INTEGRATED ENERGY, AIR QUALITY & GREENHOUSE GAS MANAGEMENT PLAN

WHISTLER

FEBRUARY 2004

RESORT MUNICIPALITY OF WHISTLER

EXECUTIVE SUMMARY

This report presents Resort Municipality of Whistler's (RMOW) integrated plan for managing energy, air quality, and greenhouse gas (GHG) emissions. This integrated plan is unique in that it is the first initiative in Canada to include energy, air quality, and GHG planning in one document. The distinct advantage to an integrated approach for these issues is that integration provides the opportunity to develop a streamlined implementation plan and to identify a number of co-management opportunities.

Whistler's Energy, Air Quality and GHG Goals

RMOW council joined the Federation of Canadian Municipalities' Partners for Climate Protection (PCP) Program in 1997, thereby committing to a 20% reduction in GHG emissions from municipal operations from 1990 levels, and a minimum 6% reduction for the entire community from 1990 levels. Whistler has also committed to preserving the 'Whistler Experience' and clean air is an important part of this experience.

Methodology

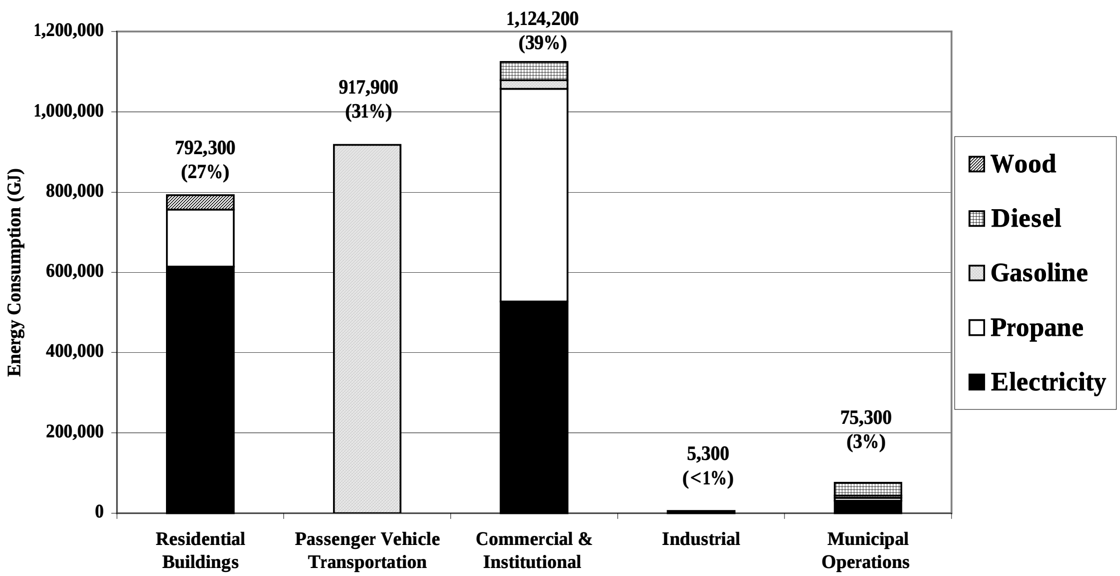
An energy and emissions inventory for the year 2000 was prepared using fuel consumption estimates for buildings, infrastructure, and transportation. GHG and Common Air Contaminant (CAC) emissions resulting from energy use were then estimated using standard emission factors for the various fuel types used in Whistler. Results of this analysis are supplemented with ambient air quality monitoring data collected by the BC Ministry of Water, Land and Air Protection.[1]

Results: Energy Consumption in 2000

Residents, businesses and visitors in Whistler consumed 2.9 million GJ of energy in 2000, representing an annual expenditure of about $47.7 million. On a per capita basis, this is the equivalent of 119 GJ, or more than $1,900 per person per year (including residents and visitors).

Municipal operations used 75,000 GJ of energy in 2000—3% of the community's total, representing an expenditure of nearly $1 million. The commercial sector is responsible for the majority of energy consumption, followed by passenger vehicle transportation and the residential buildings. Energy consumption by sector and by fuel type is summarized in Figure 1.

Figure 1: Energy Consumption by Fuel and Sector, 2000



Results: GHG Emissions in 2000

The majority of Whistler's GHG emissions result from two processes: the use of energy, and the disposal of solid waste. Other potential sources, such as agriculture, are assumed to be minimal.

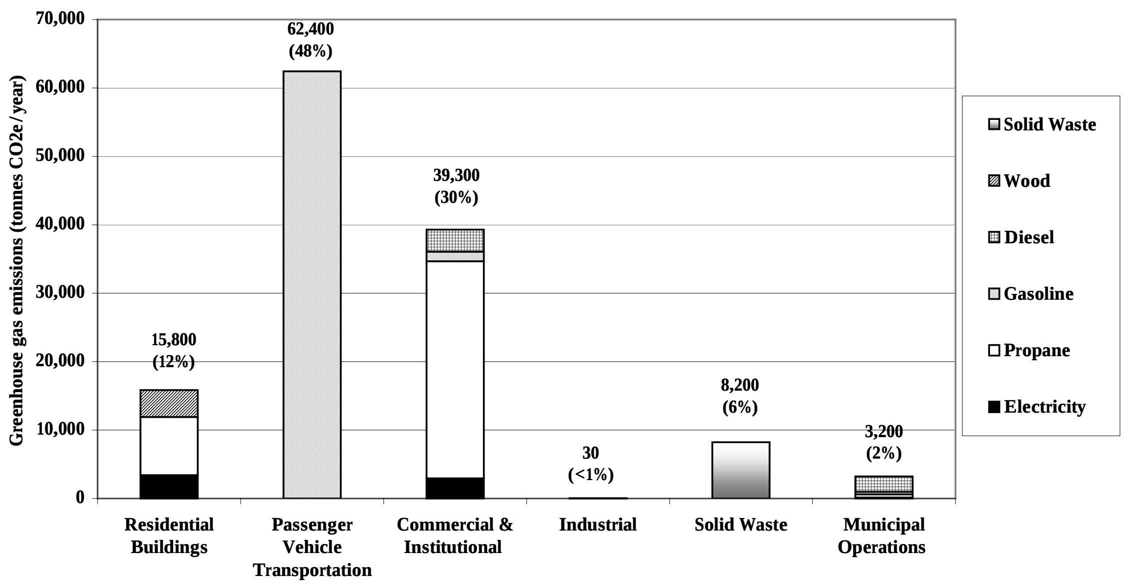
RMOW's 2000 GHG emissions were about 128,000 tCO_2e, or 5 tCO_2e (tonnes carbon dioxide equivalent) per capita. Figure 2 summarizes Whistler's GHG emissions by sector and by fuel type.

BEYOND CITY LIMITS

This inventory only includes the energy consumed within RMOW borders. However, given that the municipality is heavily dependent upon tourism, the RMOW is in fact responsible for a significant amount of transportation that occurs in bringing tourists into the region.

A rough analysis of this "inter-community" transportation was carried out, showing that this transportation represents a consumption of 23.7 million GJ of energy, which is seven times higher than the in-community consumption.

Figure 2: GHG Emissions by Sector and Fuel Type (tonnes of CO2 equivalent/year)



Eighty percent of GHG emissions are a result of two categories - personal vehicle transportation and the commercial sector. Personal vehicle transportation accounts for nearly half the GHG emissions in Whistler, while the commercial sector accounts for 30% (a significant portion of which is visitor accommodation).

Results: Common Air Contaminant Emissions in 2000

The connection between air quality and energy use is simple. **In Whistler, more than 90% of common air contaminants (CACs) emissions that contribute to air quality problems result from fossil fuel combustion.** Therefore, by managing energy and/or greenhouse gas emissions, the community can reduce emissions of these air contaminants.

CACs considered in this report include:

- Carbon Monoxide (CO)
- Oxides of Nitrogen (NOx)
- Oxides of Sulphur (SOx)
- Volatile Organic Compounds (VOCs)
- Particulate matter (PM)

Whistler has not yet experienced problems with air quality. However, this may not always be the case if current trends in vehicle transportation continue. Key findings from air quality monitoring are summarized below and estimates of CAC emissions are presented in Table 1.

Inhalable Particulate Matter (PM_{10})

On an annual average basis, PM_{10} concentrations in Whistler are lower than those found in Squamish, although maximum values are similar in both communities.

Ozone (O_3)

Preliminary results from ozone monitoring in Whistler[2] indicate that ozone concentrations in the municipality are similar to those measured in Squamish. However, the number of times the 1-hour Maximum Desirable air quality objective for ozone is exceeded is much higher (sometimes twice as many per year) in Whistler compared with Squamish.

On days when ground-level ozone concentrations are high, and high-altitude concentrations are comparatively low, one can presume that ground-level ozone "events" are driven by local pollution sources. These events occurred in July and August. Thus, management of vehicle emissions should be targeted toward the summer months (July and August) when the potential for local ozone events in Whistler is greatest.

Nitrogen Oxides (NOx)

NO_2 concentrations in Whistler were found to be relatively low (about half the concentration measured in the Greater Vancouver Regional District and Fraser Valley). Preliminary data suggests that NO_2 concentrations are closely related to vehicle traffic in Whistler, although a full study has not been conducted.

Table 1: CAC Emissions Estimates in 2000 (Tonnes)

	CO	NOx	SOx	VOC	PM	Total
Point	164	7.6	2.8	14.3	52.3	241
Area	302	48	0.6	38	41	430
Light-Duty Vehicles	1,596	184	1	160	3	1,944
Heavy-Duty Vehicles	46	46	0.8	7.4	3.5	103.5
Total	2,108	286	5.2	220	100	2,718

Results: Energy and Emissions Forecast, 2000 to 2020

Energy and emissions were forecast to 2020 so that Whistler can make informed decisions about potential energy efficiency, demand reduction, and fuel switching opportunities. Forecasts were developed using projected estimates for:

- Population (expected resident and visitor population increases),
- Infrastructure (planned infrastructure and building additions), and
- Efficiency (expected Business As Usual energy efficiency and emission reduction initiatives).

Two scenarios for energy consumption were developed: the Business As Usual Scenario (BAU) and the Recommended Scenario. The BAU Scenario describes a "do-nothing" forecast, while the Recommended Scenario analyzes the impacts of implementing proposed IEP measures.

A **Sustainable Energy Vision** for Whistler was also prepared, which identifies longer-term opportunities to apply The Natural Step system conditions to energy management.

Business as Usual Scenario

The BAU Scenario assumes the continuation of past development patterns and energy efficiency trends into the future. In this scenario, it is assumed that there is a 2% annual increase in energy prices, and a continued increase in the price of space heating fuels.

In the BAU Scenario:

- Total energy consumption in Whistler is projected to increase from 2.9 million GJ in 2000 to 3.7 million GJ in 2020. This is equivalent to an accumulative expenditure of $580 million on energy between 2000 and 2020.[3]
- On a per capita basis, however, energy consumption will decrease from 119 GJ per person in 2000 to 107 GJ per person in 2020.
- GHG emissions are expected to increase 44% from 2000 levels, and 92% from 1990 levels by 2020.
- Passenger transportation is the largest user of energy and the largest emitter of GHG emissions, and forecasts predict that this sector will continue to increase through to 2020.
- There will be a substantial increase in Common Air Contaminant emissions over the forecast years, particularly for CO and VOCs. These increases are largely attributable to increased traffic and congestion.

The Recommended Scenario

The Recommended Scenario includes the implementation of the following measures:

1. Switch from piped propane to natural gas.

[3] In 2000 dollars, assuming an 8% discount rate and a 2% inflation rate for energy.

2. Achieve a 25% improvement in efficiency over the Whistler Comprehensive Transportation Strategy (this strategy has a target to reduce peak congestion in the RMOW by 15% by 2011).
3. Achieve a 50% diversion of solid waste by 2010 and 70% diversion by 2020.
4. Improve RMOW fleet efficiency by 30% by 2020.
5. Continue public education and outreach through the "Whistler. It's Our Nature" Sustainability Initiative.
6. Convert 10% of Whistler's electricity purchases to green power sources by 2010, and 20% by 2020.
7. Improve energy efficiency of new and existing residential and commercial buildings by 25%.

The package of measures included in the Recommended Scenario will result in:

- A cumulative reduction of 10.1 million GJ of energy compared to the BAU Scenario.
- A cumulative reduction of 809,000 tonnes of GHG emissions by 2020 compared to the BAU Scenario.
- A 22% increase in GHG emissions from 1990 levels by 2020, compared to a 92% increase in the BAU Scenario.
- Decreases in Common Air Contaminant emissions over the study period, ranging from a 14% reduction for NOx to zero change in PM levels.

The package of measures presented in the Recommended Scenario is ambitious yet cost-effective. The scenario will not, however achieve RMOW's targets for energy, air quality and GHG management. Therefore a **Sustainable Energy Vision** for Whistler identifies longer-term opportunities that will move Whistler closer to its sustainability goal.

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LIST OF ABBREVIATIONS

AQMP	Air Quality Management Plan
BAU	Business as Usual
BCAA	British Columbia Assessment Authority
CAC	Common Air Contaminants
CBIP	Commercial Building Incentive Program
CEP	Community Energy Plan
CES	Community Energy Systems
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DSM	Demand Side Management
FCM	Federation of Canadian Municipalities
GHG	Greenhouse Gas
GJ	Gigajoules
GVRD	Greater Vancouver Regional District
HOV	High Occupancy Vehicle
IEP	Integrated Energy Plan
IPP	Independent Power Producers
IRP	Integrated Resource Planning
LAP	Local Action Plan (for Greenhouse Gas Emission Reduction)
LEED	Leadership in Energy and Environmental Design
MWLAP	Ministry of Water, Land and Air Protection
MVA	Mega Volt Amps
NOx	Nitrous Oxides
PCP	Partners for Climate Protection Program
PM	Particulate Matter
RMOW	Resort Municipality of Whistler
SOx	Sulphurous Oxides
SOV	Single Occupancy Vehicle
STS	Sea-to-Sky
TAG	Transportation Advisory Group
tCO_2e	Tonnes Carbon Dioxide Equivalent
TDM	Transportation Demand Management
VKT	Vehicle Kilometres Travelled
VOC	Volatile Organic Carbon

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1 INTRODUCTION

The Resort Municipality of Whistler (RMOW) is committed to becoming a sustainable community, and has already made significant progress in working towards this goal. Notably, RMOW adopted The Natural Step[4] in 2000, and initiated a Comprehensive Sustainability Plan in 2001. Progress has clearly been made toward Council's vision[5]:

To make Whistler the first sustainable resort community in the world.

This report presents RMOW's plan for managing energy, air quality, and greenhouse gas (GHG) emissions—key initiatives in helping the municipality meet its sustainability goal. Because most of the GHG and air quality issues in Whistler are attributable to energy consumption, the plan addresses these issues collectively.

This integrated plan identifies both *strategies* and *actions* for meeting a community's energy needs affordably and reliably. In doing this, it also considers the community's broader economic, social and environmental goals. **Whistler's integrated plan is unique in that it is the first initiative in Canada to include energy, air quality, and GHG planning in one document.** This approach has two distinct advantages: a streamlined implementation plan and a number of potential co-management opportunities.

CREATING A PLAN FOR WHISTLER

RMOW joined the Federation of Canadian Municipalities' Partners for Climate Protection Program in 1997, committing to reduce GHG emissions from the community. A Community Energy Plan (CEP) was initiated in 2001 in order to identify opportunities to reduce GHG emissions associated with energy consumption.

Following completion of the first draft of the CEP in 2002, the Ministry of Water, Land and Air Protection approached the RMOW and suggested that an air quality component could also be incorporated into the plan. Therefore, an Integrated Energy Plan (IEP) was initiated in 2003.

1.1 Why Energy Management?

Community energy management involves adopting initiatives with two main goals: **to improve efficiency, and to reduce potentially negative impacts resulting from energy consumption.** Through better management of energy, a community can meet its energy needs affordably and reliably while at the same time reducing associated environmental, economic, and social impacts. Improved management will also contribute to broader community objectives such as housing, transportation management, job creation, and local economic development. Finally, energy efficiency and renewable

[4] **The Natural Step** (TNS) is a tool developed by international scientists to facilitate the integration of ecological principles into the practices of communities, organizations or individuals. It provides a definition of sustainability and serves as a compass for guiding planning initiatives within the municipality. The Framework is based on the recognition that for a society to be sustainable, certain system conditions must be met. That is, in order to be sustainable, a society must not subject nature to systematic increases in: (1) concentrations of substances from the earth's crust (e.g., the burning of fossil fuels and the use of scarce metals); (2) concentrations of substances produced by society (e.g., persistent organic pollutants); (3) degradation by physical means. And in that society, (4) human needs are met worldwide. (Source: The Natural Step web site: www.naturalstep.ca)

5 A summary of past initiatives that will contribute to the CEP is included in Appendix A.

energy initiatives will reduce GHG emission and enable ongoing air quality management. This plan identifies a set of energy targets for the RMOW—milestones in the community's journey toward achieving its sustainability vision.

1.2 Why Manage Greenhouse Gases?

Human activities such as the burning of fossil fuels and the removal of carbon sinks (e.g., forests), are resulting in increased concentrations of greenhouse gases in the atmosphere, thus contributing to global climate change.

Governments across the globe are recognizing the serious threat that a temperature change of this magnitude poses to life on the planet. Furthermore, reduced snowfall and an acceleration of glacial melt that will result from climate change may threaten winter-based tourism in Whistler.

International treaties are currently being negotiated by federal governments. In Canada, municipal governments are doing their part by voluntarily joining the Federation of Canadian Municipalities Partners for Climate Protection (PCP) Program. This is a group of municipal and regional governments that are working together to reduce local GHG emissions.

Recognizing the benefits of reducing greenhouse gases, RMOW council passed the following resolution on November 17, 1997:

> *Be it resolved that the Resort Municipality of Whistler communicate to the Federation of Canadian Municipalities in support for the 20% Club and its expression of interest in participating in the Club.*

This resolution commits the RMOW to a 20% reduction in GHG emissions from municipal operations from 1990 levels, and a minimum 6% reduction for the entire community from 1990 levels.

1.3 Why Manage Air Quality?

Whistler has not yet experienced problems with air quality. However, this may not always be the case if current trends in vehicle transportation continue. Residents and visitors place a high value on the pristine environment that can be found in Whistler. Incidences of poor air quality and reduced visibility would conflict with this ideal and yield negative impact on tourism.

Through this integrated plan, RMOW is linking air quality management with strategies and actions for managing energy and greenhouse gases. This approach will ensure that the community continues to enjoy good air quality in the future, thereby preserving the pristine beauty of the "Whistler Experience."

The connection between air quality and energy use is simple. **In Whistler, more than 90% of common air contaminants (CACs) emissions that contribute to air quality problems result from fossil fuel combustion.** Therefore, by managing energy and/or greenhouse gas emissions, the community will reduce emissions of these air contaminants.

CACs considered in this report include:

- Carbon Monoxide (CO)
- Oxides of Nitrogen (NOx)
- Oxides of Sulphur (SOx)
- Volatile Organic Compounds (VOCs)
- Particulate matter (PM)

In general, air quality management is the process of (1) assessing the current status of local air quality, (2) defining a set of goals related to air quality, (3) identifying whether the current and forecast air quality complies with goals, and (4) developing a management plan to implement policies and procedures and ensure the air quality goals are met.

Under the Waste Management Act, the BC Ministry of Water, Land and Air Protection (MWLAP) is responsible for managing air quality in all regions of the province (except the GVRD). These responsibilities include issuing permits and monitoring point sources and monitoring and controlling air pollution within the province.[6]

COMMON AIR CONTAMINANTS

Carbon monoxide (CO) is emitted as a result of incomplete fuel combustion. CO limits the blood's ability to transport oxygen to body tissues; high levels of CO can cause dizziness, headaches, impaired coordination, and death at very high concentrations.

Nitrogen oxides (NOx) are created through the combustion of fossil fuels at high temperatures. NOx can damage lung tissue, aggravate chronic lung diseases, and lower the body's resistance to respiratory infection. NOx also acts with VOCs (see below) to form ground-level ozone.

Volatile organic compounds (VOCs) also form when there is incomplete combustion of a fuel. In sunlight, VOCs undergo chemical reactions with nitrogen oxides in the air to form ground-level ozone. Ground-level ozone is a major component of smog, which is a strong irritant to the respiratory tract. Ozone can damage the alveoli (air sacs in the lung) where oxygen and carbon dioxide are exchanged. VOCs are also released while handling gasoline (and diesel to a much smaller extent).

Sulfur dioxide and **fine particulate sulfates** are released during burning of fossil fuels, all of which contain small amounts of sulfur. Sulfates contribute to the overall fine particle levels in ambient air. Sulfur also interferes with the operation of a vehicle's emission control systems, especially in low-emission vehicles.

Fine particles are a product of incomplete combustion of fossil fuels, and are also a byproduct of many industrial processes. They are associated with a wide range of respiratory and cardiovascular health effects, and have been associated with premature death during pollution episodes, primarily in people over 65.

[6] More details on these objectives and standards are presented in Appendix B.

1.4 Purpose and Scope

This plan examines energy, air quality, and greenhouse gases in a holistic and integrated manner, with the aim of helping Whistler meet its broader community objectives. An integrated plan is particularly appropriate in the RMOW, given that most emissions are attributable to energy consumption.[7] This is due to the absence of significant industrial, agricultural, and forestry activity in the area.

RMOW has both direct and indirect influence over the management of energy within the municipality. Specifically, **RMOW has direct influence over its own corporate energy use, and indirect influence over community energy use.**

1.4.1 Corporate Energy Use: Municipal Services and Facilities

In the course of providing services to residents and visitors, RMOW consumes energy through the construction, management and delivery of municipal services and operation of facilities. For example, the RMOW owns and operates facilities including the Municipal Hall, recreation facilities, parks, housing and works buildings; it also operates a fleet of vehicles. Policy, planning and budgetary decisions to reduce corporate energy use are within the powers of municipal Councils and staff.

