COMMUNITY ENERGY PLANNING IN REVELSTOKE

A Preliminary Submission To:

The City of Revelstoke

Submitted By:
Natural Resources Canada
Sheltair Scientific

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Disclaimer

This is a preliminary report. Some of the data and conclusions have not yet been thoroughly reviewed and may be subject to revision.

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1. Introduction to Revelstoke's Community Energy Plan

1.1 Background

In April, 1997, Sheltair Scientific was retained by CANMET, Natural Resources Canada to develop a Community Energy Plan for the City of Revelstoke.

Revelstoke was selected as a case study for Community Energy Planning because it is an environmentally progressive community and because Central Revelstoke has favorable site characteristics for the establishment of a district energy system.

The City has a vision statement in which it states that it will be a leader in achieving a sustainable community. In their Official Community Plan, they have also included many environmental statements.

There are several energy-related issues that are currently facing the community:

Substantial increases in propane prices over the last few years. In 1990, B.C. Gas introduced propane into the community, and offered financing incentives for energy users in the community to switch to propane. Many customers switched from oil, electricity, or wood due to lower prices for propane on an energy equivalent basis. However, B.C. Gas increased the prices by about 42% between 1991 and 1997 for a typical residential customer. Many members of the community feel betrayed because of these events. The stability of energy prices is now of high priority to the community.

The need for local sawmills to comply with more stringent air pollution standards for wood waste burners. Downie Street Sawmills, the largest sawmill in the area, is one of several local sawmills which is being mandated by the BC Ministry of Environment, Lands, and Parks that it must meet compliance with particulate emission standards by the fall of 1997. In order to do so, it must replace its wood waste burner with an expensive, cleaner burning system or find an alternative solution.

Local air quality. Local air quality is a concern in Revelstoke. Particulate concentration levels are monitored at the Fire Hall once every week for a 24 hr period. Between 1993 to 1996, the number of weeks of fair air quality varied between 7 and 17 and the number of weeks with poor air quality varied between 0 and 2. In addition to the sawmills, wood stoves in homes are a significant source of particulate emissions. The use of wood for residential heating decreased after the introduction of propane into the community, but has since risen due to increases in propane prices.

The need for the community to treat its water supply. The City's primary source of drinking water has recently had water quality problems. The short-term solution has been to treat the water with

chlorine. The City is investigating various alternative water treatment options, one of which is thermal treatment.

The need for the community to find a solution to the disposal of its snow collection. The BC Ministry of Environment, Lands, and Parks has prohibited the dumping of snow collected from streets directly into the Illecillewaet River, which was its conventional practice.

1.2 Community Energy Planning

Many communities in Canada have developed explicit goals of achieving greater sustainability. Communities are realizing that it is becoming increasingly difficult to live within constraints imposed by physical resource scarcities, ecological limits and reduced budgets. But most communities do not know what they can do to help meet their goals for the future.

A Community Energy Plan can help address important issues in the community in an integrated and holistic manner and support other important community goals. It can also help the community save money, support economic development, and reduce its impact on the environment (see Box 1-1).

The primary purpose of the Community Energy Plan is:

- To identify where and how much energy is currently used in the community.
- To identify the environmental impacts of energy consumption in the community.
- To develop indicators and benchmarks which can be used to measure progress towards community goals.
- To estimate the potential energy and environmental impact reductions that can be achieved under various energy efficiency, energy source, and land development scenarios.
- To identify the benefits to the community of implementing an integrated community energy plan.

Box 1-1: Benefits of Community Energy Planning

Community Energy Planning can contribute to:

- ***saving money on energy expenditures*** by households, businesses, the municipality, and other large energy users in the community;
- ***saving money on infrastructure capital costs*** by the municipality and taxpayers, including the provision of new infrastructure and expansion of existing infrastructure facilities;
- ***creating local jobs*** through direct and spin-off industries of new energy-related businesses, such as energy and water retrofit businesses and new energy supply businesses;
- ***reducing local air pollution***;
- ***reducing greenhouse gas emissions*** which contribute to global warming.
- ***greater community control*** over energy supply and costs.
- ***creating a model sustainable community***

- To identify implementation considerations to assist the City and other stakeholders in implementing the plan.

The energy plan is conducted at the scale of the community because most decisions affecting the community and its energy use are made at this level.

Examples of some of the potential opportunities that the energy plan can capitalize on in Revelstoke include:

- Inefficient buildings offer the opportunity for energy retrofits.
- New buildings offer the opportunity to incorporate higher energy standards for construction.
- New developments, such as the proposed Mt. Mackenzie ski hill, offer the opportunity to incorporate energy-efficient design principles into the site planning and design of the development and the buildings.
- A compact, moderate density and mixed use downtown offer the opportunity for utilizing energy-efficient district energy systems.

Two local engineers, Ian Rowe and Ward Kemerer are currently proposing a district energy system for Revelstoke, with technical assistance from NRCan for district energy expertise and Sheltair Scientific for modeling the energy use of the buildings. A district energy system supplies the heating (and sometimes cooling) needs of a "district" of buildings using hot water (or alternatively steam) produced efficiently from a central plant and connected to the buildings using a network of underground pipes. The district energy system would use an efficient boiler with low particulate emissions for burning the wood waste from the Downie Street Sawmills. The district energy system also opens up alternatives for treating the community water supply since thermal treatment could potentially be conducted. The City's snow disposal could also potentially be melted using heat from the district energy system.

The community of Revelstoke and the City have implemented innovative projects related to sustainability in the past and is interested in becoming a leader in developing a sustainable community. The development and implementation of a Community Energy Plan would significantly contribute to Revelstoke becoming a model sustainable community.

1.3 Stakeholders

All members of the community have a stake in the Community Energy Plan. Some of the key stakeholders who have a leading role to play or who are large energy users include the following:

- Households, businesses, and citizens of Revelstoke
- City of Revelstoke (Mayor, Councilors, Advisory Planning Committee, Economic Development Commission, Public Works Dept., Planning Dept., Parks and

Recreation Department, Building Inspector, and Finance Department)
- School District #19 (Revelstoke)
- Downie Street Sawmills
- Ian Rowe and Ward Kemerer (district energy proponents)
- Businesses located in Central Revelstoke (which would be located on the proposed district energy distribution system)
- Revelstoke Chamber of Commerce
- Community Futures Development Corporation of Revelstoke
- Columbia Basin Trust
- Columbia Power Corporation
- Columbia-Shuswap Regional District
- B.C. Hydro
- B.C. Gas
- B.C. Transit
- B.C. Ministry of Environment, Lands, and Parks
- Natural Resources Canada

1.4 Mandates of Special Organizations

There are two organizations that are unique in the stakeholder list above, the Columbia Basin Trust and the Columbia Power Corporation, whose mandates are described below.

Columbia Basin Trust

The Columbia Basin Trust's mission statement is to support the efforts of people in the Columbia Basin, of which Revelstoke is included, to "create a legacy of social, economic, and environmental well-being and to achieve greater self-sufficiency for present and future generations." Its core functions are to invest and manage its capital assets of approximately $295 million, which are to be transferred to it from the Province, and to spend the investment income to benefit the region. An additional $250 million over the same ten year time period is to be transferred to the Columbia Power Corporation for power project investments made jointly with the Trust. The Spending Program is to provide good value for money spent by providing ongoing benefits to the Basin and its residents in the areas of social well-being; preservation, protection and enhancement of the environment; and economic development.

Columbia Power Corporation

The Columbia Power Corporation's mandate is to enter into joint ventures with the Columbia Basin Trust for the purpose of investing in power projects in the Basin.

1.5 Relationship of Community Energy Plan to Senior Government Initiatives

The Governments of British Columbia and Canada have both set targets to stabilize net greenhouse gas emissions at 1990 levels by the year 2000. Canada made this commitment in 1992 when it signed the United Nations

Framework Convention on Climate Change at the UN Conference on Environment and Development. In Canada's National Action Program on Climate Change (1995), strategic directions are set for meeting the target as well as actions beyond the year 2000. The BC Ministry of Environment, Lands, and Parks has also developed a set of actions called the British Columbia Greenhouse Gas Action Plan (1995), that includes more than 50 actions the Province has identified to undertake.

All communities in Canada and B.C. have a significant role to play in reducing greenhouse gas emissions. The Community Energy Plan for Revelstoke advances, at the local level, commitments made in the B.C. and Canada Action Plans. The Community Energy Plan is an integrated approach at the community level for reducing energy use and greenhouse gas emissions, including using energy more efficiently, switching to fuels that release fewer greenhouse gas emissions, and encouraging more energy-efficient land use and development patterns.

1.6 Relationship of Community Energy Plan to the OCP and Columbia Basin Management Plan

The official policy document for guiding the future growth and development of the community of Revelstoke is the Official Community Plan (OCP). It was last updated and adopted by City Council in 1995 (City of Revelstoke 1995). The main regional plan that relates to the energy sector is the Columbia Basin Management Plan (Columbia Basin Trust 1997).

The consultants used the OCP and the Columbia Basin Management Plan vision statements to develop an energy goal and several energy objectives for the community. (see Section 2). The energy goal, selected energy objectives, and suggested policies developed in the Energy Plan (if they receive endorsement by City Council) are intended to be incorporated into the next update of the OCP. It is important to incorporate elements of the Community Energy Plan directly back into the OCP so that sub-area plans, sector plans, zoning bylaws, subdivision bylaws, and other bylaws developed or updated by the municipality in the future will be consistent with the OCP.

Fig. 1-1: Relationship of Community Energy Plan to Columbia Basin Management Plan, OCP, Bylaws, Sub-area and Sector Plans

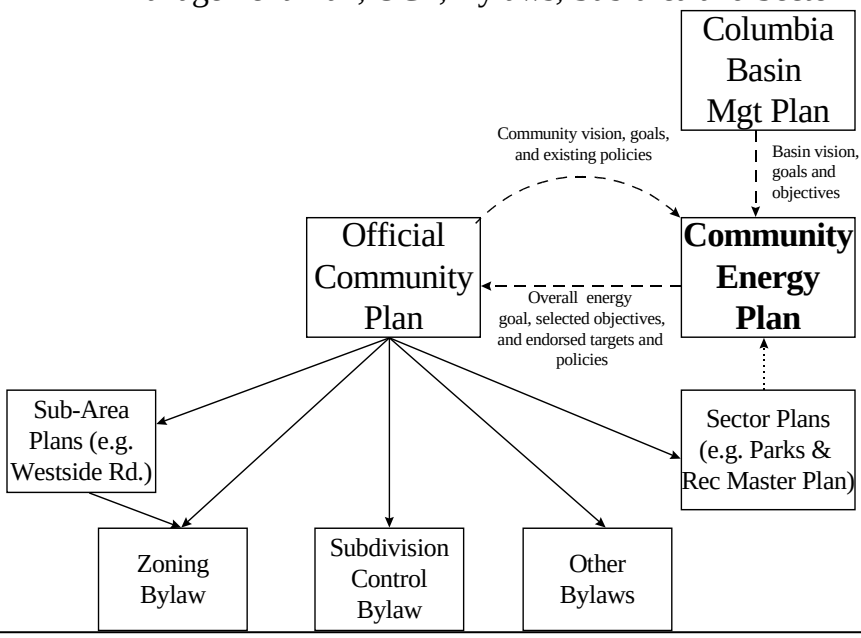


Figure 1.1 shows the relationship of the Community Energy Plan to other community plans.

In combination, the above plans and bylaws have an enormous influence on energy consumption in the community as it grows and develops. By incorporating energy considerations into the OCP, future development can be intentionally influenced in an energy-efficient direction. The Community Energy Plan serves as a more detailed reference document that includes specific energy objectives and targets, technical information, and implementation considerations.

The only other existing energy-related initiative at this time is a water use study to reduce water consumption in the community. This study is being conducted by Dayton & Knight Consulting Engineers. At the time of writing, their study is under progress and is not yet available. Initiatives to reduce water consumption also support reduced energy consumption. In addition, any water retrofit initiatives can easily be combined with energy retrofits to simultaneous delivery both these services in a cost-effective manner.

1.7 Forecasting Energy and Resource Use with TIRA

To develop an energy profile for Revelstoke and to model various scenarios for reducing energy use and carbon dioxide emissions, Sheltair's Tool-Kit for Integrated Resource Accounting (TIRA) was used. TIRA is a

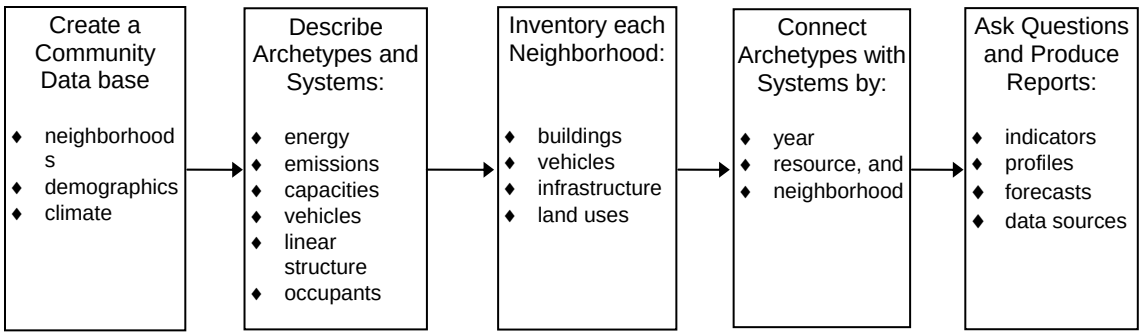


Figure 1-2: TIRA's 5 step process

desktop computer application that uses an archetyping approach that facilitates aggregating data at the community level. The archetypes are a set of statistically representative data based on key features of buildings, vehicles, industry and infrastructure.

TIRA is coupled with a Geographic Information System (GIS) which is used to generate the spatial distribution of data, to perform spatial analysis, and displaying output from the TIRA model.

TIRA is based on a 5 step process shown in Figure 1-2.

