use of renewable energy, and as a last resort purchasing carbon offsets[2] (see Table 5) (Becken & Hay, 2007; Simpson et al., 2008)

[2] A company can purchase carbon offsets and receive credits for reductions made at another location, such as wind farms that create renewable energy and reduce the need for conventional sources of electricity like coal-burning generators (David Suzuki Foundation & Pembina Institute, 2009).

***Table 5. Core Mitigation Strategies for Achieving Carbon Neutrality***

| Mitigation strategies | Example |
|---|---|
| Reducing energy use | Changing management practices or behaviours, such as walking instead of using motorized forms of transportation. |
| Improving energy efficiency | Improving the ratio between the energy input (e.g. electricity consumed by a light bulb) and the useful energy output (light energy provided by the bulb). |
| Increasing the use of renewable energy | Replacing the consumption of fossil fuels with energy sources that are not finite such as hydro, wind, and solar energy |
| Offset emissions | Purchase carbon offsets to mitigate emissions |

Source: Becken & Hay (2007); Simpson et al. (2008)

Within these four strategies are specific actions that can be implemented by transport providers, accommodation establishments, tour operators, tourists, and destination's host community governments (see Table 6)

***Table 6. Overview Of Potential Mitigation Actions***

| Action / Actor | Air Transport | Car Transport | Train Transport | Destination | Accommodation |
|---|---|---|---|---|---|
| Tourists | Minimize air transport; choose pro-environmental airline; offset emissions. | Avoid car transport; or use more energy-efficient vehicles. | Use train & coach systems that are more energy efficient. | Stay longer; favour closer destinations. | Choose environ-mentally certified hotel. |
| Tour operators | Cooperate with pro environmental airlines; develop carbon-offsetting programs. | Promote the use of eco-friendly cars. | Develop packages based on train/coach transport and other carbon smart products. | Offer destinations close by; provide carbon labeling. | Cooperate with certified hotels. |
| Destination Managers, Planners, Governments | Restructure marketing (eco-efficiency); consider domestic tourism; increase length of stay; focus on revenue, not growth. | Promote public transport systems; eventually small cars. | Cooperate with national railways systems and coach operators to offer attractive transport solutions. | Involve the entire community to engage in actions to become sustainable destination. | Promote the use of environmental management systems and eco certifications. |

Source: Adapted from Simpson et al. (2008)

Mountain-based resort communities and associated ski resorts' uptake in mitigation strategies appears to be limited due to technical, economic, and social challenges (Gössling, Hall, Peeters, & Scott, 2010). A case study on transportation management options and visitor responses in Whistler, BC found that skiers were relatively firm in their preference to use private automobiles when travelling to the destination, and determined that few conventional eco-efficient (e.g. public transit) travel management options would alter skier's behaviour (Reilly et al., 2010).

There is a limited amount of literature to help stakeholders mitigate emissions associated with transportation, superstructure, and equipment. However, they can use research (such as that presented above) to help develop tailor made mitigation strategies. For example, in 2003 the RMOW developed an in-house Integrated Energy, Air Quality and Greenhouse Gas Management Plan to reduce emissions from within the destination (RMOW, 2003). The plan did not address emissions associated with visitor travel to and from the community because they were largely beyond the their control.

**Adaptation**

Adaptation is seen as necessary to complement mitigation efforts, and reduce mountain-based resort communities and ski resorts climate change vulnerability (Becken & Hay, 2007; IPCC, 2007a) According to Jopp et al. (2010) “it is the principal way to deal with the unavoidable consequences of climate change” (p. 592). Adaptation strategies can be pursued by governments, ski resorts, NGO’s, community groups, and individuals, and is typically motivated by economic, social or environmental drivers (Simpson et al., 2008). Adaptive responses may be anticipatory or reactive and may seek to minimize present climate impacts, reduce sensitivity and exposure, and increase resiliency (see Table 7). The ability of a destination to successfully respond to climate variability and change; will determine its adaptive capacity (Simpson et al., 2008).

***Table 7. Different Types of Adaptation***

| Based On | Type of Adaptation | | |
|---|---|---|---|
| Intent in Relation to Climatic Stimulus | Autonomous<br>(e.g. individual institutions, enterprises, and communities independently adjust to their perceptions about climate risk) | Planned<br>(e.g. the result of deliberate policy decision, based on climate change awareness) | |
| Action | Reactive<br>(Post) | Concurrent<br>(During) | Anticipatory<br>(Prior-Modification) |
| Temporal Scope | Short Term<br>(Adjustments, Instantaneous, Autonomous) | Long Term<br>(Adaptation, Cumulative, Policy) | |
| Spatial Scope | Localized | Widespread | |

Source: Adapted from Lemmen, Warren, Lacroix, & Bush (2008)

Tourism specific literature describes various types of adaptation (IPCC, 2007a; Scott, de Freitas, & Matzarakis, 2009; Simpson et al., 2008). Simpson et al. (2008) summarized these strategies into: technical adaptation, business management adaptation, and behavioural adaptation (see Table 8).

***Table 8. Adaptation Types***

| Adaptation Type | What does it involve? | What does it require? | Examples |
|---|---|---|---|
| Technical adaptation | Utilizes technology and innovation in order to determine methods of coping with climate change and vulnerability. | Specialized equipment and/or the use of new technologies and innovations. Due to the cost and complexities of many technical adaptation options, this type of adaptation often requires government backing. | Snowmaking machines. |
| Business management adaptation | Techniques used by tourism operators, regional governments, and tourism industry associations to reduce vulnerability to climate change. | Destination managers to change their marketing approach to try and increase or decrease travel during certain times, and/ or redirect tourists to different locations, or encourage them to engage in different activities. | Marketing techniques such as new pricing strategies, product/ market diversification, and positioning can all be utilized. |
| Behavioural adaptation | Adaptation is normally associated with the tourist, as they have the ability to decide on the tourism activities they engage in and where and when they do so. This ability for spatial, temporal, and activity substitution subsequently provide tourists with substantial adaptive capacity. | Although the tourist generally undertakes behavioural adaptation, there are some strategies that destination managers can use to affect behaviour. Technical and business management are used to manipulate the behaviour of tourists. | Adjusting the type of clothing worn, changing the activities engaged in, adjusting the timing of the visit, changing the destination altogether. |

Source: Adapted from Simpson et al. (2008)

### 2.3.3 Adaptation and Mountain Communities

Several authors e.g. Becken & Hay (2007); Bruce, (2009); Buŕki et al. (2003); IPCC, (2001a); Reynolds, (2010); Scott, Jones, & Konopek, (2007) have illustrated the need for ski resorts to implement adaptation strategies. Typically ski resorts do not consider adaptation plans in isolation from their host communities or other business decisions, and implementation depends on market demand, global and local economies, regional and global competition, energy and operating costs, labour availability, and environmental regulations (Scott & McBoyle, 2007).

Scott and McBoyle (2007) indicate the adaptation methods utilized by ski resorts are mainly reactive responses that employ technologies and business strategies to prevent economic losses. Snowmaking is the widest spread adaptation technology, but it uses large amounts of water and requires an outdoor temperature of 0.2°C or lower (Scott & McBoyle, 2007). Snowmaking costs are estimated to substantially increase as average winter temperatures increase (Bruce, 2009). A less expensive adaptive technology involves slope modification. It entails using several landscape management techniques designed to reduce the amount of snow required on the slopes (Scott & McBoyle, 2007). Slope development is not as energy intensive when compared to snowmaking, but many aspects disturb natural ecosystems.

The environmental impact and cost of adaptation technologies has motivated many ski resorts to develop business alternatives that respond to various climate change scenarios; a common strategy is the formation of ski conglomerates and ski industry associations. Ski conglomerates are comprised of acquired assets purchased from smaller resorts in different places. Collectively the resorts provide each other with access to capital and marketing resources, which reduces the entire networks climate change vulnerability (Scott & McBoyle, 2007). Ski industry associations are organizations that support the interest of ski areas in terms of marketing, government relations, environment etc. Ski industry associations are beginning to actively engage in the climate change conversation, as evidenced by several climate change related workshops and presentations. For example in the United States the National Ski Are Association (NSAA) in partnership with the Natural Resources Defense Council (an environmental organization) initiated the ‘Keep Winter Cool’ campaign in 2003. The

objective of the campaign is to combat climate change through public education at ski areas (including incentives for energy efficient travel options), through GHG reductions within the ski industry (a wide range of energy efficiency and renewable energy initiatives), and through a coordinated political lobby by the winter tourism industry to support government GHG reduction policies in the US (65 ski areas lobbied state and national governments to support the proposed Climate Stewardship Act in the US) (Scott & McBoyle, 2007).

Ski resorts are also adapting their business model by diversifying their product and becoming four-seasons resorts that offer non-winter recreation such as golfing, hiking, and mountain biking (Scott & McBoyle, 2007). Market incentives (e.g. offering guests financial guarantees) are also considered adaptation methods that attract visitors by reducing booking reluctance due to uncertain snow conditions (Scott & McBoyle, 2007).

The wider literature on climate change and ski-dependent businesses indicates that most ski resorts view climate change as a long-term risk, and the technical, economic, and social challenges of adaptation far outweigh the benefits (Becken & Hay, 2007; Scott, 2003; Scott et al., 2009; UNWTO & UNEP, 2008). Nevertheless, Scott and McBoyle (2007) believe the ski resorts that do implement proactive adaptation strategies will be ahead of their competition, and may be the only survivors in an era of climate change. This notion is further supported by the (National Round Table on the Environment and the Economy (2012), they believe that companies who proactively implement a series of business adaptation methods can significantly limit their climate change risks, and take advantage of commercial opportunities.

## 2.4 Assessing Climate Change Planning

The climate change vulnerability of mountain-based resort communities and ski resorts creates the need for local governments and ski operators to integrate mitigation and adaptation strategies with sustainable development and management initiatives (Scott, 2010). To assess the degree that adaptation planning occurs and why, in a resort community, Jopp et al. (2010) provides a regional adaptation conceptual model (Figure 4). According to Jopp et al. (2010) "conceptual models can come in many forms; however, each has the goal of improving the understanding of a particular situation by graphically representing a number of factors. They can provide a quick and easy means of understanding complex systems and issues" (p. 598).

Jopp et al.'s (2010) model provides guidelines for adaptation planning whereby the key vulnerabilities are assessed, and appropriate adaptation actions are identified and implemented, in order to increase a resort communities resilience and resistance to climate change risks, and increase readiness to capitalize on any opportunities presented. Jopp et al. (2010) developed the model using a series of adaptation literature (Australian Government, 2005, 2007, 2008; PMSEIC, 2007; Willows & Connell, 2003), United Nations reports including the UNDP's 'Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures' (Lim, Spanger-Siegfried, Burton, Malone, & Huq, 2005), and UNEP's 'Climate Change. Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices' (Simpson et al., 2008), as well as numerous academic references (inter alia: DeLacy, 2009; Fussel, 2009; Fussel & Klein, 2006; Scott et al., 2006).

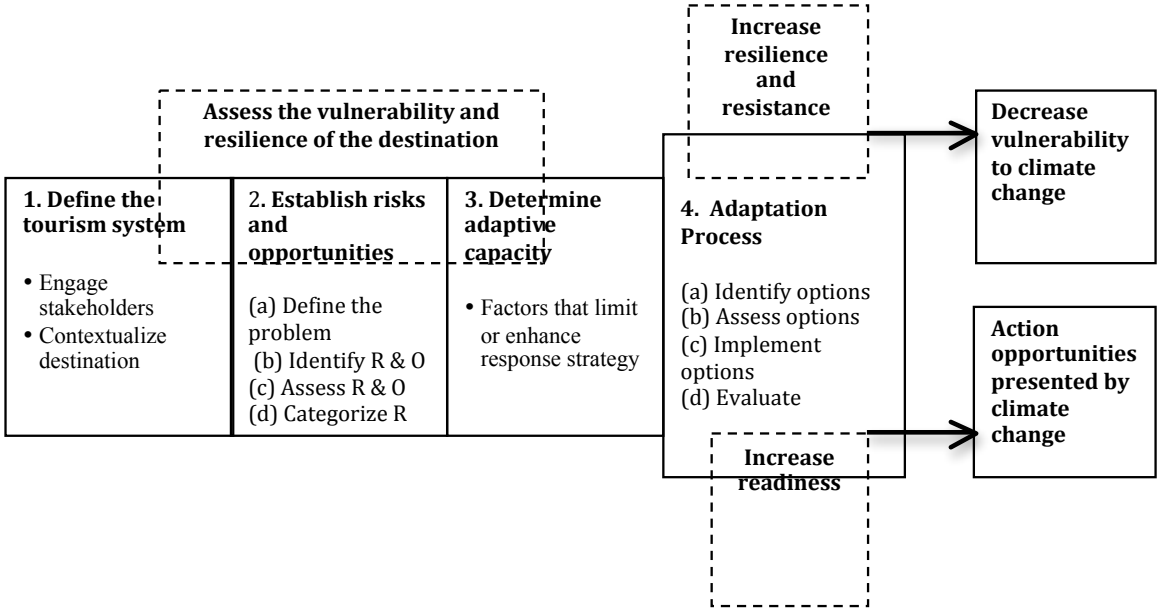


Figure 4. Regional Adaptation Model (Jopp et al., 2010, p.599)

The model is divided into two major phases. The first phase (stages 1-3) assesses the vulnerability and resilience of a resort community by defining the tourism system, establishing climate change risks and opportunities, and determining adaptive capacity (Jopp et al., 2010). Defining the tourism system involves understanding and engaging key stakeholders that shape a communities tourism industry (Jopp et al., 2010). Establishing risks and opportunities investigates how climate change is likely to impact a destination's geography and tourism activities (Jopp et al., 2010). Determining adaptive capacity entails identifying the social, educational, and institutional factors that influence a destination's climate change response strategies (Jopp et al., 2010).

The second phase (stage 4) explores resilience, resistance, and readiness of a resort community. Resilience is the ability of a resort community to absorb changes in climatic conditions, or maintain stability when subject to climate disturbances (IPCC, 2001a; Jopp et al., 2010). Resistance is the capacity of a resort community to offset climate change-induced impacts (e.g. a resort community supporting its' associated ski resort increase their snowmaking efforts in response to reduced snowfalls). Readiness refers to the ability of a resort community to capitalize on climate change opportunities that arise (Jopp et al., 2010).

In order to increase resilience, resistance, and readiness the model indicates that the adaptation planning process must identify, assess, implement, and evaluate adaption options (Jopp et al., 2010). Identifying—involves determining potential adaption options based on the risks and opportunities. Assessing—includes refining and reducing the list of potential adaptation options. Implementation—requires a clear outline of stakeholder responsibilities, resource requirements, and timelines for the chosen adaptation options. Evaluation—includes monitoring the costs, adverse impacts, and benefits delivered from implementing adaption options. Jopp et al.'s (2010) conceptual model is presented as a linear sequence of steps, but the entire process can be considered iterative in character. The process of adaptation should be recognized as part of an ongoing approach to sustainable planning, development and management (Jopp et al., 2010).

Jopp et al.'s (2010) conceptual model is concentrated on adaptation and does not address mitigation, yet reducing GHG emissions is an important component of planning for climate change (Simpson et al., 2008). For the purposes of this research, expanding the model to include mitigation response strategies would create a comprehensive tool to assess how local governments and ski resorts are planning for climate change (see section 3.2.2).

### 2.4.1 Summary

In a climate change future, the sustainability of mountain-based resort communities may depend on local governments and ski resorts integrating adaptation and mitigation response strategies into their planning and management systems. A useful method contributing to the advancement of climate change management capacity, involves exploring how these two stakeholder groups are currently facilitating and implementing such actions.

# 3 Methods

In order to examine the extent **municipal governments** and **ski resorts** in mountain-based resort communities are planning for climate change the following research questions are explored:

1. What governance approaches is the municipal government and ski resort in Whistler and Rossland, BC using to plan for climate change?
2. What are the climate change risks and opportunities facing the municipal government and ski resort in Whistler and Rossland, BC?
3. What is the climate change response capacity of the municipal government and ski resort in Whistler and Rossland, BC?
4. To what extent has the municipal government and ski resort in Whistler and Rossland, BC identified, assessed, implemented, and evaluated climate change response strategies?

A literature review contextualized the relationship between climate change, mountain-based resort communities, and ski resorts. It situated the study within the context of governance and planning for climate change.

To understand how local governments and ski resorts, in mountain-based resort communities, can plan for climate change a case study was employed using Whistler and Rossland, BC. The case study method used active interview protocols to facilitate the collection of qualitative data that elaborated on the themes identified in the literature review and Jopp et al.'s (2010) Regional Adaptation Model.

## 3.1 Case Study Selection

The case study research design is used in specific situations where there is interest in understanding individual, group, organizational, social, and political related phenomena (Yin, 2009). Furthermore, it is useful for identifying causal relationships where the boundaries between the phenomenon and the context are not clearly evident

(Yin, 2009). In this research, the case study method contextualized the interactions and relationships between multiple stakeholders relative to climate change planning. Furthermore, it allowed the researcher to inquire into the behaviours, perceptions and experience of human subjects within a specific place-context (Yin, 2009), such as Whistler and Rossland, BC.

Whistler and Rossland, BC were chosen as the case study for three main reasons. First, the Government of BC has designated the local governments of both destinations as resort municipalities, and exploring the climate change strategies of these places is critical to assessing their long-term viability as designated resort municipalities. Second, both municipalities employ sustainability-led approaches to community planning (The City of Rossland, 2010b; *Whistler 2020*, 2011). This provides unique opportunities to contrast and compare how climate change is incorporated into sustainability plans in different contexts. Third, while both communities are four-season destinations its ski resorts are the primary tourism draw. Since climate change effects are potentially very significant for ski resorts, the urgency for such research is magnified (Becken & Hay, 2007; IPCC, 2001a; Scott & Jones, 2006; Walker & Sydneysmith, 2008).