1.4.2 Community Energy Use: Systems and Standards

The consumption of energy in the municipality is shaped by land use practices, transportation systems, the energy efficiency of building stock and the source of energy (i.e., the systems and fuel used to generate electricity and power). The municipality influences these activities through land use designations, bylaws, energy use standards in building codes, development charges, zoning requirements, relationships with local utilities and communication with local businesses and residents.

1.5 Report Outline

The remainder of this document is divided into the following sections:

Section 2 — The Integrated Energy Plan: Management Framework
A framework for the IEP, outlining a common planning language and approach.

Section 3 — Community Profile: Whistler in 2000
A community profile for Whistler in 2000, including information on demographics, infrastructure, building stock, location, and geography—all of which are important determinants of a community's energy demand.

Section 4 — Energy and Emissions Inventory in 2000
An inventory of Whistler's energy and emissions for 2000.

[7] The only non-energy related source of GHG and air quality emissions evaluated in this study are those emissions that result from landfilling of solid waste.

Section 5 — Energy and Emissions Forecast 2000 to 2020
Forecasts of energy and emissions to 2020 under two scenarios: a Business as Usual Scenario, and a Recommended Scenario.

Section 6 — Sustainable Energy Vision for Whistler
A Sustainable Energy Vision for Whistler, identifying longer-term energy opportunities.

Section 7 — Implementation Strategy
A recommended process for implementing and continuing to build this plan.

2 THE INTEGRATED ENERGY PLAN: MANAGEMENT FRAMEWORK

A plan is more likely to be successful if it builds from and contributes to existing efforts. The Integrated Energy Plan uses an **Adaptive Management Framework** to ensure that the plan can be embedded within Whistler's Comprehensive Sustainability Plan.

The framework is conceived as a pyramid, which begins at the top with a vision, and divides into a widening base of goals, indicators, targets and actions. The strength of this framework is in the map it provides for aligning strategies and actions toward a shared vision.

A foundation of directions, goals, indicators, and actions supports a common vision using an Adaptive Management Framework.

Figure 3: Application of an Adaptive Management Framework to Energy

2.1 Developing a Common Language for Planning

The first step in embedding this plan within existing efforts was to develop a common language, using the vision, goals, and indicators identified in the Whistler Environmental Strategy (WES).[8]

2.1.1 Vision

As stated in the WES:

> *Whistler's vision is to become the first sustainable resort community in the world.*

The WES identifies five equally important priorities for this *vision*:

- Building a stronger resort community
- Enhancing the Whistler experience
- Moving toward environmental sustainability
- Achieving financial sustainability
- Contributing to the success of the region

The IEP focuses on identifying actions that will contribute to each of these priorities simultaneously.

2.1.2 Directions

Directions indicate a **general course of action** to be taken in working toward goals. Whistler's IEP has been structured around five broad directions identified in the WES:

- Energy Use & Air Quality
- Community Land Use
- Transportation
- Solid Waste / Materials Management
- Municipal Operations

2.1.3 Strategic Goals

Strategic goals for the IEP are based on the goals and objectives outlined in the WES and the Comprehensive Transportation Strategy (CTS). These goals describe **desired long-term environmental conditions for Whistler.**

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[8] More detail on the WES is included in Appendix A.

Collectively, the goals represent Whistler's current vision for community energy use and management. Goals established for Whistler's IEP are listed in Table 2.

2.1.4 Indicators

Indicators are conceptual tools that measure progress toward (or away from) a goal and express the change in clear and concise terms. Indicators provide a means of looking back to establish trends, and to set targets for the future. They also provide a basis for comparing one community with another.

An indicator is rarely capable of *measuring* everything contained in a goal; its role is simply to *indicate* performance. Ideally, indicators should act as a surrogate for an entire class of effects—that is, they **should give insights into a wide range of effects beyond what is being measured.** Sometimes, to avoid missing key issues, one objective may require a number of different indicators.

2.1.5 Targets

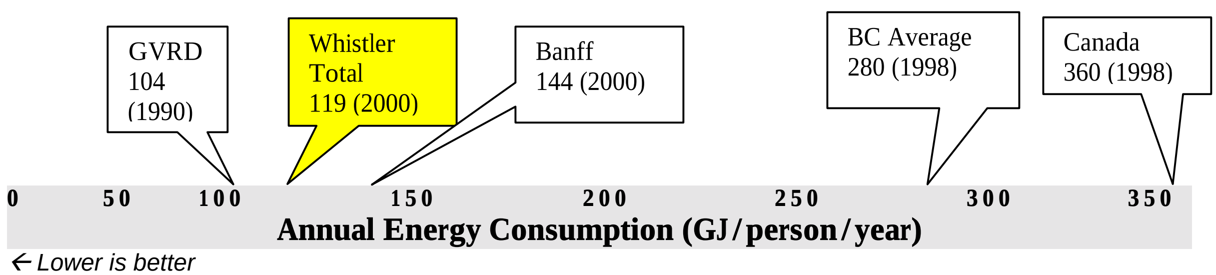
Targets establish the desired level of performance for an indicator. **Targets are intended to be technically and economically feasible, but also to be challenging.** It is crucial to recognize, therefore, that targets function as guides rather than rules.

Establishing clear targets creates a wide variety of benefits. When targets are clearly defined, many groups and individuals can translate them into terms they are familiar with, and then take personal responsibility for making a contribution. Targets engage and inspire people, and they provide an important balance to the usual rules and regulations. **Ideally, the energy targets selected for Whistler will help direct the efforts of many people toward meeting the community's sustainability goals and objectives.**

It is also important to note that meeting some of the targets will require that the municipality work not only with residents and businesses within the community, but also with other levels of government.

When setting targets, it is useful to compare a community's past performance with that of similar jurisdictions. In the case of Whistler, comparable references are resort communities such as the Town of Banff, and Vail and Aspen in Colorado. Precedents are one means of establishing what is technically and economically achievable. Benchmark scales are used to convey this information in an easy to understand format (see Figure 4).

Figure 4: Per Capita Energy Use for Whistler (Average of Residents and Visitors; GJ/year[9])



2.1.6 Actions

Actions selected for the IEP will contribute toward achieving multiple goals simultaneously. In the example shown in Figure 3, developing local renewable opportunities will also contribute to:

- Local economic development opportunities
- Reduced Greenhouse Gas (GHG) emissions
- Reduced Common Air Contaminants (CAC) emissions

2.2 Moving Toward a Common Vision for Whistler

The goals, indicators and targets for Whistler's Integrated Energy Plan are established and discussed in the following pages. Most of these goals and indicators build directly upon those from the Whistler Environmental Strategy. *New goals and indicators are identified in italics.*

[9] Sources: GVRD – 'Greater Vancouver and Fraser Valley Air Quality Management Plan: Phase 1 Options for Reducing Greenhouse Gas and Air Pollution in the GVRD', prepared by Sheltair and the Delphi Group, October 2000; Banff's Community Energy Plan (DRAFT), Prepared by the Sheltair Group, 2001.

Table 2: Whistler IEP Indicators Framework

Direction	Goals	Indicators
Energy Use & Air Quality	• Maximum use of renewable energy supplies • Excellent air quality • Energy efficient site planning and building design	• Total (and per capita) annual energy use • Amount of annual average PM-10 emissions • *Annual energy cost per capita* • *Percentage of energy derived from low-impact renewable energy sources* • *Annual non-renewable energy use for single family dwellings* • *Percentage of electricity generated locally in Whistler* • Total (and *per capita*) annual GHG emissions in Whistler
Transportation	• Minimal impacts by transportation infrastructure on local ecosystems • Minimal energy consumption and air emissions • A transportation network consistent with the "Whistler Experience" • *Provision of efficient, multimodal access for inter- and intra-municipal travel, as well as regional travel, including attractive alternative modes to SOVs*	• Percentage of dwelling units within 300 m of transit and valley trail • Skier modal shift (from vehicles) • *Total annual vehicle kilometres travelled (VKT) by Single Occupancy Vehicles (SOVs)* • *Vehicle occupancy*
Municipal Operations	• Motivated, innovative environmental leadership • Knowledgeable and effective staff • Open communication and decision making • Leading municipal operations and maintenance practices • An environmental emergency-ready organization	• Annual energy consumption by RMOW operations • Annual energy cost per capita for municipal operations • Annual solid waste generated by municipal operations • *Corporate GHG emissions*
Materials & Solid Waste Management	• Minimized disposal of solid waste per capita • Minimal effects of landfill on surrounding ecosystems	• Quantity of solid waste sent to landfill per capita

3 COMMUNITY PROFILE: WHISTLER IN 2000

The way a community consumes energy and creates emissions of air contaminants and greenhouse gases is largely determined by that community's demographics, infrastructure, building stock, location, and geography. For this reason, the first step in developing a plan for managing energy and emissions is to develop a community profile of these factors.

3.1 Location and Geography

Whistler is located 120 km north of Vancouver, approximately a two-hour drive along Highway 99. The RMOW covers approximately 164 km^2 of land area, 71% of which is forested and/or undeveloped. [10]

3.2 Population in 2000

Whistler's population varies significantly from season to season and from day to day, as is typical of a resort community. **For planning purposes it is necessary to develop an estimated average annual population that includes visitors to the region.**

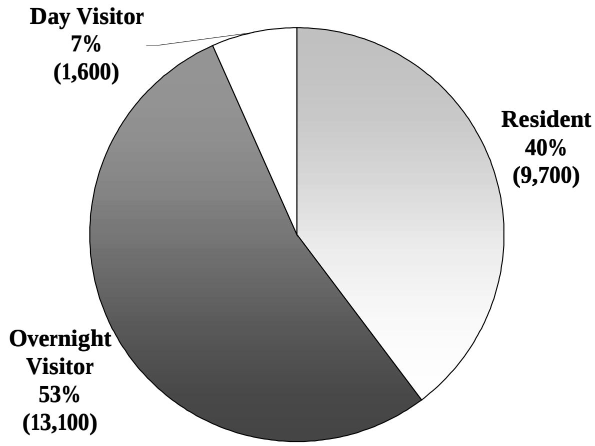
The overall population of Whistler comprises three segments:

- Residential population
- Overnight visitor population
- Day visitor population

Average numbers of daily visitors and overnight visitors are used to estimate the average daily population. The population estimate for Whistler in 2000 was 24,400.

[10] *Community and Resort Monitoring Report 1999*, Resort Municipality of Whistler, 1999, p. 18.

Figure 5: Total Average Population in Whistler, 2000[11]



3.3 Infrastructure

The RMOW is responsible for providing a range of services to residents and visitors, including:

- Street lighting and traffic control signals
- Water supply, treatment and distribution
- Fire protection services
- Community centre facilities
- Permitting and licensing services
- Whistler and Valley Express (WAVE) public transit system
- Wastewater collection and treatment
- Landfill and recycling services
- Library
- Recreation centre and park facilities
- Property taxation services
- Road maintenance, snow clearing and drainage control
- Bylaw enforcement

3.4 Residential Building Stock

In 2000 there were 9,030 residential dwellings in Whistler. Most of these units were row and multi-family dwellings (see Table 3). There are also an additional 6,800 dwelling units for visitors, including hotel rooms, hostels, pensions and other forms of accommodation

[11] BC Stats and Tourism Whistler's Visitor Volume Model forecasts

Table 3: Residential Dwellings by Detachment in 2000

Detachment	Number of Units	Floor Area [Sq. m]	% of Total Area
Row/Multi-Family	6,200	872,000	56
Single Family Dwelling	2,400	598,000	39
Duplex	430	78,000	5
Total	***9,030***	***1,548,000***	***100***

Source: BCAA, 2001

3.5 Commercial Building Stock

Whistler's commercial building stock consists of 480,700 m^2 of floor space. **Approximately 60% of this stock was made up of hotel/motel space,** while 17% of the space was retail and 15% was recreational and cultural space (see Table 4).

Table 4: Commercial Floor Area Distribution in 2000

Segment	Floor area [Sq m]	% of Total Area
Hotel/Motel	289,700	60
Retail	82,500	17
Recreational and Cultural	70,700	15
Warehouse	12,600	3
Other	12,700	3
Office	5,600	1
Institutional	6,900	1
Total	***480,700***	***100***

Source: BCAA, 2000

3.6 Transportation

Although there were fewer than 8,000 vehicles registered in Whistler in 2000 (see Table 5), **traffic congestion has become a major focus of transportation planning efforts in the municipality.** The community's high vehicle volumes are largely a result of visitor traffic.

Table 5: Vehicles Registered in Whistler by Type (as of June 30, 2001)[12]

Vehicle Type	# Vehicles Registered
Passenger Vehicles	4,848
Motorbikes	248
Trailers	419
Motor Homes	146
Commercial Vehicles	2,048
Commercial Trailers	183
Total	***7,892***

WAVE (Whistler's public transit provider) operated 24 diesel buses in 2000, with an annual ridership of 2.2 mil-lion. The RMOW also operates a fleet of more than 100 vehicles (see Table 6), and Whistler/Blackcomb and its contractors operate a number of vehicles and equipment, for which the organization has an independent supplier for fuel. The Whistler/Blackcomb fleet includes vans, cars, ATVs (all-terrain vehicles), snow cats, park cats, and snowmaking and maintenance equipment.

Table 6: RMOW Municipal Transportation Fleet by Fuel Type (number of vehicles)

Vehicle Type	Diesel	Propane	Unleaded	Total
Cars			36	**36**
Light Trucks	12		19	**31**
Heavy Trucks	3			**3**
Tractors	4			**4**
Trailers	1			**1**
Other	19	2	10	**31**
Total	39	2	65	**106**

Municipal planning for energy, air quality and GHG does not typically consider inter-community transportation—that is, transportation into and out of the community. Given that RMOW has a tourism-based economy dependent on visitors to the region, the municipality will demonstrate significant leadership by being one of the first to address this important issue. **This report includes a**

[12] Personal communication with Paul Hardy, ICBC, 604-648-7081, July 27, 2001.

rough estimate of inter-community transportation, to be used for future consideration in transportation planning efforts (see Appendix C).

3.7 Solid Waste

The practice of landfilling solid waste generates significant quantities of greenhouse gases, particularly methane and carbon dioxide. **However, these gases can potentially be used to generate electricity, making solid waste disposal an issue of interest in community energy planning.**

In 2000, 28,000 tonnes of waste was generated in Whistler,[13] or 1.16 tonnes/person. Nearly 7,000 tonnes of this material was recycled (0.28 tonnes/person), representing a diversion rate of 24% by weight.[14]

The Whistler landfill site first accepted waste in 1977 and may close in 2008. Consultants Sperling Hansen Associates analyzed the landfill gas (LFG) production potential of the Whistler landfill in spring 2001. Based on their analysis, the consultants recommended not to proceed with beneficial use of LFG.

[13] RMOW staff reported that 129,000 m^3 of solid waste was generated in 2000. This was converted to weight equivalents using density conversion factors in *Manual on Generally Accepted Principles for Calculating Municipal Solid Waste Flows: Development of a Methodology for Measurement of Residential Waste Diversion in Canada,* Corporations Supporting Recycling (CSR), Dec.2000, Appendix B, p. B-2.
[14] Complete solid waste data is included in Appendix C, Section 3.6.

4 ENERGY AND EMISSIONS INVENTORY IN 2000

To conduct an energy and emissions inventory for the year 2000, fuel consumption estimates were obtained for buildings, infrastructure, and transportation. Greenhouse Gas (GHG) and Common Air Contaminant (CAC) emissions resulting from energy use were then estimated using standard emission factors for the various fuel types used in Whistler.

Results of this analysis are supplemented with ambient air quality monitoring data collected by the Ministry of Water, Land and Air Protection.[15]

4.1 Energy Sources in Whistler

Fuel and power sources used in Whistler include electricity provided by BC Hydro, piped propane supplied by Terasen, wood used for space heating, and diesel and gasoline used in vehicles. A brief description of each of these sources is provided on the following pages.

4.1.1 Electricity

Whistler is supplied with electricity by BC Hydro. Peak demand data for electricity in 1999/2000 was 92.2 MVA (Mega Volt Amps). System capacity (117 MVA) is expected to be met between 2004 and 2008. In order to accommodate increased peak demand, BC Hydro plans to add additional capacity (a transformer), which would increase the planned capacity to 200 MVA. Discussion with BC Hydro representatives suggests that capacity constraints may become an issue, depending upon future growth, and on whether or not natural gas is introduced to the community.[16]

4.1.2 Propane

Terasen operates a piped propane distribution system serving more than 1,700 residential and commercial customers in the Whistler area. Propane is transported to Whistler by railcar and tank-truck. The propane is offloaded and vaporized at two above-ground storage sites at Nesters Road and at Function Junction. Following vaporization at these sites, the gas is distributed through underground lines to residences and commercial buildings.

Terasen currently charges customers a propane rate of $11.90/gigajoule plus a basic monthly charge of $5.00. The community of Whistler purchased 680,000 GJ of propane in 2000, representing an

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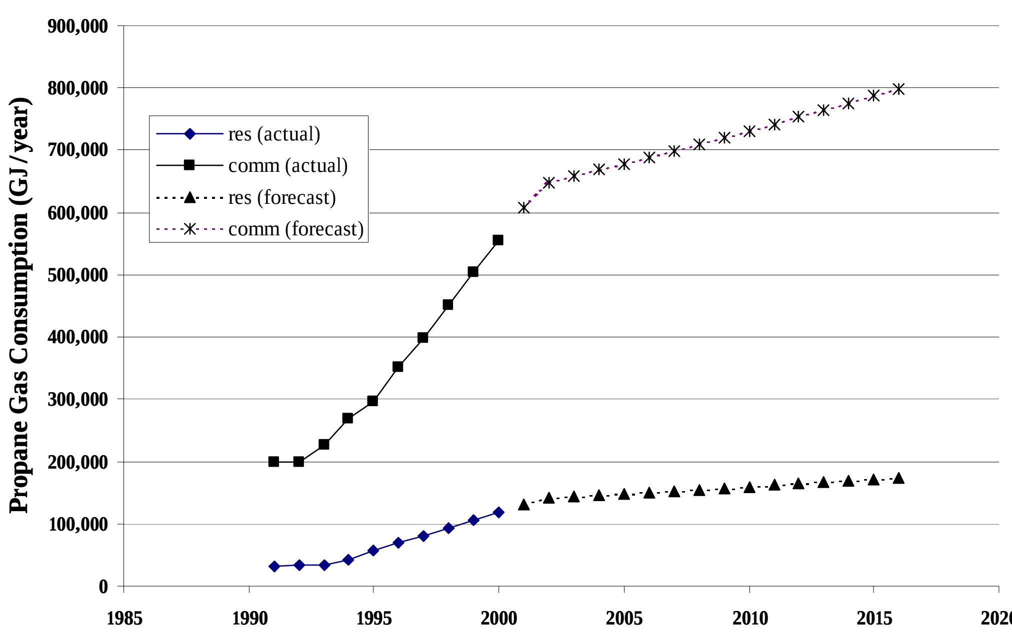
[15] A summary of the methodology and the assumptions used to develop an energy and GHG emissions inventory and forecast is included in Appendix C.

[16] Personal communication with Graham Burnip.

[17] Centra Gas web site: http://www.centragas.com/rates_whistler.html, viewed May 4, 2001.

expenditure of $8 million. Peak demand reached 6,300 GJ in 2000, which is the capacity of the current system. By 2015, peak demand is predicted to increase to 8,200 GJ (see **Figure 6**).

Figure 6: Consumption of Piped Propane Gas, 1991-2016



Source: Paul R Madsen, Centra Gas, May 31, 2000

4.1.3 Wood for Space Heating

Limited data was available to quantify residential wood heating in Whistler. Based on discussion with Whistler Housing Authority staff, there are probably about 500 homes in Whistler with full-time residents that are using wood as their primary source of heat. Assuming that each home would require about four chords of wood each year, and assuming there is 10,000 kilowatt hours of energy in each chord of wood, the total energy consumed in wood is about 36,000 GJ.[18] Further analysis of wood burning may be conducted in the development of a Sea-to-Sky Air Quality Management Plan in 2004.

[18] A second estimate was conducted using the results of the 1997 Survey of Household Energy Use in Canada (December 2000). In a sample of

4.1.4 Transportation Energy

Collecting transportation data is an intensive undertaking, and in the absence of empirical data, detailed transportation modeling is required. The methodology adopted by the Partners for Climate Protection Program (PCP) was used in this analysis and includes all intra-community transportation, but excludes inter-community transportation.

To calculate community transportation energy, two methodologies were used. The first involved using Whistler's existing EMME/2 Travel Demand Forecasting Model to calculate peak travel demand. From this information, annual common air contaminants, greenhouse gas emissions and fuel consumption were calculated. The second methodology involved obtaining fuel sales from Whistler service stations.

Fuel consumption data for municipal fleet, Whistler/ Blackcomb fleet, and WAVE vehicles was obtained from each of these entities. These organizations purchase the majority of their fuel independently, and only small amounts from local service stations.

1,092 houses in BC conducted by Natural Resources Canada's Office of Energy Efficiency, 6.9% of homes used wood as their primary heating source, 5.0% used wood as a supplementary heating source, and a further 20.7% used wood only for a fireplace. Using these proportions with Whistler's single-detached housing stock would indicate that 170 homes would be heated with wood as the primary heating source, 120 would use wood as a supplementary heating source, and 500 would have wood as an energy source for fireplaces. Data from this survey indicates that in Canada on average 4.6 cords of wood for the primary heating source, 3.0 cords of wood are used annually for a supplementary heating source, and 1.0 cords of wood are used in fireplaces. Applying these values to the BC survey figures and applying these rates to Whistler would yield just under 30,000 GJ of energy per year. These figures assume that no wood is used for space heating for visitor accommodation and in commercial buildings. Further analysis of wood burning may be conducted in the development of a Sea-to-Sky Air Quality Management Plan in 2004.