Step 1: Compile Community Databases

- Data were assembled from external sources including:
  - Environment Canada for climate
  - Statistics Canada and BC Stats for population
  - BC Assessment Authority for building stock

Step 2: Develop Archetypes

- A set of statistically representative archetypes were developed to capture the diversity of construction practice, equipment installation, occupancy rates and occupant behavior across the entire building stock.
-

Step 3: Model Resource Flows

- The estimate of residential energy consumption in Revelstoke was based on data recently collected through home energy audits under the BC21 Program. These audits provided detailed information about a building's structure and energy use. This information was then used to run a energy simulation model called AUDIT2000, developed by Natural Resources Canada (NRCan).
- The commercial building stock was identified through BCAA data and categorized into 36 commercial energy archetypes. The energy use was modeled using DOE 2.1E simulations of the archetypes.
- Industrial energy use was obtained directly from the utilities serving the industries.
- The energy consumed for transportation was divided into two categories: commuter transportation and commercial/institutional transportation. Our estimates of energy used for travel are based on Statistics Canada information and

results from a recent travel survey performed in the United States.

The estimates of energy flows were calibrated wherever possible against data from the electric and gas utilities. For example, estimates of total energy use were compared to sales of electricity and gas from BC Hydro and BC Gas. The discrepancy between calculated energy use and utility sales records was in the order of 6%.

Step 4: Create a Community Profile

- The information across all archetypes was aggregated to simulate current resource consumption and impacts in the community

Step 5: Develop and Run Scenarios

- Population growth rates were projected based on local estimates of growth.
- Rates of change concerning the "die-off" of old technologies and adoption rates for new technologies, and composition of the built stock were estimated using the most up-to-date information on trends.
- Scenarios were defined by selecting probable rates of change and identifying which factors remained constant and which varied over time.

1.8 Organization of Report

Section 2.0 of the report describes the Revelstoke community vision and goals and presents the energy objectives developed. For each energy objective, quantitative indicators, and targets were established which are used to objectively evaluate the community energy plan scenarios.

Section 3.0 presents a portrait of the community's location, climate, existing population, and building stock.

Section 4.0 is a profile of the community's energy use for the baseline year, 1996. This section also includes estimates of carbon dioxide emissions generated by the community.

In Section 5.0, various alternative scenarios are described, and the energy use and carbon dioxide implications of each scenario is estimated. The scenarios include:

- developing a district energy system,
- retrofitting older single family homes,
- improving the energy efficiency of institutional buildings, and
- adopting more energy-efficient standards for new buildings.

All of these scenarios are then combined together with the resulting benefits presented.

Section 6.0 presents suggested policies and actions that the City can adopt or undertake to take advantage of the many benefits described in the Revelstoke Community Energy Plan. Additional opportunities, other than the scenarios described in the previous section, are included.

2. Energy Objectives

In developing a Community Energy Plan, it is first necessary to formulate energy goals and objectives which can be used to fulfill the intent of the vision and goals of the community. The benefits of the community energy plan can then be compared to the energy goals and objectives.

Both the City of Revelstoke and the Columbia Basin Trust have developed vision statements that were used to develop the energy goals and objectives.

2.1 Revelstoke Vision Statement and Community Goals

The vision statement for a community is a general expression of a community's aspirations and priorities for its future. The Revelstoke Community Vision Committee, a citizen-based group, formulated a Community Vision Statement for Revelstoke in 1993 which was ratified by City Council in 1994 and is restated below:

Revelstoke Vision Statement

"Revelstoke will be a leader in achieving a sustainable community by balancing environmental, social and economic values within a local, regional and global context.

Building on its rich heritage and natural beauty, this historic mountain community will pursue quality and excellence. Revelstoke will be seen as vibrant, healthy, clean, hospitable, resilient and forward-thinking. It will be committed to exercising its rights with respect to decisions affecting the North Columbia Mountain Region.
Community priorities include:

- *opportunities for youth;*
- *economic growth and stability;*
- *environmental citizenship;*
- *personal safety and security;*
- *a responsible and caring social support system;*
- *a first-class education system;*
- *local access to life-long learning,*
- *spiritual and cultural values;*
- *and diverse forms of recreation.*

All residents and visitors shall have access to the opportunities afforded by this community."

Since the goals of the community are not explicitly defined in the Official Community Plan (OCP), the introductory sentence of the vision statement was interpreted as the overall community goal as stated below:

Overall Community Goal for Revelstoke

"To be a leader in achieving a sustainable community by balancing environmental, social and economic values within a local, regional and global context."

The priorities listed in the vision statement were interpreted as subgoals of the community. Out of the nine community priorities listed, the following two are relevant to developing a general community energy goal and specific energy objectives:

- [To promote] economic growth and stability; and
- [To foster] environmental citizenship

A community energy plan can contribute to the above goals by helping create jobs, improving the resiliency of the economy, reducing the impact of human activities on the environment, and fostering environmental awareness and responsibility.

2.2 Columbia River Basin Vision

The Columbia Basin Trust was established in 1995 to compensate the region most adversely affected by the Columbia River Treaty of 1964.

In September, 1997, a long-term Columbia Basin Management Plan will be put forward to the Trust's Board for adoption. In a draft version of the Management Plan, the vision statement below is proposed.

While the Basin Management Plan contains many goals and objectives that relate to the Community Energy Plan, the most relevant is the following goal and objective:

Goal 2) "To maintain healthy ecosystems in a naturally functioning state and to improve the functioning of those that have been altered and degraded."

Objective d) [To] "support initiatives which promote or have inherent in them the goal of energy conservation, and the development of innovative, cost-effective energy sources."

Draft Columbia River Basin Vision

"The Columbia River Basin is a place where social, environmental, and economic well-being is fostered.

Collaborative relationships and partnerships are established across the Basin. *Communities work together in a spirit of mutual support, and respect each other's differences. Residents identify with a Basin culture and feel a sense of belonging to a Basin community. Residents are involved in community decision making.*

A healthy environment is the basis for social and economic activities. *Residents are committed to long-term and enduring stewardship of the Basin's natural resources.*

The economy of the Basin is diverse, resilient and energized. *Communities are responsive to both the needs of the present and the future. Community enhancement initiatives are widely supported and residents share responsibility for their implementation. Practical and innovative investments in the basin serve to increase the range of options for present and future generations."*

The vision statements and goals for both Revelstoke and the Columbia River Basin are relatively consistent and place emphasis on environmental values, economic development, and social well-being as well as the universal values of health and safety.

2.3 Proposed Community Energy Goal and Energy Objectives

Based on the visions for Revelstoke and the Columbia River Basin, a community energy goal and energy objectives were developed by the consultants. The following general energy goal for the community is proposed. (See Box)

The energy objectives, and corresponding indicators and targets are shown below in Table 2.1.

A Proposed Community Energy Goal for Revelstoke

To encourage meeting the present and future energy service needs of the community in a manner that is cost-effective, efficient, and environmentally responsible (locally, regionally, and globally); that contributes to local economic development; and that can be sustained well into the future.

Table 2-1: Proposed Community Energy Objectives, Indicators, and Targets for Revelstoke

Proposed Community Energy Objective[1]	Proposed Indicator[2]	Proposed Performance Targets[3]
Environmental To minimize greenhouse gas emissions to reduce global climate change.	Tonnes of total greenhouse gas emissions per year in CO_2 equivalents (tonnes/year)	Minimum: To stabilize greenhouse gas emissions at 1990 levels by the year 2006 *(B.C. and Canada have both made commitments to stabilize their greenhouse gas emissions at 1990 levels by 2000; while this target will likely remain, the timeframe may be extended to the middle of the next decade or later as both B.C. and Canada are expected to come in over this target in 2000)* Desired: To reduce greenhouse gas emissions by at least 20% below 1990 levels by the year 2006 • by the community; and • by municipal operations *(the Federation of Canadian Municipalities in collaboration with the International Council for Local Environmental Initiatives has a voluntary 20% greenhouse gas reduction target of 1990 levels by 2005 for cities participating in its 20% Club including the Cities of Kamloops, Victoria, and Vancouver in B.C.)* Desired: To stabilize greenhouse gas emission levels by both the community and municipality below this level until 2016..
To have clean air by minimizing local air pollution.	24-hour average ambient PM10 particulate concentration ($\mu g/m^3$)	To not exceed provincial air quality guidelines for 24-hour average desirable particulate emission levels by the year 2006
To increase the proportion of energy supplied from renewable sources in order to increase the sustainability of the energy supply	Percentage of total local energy consumed supplied from renewable energy sources (%)	To increase the percentage of energy supplied by renewable energy sources to be at least: • 45% by the year 2006; and • 50% by the year 2016 *(based on about 40% of energy use already being from renewable sources and recognizing economics of some substitutions and that transportation fuels will be more difficult to substitute with renewables for at least the next decade)*
Financial To reduce operating expenditures on energy by reducing the consumption of energy	Energy operating expenditures per year in 1996 dollars ($/year)	To reduce operating expenditures on energy to at least 20% below 1996 per capita levels by the year 2016 • by the municipality (on a per capita basis)); • by households (on a per capita basis) ; and • by businesses (on a per thousand sq. ft. basis) *(based on realistic energy retrofit savings after capital expenditures are recovered)*

To foster prosperity through increased energy use efficiency and to re-circulate energy money saved in the local economy	Percentage of after-tax income of all households spent on energy (%)	To not exceed 5% of total after-tax income by 2006 for household energy expenditures by the community.
To minimize the effect of external fluctuations in energy prices.	2-year average increase in energy prices (%/year)	To limit energy supply rate increases to less than or equal to the rate of inflation by 2001 *(while energy rates are ultimately decided by utilities and fuel suppliers, it can be influenced to some extent by the community and is an important community energy objective)*
Economic Development To create new long term jobs in the community as a direct result of implementation of the energy plan.	Net ongoing full time job equivalents resulting from implementation of the energy plan (full time job equivalents)	To create at least: • 10 full time job equivalents by 2006; and • an addition 10 full time job equivalents by 2016.
To increase the proportion of energy expenditures going to local producers	Percentage of energy supplied by locally owned (>=25% ownership) and operated energy producers (%)	To be at least: • 10% by the year 2006 • 15% by the year 2016 for the percentage of energy supplied to the community from locally owned and operated energy producers
To diversify the local economy through the addition of new industries related to the energy plan	Number of new industry types that are locally owned (>=25% ownership) and operated resulting from energy plan.	To add at least the following number of new industry types that are locally owned and operated to the local economy: • one new industry type by the year 2006 • a second new industry type by the year 2016
Energy Awareness To increase awareness in the community about energy use, costs, impacts, energy-saving opportunities, and alternative energy supplies	Level of environmental and energy awareness	To have a higher level of environmental and energy awareness than an average community of equal size elsewhere in Canada
Transferring Experience Gained To become a model sustainable community for inspiring other communities and transferring experience gained.	Annual number of requests for information about the energy plan or local energy-related initiatives	To inspire or transfer experience gained to at least one other community by the year 2001.

Notes:

(1) E*nergy objectives* express the community's energy goal in greater detail. The energy objectives are defined by

- a qualitative statement of the objective,
- a set of one or more indicators for each objective, and
- a target for each of the indicators.

(2) An *indicator* is a yardstick that measures the performance of some key element of the objective.

The development of indicators is consistent with the Columbia Basin Management Plan's objective to "facilitate the use of social, environmental and economic indicators in Basin Communities" listed under the goal of increasing the "capacity of Basin communities to identify and meet their own needs."

Indicators were selected based on their ability to reflect the essential characteristics of the relevant objective; to be appropriate to the community; to be quantitatively measurable; and to be capable of being significantly influenced by actions or policies of the community, City, or other local stakeholders. In addition, several indicators were selected as they were considered to be high priority items for the community, such as the increase in propane prices.

(3) A *target* for an indicator is a performance standard to strive towards to help achieve the relevant objective. It is essentially a point where the community wants to reach or surpass. In certain instances, both a minimum target and a desired target are defined.

3. Community Profile

The following is a brief profile of the community from the perspective of factors that affect energy consumption in the community. The study area is limited to the City of Revelstoke municipal boundary. Unless otherwise specified, the data are for the year 1996 which is used as the baseline year for the study.

Detailed profiles of the following aspects of the community are not included in this section but are included in Appendix A:

- Industry and employment
- Neighborhood profiles
- Motor vehicle stock and transportation modes
- Proximity of dwellings to frequently visited trip attractions
- Land use profiles.

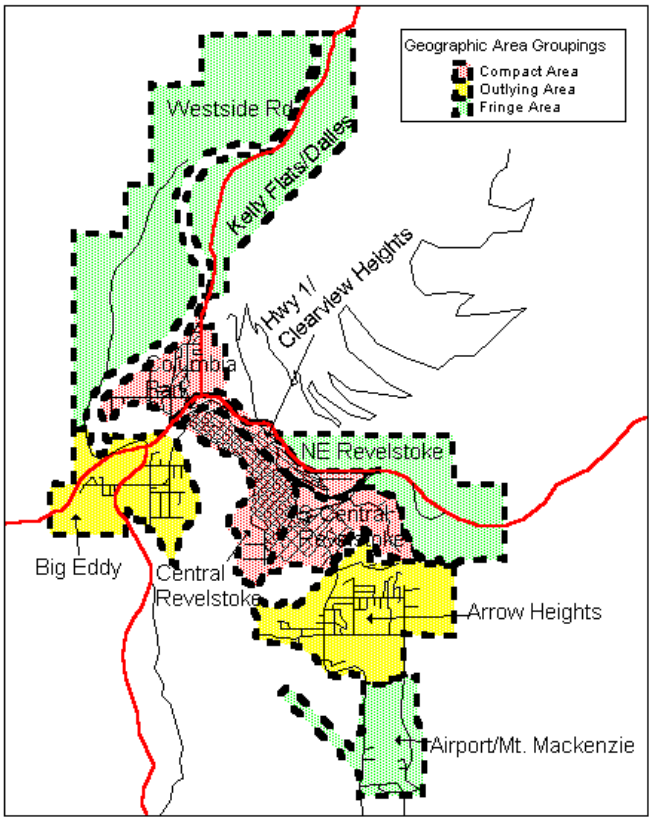


Figure 3.1; Map of Revelstoke Neighborhoods

3.1 Location and Climate

Revelstoke is located on the Trans-Canada Highway approx. 565 km east of Vancouver and 410 km west of Calgary. It is far from large population centres. The closest significant settlements are Golden, which is located 148 km to the east, and Sicamous, which is located 70 km to the west. Revelstoke is situated in the Columbia Mountains in the interior wet belt, and receives heavy snowfall in the winter months. The snow season is typically from mid-December to mid or late March. Revelstoke has an average number of 4,225 heating degree days Celsius each year.