## 3.2 Data Collection

Primary data collection occurred between April 2011 and August 2011 through a series of active interviews with community stakeholders. Overall, ten informants consisting of elected officials, municipal representatives, ski resort operators, other tourism operators, and NGO's provided their assessments of the communities' approaches to climate change planning actions. Secondary data were gathered from a variety of sources such as websites, public government documents, annual reports, tourism plans, and journal articles.

### 3.2.1 Interview Strategy: The Active Interview

In this study, a semi-structured active interview method (see Holstein and Gubrium, 1995) is adopted for primary data collection. The active interview considers the researcher and respondent as equal partners. Together they construct meaning around

an interview topic. During the active interviews respondents are considered collaborators in knowledge production. According to Holstein and Gubrium (1995: 9) “the active interview is a form of interpretive practice involving interviewer and respondent, as they both articulate ongoing interpretive structures, resources and orientations with practical reasoning"

The active interview method was utilized as opposed to more traditional approaches (e.g. structured interviews). As Holstein and Gubrium (1995) argue traditional interview methodologies position respondents as repositories of facts and passive subjects in which untainted knowledge can be mined, using strict methodological adherence. Holstein and Gubrium (1995) contend in a traditional interview the validity of results depends on how successful the researcher is in following the accepted interview methods, and reliability is determined by replicability. Whereas, the active interview produces knowledge, regardless of how sanitized the interview process is (Holstein & Gubrium, 1995). If the respondent is seen as active, it is impossible to 'spoil' information and reliability, and replicability is not considered useful measures of interview success (Holstein & Gubrium, 1995).

Furthermore, the possibility of biasing a respondent in an active interview is not a significant concern when compared to a traditional interview. According to Holstein & Gubrium (1995:14) “bias is a meaningful concept only if the subject is seen to possess a preformed, pure informational commodity that the interview process might somehow contaminate. But if interview responses are seen as products of interpretive practice, they are neither preformed, nor ever pure. They are practical productions”.

### 3.2.2 Conceptual Model

Jopp et al.'s (2010) Regional Adaptation Conceptual Model, as presented in section 2.4, does not consider mitigation planning strategies. To allow for a more thorough evaluation of climate change response strategies, this research made three modifications to the model:

1. Stage one (Define the Tourism System) was renamed 'Governance Structure, which better aligns with the terminology used in this study
2. Stage three (Determine Adaptive Capacity) was expanded and renamed 'Determine Response Capacity'. The modification allowed for a better understanding of factors that limit or enhance a destinations ability to plan for both adaptation and mitigation.
3. Stage four (Adaptation Process) was redefined as 'Response Process', which helped assess the planning process involved for both adaptation and mitigation.

Figure 5 presents Jopp et al.'s (2010) adapted model and highlights the key modifications.

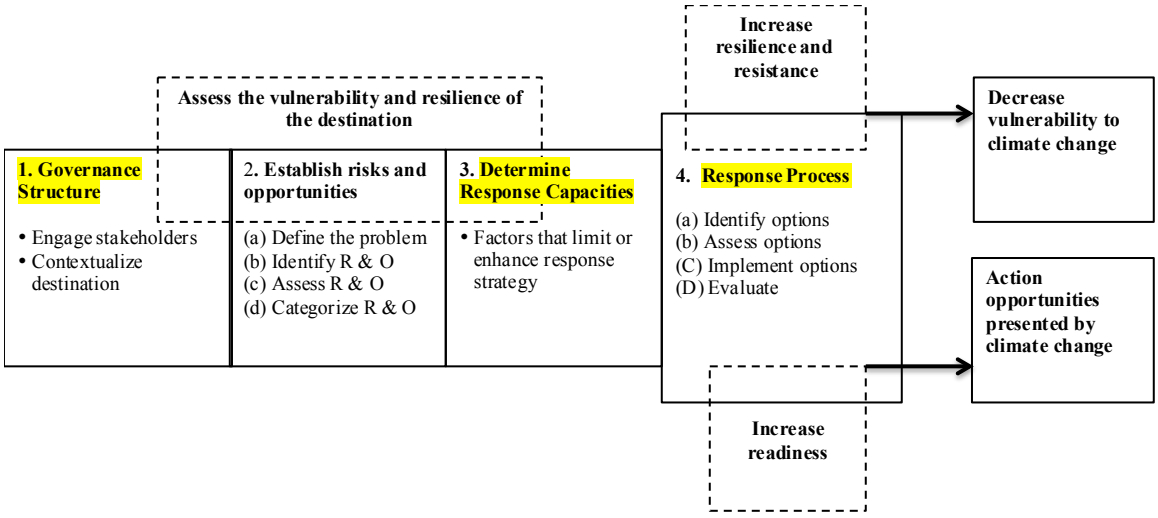


Figure 5. Regional Climate Response Model (adapted from Jopp et al., 2010)

### 3.2.3 Interview Instrument

Based on the active interview methodology and guided by themes central to Jopp et al.'s (2010) adapted model, an interview guide was developed for the stakeholder groups (Appendix B). The guiding themes included: governance structure, risks and opportunities, response capacity, and response process.

To abide by the active interview structure the instrument was created as an advisory piece/conversational agenda, and was not procedural in focus. The instrument provided directional prompting for the respondents, but they were free to communicate their perspectives.

The instruments were pre-tested with a colleague affiliated with Simon Fraser University's Centre for Tourism and Policy Research (CTPR). This individual had significant levels of experience in questionnaire design and served to identify strengths and weaknesses as well as inconsistencies in this study. As a result the wording of the instruments was improved prior to conducting the active interviews (see Table 9).

***Table 9. Climate Change Planning - Assessment Tool and Interview Guide***

| **What are the overriding climate change governance approaches in Whistler and Rossland BC?** |
|---|
| **Theme:** Governance Structure |
| **Lines of Interview Questioning:**<br>1. What role (if any) does/should your organization play in developing and implementing effective climate change adaptation/or mitigation plans and programs for your resort community?<br>2. What other organizations (if any) in and beyond your resort community does /should your organization collaborate with in developing an effective climate change adaption/mitigation plan and program?<br>3. Are there any other organizations that you feel are particularly important to collaborate with now and in the future with respect to climate change policy and planning initiatives?<br>4. What are the best processes to ensure collaborations amongst resort community stakeholders are effective in regards to climate change adaptation/mitigation planning? |

The Table is continued on the following page.

**To what extent have stakeholders assessed risks and opportunities associated with climate change in Whistler and Rossland BC?**

**Theme**: Climate Change Risks And Opportunities

**Lines of Interview Questioning:**

1. The following climate change effects have been forecasted for other tourism destinations. When (if at all) do you feel these might happen in your resort community?

| Climate Change Symptoms | Potential Tourism Destination Implications |
|---|---|
| Increased duration and frequency of higher temperatures | Altered seasonality, changes in plant-wildlife-insect populations and distribution, increase in invasive species. |
| Decreased duration of reliable snow cover, snowpack, glacier coverage | Decreased winter sport season, snow cover length, availability, and quality; increased snow-making and snow-retention costs; increased avalanche management costs; decreased winter landscape attractiveness |
| Increased frequency and duration of 'extreme storm' conditions | Increased risk insurance costs and business interruption costs. |
| Increased frequency of heavy precipitation | Damaged tourism and community infrastructure; altered lengths of winter, summer and shoulder seasons. |
| Decreased availability of reliable water supplies | Increased water shortages, increased competition over water between tourism and other sectors, desertification, increased wildfires threatening infrastructure and affecting demand. |
| Changed character of terrestrial biodiversity | Loss of natural attractions and species from destinations, higher risk of invasive species i.e. mountain pine beetle. |
| Increased frequency, intensity and extent of forest fires | Loss of natural attractions; damage to tourism |

Source: Adapted from (UNWTO & UNEP, 2008)

2. Which of the above risks are the most urgent to deal with in the short term (1-10 years), and, in the long term (11+years)?
3. What types of opportunities exist (if any) to adapt and /or gain advantages for the resort municipality and its tourism industry in both the short and long-term?

The Table is continued on the following page.

| **To what extent have stakeholders assessed the destinations capacity to respond to climate change in Whistler and Rossland BC?** |
|---|
| **Theme:** Climate Change Response Capacity |
| **Lines of Interview Questioning:**<br>1. Several factors can affect the ability of resort communities to respond to climate change. Please identify factors that affect the ability of your resort community to respond to current and future effects of climate change and why they are the most important (Simpson et al., 2008):<br>I. Availability of technologies (e.g. green energy [mitigation] or snowmaking [adaptation]).<br>II. Availability of financial, human and time resources to develop response approaches.<br>III. Community's track record of successfully developing and implementing other policies and programs responding to other environmental management issues.<br>IV. Presence of community social networks (e.g. community groups, NGOs, government organizations) and their history of working collaboratively on problem solving).<br>V. Presence of community disaster response plans<br>VI. Community awareness of the different risks and opportunities posed by climate change<br>VII. Please specify any other you feel should be included. |

The Table is continued on the following page.

**To what extent have stakeholders defined, prioritized and implemented response strategies in Whistler and Rossland BC?**

**Theme:** Response Process

**Lines of Interview Questioning:**

1. The following chart outlines the various stages of resort communities' climate change adaptation/mitigation planning readiness. What stage best describes your resort community's readiness?

| **Stage** | **What does this mean?** |
|---|---|
| Identify adaptation/mitigation options | Potential options based on the risks and opportunities have been identified. |
| Assess adaptation/mitigation options | The list of potential options have been refined and reduced to those of highest priority to address in the short and long term. |
| Test adaptation/mitigation options with community and tourism stakeholders | The appropriateness and 'buy in' of the priority options have been tested with tourism community stakeholders and consumers. |
| Adaptation/mitigation plans are selected and put into action. | Stakeholder responsibility, resource requirements, and implementation guidelines have been established, and actions are being implemented. |
| Evaluate adaptation/mitigation option success | Evaluations of the climate change adaptation plans ease of implementation, costs, adverse impacts, and benefits delivered have been conducted (during and after its implementation). |

(Jopp et al., 2010)

2. Given your assessment of this resort community's current climate change adaptation status, what factors / events will lead to an increase in its overall resilience, resistance, and readiness for climate change in short and long term?

### 3.2.4 Participant Selection and Recruitment

Participants included elected officials, municipal representatives, NGO's, ski resort operators, and other tourism operators. Participant selection was based on their level of involvement within their respective communities' or organizations' sustainability initiatives. Participants were identified using databases available to the public, and initial contact was made by phone or email. Participants were also recruited through a 'snowball effect', where supplementary informants were contacted through personal reference. Prior to each interview, respondents were sent a participant package, which included a synopsis of the study and research goals (Appendix C), a research consent form[3] (Appendix D), and an interview guide. The participants were asked to read the materials and sign the consent form prior to the interviews. Overall, ten respondents were interviewed and Table 10 illustrates their organizational affiliations.

[3] Study objects and questions, interview guides, and consent forms were approved by Simon Fraser University's Office of Research Ethics on May 19, 2011.

***Table 10. Distribution of respondents by organization***

| Stakeholder Group | Organization | Whistler # of Respondents | Organization | Rossland # of Respondents |
|---|---|---|---|---|
| Elected Officials | Resort Municipality of Whistler (RMOW) | 1 | Rossland City Council | 1 |
| Municipal Representatives | Resort Municipality of Whistler (RMOW) | 1 | Rossland City Council | 1 |
| NGO's | Whistler Centre for Sustainability (WCS) & Tourism Whistler | 2 | Sustainability Commission (SC) | 1 |
| Ski Resort Operator | Whistler Blackcomb Inc. (WB) | 1 | Red Mountain Ski and Snowboard resort | 1 |
| Tourism Operator | Ziptrek Ecotours | 1 | N/A | N/A |
| **Total:** 10 | 6 | | 4 | |

### 3.2.5 Interview Process

Six of the interviews were conducted in person at locations of the participants' choice. The remaining four were conducted via telephone at the respondents request and convenience. The Interviews lasted between thirty minutes and one hour.

As instructed by Holstein & Gubrium (1995), during the active interview this researcher set the general parameters for responses, and probed for clarification and elaboration in a way that did not influence the answers (e.g. can you please elaborate on your point, or can you provide an example?). During the process, the interviews were audio recorded and later transcribed. Once transcribed the proceeding data was analysed based on the guiding themes of the assessment tool and interview guide.

## 3.3 Data Analysis

### 3.3.1 Active Interview Analysis

Data emerging from the interviews was analyzed, in relation to themes presented in the regional climate change response model (adapted from Jopp et al., 2010), for differences, similarities, and patterns. Marshall and Rossman (1999) provided a seven step analytical procedure for such a process. Table 11 outlines this process and how it was applied to this research project.

***Table 11. Seven step analytical procedure for data and this research***

| Step | Description | How the step was followed in this research |
|---|---|---|
| 1. Organizing the data | Organize data by type, date, names, times, etc. | The data from each respondent was organized based on the four guiding interview themes: defining the tourism system (governance); risks and opportunities; response capacity; and resort community readiness. |
| 2. Immersion in the data | Review the data multiple times to become intimately familiar with the data. | Familiarity with the interview data occurred during the interview, upon transcription, and while sorting it into relevant themes of the assessment tool. |
| 3. Generating Categories and Themes | Identification of themes, recurring ideas and patterns of belief. | The interview guide is tied to categories and themes in Jopp et al.'s. (2010) adapted climate change response model. Once the data was transcribed, it was organized into the assessment tool and examined for recurring ideas, themes, and patterns of belief. |
| 4. Coding the data | Formally applying some coding scheme to identified categories and themes outlined in step 3. For example, using key words, coloured dots, numbers, etc. | No formal coding scheme was applied to the data. Sorting the data into the relevant themes of the assessment tool helped group the data in a manageable way. |
| 5. Offering interpretations through analytic memos | Attaching significance to what was said, making sense of the findings, offering explanations and drawing conclusions. | Once the data from each respondent was organized into the assessment tool's themes, it was reviewed for relevance to the research objective and sub research questions and analyzed for meaning. |
| 6. Searching for alternative understandings | Once data has been interpreted, the researcher critically challenges the patterns that seem apparent. | An interpretation of the data is identified in both Chapter 4 and 5. In an attempt to incorporate the views of all respondents, all were quoted at least once. |
| 7. Writing the report | The researcher writes the report understanding that the writing is part of the analytical process. For example, through the words that are chosen the researcher is interpreting, shaping and forming meaning | Report writing involved interpretation and meaning making, which is detailed in chapters four and five. |

Adapted from (Marshall & Rossman, 1999)

### 3.3.2 Secondary Data Analysis

Secondary data were collected to help draw connections between what was reported in the interviews and the theoretical frame applied. Secondary data sources included: websites, public government documents, annual reports, tourism plans, and journal articles were reviewed and used for several purposes.

## 3.4 Study Limitations

No research project is without limitations. This study's possible limitations are documented in order to make the research process transparent.

- When interpreting the qualitative data, this researcher may have mistaken its true intent. Every effort was made to interpret data objectively, but there is no assurance that the researcher did not misinterpret responses.

- Only a limited amount of data on the direct impacts climate change was predicted to have on both Whistler and Rossland, BC, was uncovered. Consequently, it was difficult to determine the relative magnitude and importance of the potential climate change risks and opportunities for each community. This uncertainty created challenges for the interviewer and informants when attempting to solicit climate change response options for each community.

- It is impossible to draw general conclusions about all mountain based resort communities' climate change response strategies solely based upon this study. This research only makes claims about Whistler and Rossland, BC, and cannot determine if these communities are promoting other destinations to also respond to climate change.

# 4 Findings

This chapter describes the research context and presents the case study findings in response to the research objective and questions. The findings are based on information emanating from informant interviews, as well as public government documents, annual reports, tourism plans, and journal articles. The following sections:

1. Catalogue federal and provincial climate change initiatives influencing the response strategies taken by the municipal government and ski resorts in Whistler and Rossland, BC.
2. The governance approach and stakeholder collaborations associated with climate change planning in Whistler and Rossland, BC.
3. The climate change risks and opportunities facing the municipal government and ski resort in Whistler and Rossland, BC.
4. The climate change response capacity and planning response process being taken by the municipal government and ski resort in Whistler and Rossland, BC.

## 4.1 Background

To understand the climate change planning approaches taken by the municipal government and ski resorts in Whistler and Rossland, BC, it is important to first recognize influential federal and provincial government initiatives. This section does not present a comprehensive list of all upper-level climate change strategies; it only highlights policies and programs that are relative to this study.

### 4.1.1 Government of Canada's Climate Change Initiatives

#### Mitigation

In 1997, Canada's Liberal government signed the Kyoto Protocol, an international agreement, under the United Nations Framework Convention on Climate Change (UNFCCC)[4]. The agreement aimed to reduce carbon dioxide emissions and the presence of GHG's in the atmosphere. By signing the Kyoto Protocol Canada agreed to reduce its GHG emissions by 6 per cent relative to 1990 levels by 2012 (UNFCCC, 2012). Following their Kyoto commitment, the government launched a 10-year Clean Air Agenda (CAA), and pledged $10 billion dollars in program funding to achieve its goals (Environment Canada, 2006a). The plan included endowing the Federation of Canadian Municipalities (FCM) [5] with $550 million to develop municipal climate change and clean air initiatives. Through the $550 million the FCM partnered with ICLEI's[6] Local Governments for Sustainability and developed the Partners for Climate Protection Program (PCP). This program encourages local governments to become partner cities in a network of municipalities that work towards the achievement of the five climate action based milestones:

1. Creating a GHG emissions inventory and forecast;
2. Setting an emissions reductions target;
3. Developing a local action plan;
4. Implementing the local action plan or a set of activities;
5. Monitoring progress and reporting results (FCM, 2011a).

[4] The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenges posed by climate change (UNFCCC, 2012).

[5] The FCM is an association representing Canadian municipalities on policy and program matters that fall under federal jurisdiction (FCM, 2011b).

[6] ICLEI is an international association comprised of local, regional, and national government organizations who have made a commitment to sustainable development (ICLEI, 2008).

