Name: Harold Steves

Date: October 11, 2017

Subject: Presentation to BCUC

Attached please find my presentation on Energy Alternatives to Site C Dam plus attachments.

"Energy Alternatives" to the Site C Dam   Harold Steves, BScAg, City Councillor, Richmond, BC

1. "Can BC's farmers feed our growing population?"

B.C.'s Food Self Reliance, a 2006 report by the BC Ministry of Agriculture and Lands, says "Farmland with access to irrigation will have to increase by 92,000 hectares, or 49% over 2005 levels." (attachment 1 p2)

5% of BC is arable but only 1.1% is irrigated farmland fertile enough to grow vegetables and small fruit. It's mostly in the Fraser Valley and South Vancouver Island, both threatened by urban development, and in the Peace River threatened by the Site C Dam. In 1973 we produced 86% of our vegetables, today only 43%. The fertile irrigable Peace River farmlands are essential to help provide the 92,000 hectares necessary to feed our growing population in a time of climate change, food scarcity and food uncertainty.

2. Loss of carbon storage and sequestering:

The forested land of Site C plays a major role of storing carbon and the agricultural land is also a potential carbon sink. Using BC Hydro estimates forested and agricultural lands are capable of sequestering 70,000 tonnes of CO_2 per year. If the dam proceeds the carbon stored over the centuries will also be continually released at the rate of 75,000 tonnes per year. Instead of offsetting greenhouse gases, by putting excess power on the market, the development of Site C will set back the development of solar and other clean alternative energy sources.

Conclusion: The highest and best use for Site C is Agriculture and Forestry.

3. City of Richmond "Community Energy and Emissions Plan"

The City of Richmond's "Community Energy and Emissions Plan" (2014) outlines plans to provide community energy and reduce greenhouse gas emissions. Richmond's population is expected to grow by 80,000 people to 280,000 people by 2041. Richmond has adopted community wide energy and emissions targets to reduce GHG Emissions 25% below 2007 levels and Energy Use 11% below 2007 levels by 2041. Other Cities have similar plans which will result in a net reduction of energy needs in BC by 2041.

Projected Electricity consumption (GJ) **2007 0%** base (5,926,916 GJ)

2010 +1% increase (5,994, 400GJ);

2020 +2% increase (6,027,000GJ);

2041 -11% reduction (5,280 700GJ);

2050 -10% reduction (5,317,200GJ) (attachment 2)

The estimate for 2041 is based on a reduction of 896,800GJ due to energy efficiencies and Richmond's DEU and an increase of 41,600GJ due to change to EV transportation for a total reduction of 855,200GJ. (attachment 3)

4. “Lulu Island District Energy”

District Energy in Richmond is being developed by Lulu Island District Energy, a municipally owned District Energy Utility. The Alexandra DEU began operating in 2012 to serve 3,000 residents and 3.9 million sq ft of residential, commercial, office and institutional space. It is a geo-exchange system providing heating, cooling and hot water and replaces electric baseboard heaters in modern apartments. New buildings in the area are required to connect. The Oval DEU provides space heating and hot water to seven multifamily developments and will serve 2.7 million sq ft. Other major DEU projects being considered are North City Centre (8 million sq ft.) Main City Centre (6.3 million sq ft.) Existing multi residential buildings located close to high density development will connect to district energy systems. As Richmond densifies more DEU facilities will be added.

Richmond Community Energy and Conservation utilizes local energy sources rather than electricity, natural gas and vehicles using power from far away. Richmond is presently constructing a massive new recreational complex and a new main fire-hall, both with solar roof-tops. We are also investigating re-use of waste heat from wastewater and industrial facilities, more efficient technologies, retrofitting, insulation, power bars, heat recovery ventilators, community heat exchangers at swimming pools & rinks; solar hot water, geo-exchange, photovoltaic solar panels and micro-turbines. These actions support BC Hydro’s “mandate” to encourage conservation and to develop local alternative electricity sources that reduce the burden on the Provincial generation and transmission system. We don’t need excess power from site C.