3.2 Population

The population estimate for the City of Revelstoke as of July 1, 1996 was 8,507 (B.C. Stats 1997). The census population count on May 14, 1996, was 8,047 (Statistics Canada 1997). The B.C. Stats estimate of 8,507 persons was used for the study since the census typically has an undercount of population. B.C. Stats estimated the population of Revelstoke to be 7,954 in 1991 for an increase of 553 persons or an increase of approximately 7% over the five year period.

3.3 Residential Building Stock

Table3-1 shows the breakdown of residential dwelling units by type of dwelling and year of construction.

According to the B.C. Assessment Authority (BCAA) database, there were 3,116 dwelling units in Revelstoke in 1996. This compares to an occupied private dwelling count of 3,174 for the 1996 census.

Single family detached homes comprise over 63% of the residential housing stock in Revelstoke. These buildings tend to have the largest floor area per occupant and have relatively larger lot sizes than any other dwelling type.

Mobile homes represent just over 16% of the housing stock. These buildings generally have smaller floor spaces per occupant but are typically energy inefficient.

Just over 20% of the dwelling units in Revelstoke are multifamily units. These buildings tend to have lower heat loss than single family detached houses and mobile homes that do not share walls or floors with other dwelling units.

Table3-1: Dwelling Units by Dwelling Type and Age, 1996

	Age Breakdown for Single Family Units (in dwelling units)			Age Breakdown for Multi-framily Units (in dwelling units)		TOTAL	
Dwelling Type	Pre 1960	1960-1979	1980-1996	Pre 1978	1978-1996	Total Units	% of Total Units
Single Family Detached	493	1,197	287			1,977	63.4%
Mobile Home	494	10	2			506	16.2%
Condo/Duplex/Row House				163	68	231	7.4%
Low-rise Apartment				248	154	402	12.9%
TOTAL	987	1,207	289	411	222	3,116	100.0%

In addition to dwelling type, the year that the building was constructed is also an important influence on residential building energy consumption. Newer buildings tend to be built to higher energy-efficiency standards than old buildings. The age breakdowns differ for single-family and multi-family units because the building archetypes used for calculating energy consumption are based on different age ranges.

Over 85% of the single family detached buildings were built before 1980. Approximately 65% of the multifamily units were built before 1978.

3.3 Commercial and Institutional Building Stock

For the commercial and institutional building stock, the type of use, age of the building, and floor area are important determinants of energy use.

Table 3-2 shows the breakdown of commercial and institutional buildings in Revelstoke by type of building, age, and percentage of total commercial floor space. Just over two-thirds of the commercial and institutional floor space was constructed before 1978. A breakdown of the top energy consuming commercial and institutional buildings by type and age is included in Appendix B.

Table 3-2: Number of Buildings by Type, Age, and Floor Area for Commercial and Institutional Building Stock in 1996

	Number of Buildings			Floor Area
Building Type	**Pre 1978**	**1978-1996**	**Total**	**Percent of Total Floor Area (%)**
Commercial Buildings:				
Convenience Stores/Gas Bars	4	7	11	1.8%
Halls	4		4	1.0%
Heavy Industrial Buildings	2	3	5	0.4%
Hotels/Motels	12	9	21	18.6%
Offices	17	6	23	9.9%
Restaurants, Fast Food	2	1	3	0.4%
Restaurants, Sit Down	11	2	13	2.2%
Retail Stores, Non-food	64	19	83	19.0%
Shopping Centres	1	0	1	0.1%
Supermarkets	1	1	2	0.8%
Warehouses, non-refrigerated	30	27	57	16.0%
Warehouses, refrigerated	1	0	1	0.1%
Subtotal	**149**	**75**	**224**	**70.3%**
Institutional Buildings:				
Churches	9	3	12	3.0%
Elementary Schools/Okan Univ. College	6	0	6	8.5%
Hospitals	1	0	1	3.6%
Secondary Schools	1	0	1	5.1%
Municipal and Gov't Buildings/Airport	6	4	10	5.0%
Rec. Buildings/Comm. Centres/Museums	7	2	9	4.4%
Subtotal	**30**	**9**	**39**	**29.7%**
TOTAL	**179**	**84**	**263**	**100.0%**
Percent of Total Floor Area (%)	**68.5%**	**31.5%**	**100.0%**	
Total Floor Area (sq. ft.)	**1,256,925**	**578,327**	**1,835,252**	

4. Energy Profile of Revelstoke

A breakdown of energy consumption in Revelstoke by fuel type is shown in Figure 4-1. Electricity is supplied by BC Hydro, propane from BC Gas and residential fuel oil from 2 local distributors. In addition, many homes have wood burning stoves to supply primary or secondary space heating. Gasoline and diesel fuels are the main fuels used for transportation.

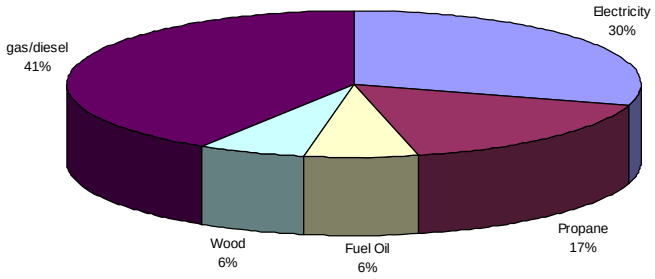


Figure 4-1: Energy Consumption by Fuel Type

Current energy consumption for the following sectors was modeled using TIRA (as previously explained in section 1.6) and validated with actual energy use data from utility and fuel suppliers:

- residential buildings (e.g., space heating, cooling, appliances, and lighting)
- commercial and institutional buildings (e.g., space heating, cooling, lighting, computers, equipment)
- personal transportation
- commercial and institutional transportation
- industrial operations.

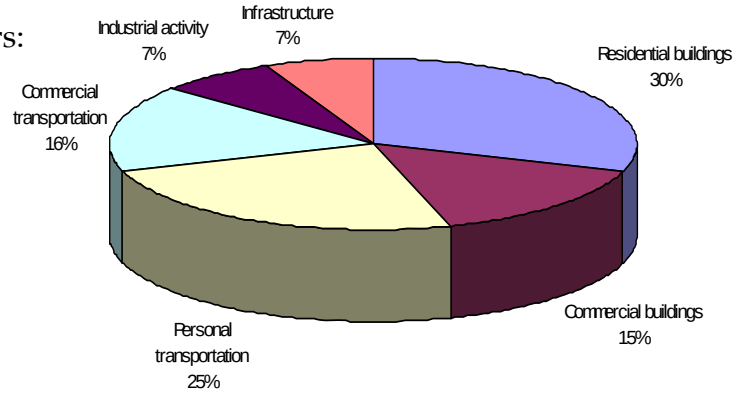


Figure 4-2: Energy Consumption by Sector

Figure 4-2 shows the proportion of energy used by various sectors in the community

Figure 4-3 shows how energy was consumed by fuel type and sector.

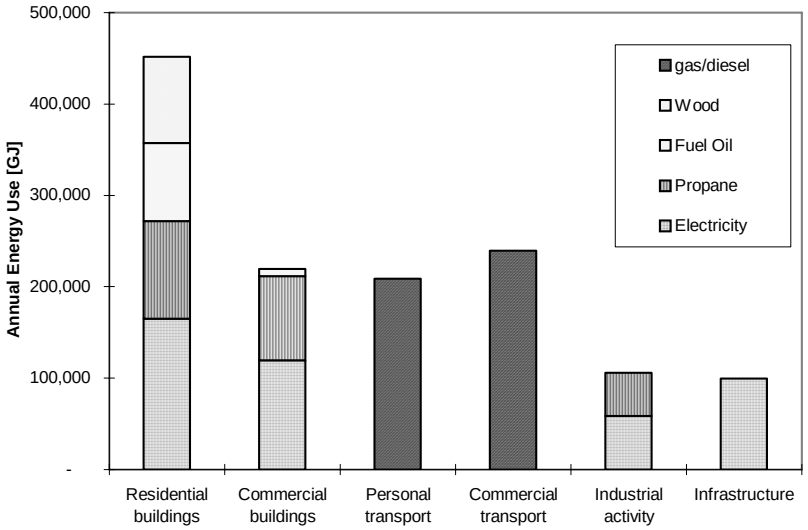


Figure 4-3: Energy Consumption by Fuel and Sector

In 1996, the total annual energy consumption in Revelstoke was 1,490,000 Gigajoules (GJ). The building sector accounted for approximately 45% of energy consumption. The transportation sector accounted for another 41%. For the purpose of the Community Energy Plan, the transportation sector was defined to include the movement of people and goods within the city, but not to include inter-city modes of transport, including air or rail.

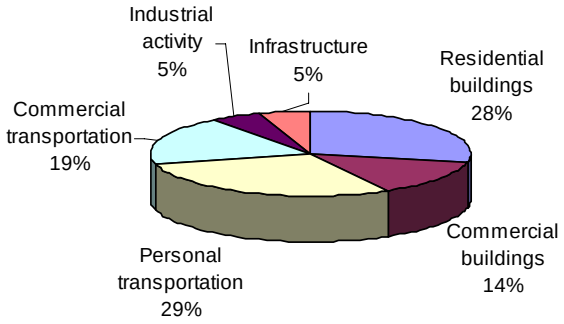


Figure4-4: Energy Expenditures by Sector, 1996

Multiplying energy consumption by fuel costs, the community of Revelstoke spent approximately $19 million dollars on energy in 1996. Figure4-4 shows the breakdown of energy expenditures by sector in the community. Personal transportation and residential buildings make up 57% of the total. On a per Capita basis, Energy consumption for the residential building and personal transportation sectors was about $1280 per person per year in 1996. This corresponds to 8% of the pre-tax income.

Indicator: Annual Per Capita Energy Use

Units: gigajoules

Revelstoke	BC	Canada	Sweden	Japan
174	350	270	170	110

Source: all numbers with the exception of Revelstoke are based on Ministry of Energy, Mines and Petroleum Resources, 1990

Dividing Revelstoke's 1996 total energy use by population, the per capita energy use is 174 gigajoules (GJ) per year. This figure is lower than the published indicators for per capita energy use in British Columbia and Canada but is consistent with per capita energy use in Sweden and Japan (See Box above).

The reason for the discrepancy between Canadian, BC, and Revelstoke per capita energy use is the low level of industrial activity in the community. (Refer to Figure 4-5). In Revelstoke, the annual per capita energy use for residential buildings is approximately 46 GJ, for commuter travel it is 49 GJ, while for industrial activity, it is only 12.5 GJ.

Figure 4-6 shows the total annual energy consumption by end use for 1996. In displaying the energy use in this way, we can readily see that three uses of energy dominate in Revelstoke: personal transportation, residential space heating, and commercial transportation. Industrial drives and commercial space heating are close behind. This use of energy reflects the reliance on vehicle transportation in the community and also shows the high leverage areas for reducing energy consumption in the community.

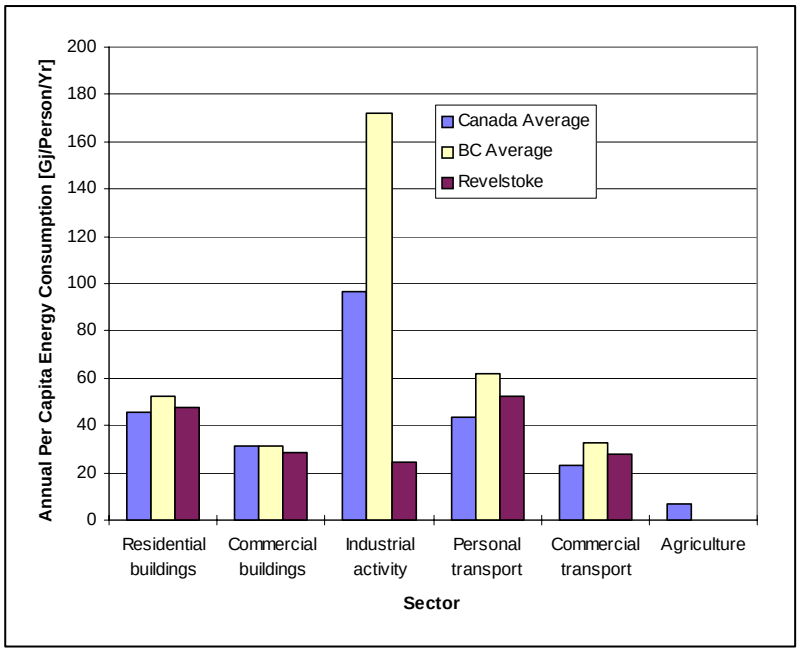


Figure 4-5; Energy Consumption By Sector

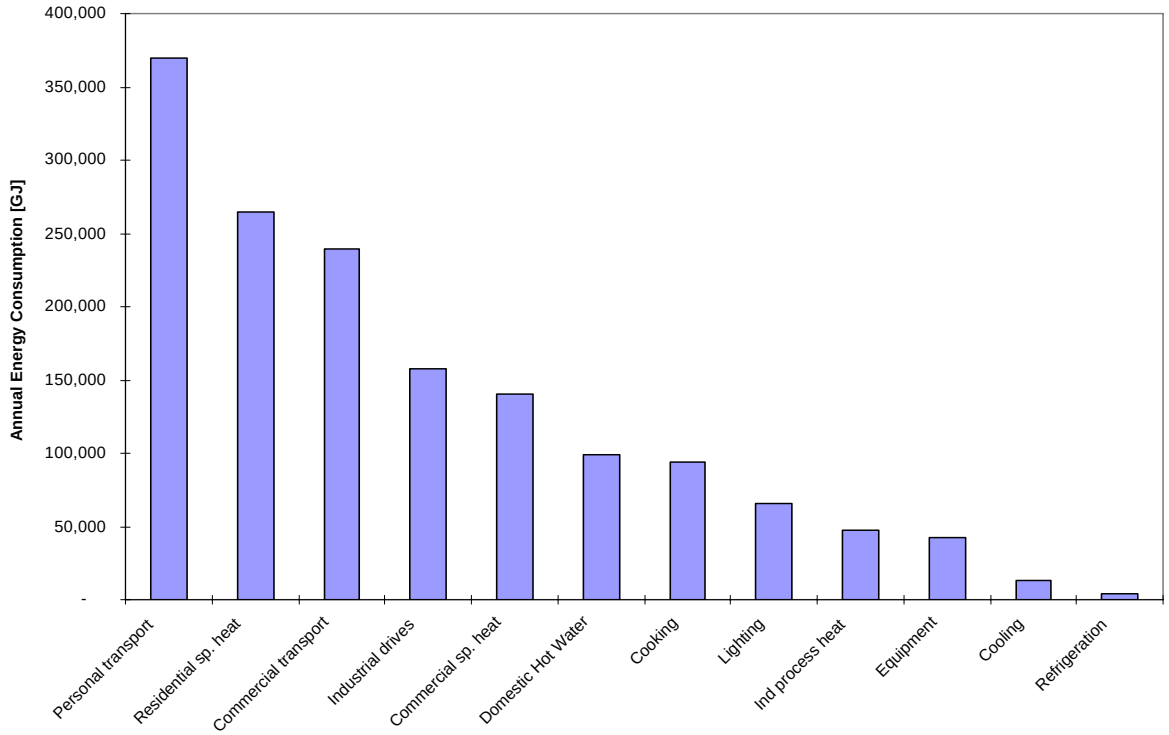


Figure 4-6: Energy Breakdown by End Use

4.1 Greenhouse Gases

Scientists around the world agree that greenhouse gases from human related activities are contributing to an overall warming of the earth's climate. Carbon dioxide is the largest greenhouse gas contributor. The main source of carbon dioxide emissions is from the burning of fossil fuels.