The FCM and ICLEI encourage municipalities to join the PCP program by providing them with grant funding and education on the potential benefits of accomplishing the five steps such as: financial savings, improved economic performance, reduced traffic, and cleaner air (FCM, 2011b).

In 2006, the federal government was concerned that Canada would not be able to reach its original Kyoto commitments, and altered its climate change budget and agenda. As an alternative it introduced a 'made-in-Canada' climate action plan, and in the process invested $2 billion dollars in mitigation and adaptation programs (Environment Canada, 2006b).

From the initial $2 billion dollars, in 2006 the federal government provided $435.9 million to Natural Resource Canada's (NRCan) Office of Energy Efficiency (OEE) to work with the provinces and reduce GHG emissions in an initiative called ecoEnergy (Environment Canada, 2006a). This programme provides financial support to homeowners, businesses, and industrial facilities to help them implement energy saving projects that reduce GHG emissions. Homeowners, can receive $5,000 in grant funding, whereas businesses and industry are eligible to receive up to $50,000 (NRCan, 2010). Some provincial governments (e.g. the Government of British Columbia) partnered with ecoEnergy and will match the federal government's homeowner grants. The relation of these mitigation programs, to the case study communities, will be discussed at a latter point in this thesis.

**Adaptation**

The federal government also recognized the need to adapt to the impacts of climate change, and provided NRCan with another $30 million dollars to establish Regional Adaptation Collaborative (RACs) programmes (NRCan, 2010). The RACs were created in collaboration between the federal government, provinces and territories. They were designed to encourage local governments to plan and implement projects that integrated adaptation measures into regional policies and programs (NRCan, 2011). RACs initiatives were established in Atlantic Canada, Quebec, Ontario, the Prairies, and British Columbia (NRCan, 2011). The RAC Program is guided by the report "*From Impacts to Adaptation: Canada in a Changing Climate*" (NRCan, 2008), which highlights

current and future impacts climate change has or might create throughout Canada (NRCan, 2008). Walker & Sydneysmith (2008) conducted climate change research for the BC section of the NRCan report. Walker & Sydneysmith's (2008) research is summarized in section 2.2.4 of the literature review.

In December 2011 the federal government formally withdrew from the Kyoto Protocol. As an alternative, it made a new commitment to cut 2005 levels of GHG emissions by 17 per cent by 2020. This of course is a much lower goal than established in the Kyoto Protocol (CBC News, 2012).

### 4.1.2 Government of British Columbia's Climate Change Initiatives

#### Mitigation

The Government of Canada's original Kyoto Protocol initiatives have somewhat influenced the mitigation/adaptation strategies implemented by the Government of British Columbia. In 2007 the provincial government began introducing a series of legislative and policy changes to reduce the province's GHG emissions. In 2007, in a Greenhouse Gas Reductions Target Act (GGRTA), the BC Government committed the province to reduce GHG emissions by 33 per cent below 2007 levels by 2020 and eventually to 80 per cent of 2007 levels by 2050 (Province of British Columbia, 2008). In the same year the BC Government and the Union of British Columbia Municipalities (UBCM)[7] created the BC Climate Action Charter. The Province designed the Charter to gain municipal support for their GHG emission goals. Municipalities were asked to voluntarily sign the Charter and commit their operations to carbon neutrality by 2012. The preceding Charter was followed in 2008 by Bill 27, the Green Communities Act, which required local governments to include GHG emission targets and mitigation actions in their OCP's and Regional Growth Strategies (Province of British Columbia, 2008).

[7] The UBCM is a legal body that represents, in one organization, the various municipalities in the province

The BC Government developed a series of tools and programs to implement this legislation and its associated policy changes. They focused on generating broader community support, and fostering a deeper understanding of the science behind climate change among the public and local decision makers. First, to help shape their intended climate change policies and actions, the Province endowed $94.5 million to create the Pacific Climate Impacts Consortium (PCIC), and the Pacific Institute for Climate Solutions (PICS) (PCIC, 2011; PICS, 2008). PCIC was developed to conduct quantitative studies relating to the physical impact of climate change and variability in the Pacific and Yukon region. PCIC is led by climate change specialists from the University of Victoria (UVIC), BC Hydro, Environment Canada and the B.C. government (PCIC, 2011). Similarly, PICS was created to undertake research on the potential impact of climate change, but also assess viable mitigation and adaptation options. PICS specialists are from UVIC, the University of British Columbia (UBC), Simon Fraser University (SFU), and the University of Northern BC (UNBC) (PICS, 2008).

In 2008 the Government of BC applied a carbon tax to each tonne of emissions related to burning fossils fuels to provide financial mitigation incentives throughout the economy. All BC businesses, individuals, and visitors who purchase fossil fuels in the province, must pay the carbon tax. However, through a Climate Action Revenue Incentive program the Government of BC offered signatories to the Climate Action Charter a grant equal to what they pay in carbon tax (Province of British Columbia, 2008).

To encourage broader community support the Government of BC initiated the LiveSmart BC incentive program. The initiative complemented the federal government's ecoEnergy program. Together both governments offered subsidies for energy retrofits to homes and small businesses (Province of British Columbia, 2008). To further encourage community support, the Government of BC collaborated with BC Hydro and FortisBC to provide homeowners and businesses with free energy efficiency assessments (Province of British Columbia, 2008). The degree these programs are being utilized in Whistler and Rossland, BC will be discussed in their respective sections.

**Adaptation**

The BC government also invested in a series of climate change adaptation strategies. In 2008, the BC Ministry of Environment and the Fraser Basin Council (FBC)[8], partnered with Natural Resources Canada on their RACs Program (Fraser Basin Council, 2010). NRCan invested $3.3 million dollars[9] towards British Columbia's Regional Adaptation Collaborative (BC RAC) "Preparing for Climate Change: Securing B.C.'s Water Future". The program focused on four areas of adaptation: water allocation and use, forest and fisheries management, flood protection, and community adaptation. Through the community adaptation initiative, a partnership was promoted with the Columbia Basin Trust (CBT)[10], and it resulted in the creation of a Communities Adapting to Climate Change Initiative (CACCI) (Fraser Basin Council, 2010). This program is aimed at helping communities in the Columbia Basin prepare for climate change impacts.

Numerous senior level government initiatives and programs have 'trickled' down to local municipalities like Whistler and Rossland, and are shaping the way these communities respond to climate change challenges and opportunities.

## 4.2 Whistler's Governance Approach

As primary stakeholders in a mountain-based resort community both the Resort Municipality of Whistler (RMOW) and Whistler Blackcomb Inc. (WB) are concerned with issues of climate change. The impact of changing climatic conditions–especially reliable

[8] The FBC is a collaboration of four orders of government (Federal, Provincial, Local and First Nations) who work to advance sustainability in the Fraser River Basin and across BC.

[9] The program received another $ 3.3 million in funding from provincial ministries, local governments, First Nations, non-governmental organizations, and the private sector (Fraser Basin Council, 2010).

[10] The Columbia Basin Trust, created by the *Columbia Basin Trust Act*, promotes social, economic and environmental well-being in BC's Columbia Basin region (CBT, 2008).

snow patterns (further discussed in Risk and Opportunities)–has the potential to substantially affect the resort community's` tourism economy (RMOW, 2011a). The following section identifies the stakeholders and programs shaping the RMOW and WB's climate change planning strategies. Specific plan details are discussed in a subsequent 'Response Process' section of this research.

### 4.2.1 The RMOW

**Sustainability Planning**

In the mid to late 90s—due to a combination of rapid growth, high levels of tourist traffic, rising real estate prices, escalating infrastructure costs, diminishing levels of affordable residence and employee housing, mountain ecosystem stresses and emerging climate change challenges—Whistler stakeholders (businesses, community groups, and residents) began expressing concern for their long-term viability. In reaction the RMOW started pursing a sustainability based approach to community planning.

In 2002 the RMOW, collaborated with WB, the Fairmont Chateau Whistler, Tourism Whistler (TW), One-hour Photo and the Association of Whistler Area Residents for the Environment (AWARE), and used the Natural Step framework's guiding principles to launch "*Whistler: It's our Nature*"—an Early Adopter program aimed at educating and inspiring sustainability practices within the community. Following on this program, they introduced "*Whistler: It's our Future",* a program designed to establish a common long-term community vision.

In 2005, the "Whistler: It's our Nature" and "Whistler: It's our Future" initiatives culminated in the RMOW adopting *Whistler 2020*—the community's long-term sustainability vision. Guided by the tenets of the Natural Step, *Whistler 2020* is the foundation for the RMOW's Comprehensive Sustainability Plan (CSP) (Gill & Williams,

2011a). The CSP is Whistler's highest-level policy document and it guides the implementation of the municipality's Official Community Plan (OCP)[11].

To help facilitate the enactment of the CSP, the RMOW founded the Whistler Centre for Sustainability (WCS), a local NGO. The WCS is composed of several community task force groups, which are led by a collection of sustainability specialists who aid the municipality implement the CSP's strategies. The groups address priority issues related to strategies concerning: Arts, Culture and Heritage; The Built Environment; Economic Development; Energy; Finance; Health and Social issues, Learning; Materials and Solid Waste; Natural Areas; Partnerships; Recreation and Leisure; Resident Affordability; Resident Housing; Transportation; Visitor Experiences; and Water (*Whistler 2020*, 2011). Relative to this research, among these priorities is the Energy task force, which is responsible for developing a more sustainable energy use system to reduce the resort-community's overall GHG emissions. Table 12 gives a brief summary of the RMOW's path to sustainability planning.

[11] The OCP is a provincially-mandated regulatory document and a set of high-level plans and policies, such as land use designations that guide land use planning, social, economic, and environmental policies, and civic infrastructure investments (*Whistler 2020*, 2011).

***Table 12. The RMOW's Path to Sustainable Governance***

| **Whistler** |
|---|
| • Resort municipality consisting of approximately 11,000 local residents<br>• 2001- Whistler residents expressed concern for sustainability. |
| • The programs *Whistler: It's our Nature and Whistler: It's our Future* led to the *Whistler 2020 Vision*—"Whistler will be the premier mountain resort community – as we move toward sustainability"<br>• *Whistler 2020* is the foundation for Whistler's Comprehensive Sustainability Plan (CSP).<br>• 17 strategies articulate the CSP in more detail: the arts, culture & heritage strategy, the built environment strategy the economic strategy, the energy strategy, the finance strategy, whistler's health & social strategy, the learning strategy, the materials and solid waste strategy, the natural areas strategy, the partnership strategy, the recreation and leisure strategy, the resident affordability strategy, the resident housing strategy, the transportation strategy, the visitor experience strategy, and the water strategy.<br>• The *Whistler 2020* vision guides the Official Community Plan (OCP).<br>• The Whistler Centre for Sustainability (WCS) manages the CSP.<br>• The WCS's energy task force plays a crucial role in implementing the municipality's mitigation initiatives. |

**Climate Change Planning: Mitigation**

Guided by recommendations emanating from the WCS's energy task force, the RMOW is focusing on actions that reduce GHG emissions and energy use associated with corporate and community operations. Corporate emissions are produce from: gasoline and diesels used to fuel fleet vehicles and equipment, and natural gas and electricity used to operate municipal buildings (RMOW, 2011a). Community emissions are produced from: passenger vehicles, the community landfill, residential electricity, commercial electricity, residential natural gas, commercial natural gas, fleet vehicles, and transit vehicles (RMOW, 2011a).

Whistler's energy reduction initiatives commenced in 1997, when Whistler's city council endorsed the Kyoto Protocol target to lower GHG emissions by 6% below 1990 levels by the year 2012 (RMOW, 2011a). Following up on this commitment, the RMOW participated in the Federation of Canadian Municipalities' (FCM's), Partners for Climate Protection (PCP) program. To meet their commitments to the PCP program, in 2004 the RMOW developed the first Integrated Energy, Air Quality, and Greenhouse Gas

Management Plan in Canada (RMOW, 2011a). The plan recognized that achieving the community's original target of 6% below 1990 levels would be very difficult to achieve by 2012. Thus, the plan recommended a reductions scenario that would see Whistler's emissions at 9% below 2000 levels (but 22% above 1990 levels) by 2020 (RMOW, 2011a). In that same year, they also completed the *Whistler 2020* vision, and founded the WCS and its energy task force to lead their mitigation initiatives.

Preceding the RMOW's commitments to the PCP, in 2007 they were one of sixty-two local governments in BC, who partnered with the provincial government and UNBC by voluntarily signing the BC Climate Action Charter (RMOW, 2011a). To achieve their commitments under the Charter, in 2009 the RMOW developed a Carbon Neutral Operations Plan (CNOP). The CNOP required the RMOW to measure emissions associated with municipal operations, reduce emissions wherever possible, and offset what they were unable to reduce (RMOW, 2009). Moreover, to improve residential buildings' energy efficiency, the RMOW partnered with BC's primary energy providers (BC Hydro and FortisBC), and joined the federal and provincial government's ecoEnergy and LiveSmart program. Through this program Whistler residents could apply for grant funding to install energy efficient retrofits.

In 2010 the RMOW fully integrated a chapter on climate action and energy management into its OCP update. This action aligned with requirements under the BC Green Communities Act (Bill 27). The RMOW's commitments to the PCP program, Climate Action Charter, and Green Communities Act also address the first sustainability objective in the Natural Step framework and the *Whistler 2020* vision (reducing the ongoing build up of substances take from the earth's crust, i.e. oil). Table 13 outlines Whistler's Mitigation governance structure and programs.

***Table 13. The RMOW's Mitigation Programs and Governance Structure***

| **National** |
|---|
| Government of Canada:<br>• Initiated the Federation of Canadian Municipalities' (FCM) Green Municipal Fund with a $550 million dollar endowment. |
| FCM:<br>• Partnered with ICLEI's Local Governments for Sustainability and formed the Partners for Climate Protection (PCP) program. |
| NRCan:<br>• Created the ecoEnergy initiative to help Canadians implement energy saving projects that reduces GHG emissions. |
| **Provincial** |
| Government of British Columbia:<br>• Implemented a Greenhouse Gas Reductions Target Act (GGRTA)<br>• Developed the Climate Action Charter.<br>• Created Bill 27 the Green Communities Act.<br>• Initiated LiveSmart BC to complement the federal government's ecoEnergy program.<br>BC Hydro and FortisBC<br>• Provided Whistler's homeowners with free home energy assessments and energy retrofits funding |
| **Local** |
| RMOW:<br>• Joined the PCP program.<br>• Developed an Integrated Energy Plan to achieve their PCP commitments.<br>• Formed the *Whistler 2020* vision.<br>• Founded the WCS and energy task force to plan and implement mitigation strategies.<br>• Signed the BC Climate Action Charter.<br>• Developed a Carbon Neutral Operations Plan to achieve their Charter commitments.<br>• Complied with Bill 27, and integrated a chapter on climate action and energy management into their 2011 OCP update. |

### 4.2.2 Whistler Blackcomb

In 1992 WB began planning for sustainability and developed an Environmental Management System (EMS) plan. Today, the plan aligns with the RMOW's *Whistler 2020* vision, and includes an energy strategy designed to help mitigate climate change impacts. According to Whistler Blackcomb (2012) "climate change is the single largest threat to the environmental, social and economic health of our planet, the impacts of climate change affect the health of our mountain ecosystems". WB's energy strategy guides activities that (Whistler Blackcomb, 2012):

1. Minimize their consumption of fuel and electricity through behavioural changes, retrofits, and the use of new technologies in their purchasing and construction activities.
2. Seek out and use clean technologies, fuels and renewable energy sources to meet their energy demands.
3. Reduce their carbon footprint and assist in guest and resort community emission reductions.

According to informant 2, from Whistler Blackcomb (WB), "prior to carrying out its energy strategy, the organization wanted to be sure it didn't over or under react to the impacts of climate change, and partnered with Environment Canada to conduct climate change modeling". The climate modeling exercise resulted in WB establishing four key partnerships to implement its energy strategy.

First, it partnered with BC Hydro to improve the ski company's operational energy efficiency. This included installing nineteen power consumption meters, and carrying out an energy management assessment (Whistler Blackcomb, 2012). WB's informant indicates "with mitigation we are heavily partnered – for example we just had a meeting with BC Hydro on how to reduce our energy consumption by 5%". Second, WB partnered with Innergex Renewable Energy Inc. and Ledcor Construction to install a micro hydro renewable energy plant/ independent power project (IPP) on Fitzsimmons River, which runs between Whistler and Blackcomb mountains. WB was not financially involved in the project, but helped lead the planning process, and worked with the RMOW and WCS to obtain broader community support for the project. As WB's

informant indicated " the RMOW and the WCS's energy task force helped get community support (for us) to develop an IPP on Fitzsimmons River". WB's, third major mitigation initiative involves a partnership with the Canada West Ski Areas Association's (CWSAA)[12] Idle-Free Campaign. It encourages guests and staff to reduce air pollution by turning off their vehicles when not in use, and an anti idle policy for buses and other vehicles servicing on-mountain programs. Finally, at the National level WB has aligned its energy conservation initiatives with the National Ski Area Association's (NSAA)[13] Sustainable Slopes Charter. The Charter is guided by twenty one Environmental Principles and includes programs associated with reducing energy use for facilities, snowmaking, ski lifts, and vehicle fleets (Sustainability Partners, 2002). WB's informant states, "we are working with different ski regions throughout the world to reduce our GHG emissions, we do not look at this as a competitive thing, but as a moral imperative". Table 12 outlines WB's programs and partnerships centre around its mitigation strategies.

[12] CWSAA represents and supports the interest of Western Canada's ski areas in terms of marketing, government relations, environment etc.

[13] The NSAA is the trade association for ski area owners and operators in the USA. Their primary objective is to meet the needs of ski area owners and operators nationwide and to foster, stimulate and promote growth in the industry (NSAA, 2012).