4.2 Energy Consumption in Whistler

Residents, businesses and visitors in Whistler consumed 2.9 million GJ of energy in 2000, representing an expenditure of about $47.7 million. On a per capita basis, this is the equivalent of 119 GJ, or more than $1,900 per person (including residents and visitors).

Municipal operations used 75,000 GJ of energy in 2000—3% of the overall total, representing an expenditure of nearly $1 million. The commercial sector is responsible for the majority of energy consumption, followed by passenger vehicle transportation. Energy consumption by sector and by fuel type is summarized in Figure 7.

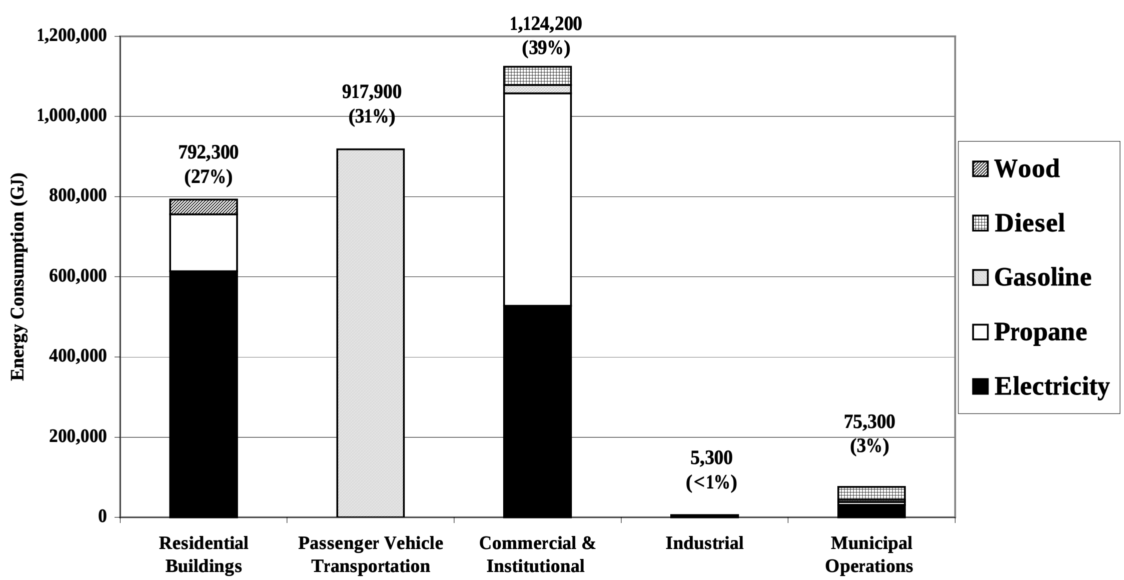
BEYOND CITY LIMITS

This inventory only includes the energy consumed within RMOW borders. However, given that the municipality is heavily dependent upon tourism, the RMOW is in fact responsible for a significant amount of transportation that occurs in bringing tourists into the region.

A rough analysis of this "inter-community" transportation was carried out, showing that this transportation represents a consumption of 23.7 million GJ of energy, which is seven times higher than the in-community consumption.

A summary of this analysis is presented in Appendix C.

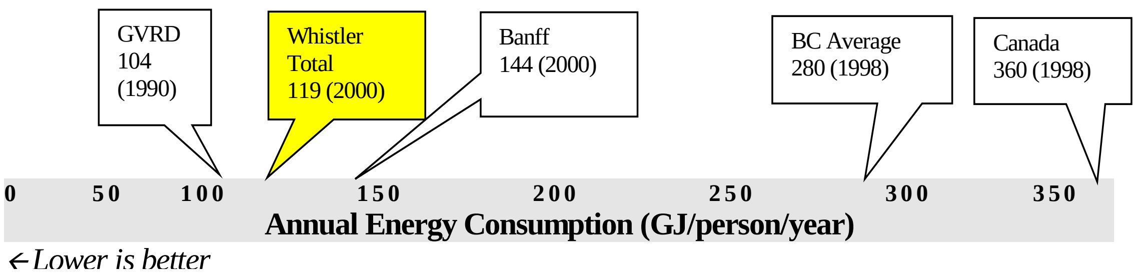
Figure 7: Energy Consumption by Fuel and Sector, 2000



4.2.1 Benchmarking Energy Use in Whistler

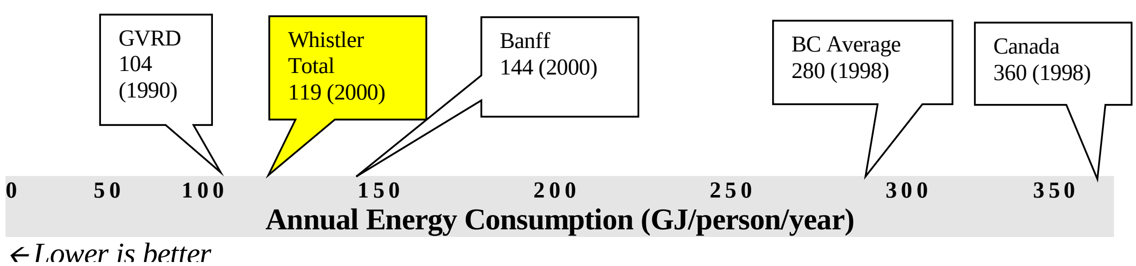
Energy use in Whistler is well below the provincial and national average[19] (see Figure 8). This is due in large part to the absence of industrial activity in Whistler, a sector that typically represents a significant component of energy use in BC and Canadian communities.

Figure 8: Per Capita Energy Use for Whistler (Average of Residents and Visitors)



Hotels in Whistler consume an average of 1.8 GJ / m2 / year, which is considerably less than the Canadian hotel average of 3.1 GJ/m2/year[20]. This is because the majority of hotels in Whistler are relatively new; a typical hotel built in the early 1980s consumes approximately 12% more energy annually than the average new hotel. However, the energy consumption of Whistler hotels is still significantly higher than the rating for a CBIP hotel[21].

Figure 9: Comparison of Energy Used by Hotels



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[19] Sources: GVRD – 'Greater Vancouver and Fraser Valley Air Quality Management Plan: Phase 1 Options for Reducing Greenhouse Gas and Air Pollution in the GVRD', prepared by Sheltair and the Delphi Group, October 2000; Banff's Local Action Plan for Energy and Greenhouse Gas Management, Prepared by the Sheltair Group, 2003.

[20] National Energy Use Database, Statistics Canada, 1997. Canada: *Improving Energy Performance in Canada, Office of Energy Efficiency*, NRCan, 2000. (Available at: oee.nrcan.gc.ca/english/publications/report2_e.pdf); B.C. - *Status and trends in energy consumption*, Ministry of Water, Land and Air Protection, 2000. (Available at: wlapwww.gov.bc.ca/soerpt/01-1-data.html)

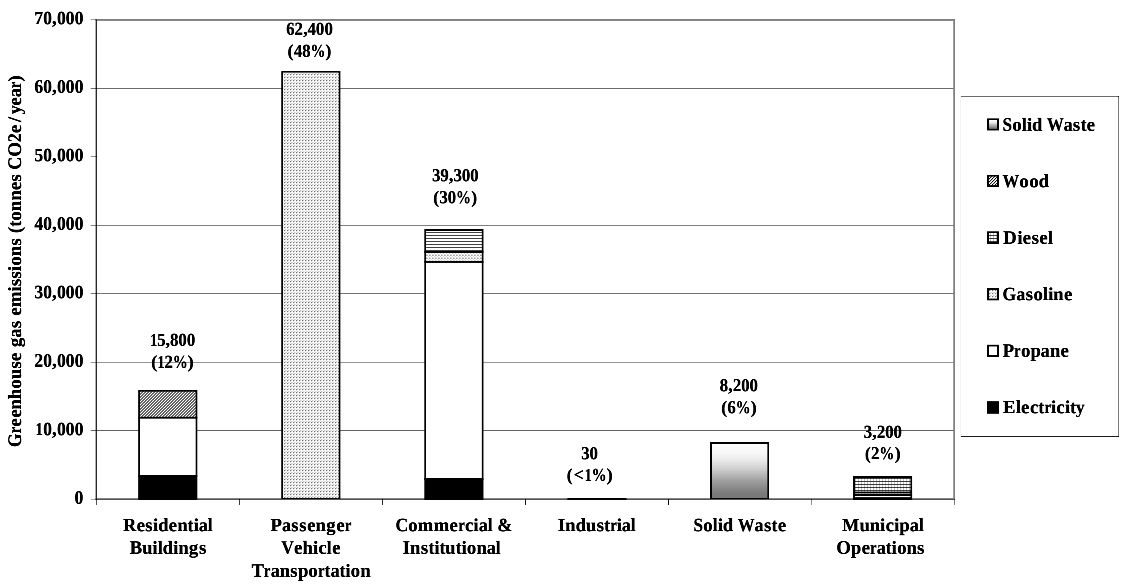
21 CBIP is an incentive program offered by Natural Resources Canada to encourage reducing energy costs by 25% below the model national energy code for buildings

4.3 Greenhouse Gas Emissions in 2000

Whistler's GHG emissions result from two processes: the use of energy by all sectors in the community, and the disposal of solid waste. Other potential sources, such as agriculture, are assumed to be minimal.

RMOW's 2000 emissions are estimated at 128,000 tCO_2e, or 5 tCO_2e (tonnes carbon dioxide equivalent) per capita. Figure 10 summarizes Whistler's GHG emissions by sector and by fuel type.

Figure 10: GHG Emissions by Sector and Fuel Type (tonnes of CO2 equivalent/year)



Personal vehicle transportation accounts for nearly half the GHG emissions in Whistler, even without consideration for the impact of inter-community transportation. The commercial sector accounts for 30% (a significant portion of which is hotels).

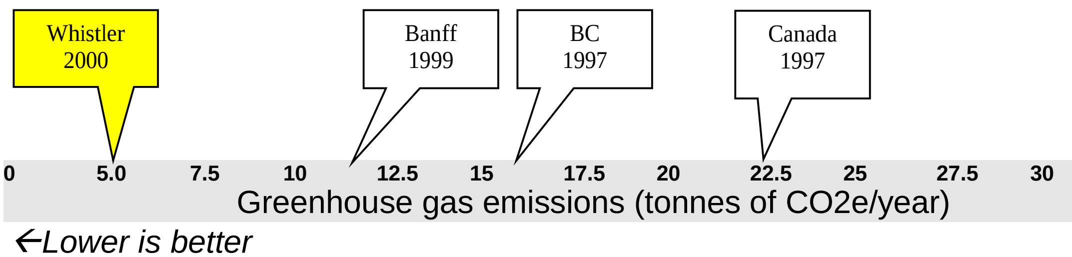
Whistler's per capita emissions (excluding those generated by inter-community transportation) are lower than provincial and national averages, and lower than the average for the comparable community of Banff (see Figure 11). Banff's higher per capita emissions can be explained by the fact that electricity generation in Alberta is primarily fossil-based, while in B.C. it is primarily hydroelectric.

Retiring Credits for Real Change

The rules for emissions trading programs are currently being negotiated internationally. However, it may be possible for Whistler to claim credits for the municipality's 11,000 hectares of forested and undeveloped area (representing more than 70% of the RMOW's land area).

If these credits do become available, Whistler could consider playing a leadership role by permanently retiring these credits, thereby achieving real reductions in GHG emissions.

Figure 11: Per Capita Greenhouse Gas Emissions for Whistler



4.3.1 Backcast of GHG Emissions to 1990

As a member of the Partners for Climate Protection Program, RMOW committed to reducing its community-wide GHG emissions by 6% relative to 1990 levels, and corporate emissions by 20% relative to 1990 levels. Unfortunately, electricity and gas sales records from 1990 were not available, and estimates for the baseline year were therefore backcast using per capita energy use coefficients. Based on this methodology, it is estimated that GHG emissions in 1990 were 96,000 tonnes.

4.4 Air Quality in 2000

Whistler's air quality was evaluated by developing an emissions inventory using energy consumption data and using ambient air quality monitoring data provided by the Ministry of Water Land and Air Protection (MWLAP).

CAC emissions are presented in three categories: point source, area source and mobile source emissions. Results were then compared with those in the 1995 Sea-to-Sky[22] Emissions Inventory (MWLAP, 2002).

4.4.1 Point Source Emissions

Point source emissions include large industrial sources that are subject to provincial regulations through a permitting process. Point source emissions by pollutant are summarized in Table 7.

Table 7: RMOW Point Source Emissions in 2000 (Tonnes per year)

Source	CO	NOx	SOx	VOC	PM	PM10	PM2.5
Cardinal Concrete					0.1	0.1	0
Action Holdings	1.7	6.4	2.7	0.6	12.2	2.1	0.5
Coastal Mountain Excavations	162.5	1.2	0.1	13.7	40	40	40
Total Point Source Emissions	164.2	7.6	2.8	14.3	52.3	42.2	41

(Source: 1995 Sea To Sky Emissions Inventory, MWLAP, July 2002)

4.4.2 Area Source Emissions

Area source emissions are those that are emitted from a number of dispersed individual small activities such as fuel use for heating and power, open burning, and agriculture. Area source emissions for the RMOW were determined by applying emission factors[23] to space heating estimates from the energy inventory. Due to the absence of significant industry and agriculture in the RMOW, this air quality inventory considers only energy-related emissions. In fact, the 1995 Sea-to-Sky (STS) Corridor Emissions Inventory found that space heating was responsible for over 90% of area source CACs.

[22] The Sea-to-Sky Airshed includes Whistler, extending from West Vancouver to Pemberton.
[23] US Environmental Protection Agency (AP-42, 2001) emission factors were used (see: www.epa.gov/ttn/chief/).

There are also natural sources of VOCs that have not been considered in this study, such as off-gassing from standing forests. Since RMOW's area is 71% forested, this contribution to VOCs would be significant and therefore should be evaluated in future planning efforts.

Carbon monoxide (CO) is the primary area source pollutant by weight in the RMOW (see Table 8). The primary cause of CO emissions from space heating is wood-burning fireplaces[24].

Table 8: RMOW Area Source Emissions in 2000 (Tonnes)

Pollutant	CO	NOx	SOx	VOC	PM
RMOW Area Source Emissions	302	48	0.6	38	41
Upper STS Area Source Emissions	1861	62	10.6	765	355

4.4.3 Mobile Emission Sources

4.4.3.1 Light Duty Vehicles

Emissions of CACs from light duty vehicles were estimated using transportation modelling results, and are shown in Table 9. [25]

Table 9: RMOW Mobile Source Emissions from Light Duty Vehicles in 2000 (Tonnes)

CO	NOx	SOx	VOC	PM	PM (inc. road dust)
1,596	184	1	160	3	568

(Source: TSI Consultants, 2001)

The 1995 Sea-to-Sky Emissions Inventory estimates[26] for the entire corridor are lower than the estimates developed for RMOW alone. For example, CO emissions in the upper STS corridor were reported to be

[24] Accurate estimates of wood used for space heating were not available for this study. Further research in this area is recommended, particularly given that RMOW is considering passing a bylaw related to residential wood burning.
[25] TSi Consultants' estimates are based on an EMME 2 model simulation of light duty vehicles, which has been calibrated with vehicle counts. The model was based on an AM peak simulation and then adjusted to estimate annual vehicle kilometres (VKT). These peak and annual VKT were then used to estimate CAC emissions.
[26] For the STS analysis, the emissions estimate is based on pro-rated population counts to derive annual VKT. Annual VKT was then multiplied by emission factors for different vehicle subclasses.

1,381 tonnes in 1995, whereas estimates for RMOW alone in this analysis were 1,596 tonnes. Variation in these estimates is likely attributable to differences in methodologies.

4.4.3.2 Heavy Duty Vehicles

Emissions from heavy duty vehicles including buses and trucks were estimated from fuel consumption data and published emission factor data (USEPA, 2001). This information is presented in Table 10. RMOW emissions from heavy duty vehicles represent approximately 54% of the total upper STS emissions for all pollutants.

Table 10: Heavy Duty Vehicle Emissions in 2000 (Tonnes)

Pollutant	CO	NOx	SOx	VOC	TPT
RMOW Heavy Duty Vehicle Source Emissions	46	46	0.8	7.4	3.5
Upper STS Heavy Duty Vehicle Source Emissions	83	85	1.5	13.3	6.4

Emissions from rail and aircraft have not been included in this analysis due to difficulty in obtaining data on local fuel consumption from these sources. However, based on a review of the upper STS emissions inventory, the contribution from these sources is likely small in the RMOW.

4.4.4 Total CAC Emissions

A summary of the CAC emissions inventory is shown in Table 11. Results demonstrate that light duty vehicles represent the largest source of CACs in the RMOW. However, it should be noted that two significant sources were not included in the analysis: road dust and VOC emissions from natural sources.

Particulates can have harmful effects on human health, further analysis of road dust is warranted. VOCs from natural sources should also be measured, as they combine with NOx to form ozone. Therefore, further analysis of this source is also recommended.

Table 11: CAC Emissions Estimates in 2000 (Tonnes)

	CO	NOx	SOx	VOC	PM	Total
Point	164	7.6	2.8	14.3	52.3	241
Area	302	48	0.6	38	41	430
Light-Duty Vehicles	1,596	184	1	160	3	1,944
Heavy-Duty Vehicles	46	46	0.8	7.4	3.5	103.5

Total	2,108	286	5.2	220	100	2,718

4.5 Ambient Air Quality Data[27]

The Ministry of Water, Land and Air Protection monitors local air quality in Whistler Village. At present MWLAP continuously monitors ozone (O_3) and nitrogen oxides (NO_x), and will commence monitoring fine particulate matter ($PM_{2.5}$) continuously and inhalable particulate matter (PM_{10}) non-continuously in Spring 2004.

Environment Canada monitors air quality at a high-altitude station on the peak of Whistler Mountain. This station measures ozone, carbon monoxide, persistent organic pollutants, particle chemistry and particle physics. The station serves to measure long-range transport of pollutants, as well as high-altitude ozone (O_3) concentrations.

4.5.1 Inhalable Particulate Matter (PM_{10}): Studies and Findings

The major sources of PM_{10} in the Whistler region are space heating/burning, and to a lesser degree, on-road and off-road vehicle exhaust.

On an annual average basis, PM_{10} concentrations in Whistler are lower than those found in Squamish, although maximum values are similar in both communities (see Table 12).

A 24-hour average of greater than 25 $\mu g/m^3$ of PM_{10} exceeds the "health reference level—the concentration at which there is a statistically significant correlation between PM_{10} and adverse health effects. As indicated in Table 12, this concentration was exceeded in eight separate samples in 1999, and in three samples in 2000. The 24-hour concentration of 50 $\mu g/m^3$ is the BC Level B air quality objective.

In spring 2004, installing a continuous $PM_{2.5}$ and non-continuous PM_{10} monitor in Whistler will presumably provide more detailed and accurate information, and an ability to monitor trends in particulate pollution in the region.

[27] The data and discussion presented in this section is based on Ministry of Water Land and Air Protection Documentation (WLAP, 2002)

Table 12: Annual Summary of Non-Continuous PM_{10} Concentrations Measured in Whistler from 1994 to 1995 (Municipal Hall) and 1997 to 2001 (Meadow Park)[28]

Year	# of Samples	Annual Average PM_{10} Concentration ($\mu g/m^3$)	Maximum 24-hour PM_{10} Concentration ($\mu g/m^3$)	Number of 24-hour samples where >25 ($\mu g/m^3$)	Number of 24-hour samples where > 50 ($\mu g/m^3$)
1994	10	n/a	19	0	0
1995	4	n/a	22	0	0
1997	18	n/a	22	0	0
1998	6	n/a	21	0	0
1999	40	16 (9)	54	8	1
2000	53	10 (8)	39	3	0
2001	22	n/a	22	0	0

4.5.2 Ozone

Preliminary results from ozone monitoring in Whistler[30] indicate that ozone concentrations in the municipality are similar to those measured in Squamish. However, **the number of times the 1-hour Maximum Desirable air quality objective for ozone (100 $\mu g/m^3$) is exceeded is much higher (sometimes twice as many per year) in Whistler compared with Squamish.**

The reason for this difference may be related primarily to the elevation differences between Squamish and Whistler (ozone increases with elevation), and the springtime ozone "high" that occurs throughout the Northern Hemisphere, which may be related to introduction of stratospheric ozone down to ground-level or long-range transport (i.e., not from local sources). Often over half of the hours in which the ozone concentration in Whistler exceeds 100 $\mu g/m^3$ occur in May when the springtime ozone "high" occurs.

[28] A PM10 monitor was installed at two locations in Whistler for two separate PM10 monitoring studies conducted in the mid- and late 1990s. The first study (Nov. 1994 to Feb. 1995) was conducted on the roof of the Municipal Hall in Whistler, and is outlined in the report "The Resort Municipality of Whistler Inhalable Particulate (PM10) Study 1994/95" (available from MWLAP, not currently available online). Annual summaries of the data from this study are presented in the first two rows of Table 12. The second study (1997 to 2001) was conducted on the roof of the Meadow Park Sports Complex, the site of the present-day Whistler Ambient Air Monitoring Station. Detailed analysis of the results of the PM10 study conducted in Whistler can be found in the report entitled "Ambient Air Quality Monitoring Report, Whistler British Columbia, PM10 and Ozone, 1997-2001" (http://wlapwww.gov.bc.ca/sry/p2/air_quality/whistler_report.html).

[29] Annual arithmetic means are given if sufficient data exists (at least 40 samples); annual geometric means are given in parentheses.

[30] An ozone monitor was installed on the rooftop of the Meadow Park Sports complex in April 2001. Specifically, the station was installed to assess whether concentrations of ozone north of Squamish were similar to those in the Lower Sea-to-Sky Airshed and the Lower Fraser Valley.