Canada has an international commitment to stabilize net greenhouse emissions at 1990 levels by the year 2000 and to develop sustainable options to achieve further progress in the reduction of emissions by the year 2005.

The total production of carbon dioxide in Revelstoke for 1996 was 77,700 tonnes. On an annual per capita basis this equals about 8.8 tonnes per person. A comparison of Revelstoke per capita greenhouse gas emissions to other parts of Canada and the world is shown in Figure 4.8.

Indicator: Annual Per Capita Greenhouse Gases

Units: tonnes CO_2

Revelstoke	Toronto	Avg. U.S. City	Average EU City	Ankara Turkey
8.8	13.5	12.9	8.2	3.9

Source: Torrie Smith Assoc. Cities and CO2, Toronto, Ont., 1993

Figure 4.8; Per Capita Greenhouse Gas Emissions

Figure 4-9 shows the breakdown of carbon dioxide emissions by sector. Over half of the carbon dioxide emissions (56%) are from transportation and one quarter (25%) are from residential and commercial buildings, primarily from space heating.

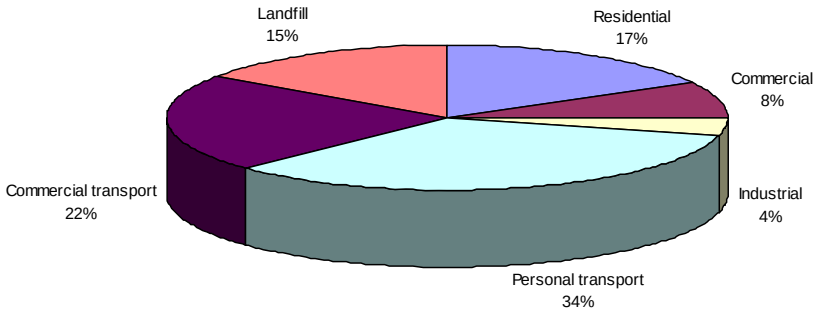


Figure 4-9; Greenhouse Gas Emissions By Sector

5. Scenarios for Reducing Energy Consumption and Greenhouse Gas Emissions

5.1 Population Growth and Alternative Scenarios

The population of Revelstoke will continue to grow over the next 20 years if current trends are sustained. New residents will be seeking homes and jobs. Residents will be aging and needing different accommodation according to their lifestyle and age. The community of Revelstoke has choices in how it meets future demands for housing, employment, and services. For example, the city can change construction standards, alter densities through rezoning, or investigate alternative energy supplies. Each of these choices has a direct impact on energy consumption and expenditures on energy services.

But which of these choices will bring Revelstoke closest to the future expressed in its vision statement? Scenarios are a way of describing and analyzing future conditions. By changing some variables–such as the rate of population growth or energy efficiency standards–and holding other factors constant, a future state can be described and modeled. Then, the consequences and impacts of that future can be evaluated in terms of the indicators and targets developed from the vision statement.

TIRA was used to develop a "Business As Usual Scenario" to forecast resource consumption over the next twenty years. The default scenario describes the most likely energy consumption pattern and resulting impacts in the absence of any major new initiatives. It assumes two conditions:

- an extrapolation of past trends, wherever reasonable, and
- the introduction of new policies, regulations, and market reforms where these are planned and probable.

TIRA was then used to examine how the following four alternative scenarios impacted energy use in Revelstoke.

1. Local energy supply system
A facility is built to burn wood waste from local sawmills. Through a district heating system, it provides space and water heating to buildings, process steam to industry, and heat to pasteurize water for the community.

2. Retrofit older residential buildings
An energy retrofit industry in Revelstoke is established that would retrofit residential buildings that were constructed before 1980.

3. Retrofit Institutional Buildings and Municipal Infrastructure

An energy retrofit program is established to retrofit existing municipal

infrastructure, and buildings owned by the City and School District.

4. New building Standards
New energy efficient building construction standards are introduced which apply to the construction of all new residential buildings (The National Energy Code for Houses).

5.2 Modeling the Scenarios

Sheltair used TIRA to examine how the alternative scenarios impacted energy use in Revelstoke over the next twenty years. For the purpose of this study, the future was based on the assumption of a continuation of past trends.

Assumptions for Revelstoke's Future:
- the annual population growth rate between 1996 and 2016 is 0.5%.
- the sex and age composition of the population is the same as that for the B.C. Stats 20 year population projection for Local Health Area #19 (Revelstoke).

Table 5-1 shows the anticipated population in Revelstoke over the next twenty years in 5 year increments. Assuming an annual population growth rate of 0.5%, the population is expected to grow to 9400 by 2016, corresponding to an increase of 10.5% over 20 years.

Table 5-1: Revelstoke Population, 1996-2016

Year	1996	2001	2006	2011	2016
Projected Population	8,507	8,722	8,942	9,168	9,399

5.3 Business as Usual Scenario

5.3.1 Scenario Description

The Business as Usual Scenario assumes the continuation of past development patterns and energy efficiency trends into the future. In this scenario, it is assumed that there are no major changes to public policy and no major or sustained real price changes for energy.

The scenario is based on the following additional assumptions:

- The same subdivision and development standards are used as currently exist.
- Energy efficiency of residential units improves at a rate consistent with past 20 year trends. Pre 1970 residential buildings are demolished at a rate of 1% per year.
- New commercial buildings comply with the ASHRAE 90.1 energy

standard. No buildings are assumed to be demolished.
- The housing mix remains essentially constant over time,
- with the majority of new housing being single family.
- the location of new dwelling units that are constructed over the next 20 years take the same geographic distribution as the housing starts in the last 10 years (while taking into account capacity constraints).
- For commuter transportation, vehicle ownership and fleet efficiency continue to change at rates consistent with past twenty-year trends.
- Commercial transportation energy remains constant over time.
- Industrial energy consumption remains constant with the increase in energy use due to increased production output offset by new processes requiring lower operating energy.
- Chlorination continues to used for water treatment.

5.3.2 Energy Consumption

The annual per capita Energy Consumption is summarized in Table 5-2 for the business as usual scenario. Total energy consumption is expected to increase from 1,480,000 GJ in 1996 to 1,550,000 GJ in 2016, corresponding to a 5% increase. On a per capita basis, the total annual energy use will decrease from 175 GJ in 1996 to 165 GJ by 2016. This change represents a 6% decrease in per capita energy consumption over twenty years.

Year	Population	Total Energy use [1000GJ]	Per Capita Energy Use [GJ/Capita]
1996	8,507	1,480	175
2016	9,400	1,550	165

Table 5-2: Total and Per Capita Energy Forecasts

Energy use by sector is illustrated in Figure 5.1. Although Revelstoke's population increases by almost 11%, energy use increases by only 5%. This is because the new stock adopted in the community between 1996 and 2016 is more energy efficient than the older stock that is being replaced. In addition, the older stock is becoming a smaller proportion of the overall stock.

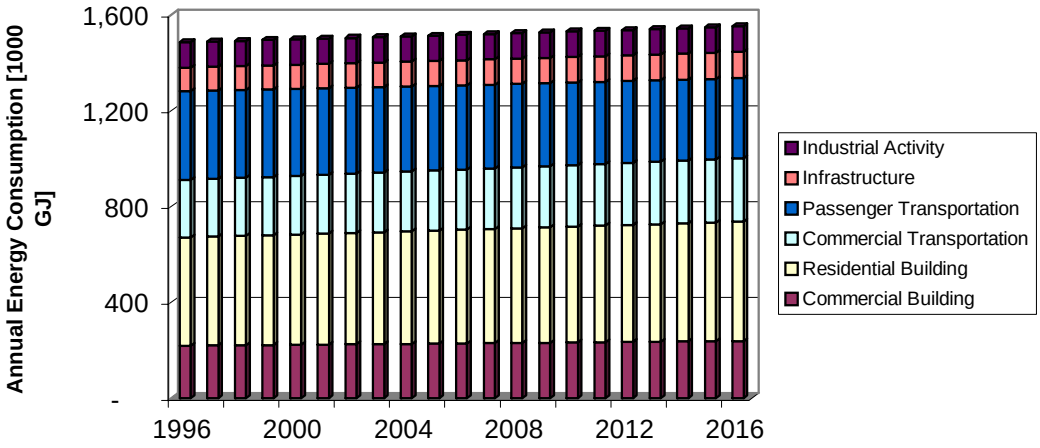


Figure 5.1; Business as Usual Energy Consumption by Sector

Carbon dioxide emissions are summarized in Table 5-.3 There is a 2% increase in annual CO2 emissions, and a 6.6% decrease in the Per Capita emissions.

Year	Total CO2 Emissions [1000 Tonnes]	Per Capita CO2 Emissions [Tonnes/cap]
1996	74.5	8.75
2016	76.8	8.17

Table 5-3: Total and per Capita CO2 Emissions, 1996, 2016

5.4 Alternative Scenarios

5.4.1 Scenario 1: District Energy

The District Energy Scenario involves establishing a wood fired district energy system (DES) in Central Revelstoke. This scenario is based on the results of TIRA analysis performed in conjunction with a study done by Ward Kemerer and Ian Rowe. For a complete description of the District Energy option, the reader is referred to the report entitled "The Potential for District Energy In Revelstoke".

5.4.1.1 Scenario 1 Description

Several factors motivated the choice of this scenario:

- Wood waste is available at low or negative cost.
- Local sawmills burn their waste wood in non air emission compliant incinerators with limited pollution control devices, or use landfills. On

an individual basis, these wood processors are facing significant investment decisions to meet current air pollution regulations.

- Typically, buildings in Revelstoke are heated directly with propane, oil, electricity or wood furnaces or stoves. Consumers of fossil fuels in Revelstoke have been subject to price increases in recent years with limited capability of switching to alternative supplies. Those who can switch often go back to burning wood, which results in increased local air quality problems.
- Saw mill wood drying kilns are presently fired with imported propane, subject to the price increases as indicated above.
- Cooling is presently provided in individual buildings by using electrically driven CFC or HCFC based chillers or air-conditioners. A District Energy system can provide the heat that drives absorption chilling cooling systems at reasonable cost.
- The City is presently required to upgrade its water supply system. A preliminary feasibility study[1] has indicated high costs for filtration and disinfection to eliminate contamination by Giardia and Cryptosporidium bacteria. Heat treatment (pasteurization) using the DES may be feasible.
- The City has one of the highest snowfalls in Canada. Melting of snow at strategically located snow-dumps heated using the DES could provide convenience and reduced clearing costs.

As a result of these conditions, the Revelstoke District Energy System has been proposed to operate as follows:

- Energy in the form of hot water will be piped to individual users for space and domestic hot water heating.
- Large building owners will replace CFC or HCFC based chillers or air conditioners with absorption chillers using the DES as the heat source.
- Local sawmills will truck their wood residues to the central District Energy incinerator and dispose of them in an environmentally acceptable manner.
- Downie Timber will use the DES to provide heat to their dry kilns
- The City will purchase heat from the DES to pasteurize the water supply and for snow melting facilities.

[1] Dayton and Knight, 1996

5.4.1.2 Analyzing Scenario 1

The archetypes and database in TIRA were modified to perform the necessary load forecast calculations for the district energy system. Peak and annual heating and cooling loads were calculated for over 40 archetypal building types. Floor areas of the different archetypes were obtained from the BC Assessment Authority, and combined with the load calculations to obtain the district energy system parameters. The predicted peak and annual loads were compared to actual load profiles of test buildings and for fuel sales in the community to ensure accuracy. Agreement between predicted and actual loads was of the order of 6%.

The results of the building load estimates were used in the district energy analysis to predict distribution and plant requirements, as well as project economics. The areas of Revelstoke studied for the district energy scenario are described as Case 1, 2, 3 or 4; 'Downtown Core' (DC) and a slightly larger area described as case 5, 6, 7 and 8; 'Extended Downtown Core' (EDC). The customers for the DE System include large and small commercial/industrial buildings, government buildings, schools, apartments, the hospital, the water treatment system, and some residential buildings. All cases include the dry kilns at the Downie Timber Sawmill.

5.4.1.3 Scenario 1 Benefits

Table 5-4 summarizes the capital cost and internal rate of return for the various options explored. Case 2 is the most cost effective option, with an internal rate of return (IRR) of 16.7%, and a net return on investment after 7 years. Case 2 involves providing heat and cooling to large buildings in the downtown core as well as to the hospital, pasteurization of Revelstoke's water supply, and providing process steam to Downie Mills.

Table 5-4: District Energy Options

Case	Large Buildings		Residential Homes		Downie Kilns	DHW Plant	Hospital	Cooling	Capital Cost	IRR
	DC	EDC	DC	EDC						
Case 2	53	-	-	-	yes	yes	yes	yes	$10,805,550	16.7%
Case 1	53	-	-	-	yes	-	yes	yes	$9,984,000	12.9%
Case 6	-	77	-	-	yes	yes	yes	yes	$13,838,000	9.3%
Case 5	-	77	-	-	yes	-	yes	yes	$13,018,000	5.4%
Case 4	53	-	492	-	yes	yes	yes	yes	$20,155,000	3.2%
Case 3	53	-	492	-	yes	-	yes	yes	$19,336,000	-
Case 7	-	77	-	725	yes	-	yes	yes	$28,483,000	-
Case 8	-	77	-	725	yes	yes	yes	yes	$29,303,000	-

Figure 5-2 is a map showing the building loads and the pipe network for the Case 2 district energy option.