***Table 12. WB's Mitigation Programs and Governance Structure***

| **Whistler Blackcomb** |
|---|
| Developed an Environmental Management System (EMS) that outlined an energy management strategy for resort operations, which was supported by the national, provincial, regional, local and private community. |
| **National** |
| Environment Canada:<br>• Conducted climate modeling for WB |
| National Ski Area Association's (NSAA)<br>• WB aligned their energy management strategy with the NSAA sustainable slopes charter. |
| **Provincial** |
| BC Hydro:<br>• Conducted an energy assessment for WB's operations. |
| **Regional** |
| Canada West Ski Areas Association (CWSAA):<br>• WB supported CWSAA's Idle-Free Campaign. |
| **Local** |
| RMOW and WCS:<br>• Supported WB's IPP development. |
| **Private** |
| Innergex Renewable Energy Inc. and Ledcor Construction:<br>• Developed a Micro hydro renewable energy plant in WB's operating area. |

## 4.3 Risks and Opportunities

The RMOW's mitigation initiatives appear to be supported by data derived from WB and Environment Canada's climate modeling**,** and Walker & Sydneysmith in NRCan (2008). The following sub sections will present the current and predicted physical climate change impacts facing the Whistler region and the associated risks and opportunities to WB. By understanding WB's climate change risks and opportunities, an overall picture is presented of the situation facing the entire resort community. However, the climate data presented in the following section is minimal and considered a research limitation.

### 4.3.1 The Physical Impacts of Climate Change in Whistler and the Coast Mountains

According to informant 2 from WB:

> " using weather station on Whistler and Blackcomb mountains, climate models signifies a temperature increase of 0.7$^{o}$C over the past 100 years. The greatest increases are occurring in the summer months, and Whistler and Blackcomb mountains are both experiencing slightly more snow at mid and higher elevations, but less overall snow. Furthermore, for every degree of temperature increases the normal snowline for ski operations may retreat by about 120 -140 meters".

WB's informant only highlighted these limited climate details. However, using climate information gathered by Walker & Sydneysmith in NRCan (2008) a slightly better understanding of the impacts the area may experience is gained. As previously mentioned in the literature review, during the 20$^{th}$ century the Coast Mountains warmed at a rate equivalent to 0.5$^{o}$C to 0.6$^{o}$C per century, or at roughly the same rate as the global average (Walker & Sydneysmith, 2008). Precipitation increased in the Coast Mountain by 2 percent per decade. These trends are based on 70 years of data and likely reflect the influence of climate change (Walker & Sydneysmith, 2008). Future projections for the province suggest a likely warming of 2-7 $^{o}$C by 2080 (for all seasons), wetter conditions for much of BC in winter and spring, but drier conditions during summer in the south and on the coast (Walker & Sydneysmith, 2008).

### 4.3.2 Climate Change Risks to Whistler Blackcomb Inc.

#### Decreases in Snowfall and Snow Pack and increases in Winter Temperature

According to informant 5, an elected official from RMOW, around 75% of Whistler's overall revenues for the entire community are generated between January and March, which has to do with skiing related activities". Although, the informant did not provide any scientific data relating to the current and predicated snowfall, it was indicated that the RMOW was concerned with decreases in 'future' snow quality and levels. The general feeling was that if future snow conditions are unfavourable WB and the entire community would see a significant reduction in visitation levels. For example in 2004-2005, Whistler had a major drop in room revenues that correlated with low

snowfalls (BC Stats, 2005). However, the informants appeared to have a low concern over 'present' snow levels. Informant 4, from the Whistler Centre for Sustainability (WCS), captures this in stating:

> "in the future - we may have decreased duration of reliable snow cover; however, I am not really sure how concerned we are about this right now. Furthermore, we are not too worried about snow conditions at the top of the mountains, but we are concerned with increasing rain in the valley during the winter. Even if there are great skiing conditions on the mountain, miserable valley conditions could impact visitor levels".

Informant 2, from WB, further illustrates this point by explaining:

> "WB`s Horstman glacier is about half the size it was 100 years ago because of the summer heat and not a lack of winter snowfall".

Despite the risks temperature increases and glacial recession could have on ski operations, the perceived notion was WB's access to high elevation terrain decreases their vulnerability to climate change. Whistler mountain's highest accessed elevation sits at 2,182 meters, while Blackcomb mountain 's is at 2,284 meters, and the associated base developments and commercial village sit at 675 meters (Whistler Blackcomb, 2012). Researchers suggest that the greatest climate change impacts will be felt at low or mid-mountain elevations (~1,600 m), compared to higher elevations (~2,600 m) (Beniston, 2003, 2006; Bu̎rki et al., 2003).

Despite WB's apparent reduced vulnerability to climate change, WB's informant indicated that if they do experience a significant decrease in snowfall they might need to intensify their snowmaking activities. Currently, the resort uses 130 to 180 million+ gallons of water to create 650 to 900 acres of snow a foot deep, which requires a minimum temperature of -2 $^{o}$C (Whistler Blackcomb, 2012). However, the general feeling from the community was unsupportive of WB increasing their snowmaking capacity because of the environmental impact. The Whistler Centre for Sustainability's informant captures this perspective by stating "if WB increased their snowmaking capacity it would just contribute to the climate change problem by using more water and energy".

**Increases in Summer Temperature**

Increases in summer heat are reducing the Hortsman glacier, and intensify the risk of forest fires on Whistler and Blackcomb mountains and in the community. Currently, Whistler's forest fire risk is attributed to lighting and human causes; however, the general feeling was increases in summer temperature intensify the areas vulnerability. In 2009 there was a serious fire on the North flank of Blackcomb, and several tourists had to be evacuated. As a result, WB is hesitant to expand their summer product offerings. As WB's informant articulated:

> "fire is a huge threat, we would like to expand the summer offerings and develop more hiking trails, but forest fires pose a risk to implementing these products in terms of safety and product quality ".

### 4.3.3 Climate Change Opportunities

Although, temperature increases pose a significant risk to WB they also present the greatest amount of opportunity. As part of a larger experience WB along with other private operators are carefully implementing: mountain biking, sightseeing, wildlife viewing, hiking, golfing, zip lining, ATV tours, spas, rafting, horse riding, cultural tourism experiences, and other festivals and events in the area`s mountain environments. These product options attract guests beyond the traditional ski season. In fact, the summer season attracts more visitors when compared to winter season traffic. In 2008/09, approximately 1.3 million visitors travelled to Whistler in the summer (May 1, 2009 to October 31, 2009), while winter (November 1, 2008 to April 30, 2009) attracted around 815,000 guests (BC Stats, 2010). However, winter visitors still generate the largest share of revenues because of their propensity to use more commercial accommodation and support services (BC Stats, 2010). Despite summer's lower revenue generation, WB's informant indicated they could economically sustain the ski resort and its host community up to a temperature increase of 3 $^{o}$C. However, changes in climate still pose significant economic risks. WB's informant states "we are more diverse in the summer, but for the most part climate change will cost more, relative to the opportunities that will be presented".

## 4.4 Response Capacity

***Factors that limit and enhance Whistler's response capacity***

Informants believed the community of Whistler has a strong climate change response capacity due to two overriding factors. First, the community has a strong track record of successfully developing and implementing other policies and programs responding to other environmental management issues. Overall, five out of the six informants indicated—the development and implementation of the *Whistler 2020* vision and the CSP has contributed to building the community`s mitigation strategies. Informant 5, a municipal representative from the RMOW, indicates, "Whistler is unique because of its firm belief in sustainability planning, and we are moving away from short-term planning cycles".

Second, all six stakeholders interviewed suggested that the RMOW, WCS, and WB have a history of working collaboratively on problem solving issues, and securing the financial, human and time resources needed to develop and implement priority actions. They indicated that this increases the community`s ability to respond to climate change challenges. Informant 5, an elected official from the RMOW, appropriately captured this sentiment:

> "we are in a good position to respond to climate change challenges because of the partnerships within the community, and everyone is on the same page in terms of wanting a successful and sustainable resort".

Informant 1, the RMOW's municipal representative, also specified:

> "there are several social networks in Whistler, and people are very good at forming planning partnerships. A unique example is how we came together to successfully deliver the 2010 Winter Olympics.

Despite Whistler's strong response capacity most informants indicated that local residents appear to have a limited awareness for potential climate change challenges, which could reduce the communities overall response capacity. Overall, five of the six respondents explained that local residents are not focused on climate change because such issues are not directly affecting them at this point.

## 4.5 Response Process

### 4.5.1 RMOW

The RMOW indicated that its climate change response process aligned with the four response stages (identify, assess, implement, and evaluate options) presented in the model adapted from Jopp et al.'s (2010). At the time of writing the RMOW had successfully identified and assessed several mitigation strategies, and had commenced implementation and evaluation.

**Identify and Assess Options**

The RMOW's mitigation strategies essentially culminate in their commitments under the BC Climate Action Charter—to measure, reduce and offset their GHG emissions. To fulfill the RMOW's commitments to the Charter, the WCS's energy task force is providing leadership on implementing mitigation strategies. In doing so the RMOW is also fulfilling their mitigation commitments under the PCP and Bill 27.

**Implementation**

The RMOW is pursuing several mitigation strategies to reduce their corporate and community emissions, this research will focus on five of their most ambitious plans: (1) replacing propane with natural gas; (2) improving municipal fleet efficiency; (3) increasing small-scale local renewable energy initiatives; (4) improving public and private buildings' energy efficiency; and (5) making changes to local waste management. The following subsections will discuss in detail these five initiatives.

*Replacing Propane With Natural Gas*

The intent of this strategy is to reduce Whistler's GHG emissions associated with heating. Prior to 2009 Whistler's residential and commercial buildings were primarily heated by propane, which was transported from Squamish to Whistler via railcar and tank-truck. In 2009 Terasen Gas (now FortisBC) converted Whistler's piped propane system to natural gas by building a natural gas connector line from Squamish to Whistler. The pipeline was developed during the Sea-to-Sky highway improvement

project[14]. Once this project was completed, Whistler experienced an immediate 15% reduction of GHG emissions.

*Improving Municipal Fleet Efficiency*

The municipality maintains a large fleet of gasoline and diesel vehicles for its operations. The intent of this strategy is to reduce emissions associated with transportation. This involves: transitioning fleet passenger vehicles (and larger vehicles where appropriate) to hybrid models; using smaller engines in the vehicles; and using fuel additives to improve fuel economy and reduce emissions.

The most significant progress the RMOW has made on this initiative involves reducing diesel consumption associate with their public transportation system. In 2009, the RMOW received financial support from the federal government ($45 million) and the provincial government ($44.5 million) to invest in twenty emission free buses. The buses were originally purchased to transport visitors during the 2010 Olympics, but will be utilized by the RMOW until 2014 (RMOW, 2011a).

*Increasing small-scale local renewable energy initiatives*

The intent of this strategy is to reduce GHG emissions associated with non-renewable energy resources. In 2006 the RMOW morally supported WB develop an IPP on Fitzsimmons Creek. The project produces enough renewable energy to power 3,000 homes in Whistler on an annual basis (more details on this project will be discussed in section 4.5.2).

[14] The Sea-to-Sky highway (highway 99) connects Vancouver to Whistler. In 2003 BC's Ministry of Transportation invested $600 million dollars in a project to widen the highway and improve the safety, reliability and capacity of travel prior to the 2010 Winter Olympics (RMOW, 2011a).

In 2009 the RMOW, in partnership with land donated by the provincial government, and a contribution of $37.5 million from the Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games (VANOC), developed Whistler's 'greenest' neighbourhood: Cheakamus Crossing. The housing development was initially built to accommodate athletes during the 2010 Winter Olympics, but was converted to affordable housing for approximately 800 local residents after the games (RMOW, 2011b). A District Energy System (DES) provides up to 90% of the energy needed for heating and domestic hot water requirements in Cheakamus Crossing (RMOW, 2011b). Heat exchangers in the waste water treatment plant capture the heat from effluent flow and pump temperate water, through an insulated underground distribution system, to heat pumps in each building. The DES substantially decreases the electrical and natural gas requirements in the community (RMOW, 2011b).

*Improve Energy Efficiency in Buildings*

The intent of this strategy is to reduce GHG emissions associated with municipal and residential buildings. Best practice examples include the RMOW's library and fire hall. The library incorporates energy efficient lighting fixtures, a geothermal heating and cooling system, high efficiency baseboard heaters, and is LEED Gold certified (LEED is an independent green building rating system administered by the Canadian Green Building Council). The fire hall has a high efficiency furnace to heat the building, a high efficiency water heater, and is LEED Silver certified. Furthermore, the RMOW facilitates local homeowners apply to the federal and provincial government's ecoEnergy and LiveSmart program for funding to install energy efficient retrofits.

*Changes to the Local Waste Management System (Landfill Gas Capture)*

The intent of this strategy was to reduce GHG emissions from the community's waste management system. The RMOW is currently collecting gas from a closed landfill that was situated near Cheakamus Crossing. The gas was originally intended to heat Cheakamus Crossing's water supply, but due to a lack of volume and poor quality that option was abandoned. Instead the RMOW is using flare stacks to burn off the methane as it is better than venting it in to the atmosphere (RMOW, 2011b).

## Evaluation

In 2010 the RMOW's corporate emissions were 4.3% lower than 2009 levels, but approximately 2.8% above 2008 levels, and above their targeted corporate emission level for 2010 (Figure 6) (RMOW 2011). In that same year the RMOW's community emissions were approximately 20% lower than the 2000 level, and 2% below the 2009 level (Figure 7) (RMOW, 2011b). However, it must be noted that these numbers were also a result of the RMOW purchasing carbon offsets associated with annual municipal operations (RMOW, 2011b). The offsets were purchased from "Offsetters", a carbon management provider based in Vancouver (RMOW, 2011b). Offsetters then invested in renewable energy in Aldergrove, BC as well as a wind turbine project in Turkey (RMOW, 2011b).

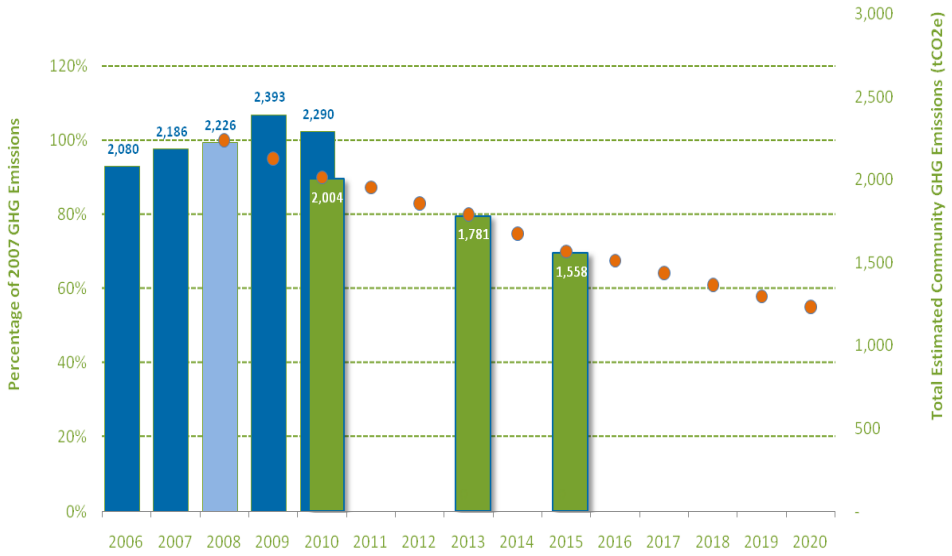


Figure 6. The RMOW's Estimated Corporate GHG Emissions (RMOW 2011).

*Blue bars refer to Whistler's Corporate GHG emissions, and the green bars represent their GHG reductions target (RMOW 2011).


Figure 7. Whistler's total Estimated Community GHG Emissions (RMOW 2011).

* Green bars represent the community GHG emissions targets, blue bars represent the historic community emissions levels, and orange dots indicate the annual reductions that would be required to achieve the prescribed targets (RMOW 2011).

The above achievements led the RMOW to complete the PCP's five-step framework, and put them on track with their emission targets and commitments to the BC Climate Action Charter. Furthermore, the RMOW incorporated their mitigation initiatives into their 2010 OCP update, which satisfies their obligation to the province's Bill 27. However, the RMOW recognizes these one-time technological changes may be less available in the future and 'energy conservation' needs to be their future focus. If this does not occur than their rate of emissions reduction may slow decrease (RMOW, 2011b).

### 4.5.2 Whistler Blackcomb WB

WB indicated that its climate change mitigation response process aligned with Jopp et al.'s 'four response stages' (identify, assess, implement, and evaluate adaption options). At the time of writing WB had successfully identified and assessed three key mitigation actions, and had commenced implementation and evaluation.

**Identify and Assess Options**

WB three mitigation actions include:

1. Minimize consumption of fuel and electricity through behavioural changes, retrofits, and the use of new technologies in purchasing and construction activities.

2. Seek out clean technologies, fuels and renewable energy sources to meet energy demands.

3. Reduce their carbon footprint and assist in guest and resort community reductions.

**Implementation and Evaluation**

WB implemented the above actions by undertaking four major projects associated with renewable energy, energy management, heating, and fuel consumption.

*Renewable Energy*

In 2008 WB partnered with Innergex Renewable Energy Inc, Ledcor Construction, the RMOW, and the WCS to develop an IPP on Fitzsimmons Creek. The environmental impacts of the project were minimal as over 70% of the project was built under the existing footprints of a mountain access road and a snowmaking intake pond. No new power lines were required because the powerhouse was located within 300m of the existing electrical grid (Ecosign Mountain Resort Planners Ltd., 2010). Furthermore, water flows from the power generating station into the Fitzsimmons snowmaking intake pond (Figure 8).

Figure 8. Fitzsimmons Creek IPP Powerhouse and Snowmaking Intake Pond (Ecosign Mountain Resort Planners Ltd., 2010)

The power produced from the IPP is not directly used for WB's operations, rather Innergex Renewable Energy Inc. sell's the energy to BC Hydro. However, the IPP produces enough renewable energy to operate WB or to power 3,000 homes in Whistler on an annual basis (Ecosign Mountain Resort Planners Ltd., 2010).