Table 13: Annual Summary of Ozone (O_3) Concentrations Measured in Whistler in 2001- 2003

Year	% Data Capture	Annual Average O_3 Conc. (μg/m^3)	Max. 1-Hour O_3 Conc. (μg/m^3)	No. of 1-Hour Values		Maximum 24-Hour O_3 Conc. (μg/m^3)
				> 100 μg/m^3	> 160 μg/m^3	
2001	66	36	122	55	0	80
2002*	96	34	116	35	0	81
2003*	96	37	134	85	0	79

* data is preliminary and has not undergone full quality control/assurance.

Preliminary data from the high-altitude ozone station on the peak of Whistler Mountain indicates that it is possible to deduce which ozone events may be driven by local pollution (locally manageable sources) versus harder-to-manage sources such as transport from other areas or natural events.

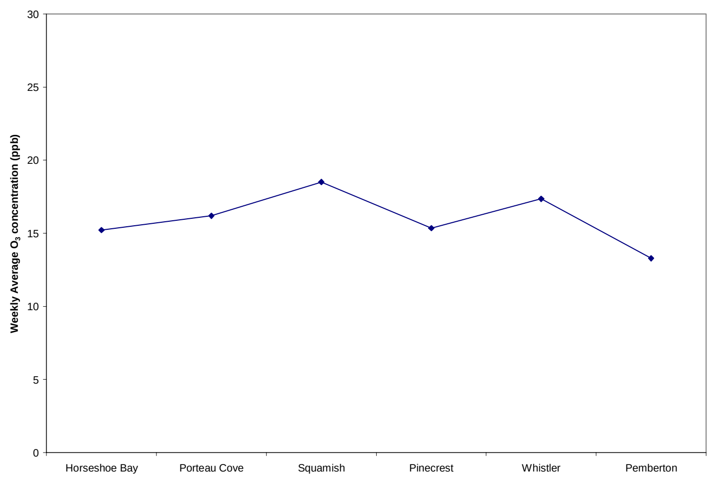
On days when ground-level ozone concentrations are high, and high-altitude concentrations are comparatively low, one can presume that ground-level ozone "events" are driven by local pollution sources. These events occurred in July and August. Thus, management of vehicle emissions should be targeted toward the summer months (July and August) when the potential for local ozone events in Whistler is greatest.

A study conducted by the University of British Columbia during the summer of 2003 found distinct local regions of high ozone concentrations in the municipalities along the Sea-to-Sky corridor.

Figure 12 shows the weekly average ozone concentrations for the week of August 6–12, 2003 at six different sites along the Sea-to-Sky corridor, starting on the left with Horseshoe Bay, and ending on the right with Pemberton at the northern end of the corridor.

As Figure 12 illustrates, distinct "rises" occur in the O_3 concentrations at Squamish and Whistler while there are "lows" in the communities/rural areas in between. This finding indicates that O_3 is not evenly distributed in the corridor, and that these local "pockets" of higher ozone concentrations in municipal areas support the case for targeting local emission sources (namely vehicle exhaust) to reduce ozone levels to near-rural levels.

Figure 12: Average Weekly Concentrations of Ozone along the Sea-to-Sky Corridor for the Week August 6-12, 2003 (in parts per billion).



4.5.3 Nitrogen Oxides

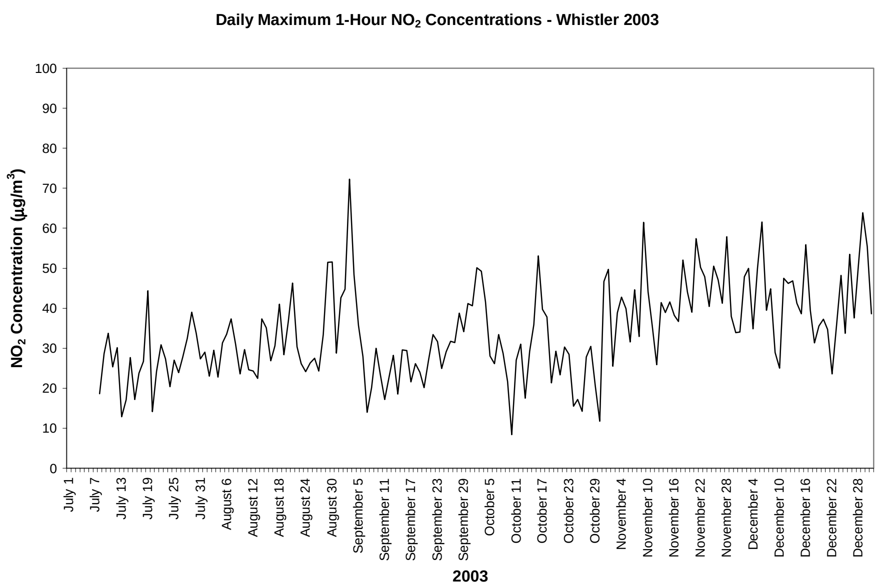
Nitrogen oxides of concern with respect to air quality are nitric oxide (NO) and nitrogen dioxide (NO_2). Both these compounds are commonly referred to as "oxides of nitrogen" (NO_x). They are produced through the combustion of fossil fuels. The most common sources of NO_x in the Sea-to-Sky Airshed are internal combustion engines.

NO_x is a precursor for ground-level ozone (O_3), secondary particulate matter (PM_{10} and $PM_{2.5}$), and acid rain. **It is therefore a significant pollutant in that it plays a major role in the formation of several health and visibility reducing pollutants.**

An NO_x monitor was installed in Whistler in July 2003. NO_2 concentrations are relatively low (about half the concentration measured in the Greater Vancouver Regional District and Fraser Valley). Preliminary data suggests that NO_2 concentrations are closely related to vehicle traffic in Whistler, although a full study has not been conducted.

Figure 13 shows the daily maximum NO_2 concentrations in Whistler in 2003. The highest spike in this graph (72 $\mu g/m^3$) occurred on the Labour Day long weekend. Beginning in late October/early November, there is a distinctive weekly pattern in the graph, corresponding to a spike in NO_2 levels each weekend: Nov 8/9, Nov 22/23, Nov 29/30, and Dec 6/7, with the pattern less distinguished during the holiday period. Presumably this is from traffic in the resort municipality due to the increase in weekend visitors who arrive by car. Further studies on NO_2 concentrations and local traffic are anticipated.

Figure 13: Daily Maximum 1-hour NO_2 Concentrations Measured in Whistler from July to December 2003



5 ENERGY AND EMISSIONS FORECAST: 2000 TO 2020

Energy and emissions were forecast to 2020 to provide the information necessary for energy management planning. This data is required so that Whistler can project energy demand requirements in the future, and make informed decisions about potential energy efficiency, demand reduction, and fuel switching opportunities. Forecasts were developed by developing projection estimates for:

- Population (expected resident and visitor population increases),
- Infrastructure (planned infrastructure and building additions), and
- Efficiency (expected Business As Usual energy efficiency and emission reduction initiatives).

A "**Business As Usual**" (BAU) Scenario and a **Recommended** Scenario, including a set of energy efficiency, demand reduction and fuel switching initiatives were developed. In addition, a **Sustainable Energy Vision** for Whistler was also developed to identify longer-term opportunities to apply The Natural Step system conditions to energy management.

5.1 Population Forecast

The Resort Municipality of Whistler has capped the total number of bed units at just over 55,000**,** however the population equivalent in Whistler is anticipated to grow from 24,400 in 2000 to 34,600 in 2020 (see Table 14).[31] This continued growth will result from a steady increase in tourism, and to a lesser extent, the addition of new housing stock.

Further factors that may affect population and associated energy consumption include:

- Whistler Blackcomb Ski Resort plans for expansion,
- Potential use of current landfill area for development (e.g., for the future Olympic Village), and
- Replacement of existing, smaller homes with larger homes.

[31] 86% of this total have already been built. Source: 2001 Monitoring Report, RMOW (not yet published) and *Whistler Business Performance Statistics*, Tourism Whistler, December 2000, p.3.

Table 14: Whistler's Estimated Population Equivalent in 2000 and 2020

Segment	Population in 2000	Population in 2020	Increase
Resident[32]	9,700	13,000	35%
Overnight Visitor[33]	13,100	17,900	37%
Day Visitor [34]	1,600	3,700	124%
Total Population	***24,400***	***34,600***	***42%***

5.2 Forecasting Energy and Emissions

Two scenarios for energy consumption were developed: the Business As Usual Scenario (BAU) and the Recommended Scenario. The BAU Scenario describes a "do-nothing" forecast, while the Recommended Scenario analyzes the impacts of implementing IEP measures.

The **Recommended Scenario** is based on the following package of measures:

1. Switch from piped propane to natural gas.
2. Achieve a 25% improvement in efficiency over the Whistler Comprehensive Transportation Strategy (this strategy has a target to reduce peak congestion in the RMOW by 15% by 2011).
3. Achieve a 50% diversion of solid waste by 2010 and 70% diversion by 2020.
4. Improve RMOW fleet efficiency by 30% by 2020.
5. Continue public education and outreach through the "Whistler. It's Our Nature" Sustainability Initiative.
6. Convert 10% of Whistler's electricity purchases to green power sources by 2010, and 20% by 2020.
7. Improve energy efficiency of new and existing residential and commercial buildings by 25%.

In the short term (the next 10 years), the Recommended Scenario identifies policy and program initiatives that will assist the RMOW in moving toward its goal of achieving The Natural Step system conditions. These initiatives can function either as transition strategies (e.g., the natural gas pipeline[35]) or as incremental steps to achieving system conditions (e.g., the building retrofit program).

[32] Assumes a 1% annual growth following build-out in 2004 as a result of in-fill.
[33] Assumes a 5.6% annual growth until build-out, as estimated by Tourism Whistler, and a 1% growth following build-out.
[34] Assumes a 3% annual growth following build-out in 2004, as estimated in the Comprehensive Transportation Plan, April 1997 p.3-1.
[35] Use of natural gas is a transition strategy since it should be considered an interim step until additional renewable and energy efficiency measures become cost-effective.

5.3 Business as Usual Scenario

5.3.1 BAU Scenario Overview

The BAU Scenario assumes the continuation of past development patterns and energy efficiency trends into the future. In this scenario, it is assumed that there is a 2% annual increase in energy prices to reflect elimination of the electricity price freeze, and a continued increase in the price of space heating fuels.

The scenario is based on the following additional assumptions:

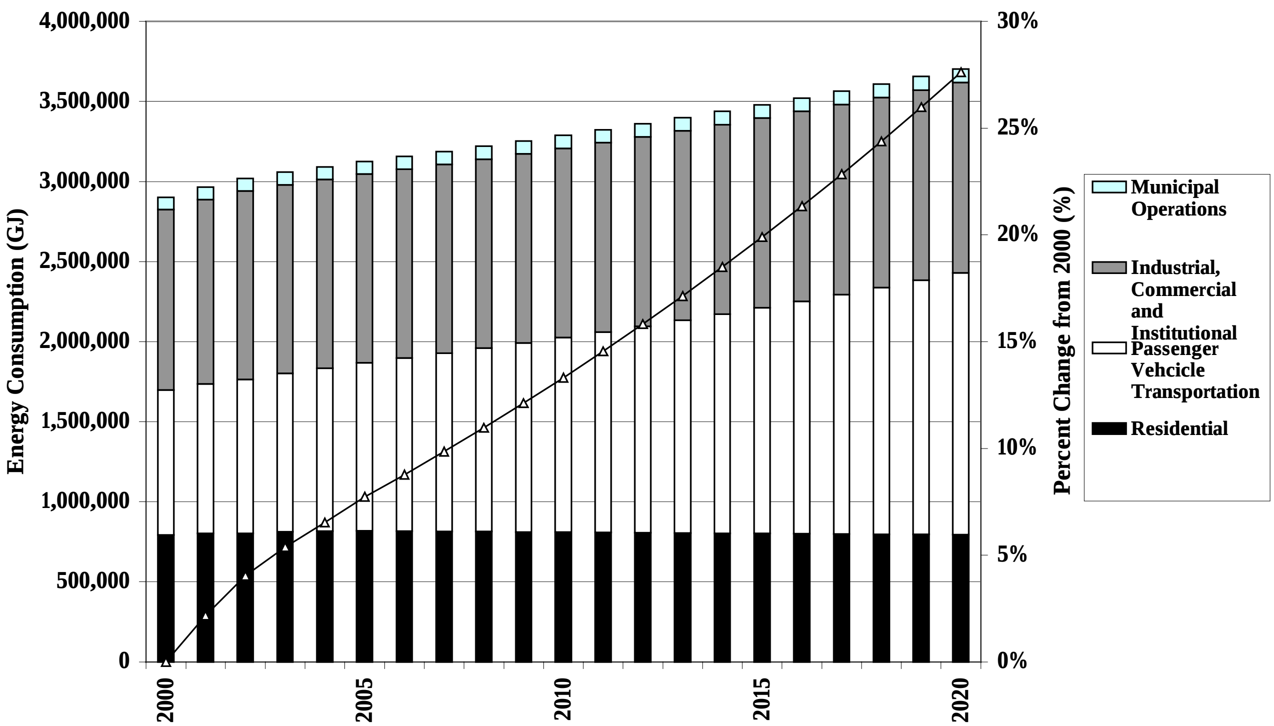
- All planned developments will be complete by 2004 (i.e., the community will be built out).
- Energy efficiency of buildings and transportation systems will improve at a rate consistent with past 20-year trends.
- Turnover in the building stock will occur at an estimated 3% per year for older buildings and 0% for newer buildings.
- Vehicle ownership and fleet efficiency will continue to change at rates consistent with past 20-year trends.[36]
- Commercial transportation energy will increase at a rate of 1.5% per year.
- Industrial and infrastructure energy consumption will remain constant.

5.3.2 BAU Energy Consumption

In the BAU Scenario, total energy consumption in Whistler is projected to increase from 2.9 million GJ in 2000 to 3.7 million GJ in 2020 (see Figure 14). This is the equivalent of an accumulative expenditure of $580 million on energy between 2000 and 2020.[37] On a per capita basis, however, energy consumption will decrease from 119 GJ per person in 2000 to 107 GJ per person in 2020.

[36] This is a conservative approach—a detailed study would be required to develop more accurate estimates.
[37] In 2000 dollars, assuming an 8% discount rate and a 2% inflation rate for energy.

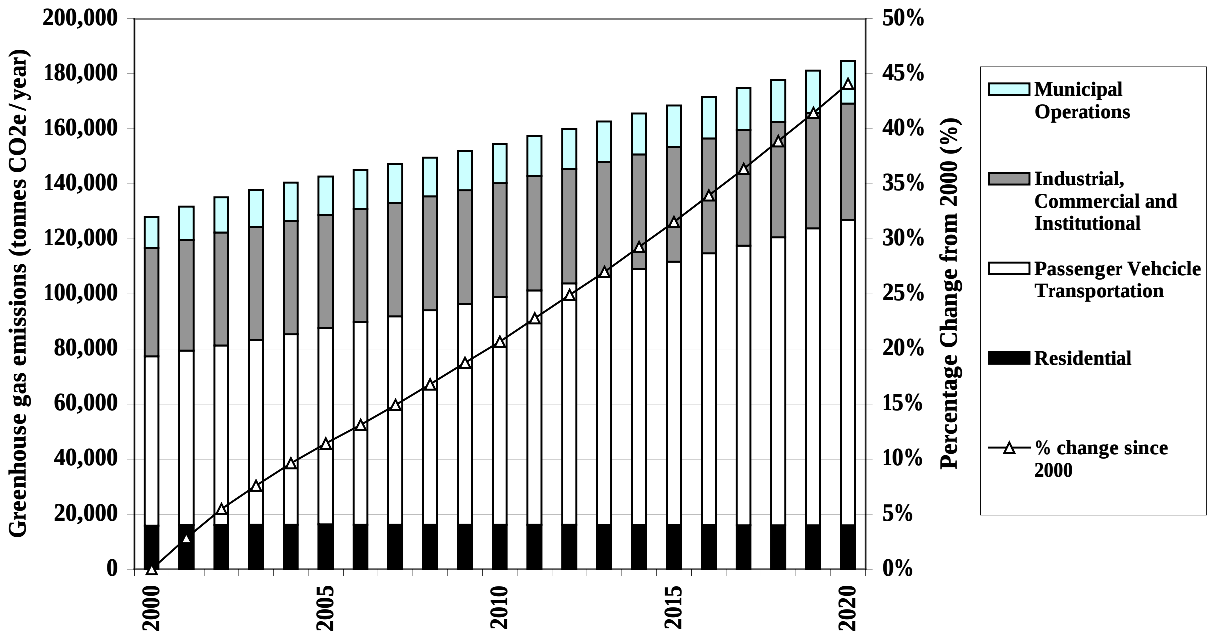
Figure 14: Business As Usual Energy Consumption Forecast, 2000-2020



5.3.3 BAU GHG Emissions

In the BAU Scenario, GHG emissions are expected to increase 44% from 2000 levels (see Figure 15**)**, and 92% from 1990 levels by 2020. Passenger transportation is the largest energy end use and the largest source of GHG emissions, and the influence of this sector will continue to increase through to 2020. Therefore, for RMOW to achieve its GHG targets, a comprehensive package of measures for transportation must be developed and successfully implemented.

Figure 15: Business As Usual Greenhouse Gas Emission Forecast, 2000-2020



5.3.4 BAU Scenario CAC Emissions

A forecast of five priority Common Air Contaminant (CAC) emissions was developed (see Table 15). Results show that **there will be a substantial increase in emissions over the forecast years, particularly for CO and VOCs.** These increases are largely attributable to increased traffic and congestion.

Growing traffic congestion in the RMOW is a major cause for increases in vehicle emissions. Over the forecast period, increased congestion will result in lower average vehicle speeds, which in turn increases CAC emissions.

Since the analysis was completed for this report, new vehicle emission regulations have been established and will come into effect over the period 2004 to 2007. These new emission standards will reduce the forecast significantly. Further analysis of this issue is recommended.

Table 15: CAC Emissions Forecast for the Business As Usual Scenario (Tonnes)

Year	CO	NOx	Sox	VOC	TPT
2000	2,108	652	19	670	110
2005	2,801	751	21	808	112
2010	3,790	864	23	984	115
2015	5,206	998	26	1,214	118
2020	7,232	1,156	29	1,516	122
% increase	***243%***	***77%***	***56%***	***126%***	***11%***

5.4 Recommended Scenario

5.4.1 Recommended Scenario Overview

The Recommended Scenario includes the implementation of the following measures.

5.4.1.1 Measure #1: Switch Fuel from Piped Propane to Natural Gas

Objective: Increase capacity of the existing pipeline system to accommodate continued growth in demand, and to increase the reliability of the pipeline system**.**

Description: The piped propane system that currently services the RMOW is nearing capacity. Terasen is proposing to convert the existing propane grid to a natural gas system. Due to the lower cost and GHG intensity of natural gas, this measure would have a significant impact on energy expenditures and GHG emissions.

Economic Analysis: Conversion to a natural gas system would incur a capital cost of $25 million.[38] **In the first year of implementation, this would result in an annual savings to customers of approximately $1.5 million through lower gas prices.**

Energy Benefit: N/A

[38] Centra Gas Integrated Resource Plan, 1996.

GHG Benefit: Over a 20-year period (2000–2020), conversion from propane to natural gas would reduce GHG emissions by 125,000 tonnes of CO2e.

Air Quality Benefit: Following implementation, conversion from propane to natural gas would on average reduce CO by 5.5tonnes/year, NOx by 47 tonnes/year, SOx by 60 kg/year, VOCs by 1.3 tonnes/year, and TPM by 1.4 tonnes /year.

5.4.1.2 Measure # 2: Implement Expanded Whistler Comprehensive Transportation Strategy

Objective: Achieve a 25% improvement in efficiency over the Comprehensive Transportation Strategy, which has a goal to **r**educe peak congestion in the RMOW by 15% by 2011.

Description: An expanded transportation demand management (TDM) program is based on the assumption that a 25% improvement over the Comprehensive Transportation Strategy is achieved through more aggressive transportation management activities. The Comprehensive Transportation Strategy (CTS) is based on a package of initiatives recommended by Whistler's Transportation Advisory Group (TAG), referred to as the "Preferred TAG". These initiatives include:

- Communications and monitoring
- Creating land use plans and policies
- Initiating improvements to Whistler and Valley Express (WAVE) public transit
- Managing transportation demand
- Developing networks for bicycles and pedestrians
- Managing and monitoring parking supply
- Improving the Whistler road system
- Improving the regional road system
- Regional improvements
- Monitoring and improving traffic operations

As a result of implementing the initiatives in the CTS, total vehicle kilometres travelled in Whistler are expected to increase by only 1.5% per year, rather than the 3% per year which would have occurred in the absence of these initiatives.

Economic Analysis: No economic analysis has been completed for an expanded CTS. If the RMOW wishes to pursue more aggressive TDM measures, a detailed study of costs and benefits should be conducted. However, the planned CTS will cost the RMOW $3.4 million annually, and will incur $45 million in capital expenditures. An expanded CTS will result in a cumulative saving of $67 million by 2020.

Energy Benefit: Over a 20-year period (2000–2020), implementing an expanded CTS will reduce energy consumption by 8.1 million GJ.

GHG Benefit: Over a 20-year period (2000–2020), implementing the CTS will reduce energy consumption by 560,000 tonnes of CO2e.

Air Quality Benefit: Following implementation, the expanded CTS would on average reduce CO by 1,900 tonnes/year, NOx by 160 tonnes/year, SOx by 4 tonnes/year, VOCs by 180 tonnes/year, and TPM by 2 tonne /year.

5.4.1.3 Measure #3: Divert Solid Waste

Objective: Achieve a 50% diversion of solid waste by 2010 and 70% diversion by 2020.