In addition to the economic benefits of the proposed energy system, there are a number of additional benefits, including:

- Consumption of all wood residue in the area and elimination of existing waste wood burners, open burning and landfilling of wood waste.
- Reduction of atmospheric particulate emissions resulting in improved air quality for Revelstoke.
- Utilization of a currently wasted resource.
- improved visibility and environmental aesthetics.
- reduction of greenhouse gas emissions by 5.5% below baseline forecasts.
- increased resiliency of energy supply through diversification.
- more money spent inside the community resulting in the creation of more local jobs. Assuming the creation of 12 full time equivalent jobs for every $1 million dollars spent within the community, this project will lead to the creation of approximately 20 full time equivalent positions in the community.

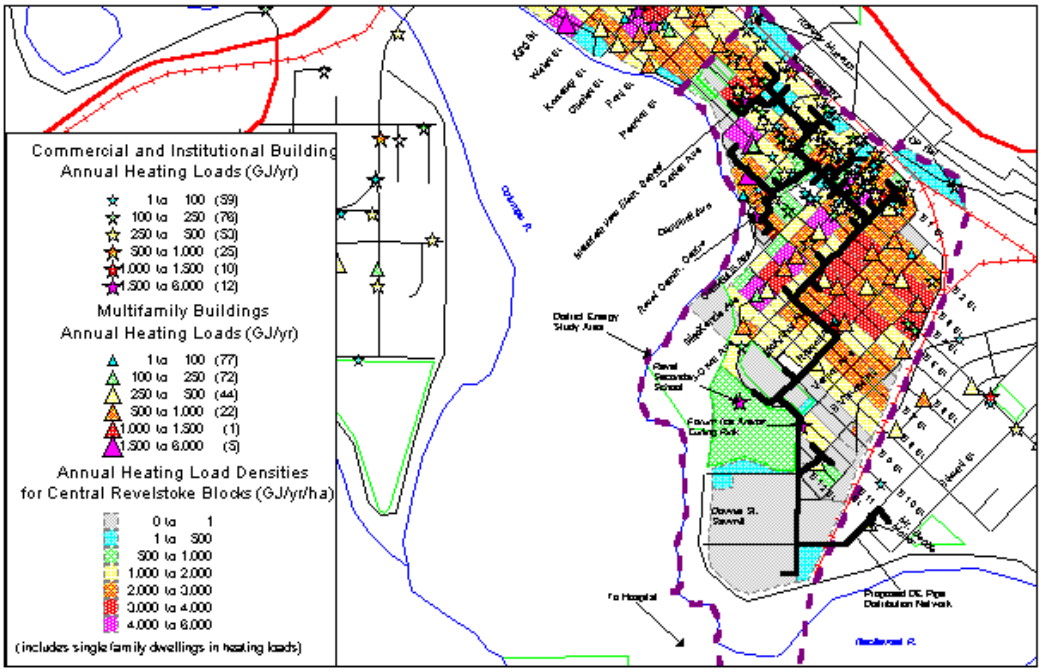


Figure 5-2: District energy Loads and Pipe Network

5.4.2 Scenario 2: Residential Buildings Energy Retrofits

5.4.2.1 Scenario 2 Description

This scenario involves the development of a utility managed energy retrofit industry in Revelstoke that would retrofit older residential single family homes. The scenario was developed to address the issues of high annual energy consumption for older buildings, as well as the unstable price for propane service in the community.

Since BC Gas, the local propane distributor, started providing service to homes in Revelstoke in 1991, the residential price of propane has increased by about 42%. Many residents originally switched to propane due to promises of lower fuel bills and stable prices. To avoid further price increases and price instabilities, many residents are now contemplating a switch back to oil, wood or electricity for water and space heating. Based on analysis used in this study, it was found that the most cost effective way for residents to reduce energy costs and buffer themselves against unstable energy costs is to make their homes more energy efficient.

5.4.2.2 Analyzing Scenario 2

Based on the TIRA analysis of the residential building stock, approximately 85% of residential buildings in Revelstoke were built prior to 1980 and could benefit from energy retrofits. Due to the size of the market and the condition of the stock, the opportunity to reduce energy and save money in the community became apparent.

While BC Gas is frequently seen as the cause of the high costs for energy, there is an opportunity to utilize BC Gas and a new program they have launched called "Homeworks" to address this issue. The Homeworks program includes:

1. A complete energy audit of a house using local contractors who are trained to perform energy audits on houses (local job creation), using sophisticated software and diagnostic tools.
2. A report showing the home-owner where energy is being consumed and the most cost effective ways to reduce their energy bills.
3. Optional financing through the utility to pay for energy retrofits.
4. Professional installation of energy saving measures.
5. A quality assurance program.

Individuals in the community can be trained to become retrofit contractors and carry out all of these tasks.

To model this scenario, it was assumed that:

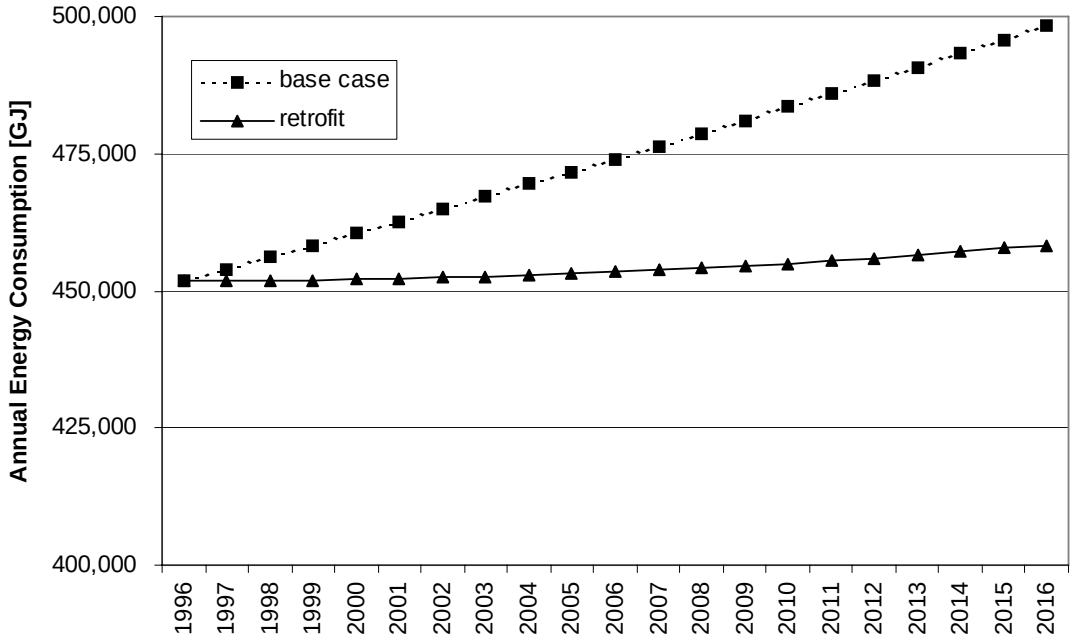
- 50% of pre- 1980 vintage houses will obtain energy retrofits over the next 20 years
- homeowners require a payback period of less than 5 years

- homeowners choose the most cost effective energy retrofit options, and
- the long run levelized cost of propane to homeowners is $13.97/GJ.

Figure 5-3: Reduction in Energy Consumption from Residential Retrofits

5.4.2.3 Scenario 2 Benefits

The predicted energy savings from this scenario over the next 20 years are shown in Figure 5-3.



Based on the assumptions listed above, it was found that

- The archetypal older home in Revelstoke can achieve a 15% reduction in annual energy costs through an investment of approximately $970. This translates into a payback period of approximately 4.7 years.
- Over the next twenty years, this scenario will save the accumulated equivalent of the energy consumed by the entire residential sector in one year. This corresponds to 428,000GJ.
- The reduction in energy consumption will result in a reduction of CO2 emissions by 3% in the community, below the baseline scenario, by 2016.

- Assuming the creation of 12 jobs for every $1 million dollars spent in the community, this scenario will create approximately four full time job equivalents.

Residential retrofit programs have been piloted in a number of communities in BC and are quite successful in saving energy, and reducing energy costs to home-owners. In some locations, the program has also included a water audit component, enabling communities to save both energy and water.

5.4.3 Scenario 3: Retrofit of Institutional Buildings and Municipal Infrastructure

5.4.3.1 Scenario 3 Description

The Infrastructure and Institutional Buildings Energy Retrofit Scenario involves the implementation of energy retrofit programs for existing Municipal buildings, School District buildings, and Municipal Infrastructure.

Using TIRA, Sheltair identified the retrofit of School District buildings, Municipal buildings and infrastructure as having the greatest potential for successful implementation. Federal and Provincial buildings also offered good retrofit potential, but were not included in this scenario.

The advantage of concentrating on institutional organizations is that there are relatively few decision makers, each group offers significant potential for energy savings, and each can have a significant impact on overall community energy consumption. In addition, the coordination of the retrofit of a large number of buildings through each institution is much simpler than the coordination of a large number of private commercial building owners.

Both Municipal and School District operations personnel have identified many energy saving retrofit opportunities in their facilities and would like to reduce operating expenditures by carrying out energy retrofits. The limitation to implementing this work however, has been the lack of available capital.

Recent changes have been made to the funding structure of the provincial Ministry of Education which make the energy retrofit of schools particularly attractive. School boards are now allowed to take money saved from reduced operating expenses and spend the money on improving the quality of education. Many school districts in British Columbia are now in the process of taking advantage of this opportunity.

Similar to the residential retrofit program explored above, there are Energy Service Companies (ESCOs) that provide energy retrofit services to larger buildings. An ESCO will:

- perform a detailed audit on a building,

- examine the most cost effective energy retrofit options,
- pay the cost of retrofitting the building,
- perform the work, and
- share in the savings from reduced energy bills to retrieve their initial investment.

After the ESCO has received their portion of the energy savings over a fixed time period, the building owners (the city of Revelstoke and the school board in this case) continue to keep the savings over the life of the building.

Energy Service Companies will only finance and carry out energy retrofit projects if they are of sufficiently large a scale to be financially viable. Through discussions with several of the largest ESCO's working in BC, it was determined that the energy retrofit of both Municipal and School District facilities at the same time would be required to make the scenario viable.

5.4.3.2 Analyzing Scenario 3

The energy consumption of commercial buildings was modeled by computer simulation for different types of buildings (by groups called archetypes) and compared to actual energy consumption figures from fuel suppliers. From this information the energy consumption for each building was estimated.

The reduction in energy consumption, cost savings, and payback periods for each building type were estimated based on typical energy savings that have been met by energy retrofit programs in similar communities and buildings in BC. The reduction in energy consumption for municipal infrastructure is based on energy savings identified for sewage treatment facilities only.

To model this scenario it was assumed that:

- The energy savings potential for the municipality in conjunction with the school district is large enough to attract the involvement of an ESCO.
- A contract can be negotiated between the ESCO and both the municipality and the school district.
- All retrofit work will be carried out on a one time basis.
- No previous retrofit work has been carried out on municipal buildings with the exception of lighting retrofits to City Hall.
- The school district has started upgrading lighting and has upgraded ventilation systems but many other retrofit options remain.

5.4.3.3 Scenario 3 Benefits

The potential opportunities for reducing operating energy requirements, and the resulting cost savings and reduction in emissions of greenhouse gas emissions, are presented for each institutional and commercial sector in Table 5-5.

Table 5-5: Institutional Building and Infrastructure Energy Retrofit Benefits

	Municipal Buildings and Infrastructure	School District Buildings	Provincial and Federal Buildings	Total
Buildings Considered	-City Hall -Community Center -Ice/Curling Forum -Firehall -Public Works Yard	-Secondary School -Primary Schools (six)	-Hospital -Airport -RCMP Office -Parks Canada /Post Office -Court House -Min of Forests -Works Yard	
Infrastructure Considered	-Sewage Treatment -Street/Traffic Lights	None	None	
Total Building Floor Area (sq. ft)	103,437	250,666	151,374	505,477
Current Energy Consumption (GJ/Year)	20,664	29,114	23,395	73,173
Range of Energy Savings Typically Achievable (%)	18% to 25%	10% to 34%	18% to 35%	10% to 35%
Energy Savings (GJ/Year)	4,200 to 5,300	4,800 to 7,100	5,890 to 7,198	14,890 to19,598
CO2 Reduction (Tonnes/Year)	66 to 90 Tonnes	118 to 176 Tonnes	163 to 199 Tonnes	347 to 465 Tonnes
CO2 Reduction (% of Total Community Emissions)	0.09% to 0.12%	0.16% to 0.24%	0.22% to 0.27%	0.47% to .63%
Current Energy Costs ($/Year)	$244,000	$310,000	$249,227	$803,227
Energy Cost Savings ($/Year)	$69,000 to $81,000	$51,000 to $76,000	$63,000 to $77,000	$183,000 to $234,000
Payback Period (Years)	7 to 9 Years	8 to 10	6 to 10	6 to 10
Net Present Value (6% Discount Rate over 40 Years)	$565,000 to $765,000	$390,000 to $670,000	$482,000 to $777,000	$1,437,000 to $2,212,000

Direct benefits to the Municipal government from energy retrofits were found to be:

- Energy savings of 18% to 25% per building.
- Energy cost savings of $69,000 to $81,000 per year. The Municipality would receive these cost savings in whole after a payback period of 7 to 9 years.
- A net present value of energy savings of $565,000 to $765,000 over the next 40 years.
- Reduction in overall community greenhouse gas emissions by approximately 0.1%.

Direct benefits to the School District from energy retrofits were found to be:

- Energy savings of 10% to 34% per building.
- Energy cost savings of $51,000 to $76,000 per year. The School District would receive these cost savings in whole after a payback period of 8 to 10 years. The money saved on operating expenses can then be put directly into general school budgets and spent on improving the quality of educational.
- A net present value of energy savings of $390,000 to $777,000 over the next 40 years.
- Reduction in overall community greenhouse gas emissions by approximately 0.2%.