*Energy Management*

In 2009 WB partnered with BC Hydro and carried out an in depth energy management assessment, and installed nineteen power consumption meters to improve their energy management strategy (Ecosign Mountain Resort Planners Ltd., 2010). Information gathered from the meters resulted in WB replacing 11,000 resort lights to more energy efficient LED and compact fluorescent technologies. It is estimated that this project currently saves about 15% of the resort's annual energy consumption or represents the amount of power it takes to run over 450 homes in BC for a year (Whistler Blackcomb, 2012).

*Heating*

WB partnered with a private engineering firm and installed five hybrid-heating projects in their large facilities (roundhouse lodge, glacier creek restaurant, day lodge and two employee housing buildings). The new heating systems maximize the

efficient use of natural gas and electricity, and reduce WB's emissions by nearly 600 tonnes annually (Whistler Blackcomb, 2012). This is the equivalent amount of electricity used to power around 679 single-family detached homes in North America (U.S Environmental Protection Agency, 2011).

*Fuel Consumption*

WB is working to reduce fuel consumption from resort operations, and employee and guest travel. They have reduced the size of their fleet of vehicles, purchased more efficient snow cats and snowmobiles, reduced company travel, and implemented an employee carpooling program, which utilizes company vehicles to transport employees living outside the resort. The program is estimated to save around 86,000 litres of fuel.

To reduce visitors fuel consumption WB partnered with CWSSA's on their idle free campaign and educated and encouraged guests to turn off their vehicles when not in use. Furthermore, they implemented an anti-idle policy for buses and other vehicles servicing on-mountain programs (Whistler Blackcomb, 2012).

### 4.5.3 Summary

This section of the findings presented Whistler's approach to planning for climate change as it relates to the community's *2020* sustainability objective. The next section will present how the community of Rossland is planning for climate change.

## 4.6 Rossland's Governance Structure

### 4.6.1 Rossland City Council

#### Sustainability Planning

In 2007 Rossland City Council and community stakeholders developed a Strategic Sustainability Plan (SSP), which articulated their *2030* vision. The plan identified eleven thematic priorities requiring attention to achieve their vision: land management, natural environment and resource links, community economic

development, recreation and leisure, housing and affordability, transportation, intergenerational care and learning, sense of community, energy and air quality, water and solid waste management, and governance. Each of these priorities was accompanied with several 'end state' goals and strategic actions (Appendix A). The Commission and City Council appointed four task forces to address the SSP's top areas of focus: economic development, water stewardship, housing and affordability, and energy issues (The City of Rossland, 2008). Relative to this research is the Energy task force, which is responsible for developing a more sustainable energy use system to reduce the resort-community's overall GHG emissions.

In 2008 the SSP was approved by Rossland's City Council and incorporated into its OCP. In 2009 City Council appointed a citizen-led Sustainability Commission (SC) that consisted of seven volunteer community members, one councillor, and two paid contractors to help implement the SSP. A City Bylaw and Terms of Reference guides the actions of the SC (The City of Rossland, 2008). Table 13 gives a brief summary of Rossland City Council's path to sustainability planning.

***Table 13. Rossland City Council's Path to Sustainable Governance***

| **Rossland** |
|---|
| • Resort municipality consisting of approximately 3,500 local residents<br>• 2007- Rossland residents expressed concern for sustainability. |
| • The V2A sustainability program led to Rossland's Strategic Sustainability Plan (SSP)<br>• The SSP was developed to achieve *Rossland's 2030* vision "…Rossland is a resilient alpine community and a leader in balancing social, environmental, and economic sustainability".<br>• 11 focus areas articulate the SSP in more detail: land management, natural environment and resource links, community economic development, recreation and leisure, housing and affordability, transportation, intergenerational care and learning, sense of community, energy and air quality, water and solid waste management, and governance.<br>• The SSP is incorporated in the OCP.<br>• The Sustainability Commission (SC) manages the SSP.<br>• The SC's energy and air quality task force is responsible for implementing City Council's mitigation initiatives. |

**Climate Change Planning: Mitigation**

Rossland City Council is using their sustainability-based approach to planning as a platform to work with national, provincial, regional, and local community organizations to develop a series of mitigation strategies. In 2007, City Council signed the BC Climate Action Charter in. To fulfill their commitments, City Council and the Sustainability Commission (SC) sought help from the Carbon Neutral Kootenays (CNK) program. The program was developed by the Columbia Basin Trust (CBT), the Regional District of East Kootenay (RDKB), and the Regional District of Central Kootenay (RDCK) with the aim to support local governments carry out emission inventories. The CNK team compiled an energy and GHG emissions inventory for City Council's municipal operations in accordance with the Climate Action Charter. Specific details of the inventory were not available at the time of writing.

Rossland's City Council also worked with FortisBC to track residential and commercial electric use. FortisBC's data indicated that Rossland residents use almost 40% more electricity than the average BC home, which was attributed to aging infrastructure and poor insulation (FortisBC, 2012). To improve residential buildings' energy efficiency, City Council worked with FortisBC as well as BC Hydro, and joined NRCan and the provincial government's ecoEnergy and LiveSmart program. Through these programs, City Council created the 'Rossland Energy Diet' initiative, whereby homeowners could apply—to both the federal and provincial government— for free energy assessments and retrofits funding. Finally, in 2010 Rossland City Council amended its OCP and integrated a complete chapter on climate action and energy management. This action aligned with requirements under the BC Green Communities Act (Bill 27). Table 14 outlines programs and partnerships centre on City Council's mitigation strategies.

***Table 14. Rossland City Council's Mitigation Programs and Governance Structure***

| **National** |
|---|
| NRCan:<br>• Developed the ecoEnergy initiative |
| **Provincial** |
| Government of British Columbia:<br>• Created the Climate Action Charter.<br>• Implemented Bill 27.<br>• Initiated LiveSmart BC to complement the federal government's ecoEnergy program.<br>FortisBC and BC Hydro:<br>• Provided Rossland's homeowners with free home energy assessments and retrofits funding through LiveSmart BC. |
| **Regional Districts** |
| CBT, RDEK, and the RDKB:<br>• Created the Carbon Neutral Kootenays (CNK) initiative, and compiled a GHG emissions inventory for Rossland's municipal operations. |
| **Local** |
| Rossland City Council:<br>• Signed the BC Climate Action Charter.<br>• Complied will Bill 27, and amended their OCP to include a section on climate action and energy management.<br>• Developed the Rossland Energy Diet in collaboration with the federal and provincial ecoEnergy program. |

**Climate Change Planning: Adaptation**

Rossland City Council is also using their sustainability-based approach to planning as a platform to work with national, provincial, regional, and local community organizations to develop a series of adaptation strategies. In 2009 the CBT chose Rossland to participate in its Communities Adapting to Climate Change Initiative (CACCI), because of City Council's well-developed sustainability-based approach to planning and their *2030* vision.

The CACCI goal was to increase Rossland's overall climate change resilience by developing a community wide adaptation plan for City Council to consider (CBT, 2008).

The initiative was managed by a local steering committee comprised of four members of the public, two representatives of the SC, two city councillors, one city staff member, one representative from the CBT, and a coordinator under contract to the City of Rossland (The City of Rossland, 2010c).

The steering committee hired Simon Fraser University's Adaptation to Climate Change Team (ACT)[15] and PCIC, to review local climate knowledge and establish climate change projections for Rossland (The City of Rossland, 2010c)—the results are presented in the Risks and Opportunities section.

Once the initial climate change vulnerabilities were understood, the steering committee engaged the broader community in the process of collaboratively assessing and determining (via an Impact Mapping Event–Appendix E) priority areas for specific adaptation planning and action. While, members of the steering committee initially felt the community would focus on priorities related to the local economy (e.g. ski tourism), instead they selected areas associated with infrastructure, water availability, energy prices and food security. The community believed that by developing adaptation plans for areas on the periphery Rossland's ski tourism industry's resilience to climate change would be enhanced, and increase the community's sustainability. After the initial priority areas were established the steering committee, ACT, and Rossland REAL Food (an NGO dedicated to improving Rossland's local food system) compiled a suite of nineteen potential adaptation actions and several implementation strategies for City Council to consider. Table 15 outlines programs and partnerships centre on City Council's adaptation strategies.

[15] ACT is the only university based research group in North America dedicated to investigating climate change adaption issues (ACT, 2012).

***Table 15. Rossland City Council's Adaptation Programs and Governance Structure***

| **National** |
|---|
| Government of Canada<br>• Made-in-Canada Climate Strategy<br>NRCan<br>• Regional Adaptation Collaboratives (RACs) |
| **Government of British Columbia and Regional Districts** |
| Ministry of Environment and the Fraser Basin Council (FBC)<br>• British Columbia Regional Adaptation Collabortives (BC RAC)<br>Columbia Basin Trust (CBT)<br>• Communities Adapting to Climate Change Initiative (CACCI) |
| **City of Rossland** |
| • Partake in the CACCI |
| **CACCI Stakeholders** |
| CACCI Steering Committee:<br>• Two representatives from the sustainability commission, two city councilors, one city staff member, one representative of the CBT, and a coordinator under contract to the city of Rossland.<br>Simon Fraser University's Adaptation to Climate Change Team (ACT)<br>• Conducted preliminary research associated with Rossland's vulnerability to climate change.<br>PCIC (UVIC, BC Hydro, Environment Canada and the B.C. government)<br>• Conduct climate modeling during the CACCI<br>Rossland Residents and Rossland REAL Food<br>• Assessed priority areas: infrastructure, water, energy, and food. |

The following sections describe Rossland's involvement with the Communities Adapting to Climate Change Initiative (CACCI). It is currently City Council's primary climate change response focus.

## 4.7 Rossland: Risks and Opportunities

This section will discuss the physical impact of climate change facing the community of Rossland and the greater Columbia Basin region and summarize the

CACCI steering committee's public assessment of the associated risks and opportunities.

### 4.7.1 The Physcial Impacts of Climate Change in Rossland and the Columbia Basin

Rossland is located in the Southern Interior Mountains in BC's Columbia Basin. Climate change is expected to impact the region's temperature, snowpack, glaciers, stream flow, and precipitation. In the last century (1913-2003) the average temperature in the Columbia Basin increased by 1.5°C. Most of the warming has occurred in the last 30 to 50 years (1971-2000), with the biggest relative temperature increases occurring at night and in the winter (PCIC, 2010). Between 1950 and 1997 the area's snowpack declined between 20 and 40 percent in the entire Columbia Basin (PCIC, 2010). The greatest declines in cover occurred at lower elevations (e.g. below 1,600m) where temperatures are near 0°C and small temperature increases can change precipitation from snowfall to rainfall (PCIC, 2010). Furthermore, between 1986 and 2000 glaciers in the Basin shrunk on average of 16%. This had significant implications for the area's normal water run-offs and overall stream flow. The spring runoff (freshet) occurred twenty days earlier in the 1984-1998 period, than during the 1970-1983 period, causing longer periods of low flow at the end of the summer, and increased streamflow in the winter (PCIC, 2010). Additionally, records from five weather stations in the Basin show increases in rainfall from 0 to 45 per cent between 1913 and 2002, and more of the area's precipitation currently falls as rain instead of snow, especially at lower elevations (PCIC, 2010).

Informant 7, from the Sustainability Commission, indicated that based on climate change impact modelling conducted specifically for Rossland (PCIC, 2010), it is anticipated that by 2050 the immediate areas may experience:

- higher average summer and winter temperatures, in the potential range of 2°C;
- increased overall precipitation in the range of 10.5%;
- decreases in precipitation in the summer in the range of 3%;
- decreases in snowfall and snowpack;

- earlier spring-run off by about 15 to 40 days;
- lower summer stream flows for longer periods; and
- increases in extreme events, such as heavy precipitation, droughts and windstorms.

Informant 10, a municipal representative from Rossland City Council, supported the presence of some of these conditions already emerging in the area:

> "We are already seeing increases in heavy precipitation, less snow and more rain in the area".

According to PCIC (2010) these emerging climate conditions could create unexpected environmental effects such as extreme wildfires, flooding, and water shortages. However, it must be noted that based on current science the future predications of climate change are relatively uncertain (PCIC, 2010).

The following section describes how the CACCI steering committee and the community of Rossland felt about the above possibilities with respect to the risks and opportunities created.

### 4.7.2 Climate Change Risks to Rossland

Despite Rossland's economic dependence on ski tourism, and the associated risks and opportunities climate change typically presents to the industry, the CACCI steering committee and the community chose not to develop an adaptation plan for Red Mountain ski resort. Their reasoning was that if issues related to infrastructure, water availability, energy prices and availability, and food security were addressed many tourism concerns would also be confronted. The proceeding subsections first present the steering committee's justification for not developing a ski related adaptation plan. Followed by identifying the climate change risks to the four priority areas.

**Red Mountain Ski Resort**

As illustrated in section 1.1.2 Red Mountain ski resort is Rossland's largest employer and tourism is a primary economic driver. However, during public consultation processes, tourism specific adaptation strategies did not emerge as a major area of concern. Informant 9 from Red Mountain pointed out:

> "the climate change risks to the tourism industry just didn't seem to be high enough to warrant a specific plan to protect the tourism economy, furthermore the public did not select economic drivers as a priority, during public consultation meetings".

The following section highlights the informant perspectives on why this may have happened.

*Decreases in Snowfall and Snowpack and Increases in Winter Temperatures*

Red Mountain resort has a base elevation of 1185m and a summit elevation of 2075m; an average snowfall of 750cm (410inch); and 4,200 acres of skiable terrain. The business operates without the use of snowmaking equipment from mid December to the beginning of April. This compares to larger resorts that do utilize snowmaking to extend their ski season. For example Whistler Blackcomb's snowmaking abilities allow them to operate from mid November until the end of May (Whistler Blackcomb, 2012). Informant 9, from Red Mountain, indicated that their relatively short ski season makes them economically dependent on good snow conditions during Christmas and throughout the entire season, and pointed out "Christmas is our crucial season, if we don't hit it, we miss about 25-30% of our revenue; in the last fifty years we have only missed two Christmas seasons of reliable snow cover".

PCIC's predications of decreased snowfall and snowpack would appear to justify the need for a ski related adaptation plan. However, Red Mountain's informant suggested that PCIC's climate models could not predict snow reliability during the Christmas season; thus it would be economically risky to devote resources to a ski related adaptation plan. Moreover, Red Mountain's dependency on snow reliability during the Christmas season reduces its concern over PCIC's early melt cycle predictions. In fact stakeholders indicated early melt cycles may pose an opportunity to

diversify Rossland's tourism offerings towards more summer related activities—e.g. golfing, biking, hiking, camping, horse riding, and cultural tourism.

*Higher Summer Temperatures*

Higher summer temperatures are typically associated with an increase in forest fires, which could threaten Red Mountain's winter and summer operations. However, Red Mountain's informant indicated that an in town consultant conducted a fire risk assessment for Red Mountain and determined their vulnerability is reduced because the resort was developed with significant tree spacing, and buildings made of non-combustible steel structure for purposes unrelated to forest fires.

Despite the CACCI steering committee and the community not tackling ski tourism and climate change concerns, City Council addresses tourism's sustainability in their OCP and SSP, which discusses the need for a year-round tourism economy to exist alongside Red Mountain resort (The City of Rossland, 2010a).

**Infrastructure**

Rossland's infrastructure (storm drainage network, residential houses, and community buildings) is deteriorating and needs to be upgraded, because of flood related destruction, sewer backups, roof collapses, and decreases in overall tourism appeal. However, the infrastructure's vulnerability is further increased by threats of climate change (e.g. heavy precipitation and windstorms). As informant 10, Rossland's municipal representative, pointed out "a lot of our infrastructure is around 100 years old and extreme weather events pose a big problem". Accordingly, the CACCI steering committee and the community determined that City Council needs to incorporate climate change related design guidelines into infrastructure upgrade plans, and improve their appeal as a tourism community.

**Water**

Rossland has a relatively high domestic water use in the summer, which stakeholders attributed to summer gardening (Figure 9). The CACCI steering committee and the public felt predications of decreased snowpack, earlier and faster spring run-off, reduced summer precipitation, and increases in extreme weather events may reduce the

reliability of Rossland's water supply. Therefore, the CACCI steering committee and the community recommend that City Council implement a series of water conservation adaptation strategies.

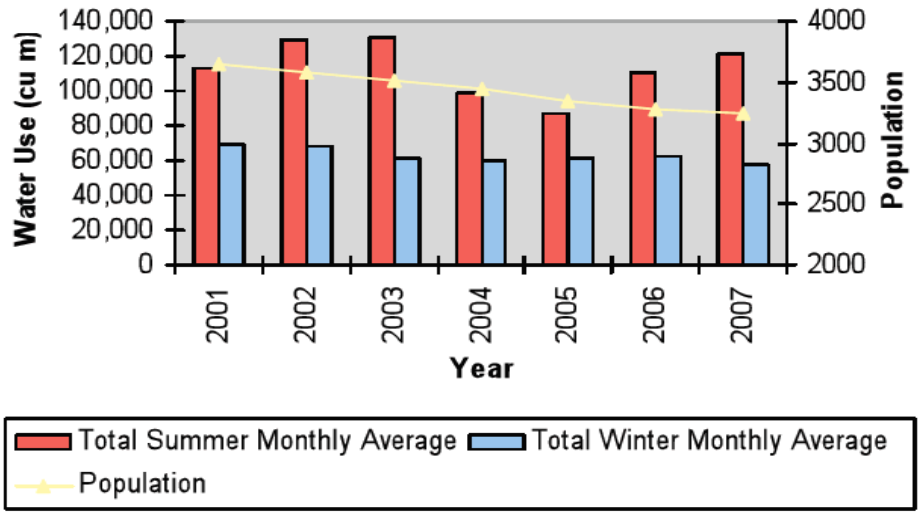


Figure 9. Rossland's Seasonal Average Water Use (City of Rossland 2010b)

**Energy**

The majority of Rossland's energy is produced by a series of hydroelectric dams on the Columbia and Kootenay River systems, but during peak demand FortisBC will purchase coal-generated power from Alberta. The CACCI steering committee and the community felt that climate related impacts (e.g. reductions in summer river flow and extreme weather events) might result in temporary power outages and increase energy prices. Consequently, they believed it was important for City Council to develop energy conservation adaptation strategies.