Richmond is investigating the effectiveness of solar thermal systems on single family dwellings and considering giving incentives for solar air heating and ventilation. A recent condominium complex added $12,000 for rooftop solar to the cost per $800,000 condominium. City staff estimate that solar costs and hydro costs will be equal in 5 to 10 years. However, when loss of food security and forest sequestering, plus flooding of habitat and First Nations Lands are factored in, costs are equal now. If built, Site C will be obsolete in 5 to 10 years.

5. BC Building Code, “Net Zero Ready”:

An improved BC Building Code by the BC government has established targets to improve the energy efficiency of commercial and residential buildings, including “Net Zero Ready” by 2032. Increased densification of buildings will result in lower residential building energy consumption. Buildings of the future will provide their own energy. Why would BC Hydro and Site C want to hold back changes recommended in the BC Building code?

Richmond estimates that by 2025 all new buildings will be “Net Zero”. With energy price swings, owner awareness, and demographic turnover of housing stock by 2050 most existing buildings will have had major renovations that dramatically reduce their external energy needs and carbon emissions.

6. “Metro Vancouver Community Energy”

Community Energy in Metro Vancouver can produce twice the power of the Site C Dam. The “Illustrated Guide To Community Energy” produced by Dr. Stephen Sheppard and a group of UBC scientists, has analyzed the potential for energy alternatives in Metro Vancouver. Additional maps are provided online at C.A.L.P showing the best potential locations for energy alternatives in the region. (attachment 4))

Alternative Sources Of Energy include:

Roof-Top Solar -generating enough power for 900,000 households,

Run-Of-River – 7,500 households;

Industrial Heat Recovery – 7,500 households;

Livestock biomass – 17,000 households;

Forest Biomass – 26,000 households;

Existing Metro Vancouver Waste To Energy – 16,000 households;

Richmond Geo-Exchange - 12,000 households, increasing as Richmond densifies.

Total Metro Energy Alternatives : 986,000 Households.

Total Site C power : 450,000 Households

Metro Vancouver is capable of producing twice as much power as the 450,000 households of power that Site C could produce. No additional transmission lines are required. Unlike Site C it is truly “clean” and green. It is time to embrace the future and leave outmoded mega-projects of the past behind. Site C is not the power of the future.

B.C.'s Food Self-Reliance

Can B.C.'s Farmers Feed Our Growing Population ?

B.C. Ministry of Agriculture and Lands

Context of Results

The attached report was conducted by the Ministry of Agriculture and Lands in 2006.

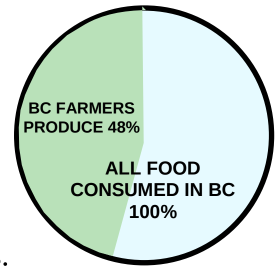
The goal of the study was to get a perspective on total food production and food self-reliance in the Province of British Columbia. The study used a methodology to estimate food self-reliance using farm gate production rather than wholesale value.

The report is an information piece, and does not necessarily represent current or future policy direction. The statistical data in the report is factual and will be used to develop benchmarks for further research and study by Ministry staff.

EXECUTIVE SUMMARY

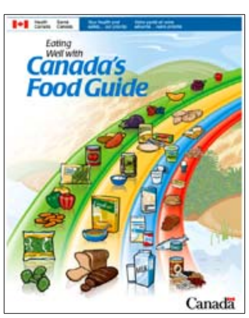
The question of food self-reliance is often raised at sustainable development planning exercises. Previous estimates of food self-reliance in B.C. have compared product flows at the wholesale level. The use of wholesale prices provides some insight into the planner's question, but it does not connect the food productive capacity to the resources in the province or the community that planners can influence. A more useful tool for sustainable development planners would be a link between food self-reliance and the resources they influence - land and water.

The general approach of this study is to estimate the food self-reliance in B.C. at the primary production level, and to use this information to examine the impacts of a change in eating habits and a change in population on the level of food self-reliance in B.C.



Production and consumption information from 2001 is used in the calculations.
It is estimated that B.C. farmers produce 48% of **all** foods consumed in B.C. and produce 56% of foods consumed that can be economically grown in B.C. The following table shows the level of self-reliance for the different food groups.