Assuming that the annual energy cost savings are spent within the community, this scenario will create approximately 1 to 2 full time jobs.

5.4.4 Scenario 4: Adopting Higher Efficiency Standards for New Buildings

5.4.4.1 Scenario 4 Description

This scenario models the impact on energy consumption in the community from adoption of the National Energy Code for Houses (NECH).

The NECH is a new, soon to be released building code that has been developed to set minimum standards for energy efficiency in new residential construction. Each region of the country has its own customized set of minimum standards that are designed to be cost effective, taking into account regional climate and construction costs. Requirements are designed using life cycle cost assessments to ensure that homeowners save money over the long term, while improving home comfort.

Once released, the NECH can be adopted by provincial or municipal governments. This scenario assumes that the City of Revelstoke adopts and enforces the NECH.

5.4.4.2 Analyzing Scenario 4

TIRA was used to model the energy consumption of new residential buildings constructed to the standards of the National Energy Code for Houses as they apply to the Revelstoke region. All other assumptions remained unchanged from the business as usual scenario.

Figure 5-4 shows the impact over the next 20 years of adopting the National Energy Code for Houses. The retrofit of older residential houses is provided to show the relative magnitude of the two scenarios. The effect of construction of all new housing to R2000 standards is also included in the figure.

5.4.4.3 Scenario 4 Benefits

The benefits of adopting higher energy efficiency standards for new residential buildings are:

- A reduction in energy consumption and greenhouse gas emissions in the residential building sector. New houses built to National Energy Code for Houses standards will consume about 3% less energy than new houses currently being constructed in Revelstoke. Although the energy savings are small, this scenario is still a step in the right direction.
- Homeowners will save money on energy costs over the long term.
- Revelstoke will be a leader in supporting a Canadian Federal Government program designed to reduce greenhouse gas emissions.
- The National Energy Code is an objective based code.

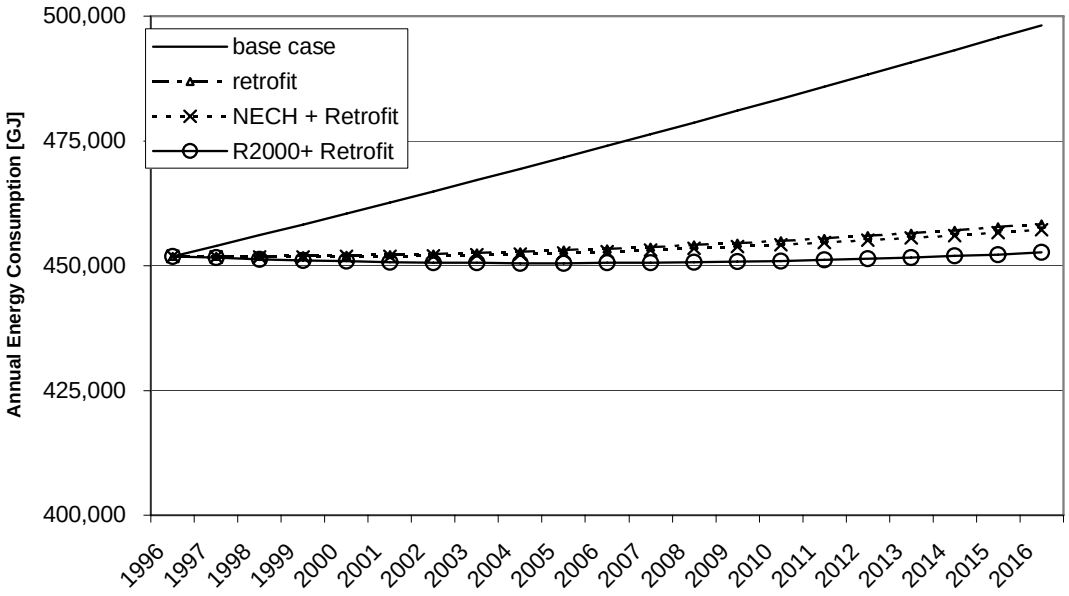


Figure 5-4: Impact of the National Energy Code for Housing (NECH)

5.5 Comparing the Business as Usual and Composite Conserver Scenarios

All four of the above Scenarios for reducing energy consumption and greenhouse gas emissions were combined to examine the overall impact on energy consumption in Revelstoke

Figure 5-5 shows the projected energy savings between 1996 and 2016. By the year 2016, there is an annual decrease in energy consumption of approximately 57,000 GJ per year. The District Energy Scenario has no impact on annual energy consumption because it affects energy supply rather than energy demand in Revelstoke.

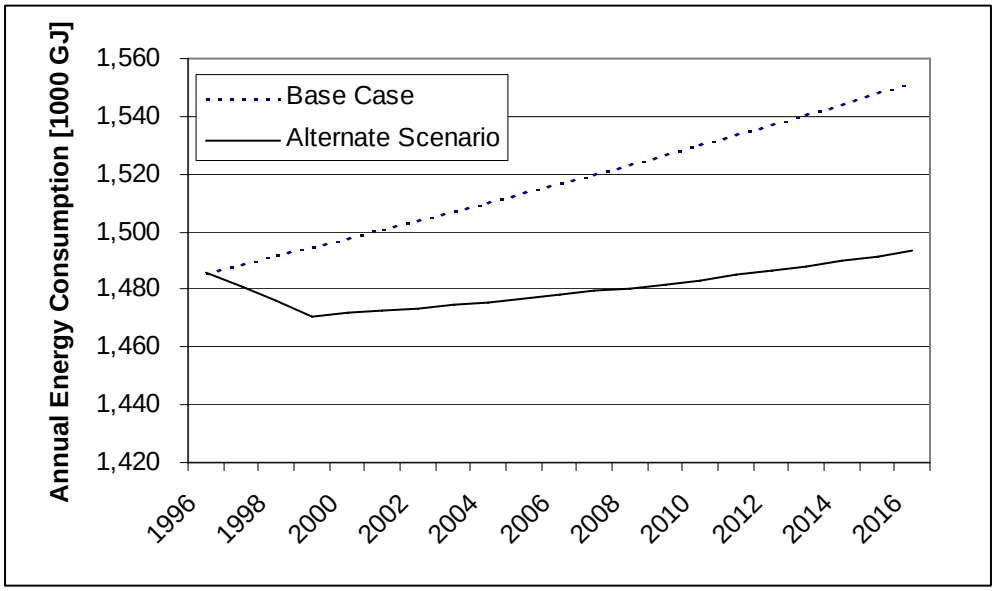


Figure 5-5; Impact of Composite Scenarios on Energy Consumption

The impact of implementation of all four Scenarios were then compared to:

- the energy targets developed in Section 2 of this report, (Energy Goals and Objectives)
- the current energy consumption profile developed in Section 4, (Energy Profile), and
- the business as usual scenario.

Results of the comparison are summarized in Table 5-6. The real price for energy was assumed to remain constant over the next 20 years.

Most noticeably, implementation of all scenarios of the Community Energy Plan will lead to:

- a reduction of household expenditures on energy by 7%
- the creation of 26 full time jobs,
- the creation 2 new local industries
- a reduction of per capita carbon dioxide emissions by 16% below 1996 levels.

In addition, the cumulative savings on energy dollars spent in the community are approximately $10 million dollars.
.

Table 5-6: Comparison of Community Energy Plan to Energy Targets, Current Energy Consumption, and the Business as Usual Scenario.

Category	Indicator	Units	Target	1996 Baseline	Business As Usual-2016	Composite Scenarios-2016
Energy	Total energy consumed per year by community	GJ / year		1,486,000	1,550,000	1,493,000
	Total energy consumed per year by community (excluding industrial processes)	GJ / year		1,380,000	1,444,000	1,387,000
	Per capita energy consumed per year (excluding industrial processes)	GJ / capita / year		162	154	147
Environ-mental	Total tonnes of greenhouse gas emissions per year in CO2 equivalents - by community	Tonnes / year	To stabilize greenhouse gas emissions at 1990 levels by the year 2006	74,500	76,800	69,900
	Per capita tonnes of greenhouse gas emissions per year in CO2 equivalents	Tonnes / capita / year		8.8	8.17	7.43
	Annual number of days exceeding 24-hour average desirable PM10 particulate concentration	Days / year	To not exceed provincial air quality guidelines for 24-hour average desirable particulate emission levels	1	0	0
	Percentage of total local energy consumed supplied from renewable energy sources	%	To increase the percentage of energy supplied by renewable energy sources to 45% by the year 2016	36%	36%	42%
Financial	Total energy operating expenditures per year in 1996 dollars - by municipality	$ / year (1996 dollars)		$803,000	$803,000	$600,000
	Per capita energy operating expenditures per year in 1996 dollars - by municipality	$ / capita / year	To reduce operating expenditures on energy to at least 20% below 1996 per capita levels by the year 2016	$94	$85	$64
	Total energy operating expenditures per year in 1996 dollars - by community	$ / year		$19,000,000	$20,000,000	$19,000,000
	Per capita energy operating expenditures per year in 1996 dollars - by community	$ / capita / year	To reduce operating expenditures on energy to at least 20% below 1996 per capita levels by the year 2016	$2,230	$2,100	$2,000
	Per Capita energy operating expenditures per year in 1996 dollars - by households	$ / capita / year	To reduce operating expenditures on energy to at least 10% below 1996 per capita levels by the year 2016	$1,250	$1,260	$1,170

	Per 1,000 sq. ft. energy operating expenditures per year in 1996 dollars - by businesses	$ / 1,000 sq. ft. / year	To reduce operating expenditures on energy to at least 20% below 1996 per capita levels by the year 2016	$1,400	$1,596	$1,500
	Percentage of after-tax income of all households spent on energy	%	To not exceed 5% of total after-tax income by 2006 for household energy expenditures by the community	9.0%	8.2%	7.7%
Category	**Indicator**	**Units**	**Target**	**1996 Baseline**	**Business As Usual-2016**	**Composite Scenarios-2016**
	2-year average real increase in energy prices (after inflation)	%		0%	0% (assumed)	0% (assumed)
Economic Development	Net ongoing full time job equivalents resulting from implementation of the energy plan	Full-time job equivalents	To create at least 20 full time job equivalents by 2016.	0	0	26
	Percentage of energy supplied by locally owned (>=25% ownership) and operated energy producers	%	To increase the proportion of energy expenditures going to local producers To at least 15% by the year 2016	0	0	8%
	Number of new industry types that are locally owned (>=25% ownership) and operated resulting from energy plan	Number of new industry types	To add at least 2 new industry types by the year 2016	0	0	2

6. Policy Recommendations

This section presents suggested policy recommendations for the City of Revelstoke to reduce energy consumption and related environmental impacts. Policy recommendations are based on the scenarios previously described in this report as well as additional energy saving opportunities which were not described in the scenarios.

The policy recommendations were selected based on their ability to:

- significantly influence energy consumption;
- contribute to meeting the targets for the energy objectives;
- fit in with the character and interests of the community; and
- be realistically implemented.

The recommendations and additional energy saving opportunities are organized into eight policy areas:

1) general,
2) land use and transportation,
3) location of new public, government, and other large buildings,
4) public transit and inter-city passenger transportation,
5) site planning and design,
6) building design and retrofits,
7) energy supply, and
8) coordination, education, information sharing, and monitoring.

The relevant stakeholders are identified in square brackets after each policy recommendation with the recommended lead agency listed first and highlighted in bold.

6.1 General

*Recommendation 1) Include an Energy Goal and Energy Objectives in the Official Community Plan (OCP) [**City**]*

The most important first step in implementing a Community Energy Plan is to include an energy goal and selected energy objectives into the Official Community Plan. This will ensure that sub area plans and bylaws that are developed or amended will be consistent with the community's energy related goals.

One potential wording for the suggested energy goal is described below. The following is the wording from the energy goal developed by the consultant.

> *To encourage meeting the present and future energy service needs of the community in a manner that is efficient and cost-effective; that is environmentally responsible (locally, regionally, and*

globally); and that fosters local economic development.

*Recommendation 2) Amend text in Revelstoke Vision Statement to clarify vision [**City**, former members of Revelstoke Vision Committee]*

Since the vision statement is the starting point for the Official Community Plan, it is important that it is clear and unambiguous. One of the priorities listed in the vision statement is "economic growth and stability". Growth can be interpreted to mean different things. If unqualified, it can potentially mean to grow larger quantitatively in terms of all components of the economy. However, an economy can develop but does not necessarily need to increase its throughput of energy and materials. Either the term economic growth should be fully defined or an alternative word should be used for the priority.

The following text amendment is suggested:

Community priorities include:

- opportunities for youth;
- economic ~~growth~~ prosperity and stability;
- [...]

*Recommendation 3) Formally commit to stabilizing or reducing greenhouse gas emissions for the community and for municipal operations [**City**]*

The City of Revelstoke does not have a formal commitment to stabilize or reduce greenhouse gas emissions. The City therefore may wish to formally endorse Canadian and/or B.C.'s commitments to stabilize greenhouse gas emissions. This endorsement could be in the form of a statement in the Official Community Plan or as a resolution by Council. Revelstoke may also wish to join the "20% Club" of the International Council for Local Environmental Initiatives (ICLEI). The 20% Club is a group of municipalities around the world that have made a commitment to reducing their greenhouse gas emissions by 20% from 1990 levels. The advantage of joining the 20% Club is that the City would be able to obtain support from ICLEI, and better share information with similar municipalities that are implementing greenhouse gas reduction initiatives.

6.2 Land Use and Transportation

*Recommendation 4) Continue to encourage infill development, particularly in Central and South Revelstoke. Foster non-automotive modes of transportation and gradually restrict parking in the Central Business District [**City**, Revelstoke Economic Development Commission, Revelstoke Chamber of Commerce].*

The Official Community Plan and recent initiatives in the community provide strong support for maintaining a compact urban area and fostering the use of non-automobile modes of

transportation. For example, infill development is encouraged over expansion of peripheral natural areas. (OCP 1.4) Complimenting this is the policy to encourage retail and service-oriented commercial uses in the Central Business District (OCP 11.3). Another policy encouraging a more compact urban form states that "accessory uses [shall] be permitted within all residential development areas". (OCP 10.10) These policies are synergistic since they support reduced automobile dependence as well as encourage development within the proposed distribution area for the district energy system.