Description: Waste management and 3R (Reduce, Reuse, Recycle) programs are cooperatively managed and delivered by the Squamish-Lillooet Regional District (SLRD) and the RMOW. Roles and responsibilities are summarized in Table 16.

Table 16: Roles and Responsibilities for Solid Waste Management

SLRD Responsibilities	RMOW Responsibilities
Education, promotion and reduction/ reuse programs	Depot collection, processing and transport
	Operation of recycling sites and compactor
	Landfill management
	Curbside collection
	Additional local initiatives

Economic Analysis: The SLRD currently budgets for one full-time Waste Reduction Coordinator and a part-time 3Rs Educator. Both positions combined currently incur an expense of about $48,000. A yearly wage increase of approximately 1% for cost of living increases is assumed for budget forecasting.

These two positions spend 30-40% of their time working within the boundaries of the RMOW. As the Whistler landfill closure date (2008) approaches, the SLRD estimates that time allocation toward Whistler may increase by as much as 20% over the next five years.[39]

[39] Personal communication: Wendy Horan, Waste Reduction Coordinator, The Squamish-Lillooet Regional District, tel: (604) 894-6371, email: (604) 894-6526, January 21, 2003.

Costs for 3R programs were not available for inclusion in this report. However, in many jurisdictions in BC, the cost to collect and process recyclables, combined with their revenue generation potential, is lower than the cost to collect and dispose of household and business waste in a landfill.

In the current analysis, the economic impact of increased diversion is assumed to be small. In order to implement the measure, it is anticipated that one full-time equivalent position will be required for a municipal recycling co-ordinator.

Energy Benefit: N/A

GHG Benefit: By achieving diversion goals, Whistler will avoid generating 72,000 tonnes of CO_2e over the period 2000–2020.[40]

Air Quality Benefit: Not evaluated.

5.4.1.4 Measure #4: Increase Municipal Fleet Efficiencies

Objective: During normal replacement cycles, convert Whistler's corporate vehicle fleet to more fuel-efficient vehicles.

Description: This measure is based on the RMOW fleet achieving an overall efficiency increase of 30% by 2020 (approximately 4% annually). This would be achieved through:

- Gradually converting fleet passenger vehicles (and larger vehicles where appropriate) to hybrid models
- Using smaller engines in the fleet
- Using fuel additives to improve fuel economy and reduce emissions
- Using exhaust scrubbers for large equipment and trucks

Economic Analysis: The incremental cost to purchase a hybrid fuel truck is approximately $10,000, while fuel consumption by this vehicle approximately 93% less.[41] The incremental cost to purchase a hybrid light duty car is approximately $5,000, while fuel consumption by this vehicle is approximately 50% less.[42] Based on current fuel consumption by Whistler's fleet, the payback period is approximately six to eight years.

Energy Benefit: Over a 20-year period (2000–2020), the fleet efficiency improvements would reduce energy consumption by 73,000 GJ.

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[40] Note that flaring of landfill gas has not been included in this analysis. Further investigation of this issue is recommended.
[41] Argonne National Laboratory (SAE Technical Paper 2000-01-0989)
[42] ibid

GHG Benefit: Over a 20-year period (2000–2020), the fleet efficiency improvements would reduce GHG emissions by 5,000 tonnes of CO_2e.

Air Quality Benefit: Following implementation, improved fleet efficiencies would on average reduce CO by 17 tonnes/year, NOx by 1.4 tonnes/year, SOx by 40 kg/year, VOCs by 1.6 tonnes/year, and TPM by 22 kg /year.

5.4.1.5 Measure #5: Support Public Education and Outreach through the "Whistler. It's Our Nature" Sustainability Initiative

Objective: Support public education by building on the "Whistler. It's Our Nature" sustainability initiative, which includes promotional activities such as internationally known speakers; a multimedia show; and support activities such as programs to engage households, businesses and schools with presentations and "toolkits".

Description: This measure would support and expand the promotion and support of energy efficiency and renewable energy improvements that have already been promoted in the "Whistler. It's Our Nature" sustainability initiative. This outreach program would also maximize access to ongoing federal and provincial programs such as the Climate Change Action Fund.

Economic Analysis: The costs for this program are included in other programs.

Energy Benefit: While there are no statistics regarding expected savings for such an innovative, wide-spread program, RMOW staff assume an across-the-board decrease in energy consumption in the order of 2-10% over 20 years as a result of this initiative. For the purpose of this analysis, a 2% impact is assumed.

GHG Benefit: Not applicable.

Air Quality Benefit: Not applicable.

5.4.1.6 Measure #6: Switch Fuel from Large Hydroelectric to Small-Scale Local Renewable Energy

Objective: Displace electricity generated from large hydro and non-renewable sources with low-impact renewable energy. More specifically, convert, 10% of electricity consumed in RMOW to "green"[43] sources by 2010and 20% by 2020.

[43] Defined as low-impact, renewable energy by Canada's Environmental Choice Program (EcoLogo). "*Renewable Low-Impact Electricity Guidelines*" were released in December 1999.

Description: This scenario is modeled on the displacement of electricity from the BC Hydro grid with small-scale local renewable energy.[44] A number of micro-hydro projects are proposed for the area.

Economic Analysis: An incremental cost of $0.015/kwh is assumed for low-impact renewable energy[45]. Based on assumed penetration rates of 10% for 2010 and 20% for 2020, this measure will cost the community $240,000 in 2010 and $450,000 in 2020. However, it is important to note that with the implementation of retrofit initiatives, there will in fact be no net increases in electricity costs.

Energy Benefit: N/A

GHG Benefit: Assuming that marginal electricity is generated using a combined cycle gas turbine, the addition of low-impact renewables would reduce GHG emissions by 330 tonnes in 2010 and 730 tonnes in 2020 below the BAU Scenario.

Air Quality Benefit: BC Hydro's natural gas facilities are not located within RMOW boundaries, therefore this activity will have no impact on air quality within RMOW. Air contaminant releases from BC Hydro's Burrard Thermal are accounted for in Greater Vancouver's emission inventory.

5.4.1.7 Measure #7: Improve Energy Efficiency for Buildings

Objective: Improve energy efficiency of new and existing residential and commercial buildings by 25%.

Description: This measure is an ongoing program aimed at reducing energy consumption in buildings by an average of 25%. To achieve this goal, the program would implement a range of activities for new and existing commercial and residential buildings.

The buildings program will be an adaptive program, taking advantage of new energy efficiency programs as they come available by using demonstration pilot projects (e.g., Spring Creek Fire Hall). Demonstration projects in concert with resort community partners (e.g., Early Adopters of The Natural Step Framework, Olympic Bid Corporation) will also be encouraged.

Specific components of the program will include:

- **Commercial Buildings (New):** Adopt a LEED Silver[46] goal for energy, which can be met through a 25% improvement in energy efficiency for new buildings. This level of performance

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[44] Green Power purchasing and local generation options were explored with BC Hydro staff; however, no opportunities were readily identifiable.
[45] Personal communication with BC Hydro staff.
[46] The LEED (Leadership in Energy and Environmental Design) Green Building Rating System™ is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. Any contractor can submit information on the project to apply for LEED for certification. An additional point is awarded to projects where the person preparing the LEED report is a certified LEED professional. More information is available at: www.usgbc.org/LEED/LEED_main.asp

also qualifies buildings for CBIP (Commercial Building Incentive Program)[47] incentives provided by NRCan.

- **Commercial Buildings (Existing):** Use existing energy management initiatives such as the Energy Innovators Building Retrofit Incentive for the Hospitality Sector—a five-year, $30 million program that will provide up to $250,000 for retrofits of hospitality sector buildings. The CBIP will also provide upfront costs for energy efficiency projects in the commercial sector.
- **Residential Buildings (New):** Adopt an enhanced Model National Energy Code for Houses (MNECH) for all new residential buildings.
- **Residential Buildings (Existing):** Encourage homeowners and property owners to undertake an EnerGuide for Houses evaluation, as part of planned renovation activity.

Economic Analysis: Implementing a LEED program in Whistler will involve providing resources and training to local contractors and building owners about certification requirements. As Whistler staff is currently fully assigned, implementing this measure will require one full-time staff position.

Experience has shown there is no incremental cost to developers to construct buildings that comply with the CBIP program, and that building operators will realize a 20% to 25% reduction in operating energy costs. Similarly, analyses of the cost of achieving a LEED silver rating for a range of commercial building types suggest an incremental cost in the range of 1% to 4%[48].

On the residential side, improved energy efficiency through (for example) the R2000[49] program may cost an additional 8% to 10% in capital cost. However, once the program has been established as the norm in RMOW, the incremental cost of meeting the R2000 standard will likely drop to about 2% to 5%.

The cost associated with retrofitting existing residential and commercial buildings varies by building type, vintage and scope of remediation. For the purpose of the current analysis, it is assumed that on average, investment is in the order of $4.5/sq m and that energy savings are $1.2/sq m, resulting in a simple payback of approximately 4.4 years.

Energy Benefit: Over a 20-year period (2000–2020), these energy efficiency improvements in buildings would reduce energy consumption by 750,000 GJ for residential buildings and 860,000 GJ for commercial and municipal buildings.

[47] CBIP is an incentive program offered by Natural Resources Canada to encourage reducing energy costs by 25% below the model national energy code for buildings. A financial incentive of up to $60,000 is awarded to building owners whose designs meet CBIP requirements. More information is available at: cbip.nrcan.gc.ca/cbip.htm

[48] GVRD, Strategic Assessment of Green Building Initiatives, 2002.

[49] The R2000 program is a high-performance residential building program established by Natural Resources Canada. Typically, R2000 homes consume 30% to 50% less energy and have a 3% to 10% incremental capital cost.

GHG Benefit: Over a 20-year period (2000–2020), these energy efficiency improvements in buildings would reduce GHG emissions by 12,000 tonnes of CO_2e for residential buildings and by 28,000 tonnes of CO_2e for commercial and municipal buildings.

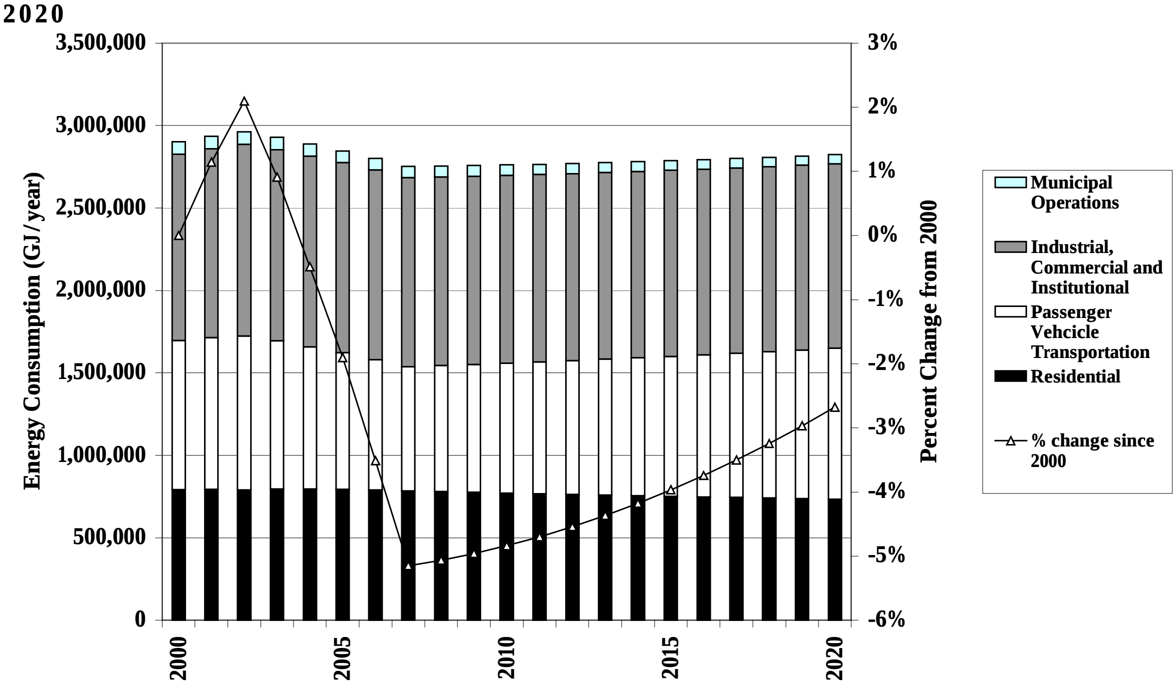
Air Quality Benefit: BC Hydro's natural gas facilities are not located within RMOW boundaries, therefore this activity will have no impact on air quality within RMOW. Air contaminant releases from BC Hydro's Burrard Thermal are accounted for in Greater Vancouver's emission inventory.

5.4.2 Summary of the Recommended Scenario Energy Consumption

The package of measures included in the Recommended Scenario will result in an overall reduction of 10.1 million GJ of energy compared to the BAU Scenario. A graph summarizing this result is included in .

Applying a discount rate of 8% and an energy inflation rate of 2%, the present value of expenditures on energy for the period 2000–2020 under this scenario would be $480 million, compared to $580 million for the BAU Scenario.

Figure 16: Recommended Scenario Energy Consumption Forecast, 2000-2020

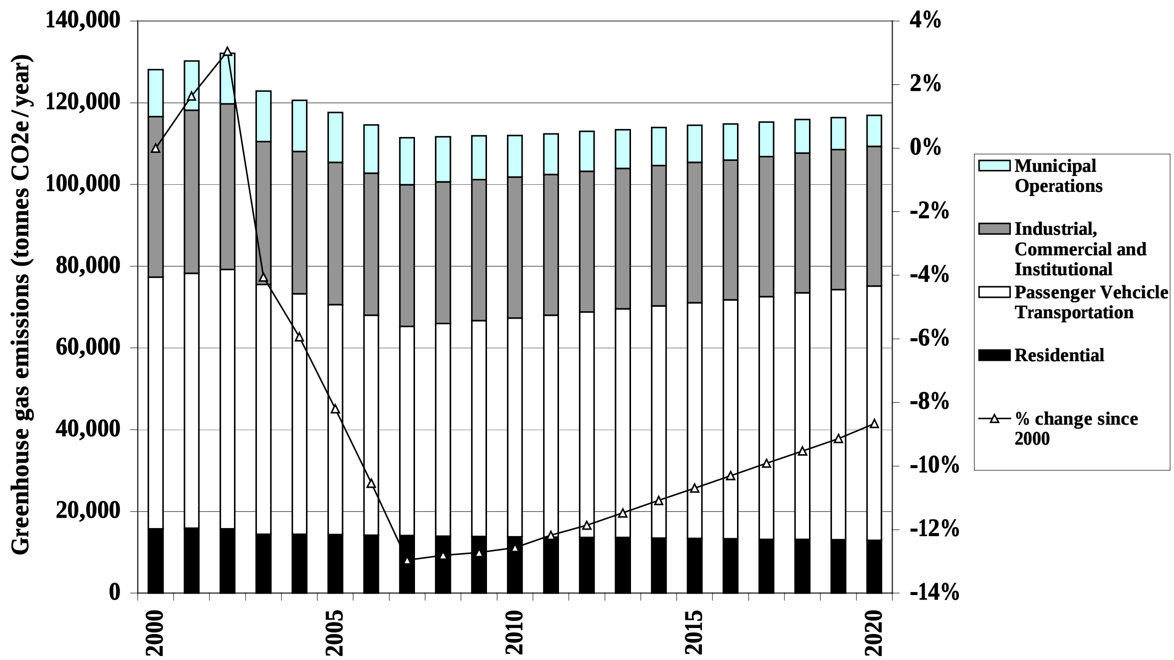


5.4.3 Summary of the Recommended Scenario GHG Emissions

The package of measures included in the Recommended Scenario will result in an overall reduction of 809,000 tonnes of CO_2e. Graphs summarizing these results are included in Figure 14.

Relative to the 2000 baseline, the recommended package of measures will reduce GHG emissions in Whistler by 9%. It should be noted that relative to the 1990 baseline established as RMOW's commitment to the PCP, the Recommended Scenario still represents a 22% increase (compared to the 6% decrease to which the RMOW committed). Given the growth in Whistler since 1990, achieving the PCP commitment will be challenging.

Figure 17: Recommended Scenario GHG Emissions Forecast, 2000-2020



5.4.4 Summary of the Recommended Scenario CAC Emissions

The Recommended Scenario includes an enhanced transportation management program, as well as a program directed at reducing energy use in the building sector. As Table 21 illustrates, emissions will generally decrease over the study period, ranging from a 14% reduction for NOx to zero change in PM levels, which will remain constant over the study period.

Table 17: CAC Emissions Forecast for the Recommended Scenario (Tonnes)

Year	CO	NOx	SOx	VOC	PM
2000	2,108	286	5	219	99
2005	2,049	242	5	215	98
2010	1,997	243	5	212	99
2015	1,948	244	5	209	99
2020	1,901	246	5	206	99
% increase	***-10%***	***-14%***	***-2%***	***-6%***	***0%***

6 SUSTAINABLE ENERGY VISION FOR WHISTLER

The package of measures presented in the previous section's Recommended Scenario is ambitious yet cost-effective. The scenario will not, however achieve RMOW's targets for energy, air quality and GHG management. The following Sustainable Energy Vision for Whistler identifies longer-term opportunities that will move Whistler closer to its sustainability goal.

As previously mentioned in this report, The Natural Step Framework is a tool developed by international scientists to facilitate integrating ecological principles into the practices of communities, organizations or individuals. **Because Whistler has adopted The Natural Step as a compass to guide the community toward its sustainability goals, this section of the IEP applies The Natural Step Framework to develop a Sustainable Energy Vision for Whistler.**

The Framework is based on the recognition that for a society to be sustainable, certain system conditions must be met. Table 18 indicates how the four system conditions from The Natural Step translate into sustainability objectives for RMOW.

Table 18: Translating the Four "Natural Step System Conditions" into RMOW Sustainability Objectives

	SYSTEM CONDITION	RMOW OBJECTIVE
1	Nature is not subject to systematically increasing concentrations of substances extracted from the Earth's crust.	Eliminate RMOW contribution to systematic increases in concentrations of substances extracted from the Earth's crust.
2	Nature is not subject to systematically increasing concentrations of substances produced by society.	Eliminate RMOW contribution to systematically increasing concentrations of substances produced by society.
3	Nature is not subject to systematically increasing degradation by physical means.	Eliminate RMOW contribution to the systematic physical degradation of nature that we bring about through over-harvesting, introductions, and other forms of modification.
4	Human needs are met worldwide.	Contribute as much as possible to meeting human needs in society and worldwide, over and above all the substitutions and measures taken in meeting the first three objectives.

The primary focus of the IEP is to help Whistler achieve **System Condition 1**. Two broad sets of strategies will be required to enable RMOW to meet this system condition: (1) dematerialization, and (b) substitution.

Dematerialization reduces the total material "throughput" for a given set of services or goods through conservation and efficiency measures such as building retrofits. *Substitution* shifts energy generation from non-renewable fossil fuels (such as gasoline) to renewable energy supplies (such as solar).

6.1 Envisioning a Systems Approach

To achieve Whistler's Sustainable Energy Vision, the RMOW will need to adopt a "systems approach" to planning. That is, when making decisions about individual components of the community's infrastructure, the municipality should consider potential implications on other components.

In order to adopt a true systems approach, the carrying capacity of the entire community should be determined, and methods for living within these limits identified.

6.2 Moving Toward Resilient, Adaptable Systems

A Sustainability Energy future for Whistler would also emphasize the need for resilient and adaptable systems, enabling the community to make transitions to more sustainable technologies and planning approaches as they become available.

This opportunity is especially important given that existing systems are becoming increasingly costly to operate on a per capita basis. A number of trends are contributing to the rising costs of traditional systems, including:[50]

- Increasing on-site demand for resources per dwelling, as homes and offices become more efficient
- Decreasing average occupancy per dwelling
- Increasing cost of securing a unit of resource
- Increasing scarcity and cost of land for facilities and distribution systems

A SYSTEMS APPROACH CAN OFTEN YIELD UNEXPECTED RESULTS

A homeowner may decide to convert all of the house's incandescent light bulbs to compact fluorescents, because compact fluorescents consume 75% less energy.

However, if the house is currently heated by natural gas, and its electricity is provided by 100% hydropower, switching to compact fluorescents will increase the heat demand (incandescent bulbs generate a lot of heat because they are inefficient), and therefore increase the house's use of fossil fuels.

[50] *Green Municipalities: A Guide to Green Infrastructure for Canadian Municipalities*, Prepared for the Federation of Canadian Municipalities by the Sheltair Group, May 2001, p. 2.

As a result, many of our existing generation and distribution operations are becoming increasingly unproductive and inefficient. Meanwhile, recent changes and advancements in technology and the economy provide tremendous opportunities to move toward the Sustainable Energy Vision. For example[51]:

- **Urban density** is increasing (or is planned to increase).
- **New "micro" utility servicing equipment** is on the market, including small-scale systems for water treatment, water recycling, cogeneration and heat transfer.
- **Innovative energy storage systems** are improving the potential for renewable energy and on-site infrastructure. In some cases, the grid is also being used as a storage substitute. As flows of electricity, heat and water become bidirectional, on-site systems can easily share surplus resources and "top up" local capacity.
- **Artificial intelligence (AI)** can now be used to reduce the need for expensive failsafe systems, and to reduce maintenance costs for small-scale systems. AI can also facilitate the management of innovative storage and hybrid systems.
- **Deregulation of utilities** is transforming single-minded monopolies into flexible and market-driven businesses focused on a broad range of customer needs—in some cases offering a service "package" of gas, electricity, water, cable, insurance, telephone, appliances and sewage from a single supplier.
- **Delivery of infrastructure** is changing from traditional general contracting to a more performance-based system, where consortia of firms undertake to design, build, own, operate and transfer systems in accordance with broad, objective-based requirements.
- **Development of renewable energy resources** including micro-hydro, solar and wind energy are increasingly capable of providing long-term energy supply to RMOW.