Food Group	B.C. Consumption Million Kg's	B.C Production Million Kg's	% Self-Reliant
Dairy	1080	617	57%
Meat & Alternatives[1]	467	298	64%
Vegetables - Grown in B.C.	764	331	43%
Fruit - Grown in B.C.	172	273	159%
Grain for Food	315	43	14%
Total - Grown in B.C.	2798	1562	**56%**
Fruit - Not Grown in B.C.	310		
Vegetables- Not Grown in B.C.	1		
Sugar	136		
Total - B.C.	**3245**	**1562**	**48%**



When comparing current production to recommended consumption by ***Canada's Food Guide to Healthy Eating***[2], B.C.'s food self-reliance drops to 34%. This is primarily because a healthy diet recommends a higher level of consumption of fruits and vegetables over actual 2001 consumption levels and fruits and vegetables is a food group in which B.C. is not self-reliant[3].

[1] Alternatives includes pulses and nuts.
[2] Published by Health Canada. http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index_e.html
[3] While B.C. produces and exports a lot of fruit, B.C. still imports 3 times as much fruit as it exports.

Given the production technology available today, over half a hectare of farmland (0.524 ha) is needed to produce the food for one person for one year. This is roughly equivalent to 6 city lots. In order to produce a healthy diet for British Columbians, farmers need 2.15 million hectares of food producing land of which 10% (215,000 hectares) needs to be irrigated. In 2005 the Ministry of Agriculture and Lands estimated that approximately 189,000 hectares of farmland had access to irrigation.

To produce a healthy diet for the projected B.C. population in 2025, farmers will need to have 2.78 million hectares in production of which 281,000 will need access to irrigation. This means that to produce a healthy diet for British Columbians in 2025, given existing production technology, the farmland with access to irrigation will need to increase by 92,000 hectares or 49% over 2005 levels.

To maintain the current level of self-reliance through to the year 2025, farmers will need to increase production by 30% over 2001 levels. The increased production will be concentrated on the land that has access to irrigation – land that is typically near the urban centers.

OUTLINE

1. Background

The question of food self sufficiency is often raised at sustainable development planning exercises. The focus of food self sufficiency can be on a local area, a region or a province. The basic question behind the discussion of food self sufficiency can be framed as follows:

> 'What portion of the food consumed in a (local area, region, province) is produced in that area and, as the population grows, what is needed to maintain or expand the portion of food produced in that area? '

The term food self sufficiency can include an element of affordability. The question from the sustainable planning perspective is more related to capacity – what is our capacity to produce our own food? The term self-reliance has been used to better fit the sustainable development planning perspective.

The population in British Columbia is projected to grow by 30% from 2001 to 2025[4]. Over the same period the demand for food will experience a similar 30% increase. Some sustainable development planners are beginning to include food in sustainability considerations. The question they ask is `Can our farmers meet the increase in demand for food - can they continue to feed us?'

The answer to this question is complex. It depends on consumer demands, the level of production technology in the farming community, the availability of farmland and water for irrigation, the impact of global markets (imports and exports) and others. The ability to analyze the question is further challenged by the lack of complete and accurate data for all these elements.

Two previous studies on food self-reliance in British Columbia (Markham and Riemann)[5] looked primarily at the flow of products at the wholesale level. The advantage of this approach is that it captures food at the same point in the marketing channel and data for the main marketing channels is readily available. The disadvantages are:

- it captures a point in time, which can be influenced by large annual swings in production,
- it needs to account for imports and exports which adds an additional level of inaccuracy to the estimates,
- it does not consider yearling cattle produced in B.C. and shipped out of province for finishing,
- it does not account well for farm direct marketed products, and
- it does not consider the forage and grain inputs used for livestock production.

The use of wholesale value provides some insight into the planner's question, but it does not connect the food productive capacity to the resources in the province or the community where the planners are working. A more useful tool for sustainable development planners would be a link between food self-reliance and the resources the planners influence - land and water.

[4] Lower Mainland Employment Study; Coriolis Consulting, 1999
[5] Reference on pare 8.

2. Introduction

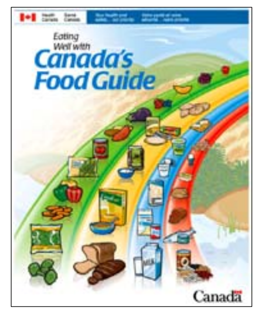
The goal of this study is to develop a methodology to estimate food self-reliance using farm gate production rather than wholesale value. This approach will provide a link between the food productive capacity of the province and the land base, water resources, and changing food needs of the population.