The OCP also includes several references to fostering use of alternative modes of transportation to the automobile. One of the objectives under transportation is to "manage demand for automobile use as the primary mode of transport through emphasizing alternative means including walking, cycling, and public transit" (OCP 4.2). Specific initiatives cited in the OCP include the implementation of the Revelstoke Greenway, the undertaking of a Bicycle Route Network Study and review of pavement width standards, and the implementation of public transit service (OCP 4.4). The OCP also specifically mentions including parking for cyclists. (OCP 4.5) A policy to discourage automobile use for local trips is that "[o]ver the long term, it is Council's policy to reduce the number of required vehicle parking spaces as non-automobile modes of transportation become more prominent" (OCP 4.5). All of these policies support the community energy objectives.

6.3 Public Transit and Intercity Passenger Transportation

*Recommendation 5) Investigate the feasibility of increasing the frequency of public transit service to every 30 minutes during peak period times during the winter months and optimize the routing and scheduling of the service [**Revelstoke Bus Committee**, **B.C. Transit**, City].*

Currently local public transit has a poor frequency of service (once every hour). In addition, the routing of the service is intended to serve as many residents as possible, but this increases the travel time for passengers located near the ends of the bus routes. The infrequent service and indirect routing is only suitable for those with flexible schedules. During the summer months, the non-automobile modes of transportation that best meet the needs of the majority of people are walking and cycling. However, during the winter months, cycling is not feasible and walking is limited to shorter distances. Therefore, a seasonal strategy should be conducted to support better public transit service when it is needed most.

It is recommended that more shelters be included to protect waiting passengers from the natural elements. This becomes especially important if bus service is targeted to winter months. The shelters should also include bus

schedules for each particular bus stop to improve the convenience of bus service.

It is also recommended that the community investigate optimizing service and routing to reduce costs and increase ridership. This may be achieved by twinning two bus routes (e.g. Columbia Park to South Revelstoke and Big Eddy to Arrow Heights) and/or by having some overlap of routes within Central Revelstoke to improve frequency of service for those riders.

*Recommendation 6) Encourage the reintroduction of passenger rail service to Revelstoke and test the service on a pilot basis [**Revelstoke Economic Development Commission**, City, Community Futures Development Corporation, Tourism Coordinator, Via Rail, Rocky Mountain RailTours]*

Via Rail discontinued passenger rail service to Revelstoke in 1989 when it began using the CN Tracks between Kamloops and Jasper. Presently, most inter city travel is by automobile. The only other significant modes of transportation are small aircraft and inter city bus service provided by Greyhound Bus Lines. By displacing inter city automobile travel with some use of passenger rail service, energy consumption for transportation to and from the community would be reduced for the same amount of distance traveled. The train station is located adjacent to the CBD in a central location which is convenient for visitors and local residents.

Via Rail has shown some interest in reintroducing service. In addition, Rocky Mountain Rail Tours, which operates a luxury rail service, has been encouraged to stop in Revelstoke. The train would have to stop overnight so the company wants a guaranteed number of hotel rooms for passengers. There is also discussion underway for the possibility of another excursion train stopping in Revelstoke. Ideally the service would be priced and scheduled for use by both local residents and out-of-town visitors.

6.4 Location of Public, Government, and Other Large Buildings

*Recommendation 7) Add to OCP 13.6 the following criteria for the location of any new government offices, public facilities or large buildings to encourage utilizing the proposed district energy system and to support transit and cycling in the community [**City**, School District #19, Provincial and Federal Government]:*

<u>To encourage new government offices, public facilities, or large buildings to locate:</u>

- <u>on the district energy distribution system</u> [if it proceeds] [more important]; and
- <u>within 400 metres of a bus stop</u> [less important]; and
- <u>within 500 metres of a cycling route</u> [less important]

Council already has a policy to "encourage any new government offices locating in Revelstoke to seek a suitable location close to the community core" (OCP 13.6). This policy is entirely consistent with the objectives of the Community Energy Plan. However, the criteria for location can be made more specific to better support the energy objectives of the community energy plan.

6.5 Site Planning and Design

*Recommendation 8) If the Mt. Mackenzie ski hill development proceeds, incorporate energy considerations into the planning and design of the site at as early a stage in the process as possible. [**City**, ski hill developer].*

The only significant development that is potentially expected to occur in Revelstoke in the next 20 years is the Mt. Mackenzie ski hill. New development offers an excellent opportunity for incorporating energy considerations directly into the planning and design stages of the development.

6.6 Building and Infrastructure Design and Retrofits

*Recommendation 9) Conduct joint water/energy retrofits of residential buildings [**B.C. Gas, B.C. Hydro, local contractors**, City]*

*Recommendation 10) Conduct energy retrofits of municipal buildings and infrastructure and school district buildings. [**City, School District #19, prospective ESCOs**]*

Significant energy and cost savings, as well as opportunities for creating local jobs, were identified in this report as a result of retrofitting residential and institutional buildings and infrastucture. These benefits provide a strong rationale for establishing a residential retrofit industry in Revelstoke. Golden was one of the first communities in B.C to receive detailed energy audit training for local housing contractors. Their expertise could be easily transferred to the Revelstoke community.

Energy retrofits can be conducted concurrently with water retrofits to deliver these services efficiently. This has been done in a number of other B.C. municipalities.

Recommendation 11) Adopt the National Energy Code for Houses. [City (including Building Inspector), local contractors, NRCan]

The National Energy Code for Houses has been shown to be cost-effective on a life-cycle basis. Training material for the City's Building Inspector and local contractors will soon be available which greatly simplifies learning the new provisions.

6.7 Energy Supply

*Recommendation 12) Encourage the development of a wood waste fueled district energy system. [**Ward Kemerer and Ian Rowe, City**, Columbia Basin Trust, Columbia Power Corporation, NRCan].*

The Revelstoke District Energy study conducted by Ward Kemerer and Ian Rowe indicates that Case #2 was economically feasible and had the highest internal rate of return. Benefits of the district energy system include eliminating the need to burn waste in polluting wood waste burners or to landfill the wood waste, reducing particulate emissions, and creating local jobs.

6.8 Coordination, Education, Information Sharing, and Monitoring

*Recommendation 13) Establish a Revelstoke Energy Initiatives Committee (or include the responsibility under an existing Committee) that is responsible for coordinating and overseeing the implementation of the Community Energy Plan and the dissemination of energy-related information [**City**]. The coordinating body should include the City's Planner, Supervisor of Public Works, and Building Inspector, a Council member from the Advisory Planning Committee, and the Revelstoke Economic Development Commissioner.*

It is essential to have a coordinating body that is responsible for overseeing the implementation of the community energy plan to ensure

*Recommendation 14) Disseminate energy saving information to households and businesses, including fact sheets [**City,** B.C. Hydro, B.C. Gas, NRCan].*

The awareness and support of the community and large energy users is essential to implementing successful energy initiatives.

*Recommendation 15) Share information and experiences with nearby municipalities, particularly the City of Kamloops [**City**, Columbia Basin Trust].*

Revelstoke does not have the resources to implement all aspects of the Community Energy Plan on its own. Therefore, it should utilize resources from outside the community to facilitate the implementation of the energy plan. The nearby City of Kamloops developed and adopted its own Community Energy Plan in 1997. Kamloops has an Energy Management Committee to coordinate the implementation of their plan. Revelstoke should contact the Kamloops Energy Management Committee to see what information, resources, and experiences can be shared.

*Recommendation 16) Regularly monitor implementation of the Community Energy Plan and the performance of energy indicators. [**City**]. It is suggested that a short report on the implementation of the community energy plan be prepared annually. Every five years, the community should conduct a detailed review of the energy plan, including updating the indicators and comparing them to the 1996 baseline and the targets that were set for the energy objectives.*

In order to evaluate the performance of the community in moving towards its energy objectives and targets, it is necessary to monitor the implementation of the plan and the impact on the indicators.

With the implementation of these recommendations, in conjunction with past successful initiatives such as the community forest, Revelstoke will be well on its way to becoming a model sustainable community.

7. Appendix A – Community Profile Details

7.1 Industry and Employment

The economy of Revelstoke is closely related to its natural resource base, strategic location on the C.P. Railway and the Trans-Canada Highway, and its extraordinary natural setting. Employment in the area breaks down into roughly four equal parts:

- transportation, including C.P. Rail and highway-related employment.
- the timber industry, including Downie Street Sawmills.
- the tourism and hospitality sector.
- the remaining private sector agencies, including B.C. Hydro, and public sector agencies.

While most of the employment is located in the City, the natural resource based nature of the economy has some employment opportunities located in its hinterland. Some of the larger employers located outside the city which may include employees living in Revelstoke include:

- B.C. Hydro at Revelstoke Dam (located 4 km north of Revelstoke),
- Selkirk Natural Spring Water (located 40 km east of Revelstoke),
- Canyon Hot Springs (located 35 km east of Revelstoke),
- Three Valley Gap (located 19 km west of Revelstoke),
- Parks Canada (with some employees working at Mount Revelstoke and Glacier Natural Parks and at Rogers Pass), and
- various logging and silviculture operations in the area.

7.2 Profile of Neighbourhoods

Revelstoke is a very centralized City. Most of the dwellings, commercial, recreational and institutional facilities and services are located in Central Revelstoke. See **Figure 7-1** for a map of neighborhoods. Approximately 37% of the dwellings, 50% of the jobs (estimate) and 62% of the commercial floor space are located in Central Revelstoke. Central Revelstoke also has the smallest average lot size in the city at a little under 5,900 square feet.

Table 7-1 shows a profile of dwellings and employment by neighbourhood, grouped into three areas: compact, outlying, and fringe areas.

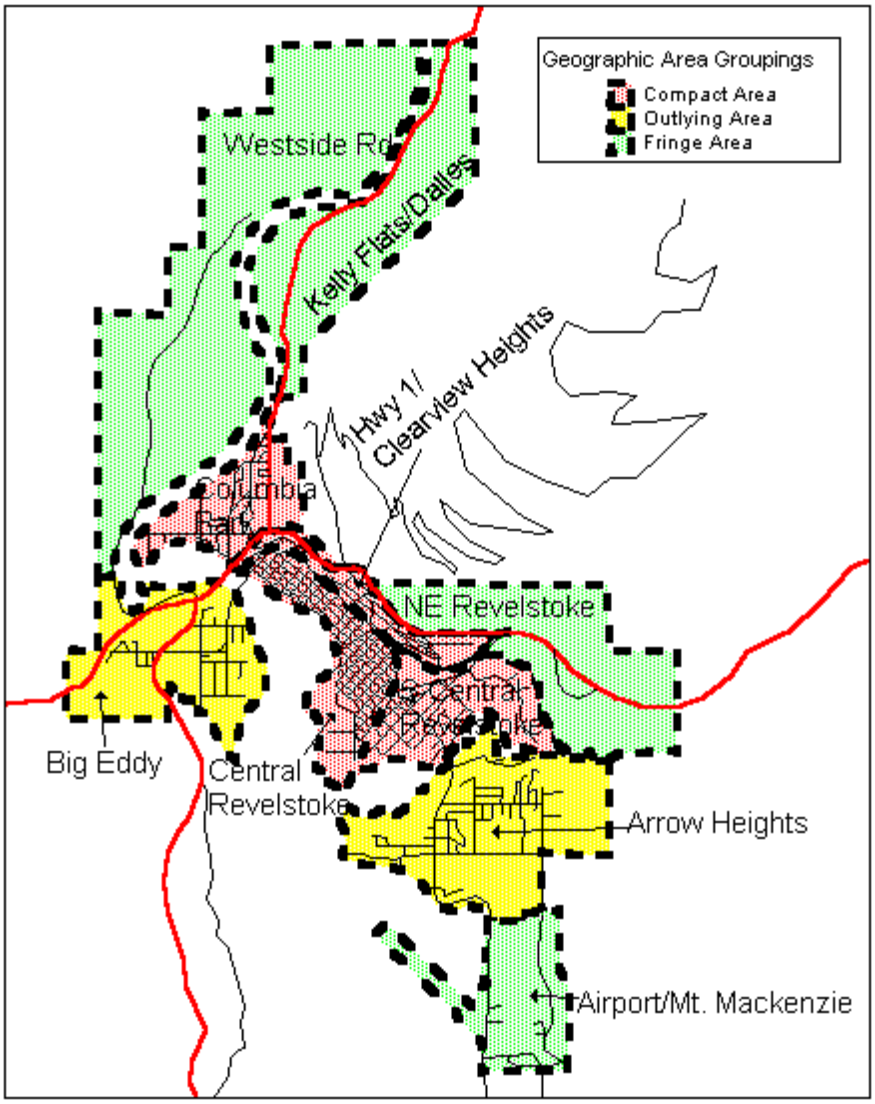


Figure 7-1; Map of Neighborhoods in Revelstoke (Sheltair Defined)

The compact area of Revelstoke was defined to include Central Revelstoke, South Revelstoke, Columbia Park, Clearview Heights, and the Highway 1 corridor adjacent to Central Revelstoke. This area comprises 76% of the total dwelling units, 78% of the jobs and about 86% of the commercial floor space. The high proportion of trip origins and destinations in this area, combined with the compact nature of development, support walking, cycling, and other self-propelled transportation modes in good weather. The population density of the compact area was estimated at 3.5 units per gross ha. The employment density was estimated at 3.9 jobs per gross ha. The job to housing balance was estimated at 1.12.

The outlining area of Revelstoke was defined to include Arrow Heights and Big Eddy. These areas comprise 23.4% of the total dwellings units. The population and employment densities are much lower than in the compact area. As these areas are both on septic systems, average lot sizes are much higher at 28,750 sq ft and 37,680 sq ft for Arrow Heights and Big Eddy respectively. The Illecillewaet and Columbia Rivers

separate Arrow Heights and Big Eddy from the compact area. These areas are connected by one bridge over the Illecillewaet River (with a separated lane for cyclists and pedestrians) and three bridges over the Columbia River (Trans Canada Highway Bridge, C.P.R. Bridge, and the single lane Big Eddy Road Bridge which has a separated lane for cyclists and pedestrians).

The fringe area of Revelstoke was defined to include Northeast Revelstoke, the Airport, Mt. Mackenzie ski hill area, Kelly Flats/Dalles, and the Westside Road area. This area has less than 1% of the dwelling units and also was estimated to comprise less than 1% of employment in the City.