These developments are creating opportunities for more flexible, diverse and integrated approaches to providing urban services. Whistler's challenge is to facilitate this transition amongst all sectors by removing institutional barriers, conducting demonstration projects, providing incentives for developers, and possibly even creating its own utility.

6.3 Demonstrating Leadership

The fourth Natural Step principle emphasizes the significance of a community's global impact. With respect to energy planning, this draws attention to the impacts of the community's purchasing practices—the energy systems used by communities that supply materials and services to Whistler, and in the messages it sends to visitors. In working toward this fourth system condition, Whistler should adopt

[51] Ibid.

alternative strategies such as purchasing from cooperatives and educating other communities about renewable energy opportunities.

In order to achieve a successful transition, it is essential to send engaging and positive messages throughout the community. The municipality can do this by taking actions that demonstrate leadership and by providing information to community members about how they can contribute. The RMOW has already moved in this direction through the adoption of TNS and through the implementation of various in-house energy efficiency and demand-side management initiatives—but as the municipality continues to set a progressive, responsible example, it must continue to take on new leadership initiatives.

6.4 Key Features of the Sustainable Energy Vision for Whistler

The Sustainable Energy Vision requires that Whistler identify holistic solutions to supplying energy to all sectors in the community, including:

- Residential buildings
- Municipal buildings
- Commercial buildings
- Municipal infrastructure
- Personal vehicle transportation
- Public transit (including buses and trains)
- Airplane travel

Each of these sectors is addressed in the following four action areas:

- Energy supply systems
- Land use planning
- Transportation
- Offsets

6.4.1 Energy Supply Systems

Current pricing structures make the adoption of renewable energy alternatives economically unfavourable, largely because current accounting systems do not incorporate social and environmental costs.

In many cases, it is assumed that potential actions relating to the supply of energy are beyond a municipality's jurisdiction, but this is not necessarily the case**. To ensure the sustainability of Whistler's energy supply, the RMOW should consider establishing its own energy utility and a**

community energy policy. Otherwise, the municipality will be restricted in the actions that it can take to increase its use of low-impact renewable energy sources.

There are more than 250 publicly owned electric utilities across the United States, and nearly 50 state and federal power agencies[52]. Typically, municipally owned utilities were established as a means of guaranteeing affordable and reliable electricity to their residents. A publicly owned utility also enables a community to take control of energy sourcing, and provides added incentive to implement effective demand-side management.

If Whistler pursues this option, it will need to undertake a thorough analysis of low-impact renewable energy sources that are available to the municipality. This would likely include a blend of geothermal, solar, wind, and other appropriate technologies.

As is the case in most Canadian communities, Whistler's current energy supply system is based on large distribution grids and remote generation facilities. **In the Sustainable Energy Vision, these systems would gradually be replaced with a network of distributed or "on-site" infrastructure systems with shared elements, finely integrated into the fabric of the built environment**[53]. This would include the use of small, locally generated, low-impact renewables (e.g., run-of-the-river hydro projects) as well as on-site generation (e.g., solar panels on houses). These decentralized distribution systems provide the flexibility to take advantage of renewable energy resources where they are available, rather than continue the practice of transporting fuels or electricity over great distances. With distributed/on-site infrastructure systems, buildings and industries become both suppliers and consumers of heat and power.

A distributed energy system can collect thermal energy from many sources:

- Methane at landfills or sewage treatment facilities
- Heat pumps connected to pipes in the ground or water bodies
- Solar water heaters on roofs
- Industrial processes

All these elements can be connected through a district heating system. When communities are redeveloped, opportunities should be evaluated for electrical generating capacity within each new cluster of buildings. These generators provide on-site electricity for lighting, appliances and the public transit system, while waste heat can be used to heat buildings and domestic hot water.

Consideration would also be made to identifying opportunities for integrating the energy distribution system with other infrastructure. Integration would begin at the building (or micro) scale, moving

[52] A list of these power and utility agencies can be viewed at www.utilityconnection.com.
[53] More detail on sustainable and resilient infrastructure systems is provided in: *Green Municipalities: A Guide to Green Infrastructure for Canadian Municipalities*, Prepared for the Federation of Canadian Municipalities by The Sheltair Group, May 2002. (available at: /www.fcm.ca)

outward as necessary to connect with the neighbourhood infrastructure. **At the building scale, integration may mean that walls, roofs, entranceways and other elements of the building serve to capture energy, water and wind, treat and separate wastes, and contribute to accessibility and transportation.** These internal collection and separation systems allow the building to produce raw materials such as clean, reclaimed water; photovoltaic electricity; used paper; CO_2; and so on.

At the neighbourhood scale, these systems are integrated with land uses and with other resource flows. Properly planned, this type of integration creates a true “urban ecology”.

The Sustainable Energy Vision will also strive towards “cascading” energy flows from highest-quality to lowest-quality uses, in order to match energy quality to end-use. That is, highest-quality energy sources such as electricity would be used for lighting, computers, motors and transportation; natural gas would be used for cogeneration, industrial processes and steam; waste heat would be used for water heating and space heating.

6.4.2 Land Use Planning

Land use planning decisions will impact the community’s ability to develop sustainable energy supply and transportation systems.

For example, it has been shown that there is an inverse relationship between density and energy consumption—as density increases, per capita energy consumption decreases. Newman and Kenworthy (1999) have demonstrated that areas with less than about 20–30 persons/hectare are indicative of an automobile-dependent land use pattern.[54]

The built environment of higher density areas also reduces the per capita energy footprint because these areas typically have less frontage, which results in more compact—and thus more efficient—infrastructure systems.

When Whistler communities are redeveloped in the long term, attention should be paid to identifying opportunities for clustering buildings and taking advantage of on-site renewables. In addition, a range of incentives and bylaws could be adopted to encourage community members to adopt more energy-efficient technologies and practices. (Examples of these measures are described below.)

[54] Newman, Peter and Jeffrey Kenworthy, *Sustainability and Cities: Overcoming Automobile Dependence*, Island Press, 1999, p. 100.

6.4.3 Transportation

The energy consumed in moving people into and around Whistler represents a significant proportion of the total energy consumed in the community.

Transportation is a complex issue in any community, but perhaps more so for a community built around tourism. In order to work toward a sustainable transportation system, a range of initiatives must be implemented that address resident and visitor transportation. A resort community is by its nature responsible for generating significant volumes of inter-community transportation; therefore, **in order to be a truly sustainable community, a resort municipality must also consider the energy consumed in bringing people into the community.**

Whistler is already making progress on public transit. It currently has the third highest per capita ridership in B.C., after Vancouver and Victoria. The RMOW also offers free shuttle service from the Village to Marketplace, and on Earth Day, Clean Air Day, International Car Free Day, and New Year's Day all public transit is free.

In 2002, Whistler tied with the Regional Municipality of York, Ontario for the Transportation Association of Canada's Sustainable Urban Transportation Award. Whistler won the award for *The Whistler Way!* Rideshare Program, which provides ride-matching services and vehicles so that new carpools and vanpools can be established. In the first three months of the program, four new vanpools had already been created between Squamish and Whistler[55].

6.4.4 Offsets

While many obvious measures can be implemented to reduce the energy expended by visitors traveling within Whistler (e.g., offering car-free tourism packages), measures directed toward those visitors' travel on airplanes, trains and automobiles on their way into and out of Whistler are not so straightforward. **By developing measures to account for this travel—or alternately, by implementing measures that will "offset" the impacts of this travel—Whistler will be taking an important leadership role.**

[55] Transportation Association of Canada's TAC NEWSVolume 28 ~ Fall 2002. Available at: www.tac-atc.ca/products/tacnews/fall2002-6.htm

7 IMPLEMENTATION PLAN

A practical, cost-effective set of measures has been included in the Recommended Scenario that will improve energy management and shift the community to using more environmentally benign energy sources. These measures have been selected because they will also reduce emissions of CACs and GHGs, as well as contribute to Whistler's local economic development and resilience.

The IEP also includes a Sustainable Energy Vision, which demonstrates how Whistler can work toward meeting The Natural Step System Conditions (see page 1) over the long term (e.g., 25 years or more).

This section outlines an Implementation Strategy for the IEP. There are two key features of this strategy:

1. It builds from existing sustainability initiatives.
2. It applies an Adaptive Management Framework to ensure alignment of the community's vision, goals and targets, and to enable the plan to evolve as conditions change.

The IEP should be considered a work in progress, and this section provides a recommended process for implementing and updating the plan over time. Information is provided on:

- Engaging stakeholders,
- Delivering the program,
- Resource requirements,
- Risk management,
- Monitoring, and
- Reporting.

7.1 Engaging Stakeholders

Whistler's goals to maintain air quality and reduce GHG emissions can only be met if the community becomes effectively engaged in this plan. Furthermore, it is the community members who best understand the range of barriers, opportunities and challenges that the plan must address. It will be essential to involve the following stakeholders in the IEP as it continues to evolve:

Stakeholders within the municipal government:
- Mayor and Councillors
- Municipal staff (planning department, public works department, etc.)

Stakeholders from the community:
- Residents
- Businesses

- Environmental groups
- Educational community
- Visitors

A unique approach will be required for each of these groups, but in general, their engagement should be sought through four stages:

1. Education to develop the community's understanding of the benefits of energy planning and management, and of addressing climate change and air quality issues
2. Consultation to identify opportunities, barriers, and challenges
3. Presentation of the updated IEP
4. Ongoing communication with stakeholders to provide regular progress updates

Of these, the most difficult group to engage is the visitor community. To address this unique challenge businesses and associations related to the tourism industry should be approached and/or surveyed to provide input on behalf of this group.

7.1.1 Stage 1: Education (Present to Fall 2004)

Whistler has already undertaken a significant amount of stakeholder engagement through the "Whistler. It's Our Nature" initiative. This is a community-based program that encourages businesses, households and other organizations to practice sustainability by using The Natural Step Framework as a "sustainability compass". The program has included the distribution of sustainability toolkits, a speakers series, a symposium, and school programs.

The community also recently reviewed and provided input on a set of development scenarios through the "Whistler. It's Our Future" program. This is a planning process to develop the long-term shared vision, priorities and plan for a sustainable future.

Therefore, through these past initiatives, the community has already been primed for involvement in the IEP. The community will simply need to be reminded about these concepts and be shown how the IEP can act as a tool for working toward these goals.

The central message to promote during this stage is that action is needed to ensure that air quality and the climate are managed in order to preserve the "Whistler Experience". Energy management can contribute toward these goals, while at the same time creating economic, environmental and social benefits.

The following educational tools could be used to introduce these concepts to each audience:

Mayor and Councillors

- Presentations at council meetings to seek approval of approach

Municipal Staff

- Presentations at municipal staff meetings
- Information in staff bulletins/e-mails

Residents

- Presentations at community meetings
- Pamphlets to promote the consultation process
- Energy audits based on the EnerGuide for Houses Program

Businesses

- Presentations at business association meetings
- Presentations to staff—emphasizing their crucial role as the people who meet the public

Visitors

- Brochures in hotels, motels, and other places of accommodation
- Brochures at major tourist attractions

7.1.2 Stage 2: Consultation (Fall 2004)

A community consultation process will provide the opportunity to develop a greater understanding of the opportunities, challenges and barriers relevant to each of the stakeholder groups. Specifically, feedback would be sought on the Sustainable Energy Vision and the proposed set of measures in the Recommended Scenario. Feedback will then be used to update this IEP to ensure all stakeholder issues are considered.

Workshops will facilitate a two-way communication process. Participants will be given information about energy and air quality (current use and forecasts), and will be asked to identify barriers, propose actions, and identify areas where additional support is required.

Workshops would be delivered for each of the following audiences:

1. RMOW staff (possibly one workshop for management staff and one for non-management)
2. Residents
3. Businesses

All relevant RMOW departments must provide a technical review of the measures included in the Recommended Scenario before the IEP is initiated. This review will facilitate the identification of additional internal resource requirements and partnership opportunities with other organizations.

The business audience should also be targeted for providing feedback on the special interests and needs of the visitor population. Whistler's business community is based on tourism, and is highly knowledgeable about the needs and demands of visitors.

Environmental groups and the educational community are also community stakeholders. These groups should be invited to the workshop for residents and offered materials that they can use in their respective work.

7.1.3 Stage 3: Presentation of Revised IEP (Early 2005)

Results of the consultation will be used to revise the IEP, which will then be presented to council for adoption.

7.1.4 Ongoing Communication

Ongoing communication channels will be established with stakeholders to provide regular progress updates on the IEP.

This ongoing communication will:

- Provide monitoring and feedback to tailor the action plan to changing realities, sensitivities, issues, etc.
- Sustain focus with changing councils, etc.
- Provide progress reports, demonstrating to people that they can make a difference and that the differences are beneficial to the local community and economy

7.2 Resource Requirements

Implementing the IEP will require a core team of planning and engineering staff; an outreach and communications coordinator; and a technical expert. The Plan will also require the participation of a number of departments within the RMOW. It is assumed that funding/contracts administration, as well as administrative and management support, will be provided as part of the overall measures currently being developed through Whistler's Comprehensive Sustainability Plan.

The public works department will be responsible for designing the overall plan, providing ongoing management, monitoring and collecting data, as well as tracking outcome and coordinating public awareness activities. Primary work activity will include coordinating and communicating IEP activities, as well as organizing detailed design and implementation of specific programs.

7.3 Risk Management

A set of risk management criteria were established to guide the selection of potential measures for the IEP. These criteria should continue to be applied as the IEP evolves.

The IEP approach to risk management is to focus on "no regrets" measures that provide significant environmental, economic, and social benefits. Specific evaluation criteria for the risk management program include:

- Design of the measure is advanced. A sufficiently developed measure will enable a high degree of certainty regarding impacts, costs and ability to obtain necessary approvals.
- The presented operating projection is credible. This will vary for each measure, and may include, for example, a benefit-cost analysis for the municipal fleet measure.
- The measure provides significant, measurable socioeconomic benefits for the RMOW.
- Potential environmental and regulatory concerns have been identified. If concerns are not assessed as low, an acceptable mitigation strategy is in place.
- Commercial arrangements provide a purchase cost that is economically attractive, giving consideration to anticipated market prices and other benefits.

7.4 Monitoring Framework

The IEP uses an Adaptive Management Framework as a tool to ensure that actions contribute to meeting the community's vision and goals. Using the framework, a set of indicators and targets have been established to measure the success of the IEP.

Monitoring and verifying reductions in energy consumption and GHG emissions may be accomplished to a large extent through accessing currently available information includes:

- Sales of electricity, propane and natural gas may be obtained directly from utilities.
- GHG emissions from landfills may be calculated from disposal tonnages.
- Corporate transportation energy consumption may be obtained from records.
- Community transportation-related energy and GHG emissions may be inferred from data collected as part of ongoing traffic monitoring programs, using data from occupancy, mode split and traffic volumes.

In the long term, it is recommended that additional transportation-related indicators be considered for use in calculating energy and GHG emissions directly.

Table 19: Proposed Performance Measurement Indicators and Targets

INDICATOR	CURRENT (2000)	RECOMMENDED TARGET for 2010	RECOMMENDED TARGET for 2020
Total annual energy use	2.9 million GJ	2.76 million GJ	2.82 million GJ
Total annual per capita energy use	119 GJ	85 GJ	82 GJ
Annual energy cost per capita	$1,900	$1,300 (2000 dollars)	$1,300 (2000 dollars)
Total annual GHG emissions	120,000 tCO2e	112,000 tCO2e	117,000 tCO2e
Total per capita annual GHG emissions	5 tCO2e	3.5 tCO2e	3.4 tCO2e
Annual average PM10 emissions	10 micrograms/m^3	10 micrograms/m^3	10 micrograms/m^3
% of electricity generated in Whistler	0	10%	20%
% of energy derived from low impact renewable energy sources	0	10%	20%
Annual energy consumption by RMOW operations	75,000 GJ	64,000	55,000 GJ
Annual energy cost for RMOW operations	$990,000	$800,000 (2000 dollars)	$670,000 (2000 dollars)
Annual GHG emissions from RMOW operations.	11,400 tCO2e	10,200 tCO2e	7,600 tCO2e
Total waste generated by the community landfilled per year	21,551 tonnes	18,768 tonnes	12,146 tonnes
Total waste generated by the community landfilled per capita per year	0.88 tonnes	0.58 tonnes	0.35 tonnes
Percentage of total waste recycled	24%	40%	70%
Percentage of dwelling units within 300 m of transit	93%	97%	100%
Percentage of dwelling units within 300 m of valley trail	81%	90%	100%
Total annual VKT by SOV	124 million km	160 million km	TBD
% of skiers traveling by auto vs. non-auto	60%	Not calculated	45%
Vehicle occupancy	2.1 (1999)	2.5	TBD

7.5 Reporting

It is proposed that annual progress reports be prepared to monitor progress on IEP implementation. In addition, it is proposed that more detailed five-year progress reports be prepared, which will include an update on the core set of indicators. This two-tiered approach to reporting will reduce the resource strain associated with compiling monitoring data on an annual basis.

Since 2000 is the baseline year for the IEP, it is proposed that the updated data be conducted for the years 2005, 2010, 2015, and 2020. This reporting frequency and timing will also coincide with the 2010 Winter Olympics and will be a milestone year for the community to measure performance. Data collection for the updated 2005 baseline year would likely occur in 2006.

IEP annual reports will describe implementation progress and establish key goals for the upcoming year. Annual energy expenditures, energy consumption and GHG reductions from municipal operations will be reported annually, since this data collection requires less time and resources.

Using progress reports and monitoring reports based on indicators, the community will be able to evaluate its performance and assess its progress in implementing the IEP. The indicators and reports will identify positive results that are being achieved, and will also identify practices and programs that require adjustment. These indicators will serve as useful tools for public processes, because they communicate in a clear way the current performance of the community and the expected impacts from proposed courses of action.

7.6 Implementation Timeline

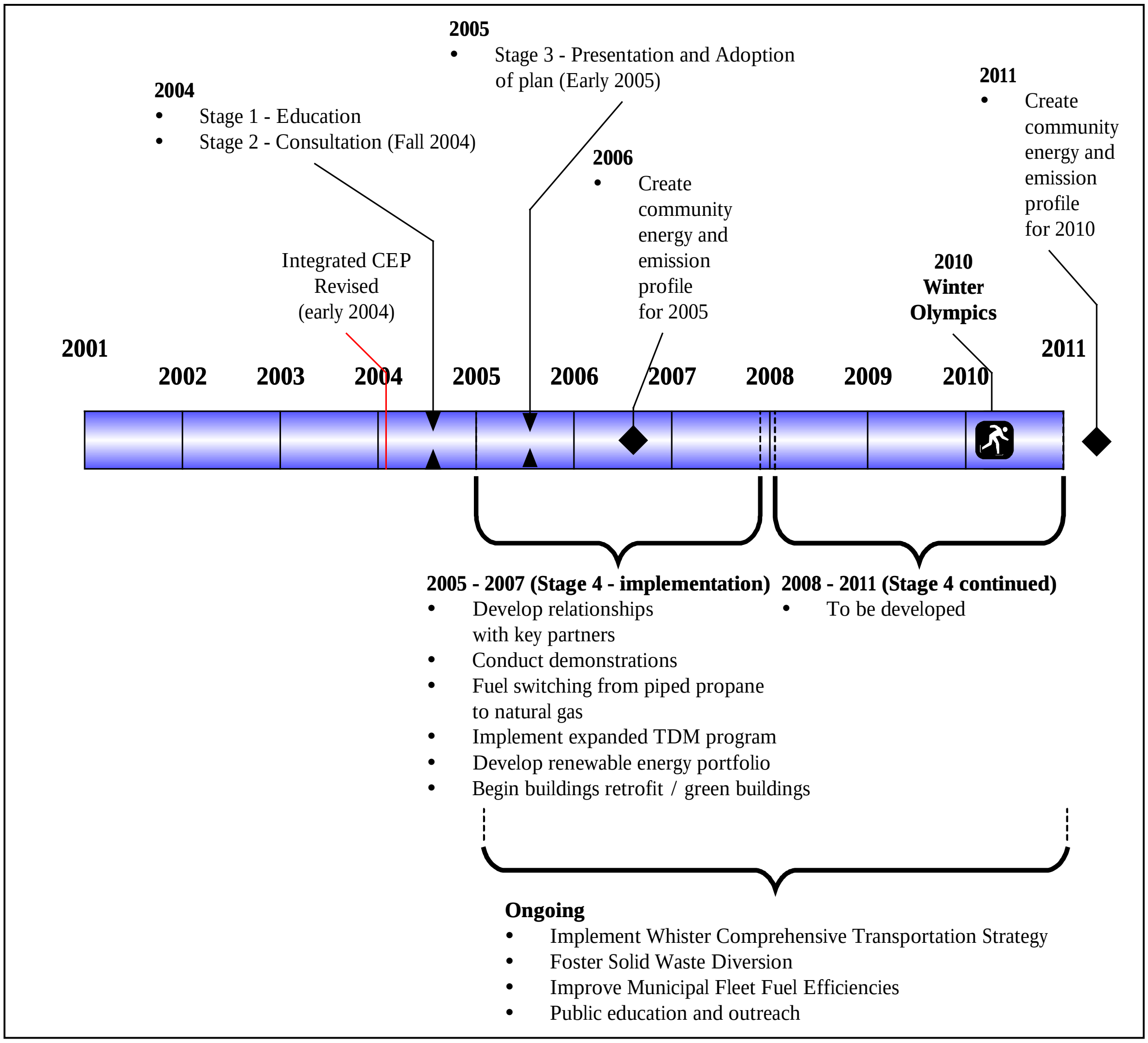
IEP implementation will commence following consultation and formal adoption of the plan by council in 2004/2005. A detailed implementation timeline is presented in Figure 18.