**Food**

Rossland imports most of its food from global markets. The CACCI steering committee and the community believed global climate change (e.g. increases in temperatures, extreme weather events, and pests) could decrease global agricultural production and threaten Rossland's food security. Thus, they felt it was important for City Council to support local and regional food production.

## 4.8 Response Capacity

**Factors that limit and enhance Rossland's response capacity**

Rossland appears to have a strong climate change response capacity in place, and two factors primarily contribute to this perspective. First, there is a noticeable presence of social networks operating successfully in the community. Overall, three out of the four stakeholders interviewed indicated that Rossland's SC and local community groups had a major influence on encouraging discussions and planning strategies associated with the CACCI. For example, informant 8, an elected official stated "a lot of what we are doing was generated by the SC", and informant 9 from Red Mountain added "there are about 40 volunteer societies in a town of 3,400—so there is a lot of motivation, awareness, and social networking going on here".

A second important factor enhancing the community's response capacity was the public planning processes involved during the CACCI, which helped condition many stakeholders to the probabilities of climate change. Overall three out the four stakeholders indicated that the community awareness of the different risks and opportunities posed by climate change increases their response capacity. For example one stakeholder stated " we did a lot of community education during the CACCI exercise, people in the community are aware of climate change, and they know there are risks".

The community's ability to access financial, human and time resources to develop adaptation approaches has also increased their adaptive capacity. Informant 7, from the Sustainability Commission, pointed out "Rossland is unique because we have the time and resources to respond to the climate change challenge because of the CACCI process".

Despite Rossland's strong response capacity informants were less convinced that the community was ready to address food production issues related to climate change. Informant 10, a municipal representative, stated:

> "we do not have a strong ability to increase our food production because of the alpine nature of the community and short growing season. We

> import the majority of our food and if we want to grow year round we pretty much need to build a greenhouse. However, there are groups (e.g. Rossland REAL Food) who are addressing these issues, and community gardens are starting to evolve."

Overall, the informants believed that as a community, Rossland has a strong climate change response capacity because of the adaptation plan developed by the CACCI steering committee, for City Council to consider. The general impression is that by ensuring the community is adaptable to climate change, the associated ski industry's sustainability will be enhanced. The following section presents how City Council intends to implement the adaptation goals identified during CACCI process.

## 4.9 Response Process

Rossland City Council indicated that the climate change planning process that occurred during the CACCI, aligned with two of the four response stages (identify, assess, implement, and evaluate options) presented in the model adapted from Jopp et al. (2010). The CACCI steering committee and the community identified and assessed nineteen-high priority adaptation actions related to Rossland's infrastructure, water, energy, and food systems. At the time of writing Rossland City Council was seeking out investors (e.g. the CBT), and determining the feasibility of implementing the nineteen-high priority adaptation actions.

**Identify and Assess**

The nineteen high priority actions were assessed based on urgency, cost, and links to City Council's SSP and OCP. Red Mountain's informant indicated that the CACCI believed the actions were 'no regret' solutions for City Council because they could also help achieve *Rossland's 2030* vision. Although, the informants did not explicitly link the actions to Red Mountain ski resort or the tourism industry some connections are apparent. The following sub sections identify the priority actions that could enhance the sustainability of Red Mountain ski resort and the tourism industry.

**Infrastructure**

The CACCI steering committee recommended to City Council five 'infrastructure' related adaptation actions. Of particular importance to the tourism industry, the steering committee advocated that City Council considers climate change in an infrastructure upgrade assessment and plan. To follow through on this recommendation, according to an elected official from Rossland City Council (informant 8):

> "in the summer of 2012 City Council will resurface Rossland's downtown streets, install new water/sewer/rainwater lines, widen the sidewalks, provide three designated crosswalks, add additional lighting, flower boxes, street furniture, etc. City Council hopes that the upgrade will adapt Rossland's infrastructure to potential climate change impacts, while enhancing the attractiveness of the downtown core for residents and tourists".

A municipal representative from Rossland City Council (informant 10) supports this notion by stating:

> "upgrading Rossland's infrastructure will make the town more attractive, which may encourage more visitors to come and stay longer".

**Water**

The CACCI steering committee recommended four 'water' related adaptation actions to City Council. Of specific importance to Rossland's tourism industry, the steering committee suggested that City Council improve their data regarding water supply and demand. At the time of writing City Council was in the planning stages of improving manual monitoring on their watersheds. If the improved monitoring is implemented it could help City Council determine tourism's demands on Rossland's watersheds, and enable the tourism industry to develop effective conservation strategies. However, it is worth noting that some informants felt that Rossland's water supply issues are not exacerbated by Red Mountain ski resort, which is attributed the absence of snowmaking. Informant 8, an elected official from Rossland City Council, captured this by stating:

> "increased water shortages and competition over water between tourism and other sectors is not a concern because Red Mountain does not utilize snowmaking".

**Energy**

The CACCI steering committee recommended to City Council three 'energy' related adaptation actions. One of which relates to Rossland as a resort community, and could be considered a tourism mitigation initiative. Similar to the example provided by the RMOW, the steering committee proposed that City Council identify and implement energy conservation measures for municipal and community operations, which may help offset the tourism industry's emissions.

Rossland's City Council is implementing the recommended action by working with the Carbon Neutral Kootenay (CNK) team to assess the municipality's GHG emissions, which also fulfills their commitments to the BC Climate Action Charter. Following the assessment City Council implemented the Rossland Energy Diet to reduce residential emissions. Around 250 residents took part in the 'Energy Diet' initiative, and were encouraged to participate through a community ambassador (hired by FortisBC and the CBT), who actively informed homeowners about the economic, environmental and social benefits of the program. Data regarding the programs specific contribution to Rossland's 2012 carbon neutral goal was unavailable at the time of this research.

**Food**

The CACCI steering committee recommended to City Council four 'food' related adaptation actions. Of particular importance to Rossland as a resort community the steering committee suggested that City Council promote local food production and processing. This could help reduce the community's dependency on imported food, while providing the tourism industry with a product diversification option, as agricultural tourism is a growing industry (Veeck, Che, & Veeck, 2006). At the time of writing Rossland REAL Food had received funding from City Council to implement a series of summer community gardens.

### 4.9.1 Summary

This section of the findings presented Rossland's approach to planning for climate change, as it relates to the community's *2030* sustainability objective. The next section will present this research's discussion and conclusions.

# 5 Discussion

Whistler and Rossland are two mountain-based resort communities economically dependent on their associated ski resorts (Whistler and Blackcomb Holding Inc. and Red Mountain ski and snow board resort) to attract visitors during the winter season. The ski resorts appeal is largely dependent on favourable alpine winter weather conditions. However, the broader literature suggests that ski resorts could be vulnerable to the symptoms of climate change (e.g. decreases in snowpack), which could ultimately deter guests from visiting (Scott & McBoyle, 2007).

In the future the long-term viability of mountain-based resort communities will depend on the local government and the associated ski resort's ability to collaboratively implement a sustainability based approach to planning that includes climate change response strategies (IPCC, 2001a; Scott, 2003; Scott & McBoyle, 2007; Simpson et al., 2008). Climate change response strategies include adaptation methods that increase the resilience, resistance, and readiness of a community and the associated tourism industry, and mitigation strategies reduce their contributions to climate change.

The findings from this research indicate that in Whistler the local government (the RMOW), and the associated ski resort (WB) formally recognize the importance of planning for climate change, and to varying degrees are using their sustainability-based approaches to planning to implement a series of mitigation initiatives. In Rossland the local government (City Council) has also formally recognized the need to plan for climate change, and with the support of the Columbia Basin Trust (CBT) they have developed a series of community wide adaption initiatives. However, the associated ski resort (Red mountain) has not developed a climate change response plan.

## 5.1 Whistler

In Whistler the exogenous force of climate change and endogenous force of sustainability appear to be factors motivating new forms of governance. Climate change threatens the RMOW's ability to achieve the *Whistler 2020* vision and goals set out in the CSP. Climate change also threatens WB's ability to reach its sustainability goals as described in its Environmental Management System (EMS). The exogenous and endogenous forces motivating Whistler's stakeholders to plan for climate change aligns with Gill & Williams's (2011b) Conceptual Model of Change in Resort Governance, as presented in section 2.3.1.

The RMOW is using the *Whistler 2020* vision and the CSP as a platform to plan and implement a series of mitigation initiatives. WB is also developing a series of mitigation plans using their Environmental Management System (EMS) objectives, which aligns with the *Whistler 2020* vision. The mitigation planning process undertaken by the RMOW and WB reflect the themes (governance structure, establish risks and opportunities, determine response capacities, and the response process) outlined in Jopp et al.'s (2010) adapted assessment model.

First, inline with the theme of 'governance structure' the RMOW developed several key partnerships to implement a series of mitigation strategies. This is primarily seen through their commitments to the PCP program, BC's Climate Action Charter, Bill 27, the formation of the *Whistler 2020* vision and the WCS's energy task force. WB has also established several key partnerships to implement a series of mitigation strategies, which is mainly seen in their commitments to work with the RMOW, the WCS's energy task force, the Canada West Ski Areas Association (CWSSA), BC Hydro, the National Ski Area Association (NSAA), Environment Canada, and various private consultants.

Inline with the second theme of establishing 'risks and opportunities' WB first wanted to understand the physical impacts climate change is/may have on the coast mountain region and in turn on its ski operations. Therefore, WB partnered with Environment Canada to conduct 'in-house' climate modeling. The RMOW looks to the information gathered by WB to understand the physical impacts climate change is/may have for the overall community.

Despite the accessibility of information, there still seems to be a lack of climate change data (e.g. future predications) available to the RMOW. Informant 1, a municipal representative from the RMOW, indicated that the municipality has never conducted in depth climate modeling and are depending on information from outside sources (e.g. WB's climate modeling). It could be valuable for the RMOW to hire a private consultant such as PCIC, to perform a climate change risk analysis. Doing so may support or refute WB's modeling, and provide the RMOW with a clearer picture on the potential impacts climate change may have for the community.

Regardless of the lack of climate data uncovered by this study, the information available seems to be a motivating factor in the RMOW's and WB's decision to focus on mitigation. For example a study conducted by the National Round Table on the Environment and the Economy (2012) found that WB's access to high alpine terrain, snowmaking abilities, extensive base development, and summer product options can be considered business adaptation techniques that will reduce the negative socioeconomic impacts climate change could have on the resort (e.g. reduced visitation levels due to changes in snow reliability). WB's strong business model is the result of good business and not climate change, but it still significantly enhances their climate change resilience, as well as the RMOW's. Thus there is a stronger need for WB and the RMOW to focus their attention on climate change mitigation efforts.

Parallel with the third theme of the model 'determine response capacity'. Both the RMOW and WB have assessed their climate change response capacity as high for two main reasons. First, they have a strong track record of successfully developing and implementing other policies and programs responding to other environmental management issues, e.g. the RMOW's and CSP, and WB's EMS. Second, they have a strong history of working collaboratively on problem solving issues and securing the financial, human and time resources needed to develop and implement priority actions e.g. the 2010 Winter Olympics.

However, the findings suggest that the general community is unaware of Whistler's overall potential climate change challenges. The lack of community awareness may be a result of the RMOW not investing in climate change research, or because of WB's strong business model. It may benefit the RMOW and WB to increase

public awareness, by developing a series of education programs, to ensure the public's support on any future climate change response initiatives.

Finally, inline with the fourth theme of the model 'response process', the RMOW is using plans outlined in their Integrated Energy, Air Quality, and Greenhouse Gas Management Plan and Carbon Neutral Operations Plan (CNOP) to implement several 'one-time' technological changes to reduce their GHG emissions. While, WB is following objectives outlined in their EMS to implement mitigation initiatives centred on renewable energy, energy management, heating initiatives, and fuel consumption.

Although, both organizations are making significant progress towards reducing their GHG emissions, the literature suggests that if the RMOW wishes to make further progress in reducing their emission, they need to start focusing on energy conservation, instead of one-time changes in technology. Furthermore, both the RMOW and WB may need to readdress the fact that the majority of emissions related to the community are created by travel to and from the destination. The RMOW and WB have indicated that they have little control over emissions produced outside of the resort, but it does not negate the transportation industry's significant contributions to global climate change.

The RMOW and WB could address their associated travel emissions by attempting to only attract the regional market oppose to destination markets. Regional markets do not have to take long-haul flights to travel to Whistler, and their associated travel emissions are typically much lower when compared to destination markets. However, in the past destination markets have generated the largest share of WB's and the RMOW's tourism revenues, as they stay for longer and make use of the community's amenities (e.g. hotels and restaurants). The RMOW and WB could work with Tourism Whistler, a marketing organization, to develop strategies that encourage the regional market to utilize the provided amenities. However, in the short-term this is not an economically viable option, and it may just be something for stakeholders to start discussing, while recognizing that it is currently not feasible.

Other literature suggests that Whistler's associated travel emissions can be reduced if stakeholders take steps to make public transportation to and from the resort convenient and affordable. Unfortunately, a study conducted by Reilly et al. (2010)

indicated that tourists traveling to Whistler are not willing to replace private modes of transportation for public.

Despite the identified, challenges both the RMOW's and WB's mitigation initiatives are seen as progressive—amongst mountain-based resort communities. In 2004 the RMOW was the first municipality in Canada to develop an Integrated Energy, Air Quality, and Greenhouse Gas Management Plan. In 2007 they were the first Canadian municipality to complete the PCP's five milestones for both community and corporate emissions (RMOW, 2011a). WB has received various awards from several organizations for their mitigation initiatives. For example they won Canada's Greenest Employer Award for their Renewable Energy Development initiatives, and were recognized by Skiing Magazine for their renewable energy project (Whistler Blackcomb, 2012).

## 5.2 Rossland

Similar to Whistler, in Rossland the exogenous force of climate change and endogenous force of sustainability appear to be motiving factors to new forms of governance being created. Planning for climate change will help City Council achieve goals laid out in its *2030* sustainability vision. For example informant 10, a municipal representative from Rossland City Council, suggested that even if the region does not experience the impacts of climate change, their adaption plans would still help improve the sustainability of the community.

The CBT chose Rossland's to participate in their Communities Adapting to Climate Change Initiative (CACCI) because of City Council's well-developed SSP and the establishment of the Sustainability Commission (SC). During the CACCI a steering committee was established and they developed a suite of adaptation plans and implementation strategies for City Council to consider. The process undertaken during the CACCI reflects the strategies outlined in the adaptation of Jopp et al.'s (2010) assessment model.

First, in line with the theme of 'governance structure' the local steering committee was established consisting of members from the public, the SC, City Council, city staff, and the CBT (The City of Rossland, 2010c). The general community and Red Mountain resort were also consulted during the process; however, ski tourism was not the focus of the initiative.

Parallel with the second 'theme of establishing risks and opportunities' the steering committed hired PCIC and ACT to review local climate knowledge and conduct climate modeling. Based on their results, the steering committee and the community felt Rossland's infrastructure, water, energy, and food systems were the most vulnerable and needed to be the focus of their adaptation plans. The steering committee believed that if City Council implemented adaptation strategies for these areas and the impacts of climate change are not experienced, Rossland's sustainability would still be enhanced. Furthermore, if City Council focuses on Rossland's energy system they would fulfill their mitigation commitments to the Government of BC. A climate change response plan that includes both adaption and mitigation is recommended in the literature (e.g. Becken & Hay; Patterson, Bastianoni, & Simpson, 2006).

Regardless of the steering committee and community's justification for choosing their four focus areas, Jopp et al. (2010) and other academics such as Scott & McBoyle (2007) believe that climate change presents far too many challenges for ski resorts not to develop an adaptation plan. However, the steering committee and the community did not feel confident focusing on Red Mountain ski resort because of the scientific uncertainty associated with PCIC's modeling. For example several stakeholders indicated that PCIC's models could not predict snow reliability during the Christmas season, which is when Red Mountain resort generates a significant portion of its annual revenues.

This author's believes that if City Council helped Red Mountain resort develop an adaptation plan it could be highly beneficial to the community's overall sustainability. To start the process, Rossland City Council and Red Mountain could seek support from ski industry associations such as the Canada West Ski Area Association (CWSAA). The CWSAA is actively engaged in climate change vulnerability issues, as evidenced by its idle free campaign. Red Mountain ski resort could also seek support from Environmental

NGO's such as the David Suzuki Foundation (DSF). In 2009 the DSF published the report "On Thin Ice: Winter Sports and Climate Change", which discussed in great details the climate change risks, opportunities, and response options available to ski resorts.

The large scope of City Council's current adaptation plan may require them to readjust their focus areas, if they wish to assist Red Mountain respond to climate change. This could be achieved by exchanging the food security focus area for ski tourism. For example the CACCI steering committee recommended that City Council support the development of community gardens to reduce Rossland's dependence on imported food. However, this study uncovered that Rossland's water use significantly increases during the summer and may be attributed to gardening, which can affect the community's water conservation goals. Therefore, it may be advantageous for City Council to focus on developing adaptation plans for the Red Mountain ski resort as opposed to food security. This author is not claiming that food security is unimportant; however, it could be more beneficial for Rossland's long-term sustainability to focus on the ski industry.

In line with the theme 'determine response capacity' the informants had assessed Rossland's response capacity as high for three main reasons. First, in Rossland there is strong presence of social networks (e.g. the SC). All of Rossland's informants indicated the SC was imperative to Rossland being accepted to participate in the CACCI. Second, the community is highly educated on the impacts climate change could have on the community because of the process that occurred during the CACCI. Finally, the CBT provided City Council with the financial, human and time resources to develop an adaptation plan. Yet, when relating the findings to the literature (e.g.Scott, 2010; UNWTO & UNEP, 2008) because an adaptation plan was not developed for Red Mountain resort, Rossland may actually have a lower response capacity than perceived by the informants.