The results of the study will help answer the following questions:

- what is our current level of food self-reliance?
- what impact will a growing population have on our food self-reliance?
- what impact will changing food consumption patterns have on our food self-reliance?

The approach used in this study is different from previous studies in that it:

- examines primary production (farm gate) rather than wholesale value.
- uses land in production and average yields to estimate production rather than the value of production that reaches the wholesale level.
- estimates the amount of land needed for self-reliance now and in the future.
- compares production to both actual consumption and the recommended consumption according to ***Canada's Food Guide to Healthy Eating.***



Using farm gate production eliminates some of the challenges of the wholesale value approach. Specifically it:

- eliminates the need to address imports and exports as they net out (on a weight basis) in the production approach,
- captures all the direct market sales by capturing the production,
- includes the weight of all yearling calf production in B.C., and
- includes forage and grain production required for livestock feed.

An added benefit of using farm gate production as compared to wholesale value is that food production can be connected to farmland. Connecting food production to the land base provides the opportunity to explore the impacts of changes in population and production technology on the land needs for the future, and enables policy makers to better understand the impacts of land use policy decisions on B.C.'s food self-reliance.

The methodology can examine the impact of production technology (through improved yields), however, that analysis is beyond the scope of this study. For the analysis and discussion of the impacts of population growth in this study, it is assumed that food production technology is held constant.

3. General Approach

The general approach of this study is to estimate the food self-reliance in B.C. at the primary production level. An important consideration was to structure the analysis so that it could be repeated in the future. The majority of the data used is obtained from Statistics Canada. For this report the 2001 census data was used. Specific references are included in the bibliography in Section 9.

A number of data challenges were identified in Sections One and Two. They include: accounting for cross border food product flows, estimating production, accounting for forage and feed grain for livestock production, and considering the responsiveness of food production to market pressures. The following paragraphs outline how these challenges were addressed.

Cross-Border Food Product Flows

Commodities that are produced in B.C. for trade create a challenge when analysing food self-reliance at the wholesale level. For example B.C. produces high quality greenhouse tomatoes that are sold to the U.S while at the same time it imports less expensive field tomatoes from California. Estimating farm gate production directly eliminates the need to use imports and exports to estimate what portion of the wholesale value is produced in B.C. The wholesale value approach will also tend to overestimate B.C. production on a weight basis as B.C. tends to export high value tomatoes and import lower value tomatoes[6].

B.C. yearling cattle are often sold to Alberta where they are fed for a period of time before slaughter. Some of this meat is shipped back to B.C. for consumption. In this study, for calves finished out of province, the calf to yearling stage of production in B.C. was added to B.C. production.

Estimating Production

Estimating production poses the challenge of capturing the growing farm direct market sales, and adjusting for unusually large or small crops in the study year. These two challenges are addressed by estimating the area of production and multiplying by an average or standard yield. The advantage of this approach is that it smoothes production spikes, includes production for farm direct sales, and better estimates B.C.'s production 'capacity'. It may, however, overestimate production in some areas where farm management practices vary significantly, i.e. forage and pasture management on small acreages.

[6] This means that $10 of exports may relate to 5 lbs of tomatoes exported while $10 of imports may relate to 10 lbs of tomatoes imported.

Inputs for Livestock Production

Forage and grain inputs are required to feed livestock in order to produce meat, eggs and dairy products. B.C.'s ability to meet the feed requirements of these animals is included in the analysis of food self-reliance.

Other Considerations

Agricultural land produces more than just food, and food also comes from B.C.'s ocean and rivers. The focus of this study was to connect the land based food production to the land. The food self-reliance was estimated with and without seafood, and the non-food agriculture production is also estimated.

The soils and climate in B.C. can support the production of many food products, however, some popular foods such as bananas, some vegetables and citrus fruit cannot be produced economically in B.C. Self-reliance is calculated for foods produced in B.C. and also when including foods not normally produced in the province.

4. Other Studies

There has been limited work done on addressing the issue of food self-reliance in a large regional area. Much of the work examining the term `food self sufficiency' involves providing food to disadvantaged groups, looking at very small regional production areas and including consideration for food prices.