In the first year following adoption of the IEP, RMOW will work with key partners to prepare a detailed IEP Implementation Strategy that outlines staff work plans, roles, responsibilities and budgeting for the next five years. IEP measures will then commence.

By Year 2, it is expected that an initial core group of programs will be in place. The focus in this second year will be on continuing program roll-out and ensuring the acquisition of performance monitoring data.

By Year 3, the recommended measure will be in full operation. It is expected that activities will be divided between (1) ongoing development and monitoring, and (2) the promotion and technology transfer activities required to achieve program targets. Ongoing communication channels with stakeholders will also be maintained. Figure 18 illustrates the implementation and monitoring timeline for the plan.

Figure 18: Implementation and Monitoring Timeline



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NR Can's Commercial Building Incentive Program web site: cbip.nrcan.gc.ca/cbip.htm

LEED web site: www.usgbc.org/LEED/LEED_main.asp

The Natural Step web site: www.naturalstep.org/about/whatis_framework.htm.

The United Nations Framework Convention on Climate Change Web site (Climate Change Information Kit): www.unfccc.org/resource/iuckit/fact01.html.

Personal Contacts

Cliff Jennings, RMOW Wastewater Treatment Plant, 604-866-932-5535

Don Boyd, BC Transit, 250-995-5629.

Paul Hardy, ICBC, 604-648-7081.

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APPENDIX A : SUPPORTING INITIATIVES

A.1 RMOW Initiatives

Although RMOW has not specifically undertaken energy planning to date, related initiatives have a significant impact on energy efficiency and include:

- The establishment of development limits ("bed unit capacity") through the Official Community Plan and the Comprehensive Development Plan
- The Whistler Comprehensive Transportation Strategy
- The Whistler Environmental Strategy
- Adoption of The Natural Step Framework

A number of other organizations in Whistler have been involved in a variety of additional initiatives that will have a positive impact upon energy efficiency.

The following section describes initiatives that have been undertaken both by the RMOW and by other Whistler organizations. The IEP will build from and integrate new initiatives into these activities.

A.1.1 Adoption of The Natural Step Framework

The Natural Step is a tool developed by international scientists to facilitate the integration of ecological principles into the practices of communities, organizations or individuals.

The Framework is based on the recognition that for a society to be sustainable, certain system conditions must be met. That is, in order to be sustainable, a society must not subject nature to systematic increases in[1]:

1. Concentrations of substances from the earth's crust (e.g., the burning of fossil fuels and the use of scarce metals)
2. Concentrations of substances produced by society (e.g., persistent organic pollutants)
3. Degradation by physical means

And in that society,

4. Human needs are met worldwide.

[1] See the Natural Step web site: www.naturalstep.org/about/whatis_framework.htm, viewed May 2, 2001.

The RMOW adopted The Natural Step Framework following a visit from its founder, Dr. Karl-Henrik-Robèrt in March 2000. This framework provided an excellent tool for communicating and strengthening the Whistler Environmental Strategy.

A number of Whistler businesses and organization joined the RMOW in adopting the Natural Step Framework. These "Early Adopters" included Tourism Whistler, Whistler-Blackcomb, Whistler Fotosource, Fairmont Chateau Whistler Resort, and AWARE (Association of Whistler Area Residents for the Environment). These organizations have been involved in the development stages of this initiative and many of them are already well on their way towards incorporating The Natural Step Framework into their practices.

The Early Adopters Agreement specified that all signatories would:

- Work to adopt The Natural Step framework, and its language, including the four system conditions
- Use The Natural Step Framework as a basis of their sustainability programs
- Adopt a common communications strategy to launch the Natural Step framework
- Conduct a "Level 1 Audit" to analyze environmental impacts
- Participate in train-the-trainer programs and develop tool kits
- Host a symposium for interested businesses and organizations to highlight progress-to-date and future priorities in December 2000

The municipality and the early adopters are establishing their own strategies, actions and metrics based on the four Natural Step principles.

The Integrated Energy Plan will assist Whistler in achieving its sustainability goals, as the municipality works within The Natural Step Framework. Specifically, the IEP will help RMOW avoid systematic increases in concentrations of substances extracted from the earth's crust (i.e., through burning of carbon-based fuels), and it will help to grow an awareness of the principles behind the funnel throughout the community.

Prior to adopting The Natural Step Framework, RMOW's commitment to building a sustainable community was formalized in the visioning document, *Whistler 2002: Charting a Course for the Future* (1999). *Whistler 2002* outlines the municipality's strategy for the 21st century and identifies five key priorities:

- Building a stronger resort community
- Enhancing the Whistler experience
- Moving towards environmental sustainability

- Achieving financial sustainability
- Contributing to the success of the region.

As demonstrated in the priorities listed above, the visioning document placed a strong emphasis on environmental values and sustainability. Whistler's environmental priority was strongly supported by members of the community that participated in this process. As a result, RMOW developed the Whistler Environmental Strategy Discussion Paper in 1999.

A.1.2 The Whistler Environmental Strategy

A number of the initiatives identified in the Whistler Environmental Strategy will reduce energy consumption. In particular, the WES identified the need to complete this IEP and implement its recommendations in concert with other sustainability initiatives. Other examples identified in the WES include:

- Focusing on concentrating commercial buildings in medium-density, mixed-use, pedestrian-oriented areas, and clustering these developments in neighbourhoods throughout the valley
- Continuing Transportation Demand Management programs consistent with Whistler's Comprehensive Transportation Strategy
- Establishing green building design guidelines for new and retrofit buildings
- Continuing to encourage mixed-use, compact, pedestrian-oriented resort and urban design.

A.1.3 Whistler Comprehensive Transportation Strategy

The Transportation Advisory Group (TAG) was established in 1996 to address transportation issues in Whistler. The multi-stakeholder group developed a vision for Whistler that was based on promoting alternative modes of travel and limited additional road capacity.[2] TAG undertook a strategic planning process and identified key transportation issues, which included[3]:

- Congestion on Highway 99 and in the village during peak hours
- High cost of housing, which forces many employees to commute from outlying areas
- Low number of visitors to Whistler using local transit
- Lack of services and daily needs shopping locally
- Infrequent and inconvenient passenger rail system

[2] *Whistler Comprehensive Transportation Strategy: Summary Report,* Transportation Advisory Group, Resort Municipality of Whistler, September 1999, p.2.
[3] Ibid., p.3.

TAG developed the Whistler Comprehensive Transportation Strategy in 1999, outlining a comprehensive plan including the following elements.

1. **Communication and monitoring**
   - Promote and encourage transit use, carpooling, cycling and walking by providing information targeted to all groups and individuals in the resort. Tools will include information packages for tour operators, travel agents, and visitors; promotional campaigns; information packages and a bike map; various reports; and facilitate coordination of the various transportation providers in the region.

2. **Land use plans and policies**
   - Minimize travel distances to work for Whistler employees and for common daily trips.
   - Increase density of affordable employee housing close to centres of major employment.
   - Reduce future vehicle parking requirements and encourage alternative travel modes.
   - Continue to locate tourist accommodation near or within commercial centres and ski lifts.
   - Require new and encourage existing developments to provide bicycle storage, showers and change rooms, ski and clothing lockers for bicycle/ski commuters.

TAG has a goal to increase average vehicle occupancy rates to 2.5 people per vehicle by 2009.

3. **Whistler transit**
   - Make transit more attractive by improving and expanding services and vehicles.
   - Reduce the need to carry large items on the transit system by providing lockers.

4. **Transportation demand management**
   - Implement policies, programs and actions that will reduce the volume of automobiles by 15% in peak hours; for example, modification of mountain operating times to spread out traffic peaks.
   - Encourage travellers to adjust their travel time to avoid peak times.
   - Provide a “Peak Day Program” that includes free transit service and pay parking strategies.
   - Establish and promote an Employee Trip Reduction Program.
   - Provide preferential parking for car pools.
   - Encourage major employers to purchase more fleet vehicles to increase carpooling.
   - Develop infrastructure and programs to increase carpooling, e.g., preferential parking for car pools, and pay parking for employees.
   - Organize a rideshare program for day visitors and employees that runs between Squamish, Pemberton and Whistler.

5. **Bicycle/pedestrian networks and end-of-trip facilities**
   - Expand and improve the existing trail system and bicycle routes.

- Provide end-of-trip facilities for bicycle commuters and adopt by-laws and standards for the provision of end-of-trip facilities in new developments.
- Create an on-street bicycle route on Highway 99.

6. **Parking supply / management**
   - Limit total area provided for skier parking.
   - Expand the use of paid parking to encourage the use of alternate modes.
   - Encourage employers to charge employees for the use of parking privileges and to provide incentives for use of alternate modes.
   - Investigate satellite parking opportunities with a shuttle service for day skiers and employees.

7. **Improve Whistler road system**
   - To divert local traffic from Highway 99 consider developing an internal street system.
   - Develop roadways in a way that supports improved transit.

8. **Improve the regional road system**
   - Discourage through traffic from using local streets by improving Highway 99 and by implementing traffic calming measures.
   - Consider a southbound transit / high occupancy vehicle lane.

9. **Other regional improvements including transit, rail and air connections**
   - Make regional transit services and rail more attractive by improving services.
   - Improve air connections to Whistler by upgrading the Pemberton airport.

10. **Improve traffic operations**
    - Consider structural changes, for example, one-way streets, roundabouts and yield lights to reduce congestion.
    - Implement an Intelligent Transportation System to better manage peak flows.

11. **Lift systems and mountain equipment**
    - Plan and implement new lift systems and mountain equipment to minimize travel distances.

12. **Fiscal impacts**
    - Ensure improvements are affordable.
    - Create funding partnerships.

TAG identified that the first step in implementing the Transportation Strategy would be to establish trigger points—thresholds that indicate when a condition reaches an unacceptable level. They can be used to identify when the implementation of activities in the Whistler Comprehensive Transportation Strategy are warranted.

A.1.4 Municipal House-In-Order Initiatives

A.1.4.1 Energy Audits

A range of energy efficiency initiatives have already been completed to reduce corporate energy use and greenhouse gas emissions. To date, RMOW has:

- Conducted an energy audit of the Meadow Park Sports Centre and the Public Works Yard with BC Hydro
- Implemented the electrical energy efficiency policy, which has resulted in improvements to underground parking, and passive heat tracing in malls
- With BCBC and BC Hydro, conducted audits of the wastewater treatment plant.

A.1.4.2 Retrofits and Alternative Energy Systems

As a result of the audit of the Public Works Building conducted by BC Hydro, the facility undertook lighting retrofits and installed motion detectors. The audit of the wastewater treatment plant (WTP) did not result in any recommendations because it was found that the energy use patterns of the facility were too complex for the auditing procedures implemented. BC Hydro recently conducted another audit of the WTP, focusing on the lighting and HVAC system. Results of this audit and recommendations were not available at the time of submitting this report. However, the WTP has already implemented efficiency measures, including the use of variable speed drives and a SCADA (Supervisory Control and Data Acquisition) data control system.[4]

The municipality is currently investigating opportunities to convert three facilities from gas-fired heating systems to geothermal systems. These buildings include the Public Works Building, the Spruce Grove Building and the new Spring Creek Firehall.[5]. The municipality also looked into the use of solar walls, particularly for the Public Works Building.

A.1.4.3 Fleet and Employee Transportation

By 2004, the RMOW plans to have one or two hybrid passenger vehicles in their fleet. They also plan to replace some of their larger vehicles with hybrid models when they become available on the market. Municipal staff are evaluating other energy and emission reduction opportunities including:

- Smaller engines in their fleet
- Low sulphur fuels
- Fuel additives that improve fuel economy and reduce emissions
- Exhaust scrubbers for large equipment and trucks

[4] Personal communication with Cliff Jennings, RMOW Wastewater Treatment Plant, 866-932-5535, May 24, 2001.

A.2 Community Wide Initiatives

A.2.1 Centra Gas Whistler Inc. (now Terasen)

Centra Gas' Integrated Resource Planning (IRP) process began in 1995, with a goal of evaluating means of meeting future demand. The plan was updated in September 1997, involving a consultative process to evaluate a series of proposed options with local and regional governments, business groups, environmental groups, community organizations and First Nations. Key objectives of the IRP were to incorporate environmental and social values into the evaluation of demand and supply resources, and to encourage community initiatives on energy efficiency.

The consultative group selected the "Modified Least Cost" portfolio as their preferred choice. This portfolio had four components:

- Natural gas pipeline from Squamish to Whistler
- Energy sustainability education for the community
- Residential home visits
- Commercial audit/visit

The capital cost of adding the pipeline was estimated to be almost $25 million and the annual cost would result in a savings of $100,000 per year. CO_2 emissions would be reduced by 294 tonnes each year due to the lower emission intensity of natural gas. Costs and savings associated with demand side management activities are summarized in Table 22.[6]

Table 1: Summary of Impacts of Demand-Side Management Initiatives

Initiative	Energy Savings (GJ/year)	$C0_2$ reductions (tonnes/year)	Cost ($/year)
Residential home visits	1,060	53	21,245
Commercial audits	2,000	100	22,365
Energy sustainability education	N/A	N/A	20,000
Total	***> 3,060***	***>153***	***63,610***

In summary, Centra Gas anticipated that this portfolio would result in a reduction of at least 447 tonnes of CO_2 emissions each year, not including the reductions that would be achieved through community education.

[6] *Whistler Integrated Resource Plan Update: Executive Summary*, Centra Gas Whistler Inc., December 1997, p.ES-4.

At the time of submitting this report, BC Gas was in the midst of finalizing an update to this report. The new report will contain new program recommendations and costing information.

A.2.2 Housing

The Whistler Housing Authority (WHA) was established as a non-profit subsidiary of RMOW in Octo-ber 1997 to oversee the development of employee housing in Whistler through the Employee Housing Fund. The WHA now manages 200 units, 57 of which are currently under construction.

A Housing Needs Assessment

In April 1997, City Spaces Consulting completed a Housing Needs Assessment for the RMOW Council that suggested at least 300 housing units per year for three years were needed to meet the shortage of resident housing.

Between 1997 and 1999, more than 500 units (or 1600 beds) have been added to Whistler's resident housing inventory. With more than 300 additional units planned in the next two years, the WHA is coming close to meeting the target established in the Needs Assessment. (Source: Overview 2000, Whistler Housing Authority, 2000.)

A key goal for the WHA is to have 80% of Whistler's workforce living within municipal boundaries, and to have 33% of these residents living in resident restricted homes. This goal will effectively reduce energy consumption associated with transportation. In working toward this goal, WHA is addressing strong market forces in Whistler that are causing current homeowners to sell or rent their homes at rates that are not affordable to most local residents, are renting to vacationers rather than locals, or are redeveloping older properties so that they can be rented or sold at higher rates.

WHA received a grant from the Commercial Building Incentive Program (CBIP) to construct a resident housing apartment building. The building was completed for occupancy December 2001. WHA received the grant as a result of the approach they have taken to heating and cooling the building. The heating system consists of 80 geothermal wells, drilled to depths of 200 feet. A closed piping loop runs down to each well and heating or cooling is transferred through a pump. Excess heat is used for heating water, and a natural gas water heater provides additional demand as a backup.

A requirement of the CBIP grant is that the building must exceed the Model National Energy Code for Buildings by at least 20%, and the building will likely exceed this requirement.[7]

A.2.3 Whistler Blackcomb

Whistler Blackcomb is currently stepping up their energy efficiency initiatives. As a first step, they are working with BC Hydro to conduct a baseline of their facilities. Based on the results of this evaluation, Honeywell will be contracted to develop performance solutions.

[7] Communication with Tim Wake, Whistler Housing Authority, May 15, 2001.

This is part of Whistler Blackcomb's overall environmental programs that were launched in 1993, using an Environmental Management System (EMS) framework.

A.2.4 Fairmont Chateau Whistler Resort

The Fairmont Chateau Whistler elected to adopt the Natural Step framework in 2000. Since adopting the Natural Step, the resort has been working to incorporate the Natural Step principles into their practices. In addition, the Fairmont Hotels is one of two BC Companies that are Power Smart Partners as of December 1, 2002.

The resort established a Sustainability Team to develop and coordinate programs and activities. Through the work of the team, the resort has already achieved a number of successes, including:

- Retrofitted all 24-7 lighting to T-8's or compact fluorescents (CFLs), saving roughly 800,000 kWh of electricity annually. For example, all rooms were retrofitted to CFLs at a cost of $130,000, 50% of which was paid for by BC Hydro, and total savings have already reached $42,000.
- Agreed to conduct a detailed energy audit in January, with expected yearly savings from resultant initiatives of up to $200,000.
- Committed to expand and modify their computerized EMS. This will include optimizing their air handling systems, including the installation of motion sensors that will allow the system to turn off when rooms are not in use. These initiatives will cost approximately $45,000.
- Changed meeting room controls to default to low-energy mode, and are considering using motion sensors in the future.
- Began studying the potential for retrofitting the hotel to a geo-exchange system, which would reduce propane demand by 80%.
- Agreed to development of a Strategic Energy Management Plan to move toward more sustainable energy sources.
- Began monitoring energy use from company travel.
- Held two contests to promote ideas for reducing energy and for actions towards energy reduction. 100 CFLs were distributed as prizes.
- During the 2000 season, reduced their domestic hot water heating by 3 degrees, and will continue to reduce temperatures until the point at which it is shown to impact customer comfort.

- Began to realize energy savings through procurement initiatives. Staff began to evaluate new equipment purchases for energy efficiency; for example, the hotel recently purchased 11 new high-efficiency ice machines.

In support of these initiatives and to provide the training required to implement them, the hotel established an awareness team. This group encourages staff to turn off equipment and lights when they are not in use.

APPENDIX B : AIR QUALITY GOALS, OBJECTIVES AND STANDARDS

B.1.1 Provincial Government Air Quality Objectives

The Provincial Ambient Air Quality Objectives define objective concentrations for common atmospheric pollutants such as SOx, NOx, and ozone.

Objective concentrations are generally referred to as Level A, Level B, or Level C. The Provincial Level A, B, and C Objectives generally correspond to the National Ambient Air Quality Objectives[8] of "maximum desirable", "maximum acceptable", and "maximum tolerable" concentrations, respectively.

- *Maximum desirable concentration* is intended to provide long-term protection.
- *Maximum acceptable concentration* is intended to provide adequate protection to soil, water, vegetation, animals, visibility, personal comfort and well-being.
- *Maximum tolerable concentration* indicates concentrations requiring prompt appropriate action to protect the general health of the population. For purposes of this report, Federal and Provincial Objective Levels are collectively referred to as "Ambient Air Quality Objectives".

B.1.2 Federal Government Air Quality Goals

Environment Canada has established the "Canada Wide Standards" (CWS) for the management of PM2.5[10] and Ozone. Within the CWS is a target for ambient concentrations of these pollutants. The CWS are:

- A 24-hour average concentration of 30 micrograms per cubic metre for PM2.5
- An 8-hour average concentration of 65 parts per billion (ppb) for ozone

It is recognized that in most parts of Canada, ambient levels are already lower than the CWS. Where ambient concentrations are lower than the CWS, there are provisions for "continuous improvement" and "keeping clean areas clean".

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[8] Health Canada. 2001. National Air Quality Objectives. http://www.hc-sc.gc.ca/hecs-sesc/air_quality/naaqo.htm
[9] Particulate matter less than 2.5 microns in size
[10] Particulate matter less than 2.5 microns in size.

Table 2: Air Quality Objectives and Standards[11] [micrograms per cubic metre]

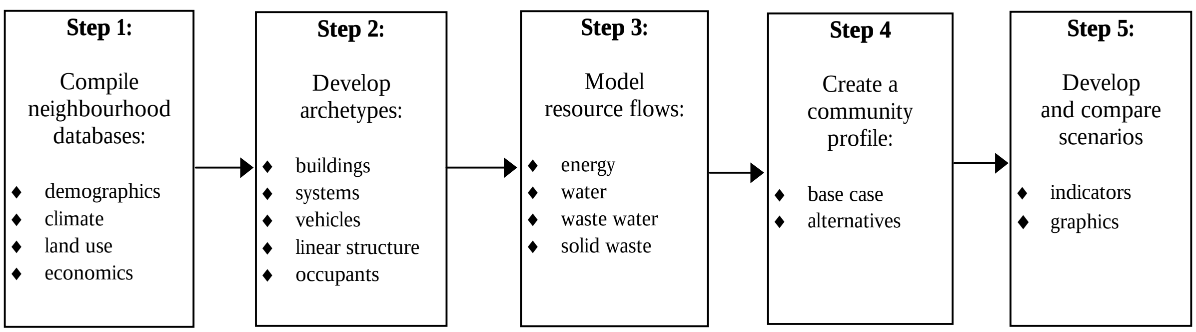
		Canada			BC		
Pollutant	**Averaging Period**	**Maximum Desirable**	**Maximum Acceptable**	**Maximum Tolerable**	**Level A**	**Level B**	**Level C**
CO	1 hr	15000	35000		14300	28000	35000
	8 hr	6000	15000	20000	5500	11000	14300
NOx	1 hr		400	1000			
	24 hr		200	300			
	Annual Arithmetic	60	100				
Ozone	1 hr	100	160	300			
	24 hr		30	50			
	Annual Arithmetic			30			
SOx	1 hr	450	900		450	900	900-1300
	3 hr				375	665	
	24 hr	150	300	800	160	260	360
	Annual Arithmetic	30	60		25	50	80
Total Suspended Part	24 hr		120	400	150	200	260
	Annual Arithmetic	60	70		60	70	75
PM10					25[12]	50	

[11] Ref http://wCEPwww.gov.bc.ca/air/airquality/airqual_1.pdf
[12] This is not a formal objective set by the ministry. This value also corresponds with the 'reference health level'.