Inline with the 'response process' theme, the CACCI steering committee provided City Council with nineteen adaption actions and several corresponding implementation strategies. At the time of writing City Council was determining ways to

implement the adaptation strategies, which was largely dependent on financial support from outside funding (e.g. provincial grants).

Overall, the findings suggest that Rossland's impressive community wide adaptation initiatives are mainly connected to the CBT. The CBT is also working with other communities in the Kootenay Region to develop a series of community adaptation plans. Related to this research project, the CBT is working with the resort municipality of Kimberly, BC. Like Rossland, Kimberly was once highly dependent on the mining industry, but has slowly transitioned to a ski tourism based economy, and its City Council has implemented a sustainability-based approach to planning. Unfortunately, due to time and financial restraints, this research did not explore Kimberly's adaptation program or other adaptation initiatives in the area.

Whistler and Rossland's climate change response strategies appear to be the result of their well-established community based approach to sustainability planning, which supports the academic literature surrounding sustainable governance and climate change (e.g. Scott, 2010; Bramwell & Lane, 2011; Jopp et al. 2010; Gill & Williams, 2011a). Academics and researchers can use these findings as examples of mountain-based resort communities that are actively responding to climate change in combination with broader sustainable development goals. This research may also be used to further highlight the need to for mountain based resort communities to develop ski industry focused adaptation plans.

# 6 Conclusion

## 6.1 Research Summary

This research set out to explore the extent **municipal governments** and **ski resorts** in mountain-based resort communities are planning for climate change. The following questions were used to guide the investigation:

1. What governance approaches is the municipal government and ski resort in Whistler and Rossland, BC using to plan for climate change?
2. What are the climate change risks and opportunities facing the municipal government and ski resort in Whistler and Rossland, BC?
3. What is the climate change response capacity of the municipal government and ski resort in Whistler and Rossland, BC?
4. To what extent has the municipal government and ski resort in Whistler and Rossland, BC identified, assessed, implemented, and evaluated climate change response strategies?

The findings with respect to each of the above questions are summarized below.

*What governance approaches is the municipal government and ski resort in Whistler and Rossland, BC using to plan for climate change?*

The Government of Canada, the Government of BC, and private organizations throughout Canada have developed initiatives that can influence the way municipal governments and ski resorts plan for climate change. In Whistler, the RMOW and WB are using their sustainability-based approaches to planning as platforms to partake in broader climate change response initiatives.

In Rossland, City Council is also using its sustainability-based approach to form partnerships and plan for climate change. However, Red Mountain ski resort has not developed a response plan or formed partnerships centred on planning for climate change.

*What are the climate change risks and opportunities facing the municipal government and ski resort in Whistler and Rossland, BC?*

In Whistler, predictions of increased summer and winter temperatures and precipitation, and decreases in reliable snow cover at lower elevations may pose a significant threat to their ski tourism economy and future visitation levels. However, increases in summer temperatures also provide a significant opportunity for the ski resort to expand their tourism product, as long as they can effectively manage forest fire risks.

In Rossland predications of higher average summer and winter temperatures, decreases in summer precipitation, decreases in snowfall and snowpack, earlier spring-runoff, lower summer stream flows for longer periods, and increases in extreme events threaten the community's infrastructure, water availability, energy prices and availability, and food security, and offer stakeholders an opportunity to develop adaption strategies for these areas.

*What is the climate change response capacity of the municipal government and ski resort in Whistler and Rossland, BC?*

Whistler's key informants indicated that the RMOW, WB, and the overall community have a strong climate change response capacity. The contributing factors discussed by the key informants align with the academic literature (e.g. Simpson et al., 2008).

Rossland's key informants believed that City Council and the overall community have a strong climate change response capacity, which was mostly attributed to the CBT and its CACCI. However, the informants also indicated that a climate change response plan was not developed for Red Mountain ski resort, and this author believes it may actually limit the entire community's response capacity.

*To what extent has the municipal government and ski resort in Whistler and Rossland, BC identified, assessed, implemented, and evaluated climate change response strategies?*

In Whistler, both the RMOW and WB were at the implementation and evaluations stages of their mitigation plans.

In Rossland the CACCI steering committee had identified and assessed an adaptation plan for City Council to consider. At the time of writing City Council was determining an implementation strategy.

## 6.2 Study Limitations

Two-primary study limitations were discovered during the course of this research. First, a lack of climate data made it difficult to comprehend the physical impacts facing both communities, which limits the certainty of the risks and opportunities facing the destinations. To compensate this researcher made every attempt to thoroughly review the limited climate data available for each community, examine climate data on communities of similar nature, and gain insight from informants.

Second, it is also impossible to draw general conclusions about all mountain based resort communities' climate change response strategies solely based upon this study. This research only makes claims about Whistler and Rossland, and cannot determine if these communities are promoting other destinations to also respond to climate change.

## 6.3 Recommendations for Further Research:

This study prompts new lines of inquiry. Possible avenues for further research are outlined below:

- This research lightly addressed the governance processes involved in shaping Whistler and Rossland's climate change response strategies; further exploration of this topic could be a worthwhile endeavour.

- The results presented here are limited to two of BC's nine mountain based resort municipalities. The analysis of other municipalities dependent on ski tourism might yield new insights into the significance of using sustainability-based approaches to planning to respond to climate change.

- While this research was able to uncover some physical impacts climate change is/may have on both communities, a more comprehensive analysis of the direct impacts climate change could have on the communities is an obvious avenue to explore. Furthermore, the lack of climate data limits the effectiveness of Jopp et al.'s (2010) model. If climate data does not exist local governments and ski resorts cannot accurately develop a climate change response plan. Therefore, future research could explore how to expand the model to address scientific uncertainty.

- A thorough investigation of the need/possibility of developing a 'ski' specific adaptation plan for Red Mountain resort may be invaluable to the community's long-term sustainability.

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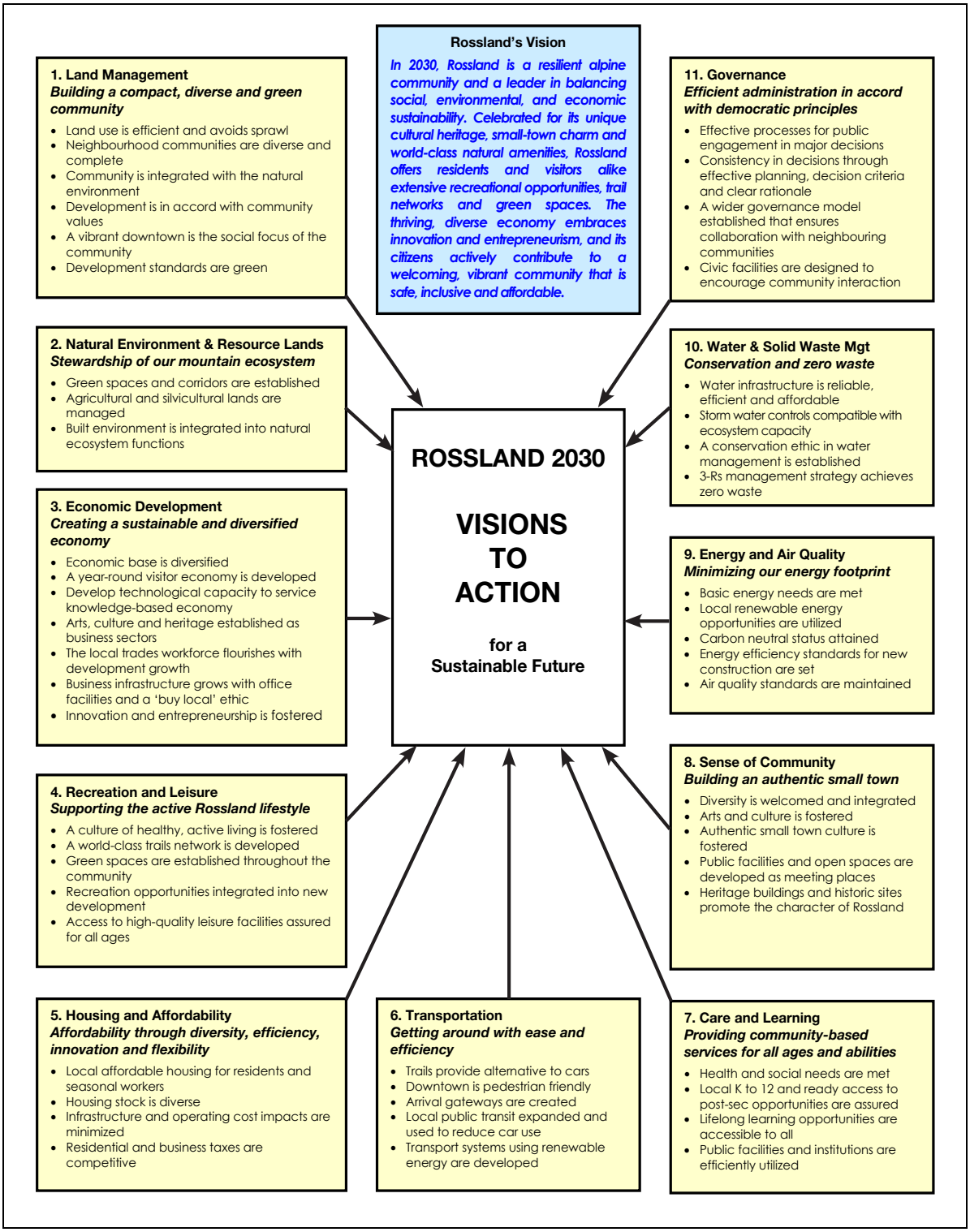
# Appendices

# Appendix A. Rossland's Strategic Sustainability Plan (SSP)



# Appendix B. Interview Guide

**OBJECTIVE**

Tourism is a climate-dependent industry, many tourist travels to destinations to enjoy suitable weather as they participate in outdoor activities (Joppa, DeLacya, & Maira, 2010). Climate change presents substantial challenges to destinations as they may become less attractive or competitive due to the impacts of climate change (Joppa, DeLacya, & Maira, 2010).

This project aims to:

1. Learn how mountain based resort communities are preparing for and adjusting to emerging climate change impacts.
2. Determine ways in which such places can decrease their vulnerability to and capitalize on existing and future climate change effects, and increase their overall sustainability.

**DEFINITIONS**

Resistance – involves blocking the effects of a particular climate change-induced impact (such as glacial recession) in order to reduce the number of impacts that are likely to affect tourism (Joppa, DeLacya, & Maira, 2010).

Resilience – is the community's ability to absorb damages caused by climate change (Birkmann, 2007; Lorenz et al., 2008; Sivell et al., 2008)

Readiness- refers to the ability of regional tourism destinations to take advantage of the opportunities climate change will present (Birkmann, 2007; Lorenz et al., 2008; Sivell et al., 2008)

Adaptation-aims to moderate, cope with, and benefit from the consequences of climate change in order to manage risk and reduce vulnerability (Becken & Hay, 2007; COAG, 2007; DeLacy, 2007; Scott et al., 2006; Simpson et al., 2008).

**BACKGROUND INFORMATION**

1. What is your position / association with government / organization?
2. How many years have you been associated with this resort municipality / organization?
3. What roles have you played (if any) in previous resort municipality policy and planning activities?
4. Are you aware of any initiatives happening in BC communities to address climate change issues?

**A. CLIMATE CHANGE RISKS AND OPPORTUNITIES**

A1. The following climate change effects have been forecasted for other tourism destinations. When (if at all) do you feel these might happen in your resort community?

| Climate Change Symptoms | Potential Tourism Destination Implications |
|---|---|
| Increased duration and frequency of higher temperatures | Altered seasonality, changes in plant-wildlife-insect populations and distribution, increase in invasive species. |
| Decreased duration of reliable snow cover, snowpack, glacier coverage | Decreased winter sport season, snow cover length, availability, and quality; increased snow-making and snow-retention costs; increased avalanche management costs; decreased winter landscape attractiveness |
| Increased frequency and duration of 'extreme storm' conditions | Increased risk insurance costs and business interruption costs. |
| Increased frequency of heavy precipitation | Damaged tourism and community infrastructure; altered lengths of winter, summer and shoulder seasons. |
| Decreased availability of reliable water supplies | Increased water shortages, increased competition over water between tourism and other sectors, desertification, increased wildfires threatening infrastructure and affecting demand. |
| Changed character of terrestrial biodiversity | Loss of natural attractions and species from destinations, higher risk of invasive species i.e. mountain pine beetle. |
| Increased frequency, intensity and extent of forest fires | Loss of natural attractions; damage to tourism |

A2. Which of the above risks are the most urgent to deal with in the short term (1-10 years), and, in the long term (11+years)?

A3. What types of opportunities exist (if any) to adapt and /or gain advantages for the resort municipality and its tourism industry in both the short and long-term?

**B. IDENTIFYING CLIMATE CHANGE PLANNING STAKEHOLDERS**

B1. What role (if any) does/should your organization play in developing and implementing effective climate change adaption plans and programs for your resort community?

B2. What other organizations (if any) in and beyond your resort community does /should your organization collaborate with in developing an effective climate change adaption plan and program?

B3. Are there any other organizations that your feel are particularly important to collaborate with now and in the future with respect to climate change policy and planning initiatives?

B4. What are the best processes to ensure collaborations amongst resort community stakeholders are effective in regards to climate change adaptation planning?

**C. CLIMATE CHANGE ADAPTIVE CAPACITY**

C1. Several factors can affect the ability of resort communities to adapt to climate change. Please identify the factors that affect the ability of your resort community to adapt to current and future effects of climate change:

| | |
|---|---|
| Availability of climate change impact adaptation technologies (e.g. snow making) | |
| Availability of financial, human and time resources to develop adaptation approaches. | |
| Availability of natural resources to support adaptation strategies (e.g. water to increase snow making capacity). | |
| Community's track record of successfully developing and implementing other policies and programs responding to other environmental management issues. | |
| Presence of community social networks (e.g. community groups, NGOs, government organizations) and their history of working collaboratively on problem solving). | |
| Presence of community disaster response plans | |
| Community awareness of the different risks and opportunities posed by climate change. | |
| Please specify any others you feel should be included. | |

Source: Simpson et al. 2008

C2. Please indicate why these are the most important.

**D. RESORT COMMUNITY READINESS**

D1. The following chart outlines the various stages of resort community's climate change adaptation planning readiness. What stage best describes your resort community's readiness?

| Stage | What does this mean? |
|---|---|
| Identify adaptation options | Potential options based on the risks and opportunities have been identified. |
| Assess adaptation options | The list of potential options have been refined and reduced to those of highest priority to address in the short and long term. |
| Test adaptation options with community and tourism stakeholders | The appropriateness and 'buy in' of the priority options have been tested with tourism community stakeholders and consumers. |
| Adaptation plans are selected and put into action. | Stakeholder responsibility, resource requirements, and implementation guidelines have been established, and actions are being implemented. . |
| Evaluate adaptation option success | Evaluations of the climate change adaptation plans ease of implementation, costs, adverse impacts, and benefits delivered have been conducted (during and after its implementation) |

D2. Given your assessment of this resort community's current climate change adaptation status, what factors / events will lead to an increase in its overall resilience, resistance, and readiness for climate change in short and long term?

*Thank you for your valuable perspectives on this important topic. We will be pleased to share the collective findings of this work with you upon completion of my thesis.*

# Appendix C. Typical Particpant Briefing

| Particpant Briefing | |
|---|---|
| **Title of Research:** | **Primary Research:** |
| Planning for Sustainability and Climate Change in Mountain Based Resort Municipalities: A Case Study of Whistle and Rossland, British Columbia | Shannon Jones<br>School of Resource and Environmental Management- Simon Fraser University |

Dear Respondent,

I am conducting research concerning resort community strategies for climate change adaptation. It is part of an ongoing research program at Simon Fraser University's Centre for Tourism Policy and Research concerning resort community strategies for dealing with the effects of climate change. Because of your professional experience, I am interesting in learning your views on how resort communities are preparing for and adjusting to emerging climate change impacts. I am particularly interesting in discussing with you and other resort community representatives ways in which such places can decrease their vulnerability to and capitalize on existing and future climate change effects. While your viewpoints will be kept confidential, they will be combined with those of other 'informed people" to collectively provide a greater understanding of climate change response options available to all mountain resort municipalities in British Columbia.

If you agree to participate in my research, your interview with me will be conducted in person or by telephone. It will involve responding to a range of general questions about planning for climate change adaptation in your resort community. It should last between 45-60 minutes, and with your permission it will be recorded. However, all transcripts will be kept strictly confidential and will be destroyed after two years. Copies of my final report will be shared with you and other resort communities when I have completed this project.

Your participation in this research would be most appreciated. I would be pleased to meet with you at a time and place that is convenient for you. Please let me know of your availability by phone or email. My contact coordinates are: email: slj8@sfu.ca telephone: 778-321-6079. I look forward to hearing from you in this regard.

| Research and Supervisor Contact Information | |
|---|---|
| Primary Research | Senior Supervisor |
| Shannon Jones – Student, School or Resource and Environmental Management | Dr. Peter Williams - Professor, School or Resource and Environmental Management |
| Phone: 778-321-6079 | Phone: 778-782-3103 |
| Email: slj8@sfu.ca | Email: peter_williams@sfu.ca |

# Appendix D. Consent Form

**SIMON FRASER UNIVERSITY**

Informed Consent by Participant in a Research Study

**Study Title: Planning for Sustainability and Climate Change in Mountain Based Resort Municipalities: A Case Study of Whistle and Rossland, British Columbia**

**Purpose of Consent:** Semi-structured interviews will occur either in person or by telephone and will be audio recorded with the permission of participant.

**Purpose and Goals of Study:**

I am conducting research at Simon Fraser University's Centre for Tourism Policy and Research, housed within the School of Resource and Environmental Management. The objective of this study to investigate the extent to which government representatives, tourism associations, NGO's and local tourism operators in BC's Mountain Based Resort Municipalities are developing and/or implementing strategic response plans designed to reduce vulnerability and enhance climate change readiness, as well as to determine what governance approaches are being used to develop and/or implement these response plans. More specifically the study aims discover how BC's mountain based resort communities are preparing for and adjusting to emerging climate change impacts, and how they can decrease their vulnerability to and capitalize on existing and future climate change effects.