Table 7-1: Profile of Dwellings and Jobs by Neighbourhood (Sheltair Defined) for City of Revelstoke - 1996

Neighbourhood or Sub-Area	Area (ha)	Dwelling Units (units)	% of Total Dwelling Units	Dwelling Unit Density (units/ha)	Avg. SFD Lot size (sq. ft.)	Number of SFD Units (units)	Jobs	% Total Jobs	Jobs Density (Jobs/ha)	Ratio of Jobs to Housing	% of Total Commercial Floor Area
Compact Area											
Central Revelstoke	194	1,116	36.5%	5.74	5,881	703	1,670	49.5	8.59	1.50	61.5%
S Central Revelstoke	205	646	21.2%	3.15	12,589	328	219	6.5%	1.07	0.34	9.2%
Hwy 1/Clearview Heights	96	54	1.8%	0.56	29,447	49	406	12.0	4.22	7.52	1.8%
Columbia Park	175	516	16.9%	2.94	16,901	354	322	9.5%	1.84	0.62	14.0%
SUBTOTAL	**671**	**2,332**	**76.4%**	**3.48**		**1,434**	**2,617**	**77.5**	**3.90**	**1.12**	**86.4%**
Nearby Outlying Area											
Arrow Heights	429	460	15.1%	1.07	28,750	417	275	8.1%	0.64	0.60	1.6%
Big Eddy	324	255	8.3%	0.79	37,679	116	423	12.5	1.31	1.66	12.0%
SUBTOTAL	**753**	**715**	**23.4%**	**0.95**		**533**	**698**	**20.7**	**0.93**	**0.98**	**13.6%**
Fringe Area											
NE Revelstoke	391	7	0.2%	0.02	4,356	1	6	0.2%	0.02	0.86	
Airport/Mt. MacKenzie	218	0	0.0%	0.00	0		26	0.8%	0.12	0.00	
Kelly Flat/Dalles	394	0	0.0%	0.00	0		0	0.0%	0.00	0.00	
Westside Rd	879	0	0.0%	0.00	0		30	0.9%	0.03	0.00	
SUBTOTAL	**1,882**	**7**	**0.2%**	**0.00**		**1**	**62**	**1.8%**	**0.03**	**8.86**	**0.0%**
TOTAL	**3,306**	**3,054**	**100.0%**	**0.92**	**16,466**	**1,968**	**3,377**	**100**	**1.02**	**1.11**	**100.0%**

7.3 Motor Vehicle Stock and Transportation Modes Available

Table 7-2 presents a breakdown of vehicles by vehicle type and fuel type for all registered vehicles in the Revelstoke area.

Table 7-2: Breakdown of Vehicles by Vehicle Type and Fuel Type

			Breakdown by Vehicle Type and Fuel Type			
	TOTAL VEHICLES	TOTAL IN PERCENT	Passenger (%)	Commercial (%)	Motorcycle (%)	Motorhome (%)
Diesel	843	5.9%	0.9%	14.0%	0.0%	1.3%
Gasoline	11,221	78.2%	82.6%	71.8%	75.1%	88.3%
Propane	94	0.7%	0.3%	1.3%	0.0%	2.2%
Gasoline-Propane	19	0.1%	0.0%	0.3%	0.0%	0.4%
Other	15	0.2%	0.1%	0.5%	0.0%	0.4%
Unknown	2,160	15.1%	16.3%	12.4%	24.9%	7.6%
TOTAL VEHICLES	14,352	100.0%	7,947	5,504	678	223

There were approximately 6,151 vehicles licensed in Revelstoke as of December 31, 1995, which may also include some licensees from outside the municipal boundaries. Of these, 2,782 were passenger vehicles and 2,279 were commercial vehicles. Standardizing these numbers to the population indicates approximately 327 passenger vehicles per 1,000 persons in Revelstoke. This compares to an average of 419 passenger vehicles per 1,000 persons in B.C. For commercial vehicles, Revelstoke had 268 vehicles per 1,000 persons compared to the B.C. rate of 146 vehicles per 1,000 persons. This number may be higher than the BC average due to the natural resource base nature of the economy. Some of the commercial vehicles may also double as passenger vehicles for some businesses.

The dominant fuel in the fleet of vehicles is gasoline. Less than 0.5% of all passenger vehicles licensed used fuels other than diesel or gasoline. Approximately 14% of the commercial fleet used diesel and about 2% used fuels other than diesel or gasoline, such as propane.

For passenger travel, there are several other modes of transportation available besides the private automobile, including public transit, cycling, and walking. Cycling and walking are particularly feasible because of the small size and compact nature of the community which reduces transportation distances. In addition, the terrain is relatively flat and the weather is suitable for cycling and walking for approximately 8 months of the year (City of Revelstoke 1996). Central Revelstoke is very well-suited to walking and cycling as it has sidewalks on most streets for pedestrians and is oriented in a grid pattern.

There is some cycling infrastructure in place including separate bike lanes over two of the bridges, a cycling connector path under Highway 1 that links Columbia Park with Central Revelstoke, and a recreational path along the Illecillewaet River. There are also bike racks in the downtown area which encourage cycling. In 1997, the City applied to the B.C. Cycling Network Program under a cost-sharing arrangement to develop additional cycling routes. This initiative, described in the Revelstoke Greenway Plan, is part of the implementation of a multi-use urban trails network for commuter, utilitarian, and recreational purposes. It envisions 35 kilometres of pathways linking all areas of the City, including off- and on-street pathways.

In October, 1995, B.C. Transit and the City of Revelstoke introduced an 18 passenger minibus with service everyday except Sundays. During weekdays, the bus provides eight trips a day between Arrow Heights and Central Revelstoke via South Central Revelstoke, six trips a day between Columbia Park and Central Revelstoke, and five trips a day between Big Eddy and Central Revelstoke. The best frequency of service is once every hour, therefore the service is primarily intended for unable to drive such as the elderly and youth. The service receives increased ridership in the winter months which coincides with heavy snowfall accumulations that make walking and cycling difficult. Based on revenue information in 1996, the average number of rides is 75 per day. Taxi service is also available in Revelstoke. For elementary and high school students, there is a school bus service available.

7.4 Proximity of Dwellings to Frequently Visited Trip Attractions

Within Revelstoke, there are many public facilities and commercial areas that attract a large number of trips. Some of the key trip attractions within the City limits include the central business district, grocery stores, the elementary and secondary schools, the community centre, library, post office, Centennial outdoor pool, Forum ice arena and curling rink, and the municipal parks. The percentage of dwelling units within a certain distance, or proximity, of these trip attractions provides an indication of the average length of trip and the feasibility of walking or cycling to these destinations.

Each dwelling unit in the city was rated by its proximity to the above trip attractions, as well as to a bus route or bike path. Each of these destinations or features was assigned a certain number of points based on its relative importance to attracting trips in the City.

Figure 7-2 shows a map of each of the dwellings classified by its proximity score. As most of the trip attractions, such as the community centre, pool, ice arena/curling rink, library, high school, and post office, are located in Central Revelstoke, these dwellings have the highest average proximity scores at 12.7. Dwellings located in South Revelstoke and Clearview Heights have the next highest average proximity scores at 9.53 and 10.1 respectively. The average proximity scores for the remaining areas were

4.6 for Big Eddy, 4.2 for Columbia Park, 2.3 for Arrow Heights, and 0 for Northeast Revelstoke. As the B.C. Assessment Authority did not include dwellings located in the Airport/Mt. Mackenzie area, there is no average proximity score calculated for that area.

Table 7-3 shows how points were assigned to derive the proximity score for each attraction and feature. A penalty score is assigned to dwellings if there is a major barrier, such as a highway or river, located between the dwelling and the central business district. The maximum number of points a dwelling can score is 17 and the minimum is -1 points. The average proximity score for dwellings located in the City of Revelstoke using this point system was 8.2.

The table also includes the percentage of dwelling units in Revelstoke that satisfy the indicated distance or other specified criteria. For example, the dwellings located within 400m or between 400 and 800m of an elementary school were assigned 2 or 1 points respectively. Over 31% of dwellings were located within 400m of an elementary school, with this increasing to almost 89% when the distance criteria are increased to 800m. The high percentage of dwelling units falling within the specified distance of the elementary schools, as well as the municipal parks, show that they are well distributed geographically.

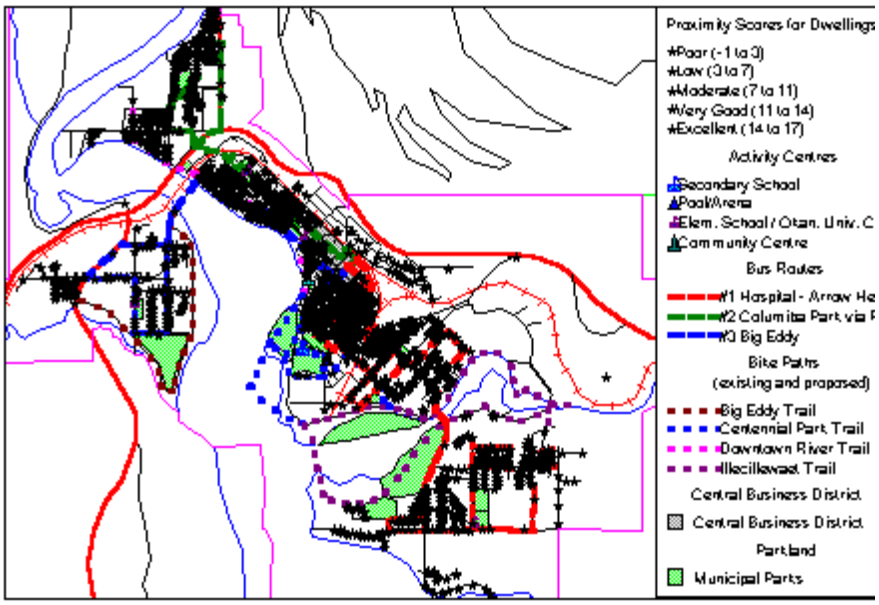


Figure7-2: Proximity of Dwellings to Trip Destinations

Table 7-3: Proximity Point System and Percentage of Dwelling Units Satisfying Criteria for Points

	Criteria (distance or other)	Points	Percentage of Dwelling Units Satisfying Criteria
Central Business District	<= 400 m	4	23%
	> 400 m and <= 800m	2	17%
	> 800m and <= 1600m	1	23%
	<= 800m	N/A	40%
	<= 1600m	N/A	63%
Grocery Store	<= 600m	2	61%
	> 600m and < =800 m	1	20%
	<= 800 m	N/A	81%
Elementary School	<= 400m	2	31%
	> 400m and <= 800 m	1	57%
	<= 800 m	N/A	88%
High School	<= 800 m	2	23%
	> 800 m and <= 1600 m	1	27%
	<= 1600 m	N/A	50%
Community Centre	<= 800 m	1	26%
	> 800 m and <= 1600 m	0.5	28%
	<= 1600 m	N/A	54%
Library	<= 800 m	0.5	26%
Post Office	<= 800 m	0.5	26%
Pool	<= 800 m	1	27%
	> 800 m and <= 1600m	0.5	23%
	<= 1600 m	N/A	51%
Arena	<= 800 m	1	27%
	> 800 m and <= 1600m	0.5	23%
	<= 1600 m	N/A	51%
Municipal Park	<= 800m	0.5	99%
Bike Path	<= 1000m	1	97%
Bus Route	<= 400m and service every 20-30 minutes	2	0%
	<= 400m and service >= every 60 minutes	1	97%
Barriers (between dwelling and CBD)	River or highway	-1	41%
	At grade rail crossing	-0.5	23%
	River, highway, or at grade rail crossing	N/A	64%

7.5 Land Use Profile

Figure 7-3 illustrates the breakdown of land in the developed portion of the city by zoning category. Together, transportation surfaces and single-family residential buildings and lots represent over 60% of land used in Revelstoke's developed areas.

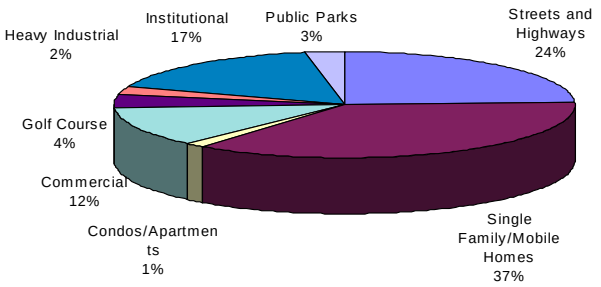


Figure 7-3: Breakdown of land use in Revelstoke

Land use in the City of Revelstoke was also classified according to ecological land use categories. This classification system is based on how land is appropriated for human consumption. Within the city's boundaries, land was classified into:

- degraded land, such as road surfaces which have been rendered biologically unproductive;
- garden land, such as yards and parks;
- agricultural land;
- and undeveloped land.

Table 7-4 shows the breakdown of land by the above ecological land uses. Streets and highways comprise the largest amount of degraded land at almost 250 ha, while single-family and mobile homes constitute the largest amount of garden land used at almost 30 ha.

On a per capita basis, 0.05 ha of land are degraded and 0.07 ha are classified as garden land.

Table 7-4: Land Use by Ecological Land Use Accounting Categories

Land Use Category		ly Degraded Lands [ie. buildings and	"Garden" Lands [ie. yards, parks, etc.] (ha)	TOTAL (ha)	Percent of Developed Lands (%)	Percent of All Lands (%)
Developed Lands	Streets and Highways	249	0	249	24%	8%
	Single Family/Mobile Hor	40	338	378	37%	12%
	Condos/Apartments	4	8	12	1%	0%
	Commercial	75	54	129	12%	4%
	Golf Course	0	39	39	4%	1%
	Heavy Industrial	25	0	25	2%	1%
	Institutional	26	147	173	17%	6%
	Public Parks	0	29	29	3%	1%
	SUBTOTAL	**420**	**615**	**1,035**	**100%**	**34%**
Resource Lands	Agricultural Classified			130	N/A	4%
	SUBTOTAL			**130**	**N/A**	**4%**
Undeveloped or Limi	Lands not in B.C.A.A. database			1,878	N/A	62%
Development Lands	**SUBTOTAL**			**1,878**	**N/A**	**62%**
TOTAL	**All Lands (Excluding Water)**			**3,043**	**N/A**	**100%**

8. Appendix B-Highest Energy Consuming Buildings in Revelstoke