APPENDIX C : APPENDIX C: SUMMARY OF METHODOLOGY AND ASSUMPTIONS

The Sheltair Group applies the following method in developing energy and emissions inventories.

Figure 1: The Integrated Resource Accounting Method



Step 1: Compile Community Databases

Data was assembled from the following sources:

- Terasen propane consumption data
- BC Hydro electricity consumption data
- British Columbia Assessment Authority data on buildings
- Whistler Transit vehicle kilometres travelled and fleet efficiencies
- Whistler's EMME/2 Peak Flow Transportation Model (extrapolated to annual estimates)
- Gasoline and diesel volume data from Husky and Petro Canada service stations
- RMOW fleet's fuel consumption
- Whistler Blackcomb's fleet fuel consumption
- Estimates of wood burned as fuel

- Emission factors were obtained from Environment Canada and from the Partners for Climate Protection software

Step 2: Develop Archetypes

- A set of statistically representative archetypes were developed to capture the diversity of energy characteristics for various building types.

Step 3: Model Energy Supply and Demand

- Energy flows for buildings and infrastructure were estimated using data from the electric and gas utilities. This data was then compared to model results calculated using BCAA floor area data and archetypes (energy use intensities and average floor areas) for each building type.
- The results from extrapolating the EMME/2 peak flow data to annual estimates were compared to gas sales at Whistler gas stations.
- Transportation energy has been determined using the EMME/2 transportation model and from municipal, Whistler Blackcomb, and transit fuel purchases. These results were then compared with service station records.

Step 4: Create a Community Profile

- Data from all sectors was aggregated to analyze current resource consumption and resulting impacts at the community scale.

Step 5: Develop and Run Scenarios

- Population and development growth rates were developed for five categories of individuals:
    - Residents
    - Second home population
    - Population visiting friends and relatives
    - Visitors in paid accommodation
    - Day visitors
- Scenarios were defined by selecting probable rates of change and by identifying those factors that are likely to remain constant and those that will vary over time.

[13] *Whistler Comprehensive Transportation Study*, (prepared by Reid Crowther), April 1997. p. 3-1.

C.1 Methodology for Estimating Energy Used for Transportation

To calculate community transportation energy, two methodologies were used. The first involved utilising Whistler's existing EMME/2 Travel Demand Forecasting Model to calculate peak travel demand. From this information, annual common air contaminants, greenhouse gas emissions and fuel consumption were calculated. The second methodology involved obtaining fuel sales from Whistler service stations.

To obtain corporate transportation energy, fuel consumption data for municipal fleet, Whistler/Blackcomb fleet, and WAVE vehicles was obtained from each of these entities. These organizations purchase the majority of their fuel independently, and only small amounts from local service stations.

C.1.1 Transportation Fuel Consumption Based on Whistler Transportation Modelling Results

The EMME/2 model does not account for trucks or other sources of mobile emissions, beyond those associated with direct passenger vehicle emissions. The Whistler EMME/2 Model consists of 86 internal traffic zones and five external traffic zones, and includes the following scenarios:

- Scenario 201 – 1997 Base;
- Scenario 311 – 2005 TAG[14] Preferred with TDM;
- Scenario 401 – 2011 Base without TDM;
- Scenario 411 – 2011 TAG Preferred with TDM; and,
- Scenario 431 – 2011 TAG Preferred with TDM & Hwy 99
- @ 2 Lanes Northbound.

Based on data from the EMME/2 model, 904,000 GJ of fuel were used for personal transportation in 2000, as shown in Table 3.

[14] TAG Preferred refers to the package of measures recommended by the Transportation Advisory Group.

Table 3: ***TSi's EMME/2 Model Data***

	Fuel Consumption	
Year	**Litres[15]**	**GJ**
1997	21,402,000	827,000
2000[16]	26,100,000	904,000

The BC Ministry of Transportation is conducting studies to evaluate transportation improvements along the Sea-to-Sky Corridor. Transportation in Whistler will be impacted by the decisions that are made through this process. It is important to note that the Sea-to-Sky Corridor Travel Demand Study (January 2002) did not include an evaluation of Transportation Demand Measures. Rather, it evaluated the impact of four potential actions, categorized as:

- Highway emphasis (including highway safety improvements and 4-laning)
- Medium Rail (including increased rail service between Lonsdale and Whistler)
- Maximum Rail (including increased rail service between Lonsdale and Whistler and reduced travel time of 25 minutes)
- Passenger Ferry/Bus (a new passenger only service between central waterfront to Squamish, with a bus connection to Whistler)

The Sea-to-Sky Corridor Travel Demand Study concluded that[17]:

- The multi-modal options evaluated did not appear to divert significant demand from Highway 99 northbound
- Enhanced bus services may divert some of the northbound traffic from Highway 99
- The passenger only ferry may offer potential as an independent service
- The medium and maximum rail options presented are not viable alternatives to satisfy transportation demand along the Highway 99 corridor

The only TDM measures that have been evaluated in the Sea-to-Sky studies have been the implementation of a toll system[18]. Due to the importance of TDM in developing regional transportation policy and its direct impact on the RMOW, further analysis of TDM options is recommended.

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[15] Assuming all fuel purchases are gasoline, with an energy content of 0.03466 GJ/L.
[16] Forecast assuming 3% growth.
[17] *Sea-to-Sky Corridor Travel Demand Study Final Report*, prepared by Tsi Consultants and McIntyre& Mustel, January 2002, p. 66.
[18] *Sea-to-Sky Corridor Modal DiversionStudy Final Report*, prepared by Tsi Consultants and McIntyre& Mustel, June 2002. Available at: www.th.gov.bc.ca/Sea-to-Sky_Reports/Modal_Diversion_June_draft.pdf

C.1.2 Service Station Data

To provide a cross-check of estimates derived from the transportation model, fuel sales from local service stations were obtained. As shown in Table 4, these service stations sold a total of 383,358 GJ of fuel in 2000.

Total sales at the service station are significantly lower than the volume estimates generated with the EMME/2 Model. This is likely attributable to visitors filling up their vehicle prior to entering Whistler and because local residents often travel to Pemberton or Squamish where fuel is cheaper. Further analysis is required to reconcile fuel sales data with transportation model outputs.

Table 4: Volume Sales of Fuel from Whistler Service Stations in 2000

	Volume (L)	GJ	Estimated Value ($)
Gasoline	10,300,000	356,000	7,725,000
Diesel	500,000	19,000	210,000
Propane	300,000	7,700	105,000
TOTAL		***383,000***	***$8,040,000***

C.1.3 Local Transit

There are currently 24 diesel buses being used by the Whistler and Valley Express (WAVE) local transit system. These vehicles have an average efficiency of 0.513 L/km and BC Transit statistics show that these buses traveled a total of 1,271,950 km in 2000[19]. Based on the average efficiency of the fleet, a total of 652,510 litres of diesel was consumed in that year.

C.1.4 Municipal Fleet

The municipal fleet purchased 159,114 L (6,155 GJ) of diesel and 163,812 L (5,678 GJ) of gasoline in 2000.

C.1.5 Whistler/Blackcomb

Whistler/Blackcomb and its contractors operate a number of vehicles and equipment, for which the organization has an independent fuel supplier. These include vans, cars, ATVs, snow cats, park cats, and snowmaking and maintenance equipment. In 2000, Whistler Blackcomb and its contractors used 608,255 L (21,082 GJ) of unleaded gasoline and 1,171,183 L (45,301 GJ) of diesel.

[19] Personal Communication with Don Boyd, BC Transit (250-995-5629), May 15, 2001.

The total estimated expenditures for all transportation related fuel purchases are summarized in Table 5. Expenditures have been estimated using the data generated in the EMME/2 Model and the total purchases for the municipal fleet, Whistler-Blackcomb fleet, and WAVE. As previously mentioned, for the purposes of this analysis it has been assumed that the majority of fuel purchases for personal vehicle transportation are gasoline. A uniform rate of $0.42/L and $0.75/L have been assumed for diesel and gasoline respectively.

Table 5: Transportation Energy and Expenditures in 2000

	Gasoline	Diesel	
Personal vehicles (L)	26,482,000		
Municipal fleet (L)	163,000	159,000	
Transit (L)		652,000	
Whistler/Blackcomb fleet and equipment (L)	608,000	1,171,000	
Total (L)	**27,254,000**	**1,982,000**	
Total (GJ)	**944,000**	**76,000**	
Estimated Expenditure ($)	***$20,440,000***	***$832,000***	***$21,273,000***

C.1.6 Rail and Coaches

Passenger rail and freight rail are both forms of inter-community transportation, which the PCP program does not require municipalities to include in inventories. As previously mentioned, however, Whistler could take a leadership role by considering both of these sources of emissions. As a starting point, passenger rail estimates were calculated within the inter-community transportation analysis.

C.1.7 Methodology for Estimating Inter-Community Transportation

A high level evaluation of Inter-Community Transportation was also conducted for this study. This information is presented so that RMOW may consider opportunities to address this issue in the future.

Table 6: Estimation of Visitors' Mode of Transport to Whistler

		Number of Visitors by Mode		
Origin	**Total Visitors**	**Single Occupancy Vehicle**[20]	**Bus, Train, Other**[21]	**Aeroplane**
BC	748,000	449,240	299,494	0[22]
Other Provinces	272,000	163,000	108,000	272,000
WA & OR	234,000	140,000	93,000	117,000
Other US States	489,000	293,000	195,000	489,000
International	355,000	212,000	141,000	354,000

[20] Includes 60% of total visitors traveling by airplane (to account for transport from airport to Whistler). Modal split is assumed to be 60/40: SOV/other. This will be an overestimate as some of these visitors will have traveled from Vancouver by small plane or helicopter, but sufficient data for this form of travel was not available. Further data collection is warranted in future studies.

[21] Includes 40% of total visitors traveling by airplane (to account for transport from airport to Whistler). Modal split is assumed to be 60/40: SOV/other. This will be an overestimate as some of these visitors will have traveled from Vancouver by small plane or helicopter, but sufficient data for this form of travel was not available. Further data collection is warranted in future studies.

[22] Data identifying the percentage of BC visitors traveling to Whistler by plane, compared to rail, bus, or automobile was not available. Further data collection is warranted in future studies.

Table 7: Order of Magnitude Analysis of Inter-Community Transportation

							Energy Consumption (GJ)				GHG (tCO2e)			
Forecast	# Visitors (1.5% growth)	Visitors from BC	Other provinces	WA & OR	Other states	International	Auto	Train	Plane	TOTAL GJ	Auto	Train	Plane	TOTAL GHG
2000	2,100,000	748,734	272,265	254,444	485,615	354,942	550,747	236,492	22,900,910	23,688,149	37,450	16,670	1,663,042	1,717,168
2001	2,131,500	759,965	276,349	257,961	492,939	360,266	559,008	240,039	23,230,313	24,049,561	38,012	16,920	1,687,987	1,742,920
2002	2,163,473	771,364	280,494	261,528	504,434	365,670	567,393	243,640	23,599,271	24,410,304	38,582	17,177	1,713,287	1,769,046
2003	2,195,925	782,935	284,702	265,153	511,980	371,155	575,904	247,294	23,953,260	24,776,458	39,161	17,434	1,739,887	1,795,602
2004	2,228,863	794,679	288,972	268,858	519,660	376,723	584,543	251,004	24,312,559	25,148,105	39,749	17,696	1,765,852	1,822,536
2005	2,262,296	806,599	293,307	272,563	527,414	382,374	593,311	254,769	24,677,247	25,525,327	40,345	17,962	1,791,569	1,849,876
2006	2,296,231	818,698	297,706	276,351	535,366	388,109	602,210	258,590	25,047,406	25,908,207	40,950	18,231	1,818,442	1,877,623
2007	2,330,674	830,979	302,172	280,196	543,397	393,931	611,244	262,469	25,423,117	26,296,830	41,565	18,504	1,845,720	1,905,787
2008	2,365,634	843,443	306,705	284,099	551,548	399,840	620,412	266,406	25,804,464	26,691,282	42,188	18,782	1,873,404	1,934,374
2009	2,401,119	856,095	311,305	288,061	559,821	405,837	629,718	270,402	26,191,531	27,091,652	42,821	19,063	1,901,505	1,963,389
2010	2,437,136	868,936	315,975	272,083	568,219	411,925	639,164	274,458	26,584,404	27,498,026	43,463	19,349	1,930,028	1,992,840
2011	2,473,693	881,970	320,714	276,163	576,741	418,104	648,752	278,575	26,983,170	27,910,497	44,115	19,640	1,958,978	2,022,733
2012	2,510,798	895,200	325,525	280,306	585,393	424,375	658,483	282,754	27,387,917	28,329,154	44,777	19,934	1,988,363	2,053,074
2013	2,548,460	908,628	330,408	284,518	594,173	430,741	668,360	286,995	27,798,736	28,754,092	45,449	20,233	2,018,188	2,083,870
2014	2,586,687	922,257	335,364	288,778	603,086	437,202	678,386	291,300	28,215,717	29,185,403	46,130	20,537	2,048,461	2,115,128
2015	2,625,487	936,091	340,394	293,109	612,132	443,760	688,561	295,670	28,638,953	29,623,184	46,822	20,845	2,079,188	2,146,855
2016	2,664,870	950,133	345,500	297,506	621,314	450,416	698,890	300,105	29,068,537	30,067,532	47,525	21,157	2,110,376	2,179,058
2017	2,704,843	964,385	350,683	301,969	630,634	457,173	709,373	304,606	29,504,565	30,518,545	48,237	21,475	2,142,031	2,211,744
2018	2,745,416	978,850	355,943	306,498	640,094	464,030	720,014	309,175	29,947,134	30,976,323	48,961	21,797	2,174,162	2,244,920
2019	2,786,597	993,533	361,282	311,096	649,695	470,991	730,814	313,813	30,396,341	31,440,968	49,695	22,124	2,206,774	2,278,594
2020	2,828,396	1,008,436	366,701	315,762	659,440	478,055	741,776	318,520	30,852,286	31,912,583	50,441	22,456	2,239,876	2,312,773

C.2 Detailed Summary of Solid Waste Data 2000

Table 8: Solid Waste Generation & Diversion in Whistler, 2000

LANDFILLED	Cu Meter	Conversion	TONNES
Construction	**44,556.2**	*0.125*	**5,569.5**
Garbage	**30,613.2**	0.41	**12,551.4**
Nesters Compactor	**5,347.9**	0.41	**2,192.6**
Function Compactor	**3,018.4**	0.41	**1,237.5**
Total Landfilled	***83,535.6***		***21,551.1***
COMPACTOR SITES			
Aluminum	**117.3**	0.037	**4.3**
Glass	**375.4**	0.267	**100.2**
Mixed Paper	**870.8**	0.226	**196.8**
Corrugated Cardboard	**2,345.0**	0.053	**124.3**
Office Paper	**8.0**	0.226	**1.8**
Newspaper	**508.5**	0.257	**130.7**
PET/HPDE	**1,356.6**	0.017	**23.1**
Tin	**237.5**	0.089	**21.1**
Total Compactor Sites	***5,819.1***		***602.3***
COMMERCIAL SITES			
Aluminum	**34.0**	0.037	**1.3**
Glass	**82.5**	0.267	**22.0**
Corrugated Cardboard	**25,875.3**	0.053	**1,371.4**
Office Paper	**256.6**	0.226	**58.0**
Mixed Paper	**14.0**	0.226	**3.2**
Newspaper	**53.5**	0.257	**13.7**
Tin	**110.0**	0.089	**9.8**
Tote-Containers	**1,690.2**	*0.075*	**126.8**
Tote-Glass	**593.4**	0.267	**158.4**
Totes-Paper	**2,764.6**	0.226	**624.8**
Total Commercial Sites	***31,474.1***		***2,389.4***

[23] Manual on Generally Accepted Principles for Calculating Municipal Solid Waste Flows: Development of a Methodology for Measurement of Residential Waste Diversion in Canada, Corporations Supporting Recycling (CSR), Dec.2000, Appendix B, p.B-2.

RECYCLE CENTRE			
Aluminum	**1.0**	0.037	**0.0**
Appliances	**1,041.0**	0.292	**304.0**
Drywall	**3,118.6**	*0.125*	**389.8**
Glass	**22.3**	0.267	**5.9**
Mixed	**42.0**	0.226	**9.5**
Corrugated Cardboard	**1,158.0**	0.053	**61.4**
Office Paper	**85.5**	0.226	**19.3**
Newspaper	**46.5**	0.257	**12.0**
PET/HPDE	**137.0**	0.017	**2.3**
Land Clearing	**2,121.3**	*0.125*	**265.2**
Steel	**419.2**	6	**2,515.3**
Tin	**102.5**	0.089	**9.1**
Tires	**151.9**	1.13	**171.7**
Batteries	**26.5**	*0.020*	**0.5**
Paint	**23.0**	1.47	**33.8**
Total Recycle Centre	***8,446.7***		***3,799.8***
TOTAL RECYCLED	***45,739.9***		***6,791.6***

Summary:

Total Generation (Tonnes):	28,343
Per Capita Generation (Tonnes):	1.16
Per Capita Landfilled:	0.88
Per Capita Recycled:	0.28
% Recycled By Weight:	24%

C.2.1 Landfill Gas Generation Potential

Consultants Sperling Hansen Associates analyzed the landfill gas (LFG) production potential of the Whistler landfill in spring 2001. The study found that in 2008 (year of projected closure), the maximum gas generation rate will be an estimated 720m^3/hour.

Assuming a 50% efficiency, Sperling Hansen estimated that a gas supply of 250m^3/hour could be maintained through 2001 to 2012, with a peak of 360m^3/hour. This is the equivalent of 40,000 GJ of heat per year. At 2000 rates of about $15/GJ, this quantity of energy is worth about $600,000.

Capital costs for the collection and utilization system were estimated at $950,000, with an annual operating cost of $50,000 (see Table 9). Based on these results, the consultants recommended not to proceed with beneficial use of LFG.

Table 9: Capital Costs for a Collection and Utilization System[24]

Item	Cost
LFG Collection and Pumping System	$650,000
LFG Combustion Flare	$150,000
Piping to the WWTP and Recycling Plant	$125,000
Revisions to the Boilers	$25,000
Total	**$950,000**

C.3 Assumptions Used to Develop the Business as Usual (BAU) Scenario

The following assumptions were made in the BAU Scenario:

- Growth rates prior to build-out, which is anticipated to occur in 2004, are based on BC Statistics data and on Tourism Whistler data.
- Following build-out, growth rates for resident population were assumed to be 1%, based on in-fill assumptions and conversion from second-home to permanent resident. Numbers of paid-accommodation visitors were assumed to remain static following build-out, and day visitors are assumed to grow at a conservative rate of 3%.
- Second-home visitors were estimated to decline by about 1% annually due to in-fill; visitors staying with friends were estimated to increase by 0.8% annually; and it was assumed that there would be no growth in paid visitors following build-out. Combined, visitor population therefore is anticipated to increase by an average of about 1% per year.
- The number of residential and commercial buildings will increase at a rate of 1.9% per year until 2004, when the bed-unit cap will be met. The redevelopment rate is assumed to be 3%, and new residential buildings are assumed to be approximately 10% more efficient. Improvements in the commercial sector are less dramatic (on average about 1%).

[24] Memo from Sperling Hanson Associates, March 19, 2001, Re: Landfill Gas Utilization from the Whistler Landfill.

- Research conducted for the Whistler Comprehensive Transportation Study estimates that skier visits will grow anywhere from 1.5% (low), to 3.05% (medium), or even to 3.5% (high) per year until 2011. These estimates are based on a linear regression of historical skier visits with respect to time.[25] The BAU analysis has assumed the medium growth rate, rounded to 3% for passenger vehicle transportation, but a more conservative estimate of 1.5% for increases in public transit and Whistler Blackcomb fleet.

- The level of industry will remain constant and that municipal infrastructure (including municipal fleet) will remain constant (no growth).

- Efficiency factors for various fuel types are assumed to be 94% for hydroelectric, 36% for Burrard Thermal, 30% for piped propane and 25% for diesel and gasoline.

- The current blend of electricity vs. gas is maintained.

- Current emission factors remain constant.

C.4 Assumptions used to Develop the Inter-Community Model

The following assumptions were made in developing the inter-community model:

- Summary of Visitor Origins data compiled by Tourism Whistler (Business Performance Statistics, Tourism Whistler, December 2000, p. 6) were applied, combined with the 60:40 modal shift (auto: non-auto) reported in the Transportation Trigger Points Study.
- Average distances traveled were assumed to be 120 km from Vancouver (including those traveling from the airport), 150 km for the average BC visitor, 300 km for visitors from Washington and Oregon, 3000 km for visitors from other provinces and other U.S. states, and 7500 km for international visitors.

C.5 Assumptions used to Develop the Recommended Scenario

The following assumptions were made in developing the Recommended Scenario:

- Initiatives will result in energy and emission reductions beginning in 2003.
- The fuel switch from propane to natural gas will occur in 2003.
- The RMOW fleet will be 30% more efficient in 2010 than in 2000 as a result of conversion to hybrid vehicles; use of lower-emission and higher-performing fuels; and an unchanged total number

[25] *Whistler Comprehensive Transportation Study*, (prepared by Reid Crowther), April 1997. p. 3-1.

of vehicles in the fleet. Therefore, an efficiency increase of 4% per year has been assumed beyond 2002. A 1% increase in efficiency for the diesel fleet is assumed beyond 2002.

- It is assumed that the diversion rate for solid waste will be 40% by 2010.
- The conversion of BC Hydro (large hydroelectric) to local, small-scale renewables will occur at a rate of 10% by 2005; 20% by 2010; and 50% by 2020.
- Achieving a 25% improvement upon the Comprehensive Transportation Strategy (The CTS would achieve an annual transportation growth rate of 1.5%, instead of 3%.).
- A 25% improvement over the BAU scenario in energy efficiency for residential and commercial buildings (through retrofits, green building design guidelines, etc.).