**Participant Requirements:**

The interview will measure your experiences in the following: identifying climate change planning stakeholders; establishing climate change risks and opportunities; determining climate change adaptive capacity; and increasing resort community readiness**.** The entire interview will take approximately 45-60 minutes of time and can be ended at anytime during the process.

**Risks to the participant, third parties or society:**

There are no foreseeable risks that you will be exposed to.

**Statement of confidentiality and anonymity:**

The University and the researcher subscribe to the ethical conduct of research and to the protection at all times of the interests, comfort, and safety of participants. This research is being conducted under permission of the Simon Fraser Research Ethics Board. The chief concern of the Board is for the health, safety, and psychological well-being of research participants. Should you wish to obtain information about your rights as a participant in research or about the responsibilities of researchers, or if you have any questions, concerns, or complaints about the manner in which you were treated in this study, please contact Dr. Hal Weinberg, Director, Office of Research at hal_weinberg@sfu.ca or 778-782-6593

With your agreement our interview will be recorded, transcribed and reported data collected will be maintained in a secured location, only accessed by the researcher and project supervisor. Information that you share during the interview will be used as data for any reports produced from the project. Things you say may be quoted in reports, but your identity will never be linked to those quotes or opinions. If you are employed by an agency or group about which you will be giving information this is to confirm that your employer has not been approached for approval of this interview. Although, you will not be identified in any reports, if your agency or

company/employer is identified in any reports, it is possible for you to be identified, thus confidentiality cannot be guaranteed. If you are interviewed over the phone, your confidentiality and identity also cannot be guaranteed, as the phone is not a confidential medium.

The interview transcripts and recordings (if applicable) will be retained for two years, after which they will be destroyed to ensure the confidentiality of your responses.

I have been fully informed of the objectives of the project being conducted. I understand these objectives and consent to being interviewed for the project. I understand that steps will be undertaken to ensure that what I say in this interview will not be linked to my identity and will be kept confidential upon completion of the study. I understand that if I wish to withdraw from the study I may do so without any repercussions.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Participant First and Last Name (Please Print):

---

Participant Contact Information (Please Print):

---

Participant Signature: Witness:

---

Date (MM/DD/YY):

---

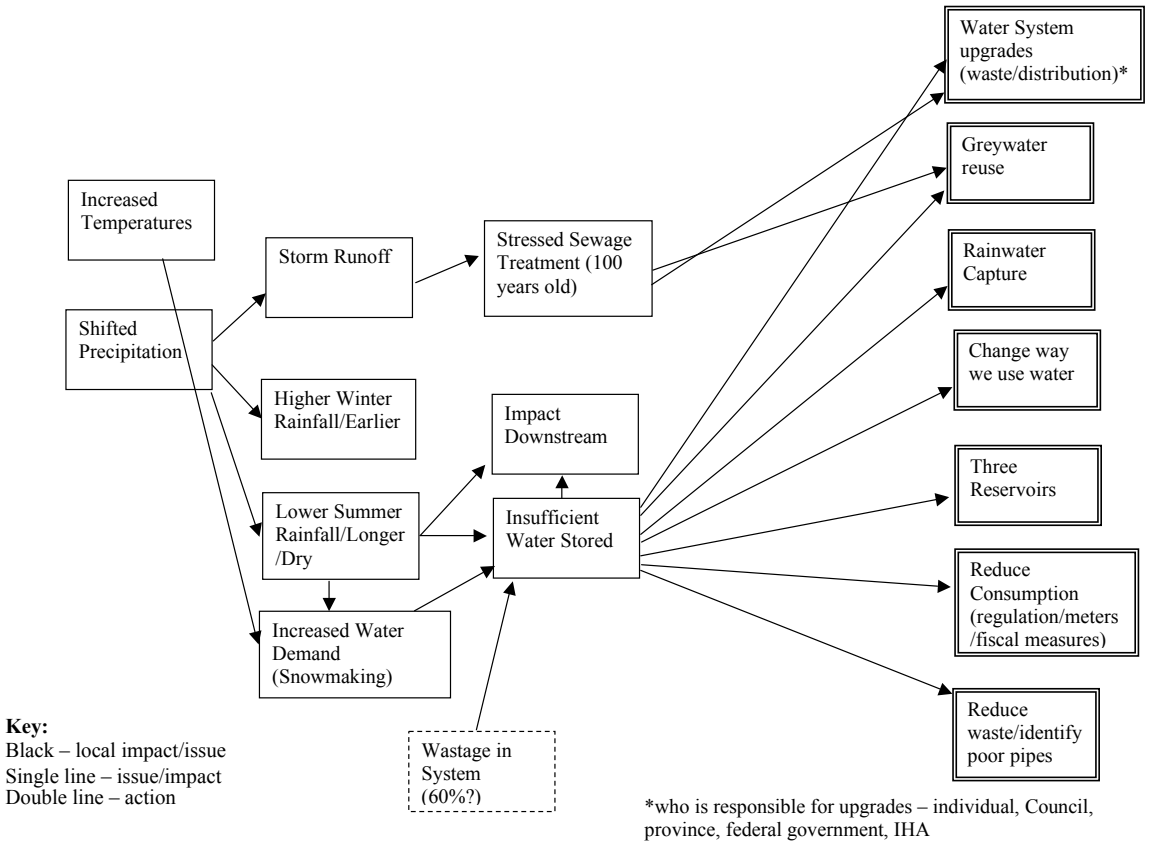
**For research results, further comments, ideas and questions please feel free to contact Shannon Jones or Peter Williams:**

**Shannon Jones**
Masters Candidate, Centre for Tourism Policy and Research
School of Resource and Environmental Management
Simon Fraser University, Burnaby BC V5A 1S6
Cell: 778 3321 6079
e-mail: slj8@sfu.ca

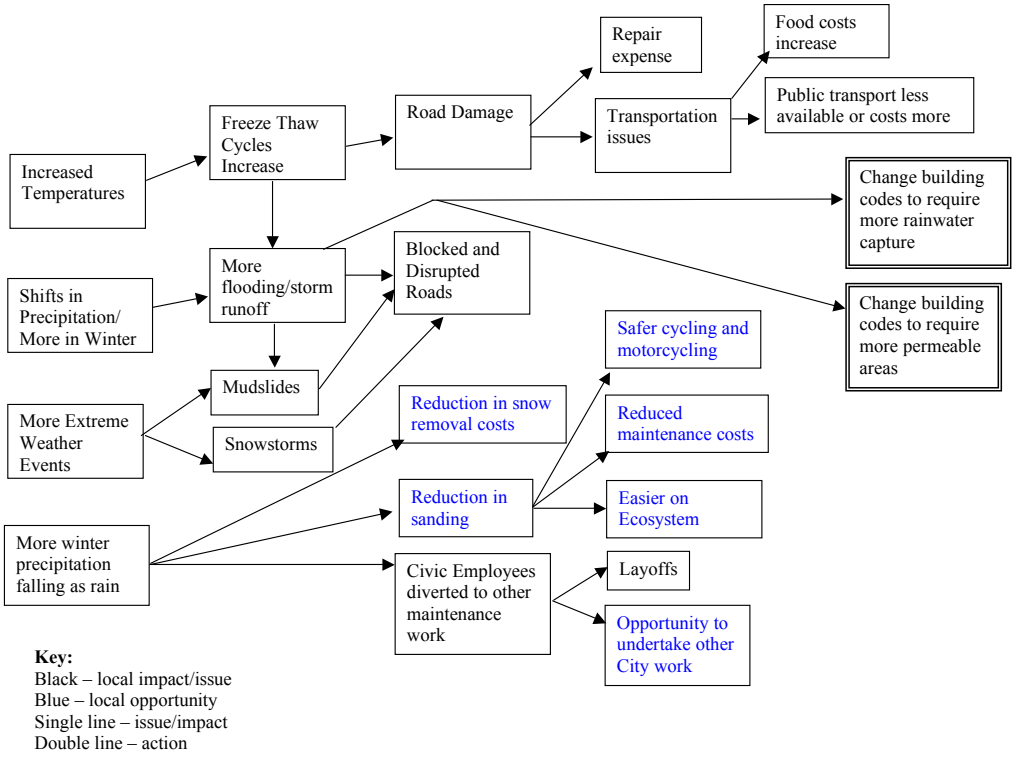
**Supervisor Contact Information**
Prof. Peter Williams
Centre for Tourism Policy and Research
School of Resource and Environmental Management
Simon Fraser University, Burnaby BC V5A 1S6
Phone: 778 782-3074
e-mail: peterw@sf.ca

# Appendix E. CACCI Impacting Mapping Event

## Built Environment and Infrastructure - Water

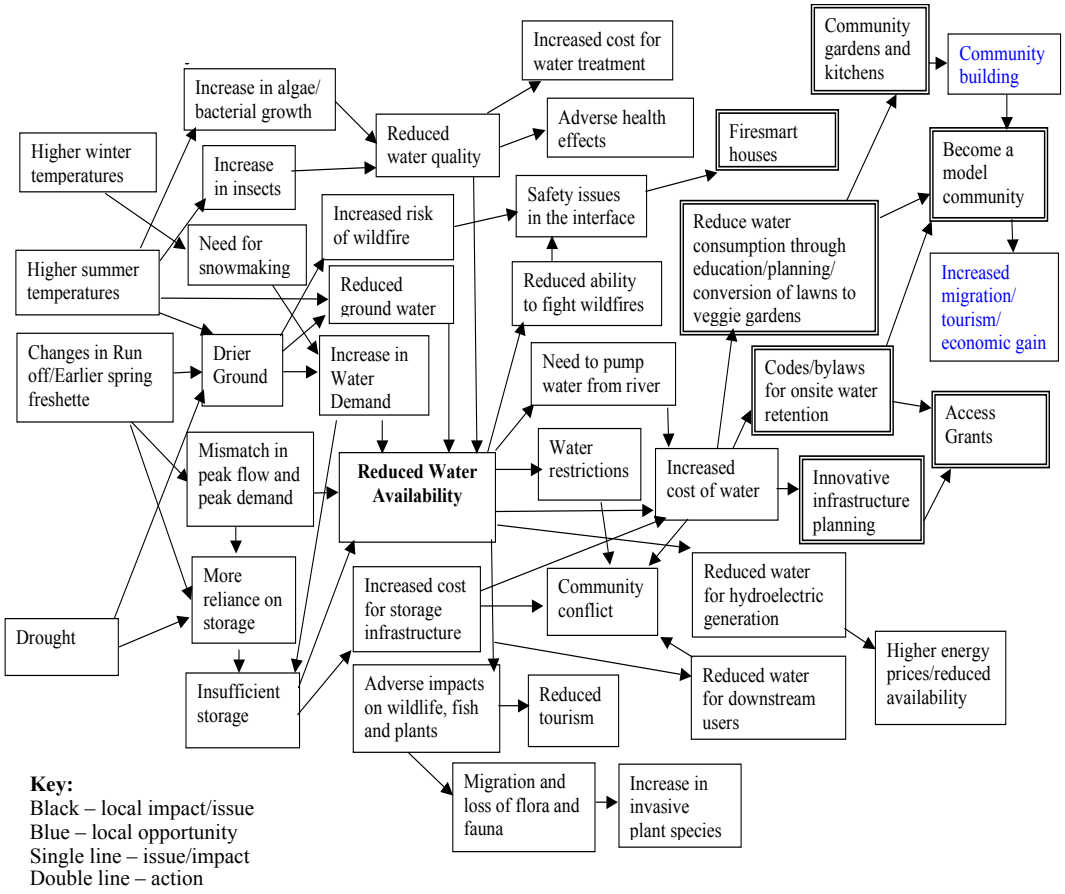


## Built Environment and Infrastructure – Roads

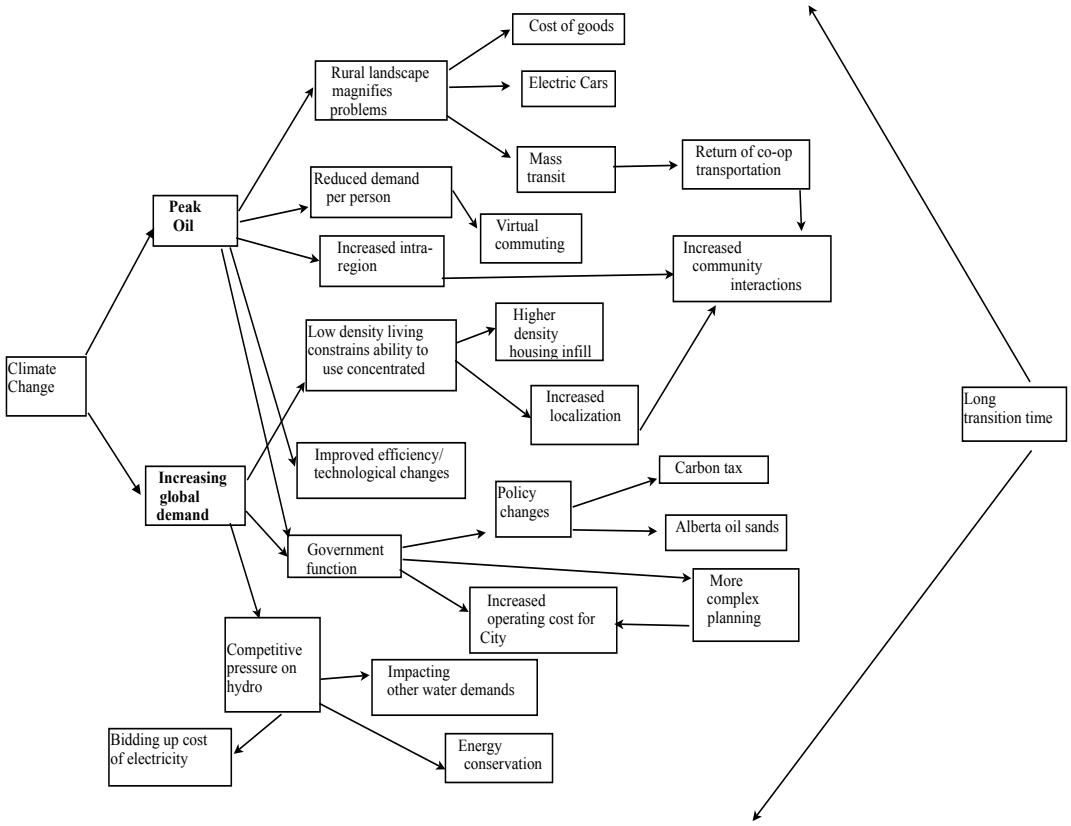



**Key:**
Black – local impact/issue
Blue – local opportunity
Single line – issue/impact
Double line – action

## Water Availability



## Energy Availability and Pricing




**Key:**
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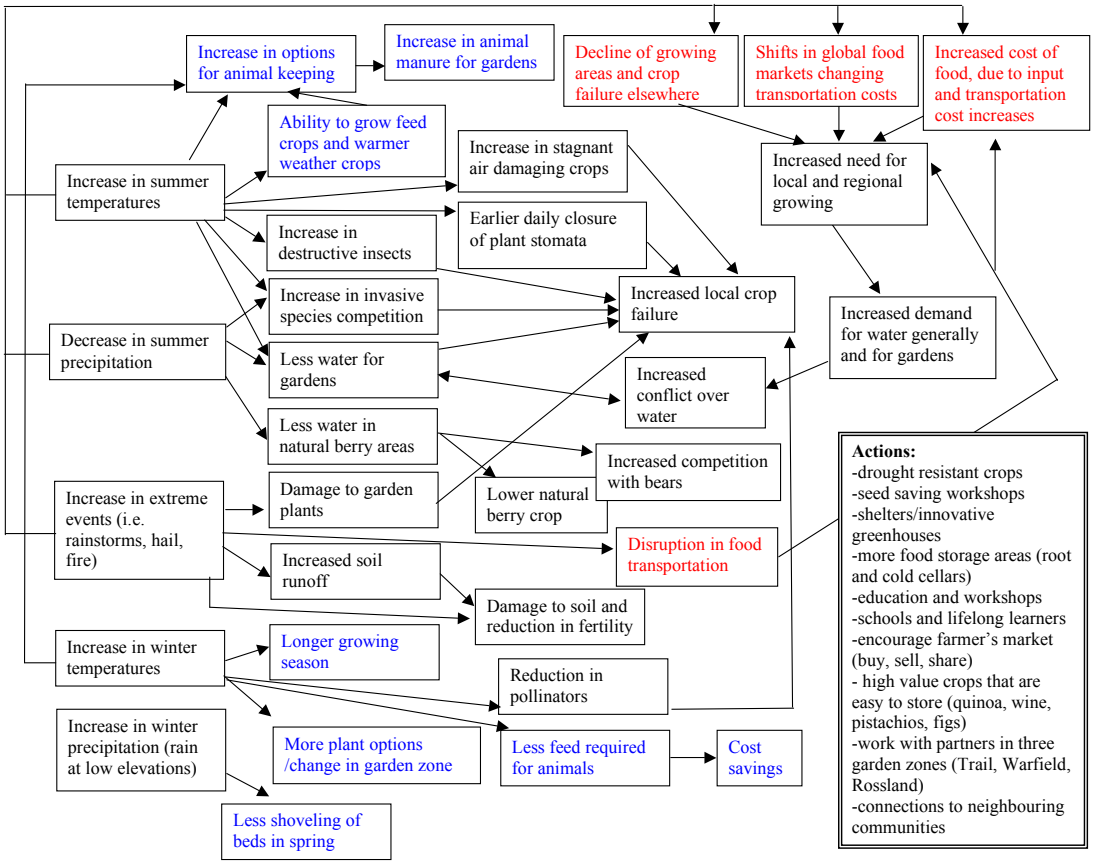
Single line – issue/impact
Double line – action

## Food Security




**Key:**
Black – local impact/issue
Blue – local opportunity
Red – global impact/issue
Single line – issue/impact
Double line – action