Two studies have looked at food self-reliance in B.C., Markham (1982)[7] and Riemann (1987)[8]. Van Bers (1991)[9] did a future estimate of self-reliance in 5 provinces for the year 2031 and Warnock (1982)[10] did a less rigorous estimated of self-reliance in 1982. The results are summarized in Table 1:

[7] Markham, Roe. *Supply and Demand Balance in the B.C. Food Sector: A Statistical Analysis.* ARDSA Project No. 271304. (1982).
[8] Riemann, Walter. The B.C. Food Balance. B.C. Ministry of Agriculture and Fisheries (1987).
[9] Van Bers, C.1991. Sustainable Agriculture in Canada : a scenario of the future. M.A. Thesis, University of Waterloo, ON
[10] Unpublished report – no longer available

Table 1	**Summary of Self-Reliance Estimates of Previous Studies in BC**					
	1975	**1978**	**1980**	**1982**	**1984**	**1985**	**2031**
Markham	51%	53%	56%				
Warnock				47%			
Reimann					69%	73%	
Van Bers							< 50%

Both Markham and Riemann looked at foods produced in B.C. and used the wholesale value of production and consumption. Looking at wholesale value ($) as compared to quantity (weight) will tend to increase the estimated level of self-reliance because:

- B.C. tends to produce more high value to weight products (e.g. more meats as compared to vegetables), and
- B.C. produces more high value products within commodity groups. For example B.C. produces more greenhouse vegetables relative to field vegetables, and more fluid milk relative to industrial milk.

The main difference between Markham's and Riemann's results are their estimates for red meats – Markham estimated roughly 25% self-reliance while Riemann estimated 49%. The different estimates are primarily the result of Riemann considering the B.C. contribution of yearling cattle to the Alberta feedlots, while Markham did not.

Warnock concluded that BC was 47% self-reliant and that to maintain this level would require a 40-60% increase in production to the year 2000. The complete paper was not available[11].

Van Bers (1991) conducted a futuristic estimate of food self-reliance for 5 Canadian provinces in 2031. The study looked at food groups but excluded meat and animal feed. The estimates for B.C. are shown below in Table 2:

Table 2	**Van Bers - Self-Reliance Estimates for B.C. - 2031**
Vegetables	23%
Fruit	25%
Grain – Food	86%
Grain – Feed	16%
Forage / Hay	69%

Van Bers estimate suggests a total level of self-reliance at or below the other studies.

[11] The author was contacted and indicated it was not a very rigorous study

5. Results

This section summarizes the results of the two approaches taken by this report to estimate food self-reliance in B.C.

Table 3 summarizes the results for the comparison of actual consumption to B.C. production in 2001. Table 4 is a summary of the comparison of consumption as recommended by the ***Canada' Food Guide to Healthy Eating*** to B.C. production in 2001.

Production Compared to Actual Consumption

The estimates in Table 3 separate the foods that are grown in B.C. from the foods that are not grown in B.C. Fish is considered separately. Feed and forage needs for the production of meat and dairy are estimated. Both are noted at the bottom of Table 3 for interest.

These results are consistent with previous studies and with the prevailing perceptions in industry and government agencies[12]. Self-reliance estimates on a commodity basis are presented in the detailed data sheets in Section 9.

Table 3 Summary of Comparison of Food consumed in B.C. and Food Produced in B.C.

Food Group	B.C. Consumption Million Kg's	B.C Production Million Kg's	% Self-Reliant
Dairy	1080	617	57%
Meat and Alternatives	467	298	64%
Vegetables - Grown in B.C.	764	331	43%
Fruit - Grown in B.C.	172	273	159%
Grain for Food	315	43	14%
Total - Grown in B.C.	**2798**	**1562**	**56%**
Fruit - Not Grown in B.C.	310		
Vegetables- Not Grown in B.C.	1		
Sugar	136		
Total - B.C.	**3245**	**1562**	**48%**
Fish	38	179	471%
Forage and Feed Grain	3538	3795	107%

If fish is added to the land based production it would raise the self-reliance on products produced in B.C. from 56% to 61% and total food from 48% to 53%

[12] Anecdotal evidence from the author's interactions with other agencies indicates there is a general perception that B.C. is roughly 50% self-reliant in food production.

While the level of feed and forage production meets the input needs of the industry on a weight basis, it does not meet the needs on a grain/forage ratio basis. Currently the horse industry uses over 200 million kilograms[13] of forage per year that is not part of food production and the poultry, dairy and hog sectors use more grain than is produced in B.C.

The dairy sector has recently received a higher relative allocation of the national milk quota so it is likely that self-reliance in dairy food products will be higher in 2006.[14]

Production Compared to Consumption Based on *Canada's Food Guide to Healthy Eating*

Canada's Food Guide to Healthy Eating makes recommendations in `servings per day'. For a comparison to actual production, production had to be converted to servings per day. Table 4 shows the actual and recommended consumption in servings per day and compares them to actual production in servings per day.

Table 4 Summary of Food Guide Recommendations with Food Produced in B.C.

Food Group	Daily Servings (consumption)			Home Grown Production Million Kg's	Home Grown Production as % of Recommended (Food Guide)	Home Grown Production as % of Consumption
	Food Guide	Actual	Actual as % of Food Guide			
Dairy	2.87	2.23	78%	1.28	45%	57%
Meat & Alternatives	2.25	2.37	105%	1.49	66%	64%
Fruits	3.75	.75	20%	1.47	39%	159%
Imports [15]		1.18	31%			
Vegetables	3.75	2.91	78%	1.6	41%	43%
Grain - Food	8.5	9.8	115%	1.3	15%	14%
Total	**21.12**			**7.14**	**34%**	
Fish	.25	.25	100%	1.09	436%	

Canada's Food Guide to Healthy Eating recommends higher consumption of dairy, fruit and vegetables and lower consumption of meat and grains than is currently consumed in B.C.

Imported fruits have been included (tan colour) in the comparison of British Columbians' actual consumption to the recommended consumption. Combining the locally grown fruit (20%) and import fruit (31%) totals actual consumption of 51% of the Food Guide recommendation for fruits.

When looking at the foods we produce, a shift to the recommended healthy diet by all British Columbians would reduce our food self-reliance to 34%.

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[13] Ministry of Agriculture Fisheries and Food, *B.C Horse Industry in the 1990's*. 2000

[14] This may reduce self-reliance in forage production, however, it will depend on how and where the increased production occurs.

[15] This may reduce self-reliance in forage production, however, it will depend on how and where the increased production occurs.

6. Discussion and Implications

6.1 Trends in Food Self-Reliance

While it is difficult to summarize across studies that use different methodologies, the various analysis of B.C.'s food self-reliance indicate B.C. is at best maintaining past levels of self-reliance. Previous studies, most focusing on products B.C. farmers produce, have estimated self-reliance between 47% and 73%. The estimate of 56% in this study is in that range.

Self-reliance in supply managed[16] commodities was limited in the 1980's and 1990's by a national policy of allocating quota on historical population distributions. B.C. producers have recently been given additional quota based on actual population so the level of self-reliance will likely increase in these sectors in 2006 – particularly in dairy.

The population of B.C. has increased 82% from 1971 to 2001. Agriculture (including non-food) output, adjusted for inflation, has gone up 114 %[17] over the same period. Farm output[18] has been able to grow along with an expanding population to meet market demand. How long B.C. farmers can continue to meet this growing demand for food is uncertain.

6.2 Land Needs for Self-Reliance

The methodology used in this study connects the food production to the land base. This provides the opportunity to estimate the land needed to produce food for British Columbians today and in the future.

Table 5 is a summary of the land needed to produce a healthy diet for one person. It is important to recognize that some foods can only be economically produced on land that is irrigated[19]. Land that needs to be irrigated is noted in green and includes fruit, vegetable and dairy production.

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[16] Production of dairy and poultry products in B.C. are regulated under the Natural Products Marketing Act. The Act limits imports and allocates production (supply) in B.C.

[17] Statistics Canada Census of Agriculture adjusted by the CPI for food.

[18] Farm output includes non-food agriculture such as floriculture and nursery that have shown very high growth over this period.

[19] Farmland can be very broadly divided into land that does not have access to additional water (dry land farming) and land that has access to water for irrigation. Many crops, particularly fruits and vegetables need supplemental water to be economically grown in most of B.C.

Table 5	Hectares Needed to Produce a Healthy Diet for One Person				
	Servings /day	**Raw Weight/day**	**Raw Weight/Year**	**Yield/Ha/yr[20]**	**Hectares Needed (Irrigated)**
Dairy	2.87	718 g	262 L	13,000 L	.020
				Grain	.048
Meat	2.5	188 g	68.6 kg		.394
				Range[21]	
Grains	8.5	140 g	51.1 kg	1,750 kg	.029
Vegetables	3.75	225 g	82.1 kg	6.600 kg	.0177
Fruit	3.75	319 g	116 kg	9,600 kg	.0152
Total					**.471**
					.053

Combining the 0.471 ha of non-irrigated land with the 0.053 ha of irrigated land adds up to just over one half a hectare(0.524ha) of producing agriculture land is needed to produce a healthy diet for one person for one year. 10% of the land needs to have access to irrigation. In 2001, British Columbians needed 2.15 million hectares of food producing land to meet their food needs. 217,000 hectares of that land needed to be in the fruit, vegetable and dairy producing areas and have access to irrigation. By 2025, with similar production technology, British Columbians will need 2.78 million hectares of food producing land, of which 281,000 hectares would need access to irrigation, to meet their food needs. In 2005 the Ministry of Agriculture and Lands estimated that approximately 189,000 hectares of farmland in B.C. had access to irrigation.

In 2001 farmers in the fruit, vegetable and dairy producing areas reported irrigating 88,000 hectares - approximately 40% of what is needed for self-reliance. Interestingly, the estimated level of self-reliance in the sectors that need irrigation, dairy, fruit and vegetables, was 45%, 39% and 41% respectively – close to the proportion of reported hectares under irrigation[22].

6.3 Pressure on Agriculture Land

The study indicates that as population grows and the demand for food grows, major pressure on agriculture land will likely come in the form of:

- the need for more irrigated land in the fruit, vegetable and dairy producing areas, and
- the need for more broadly applied pasture/forage management practices.

[20] Farmland can be very broadly divided into land that does not have access to additional water (dry land farming) and land that has access to water for irrigation. Many crops, particularly fruits and vegetables need supplemental water to be economically grown in most of B.C.

[21] Farmland can be very broadly divided into land that does not have access to additional water (dry land farming) and land that has access to water for irrigation. Many crops, particularly fruits and vegetables need supplemental water to be economically grown in most of B.C.

[22] Some irrigated land is for forage production for beef operations and in a few small areas fruits and vegetables can be grown without irrigation

The largest self-reliant shortfall in B.C. is in fruit and vegetable production. To be economically viable, fruit and vegetable production in B.C. needs irrigation. In 2001 farmers located in the main vegetable, fruit and dairy producing regions reported irrigating approximately 40% of the land needed for food self-reliance.

If prices for imported fruits and vegetables begin to rise, there will be significant pressure to bring more irrigated farmland into production to meet local demand.

The estimate for animal feed and forage self-reliance is based on the assumption that all census farms are using good pasture management techniques - achieving average production levels of 75% of those achieved in forage trials. This is not always the case. To continue to achieve self-reliance in animal feed and forage production the management of pasture land, particularly on small parcels around the urban centers, will need to be improved.

6.4 Regional Considerations

Agriculture production in B.C. is regionalized. For example, grains and oilseeds are produced primarily in the north, beef ranching occurs mainly in the Interior, the majority of tree fruits are produced in the Okanagan, dairy is concentrated in the Fraser Valley and north Okanagan, and the major production area for small fruits and vegetables is in the Fraser Valley. These regional differences are primarily driven by climate and soil type. Regional production differences need to be considered when evaluating farmland needed to meet the food needs in B.C. For example for B.C. to expand small fruit and vegetable production it will need access to more farmland with irrigation in the Fraser Valley or Vancouver Island. If B.C. needs to expand tree fruit production it will need access to more farmland (with access to irrigation) in the Okanagan.

6.5 Production from Dry Land Compared to Irrigated Land

The table below further illustrates, in very general terms, the difference in production potential between dry land and irrigated land[23].

	Land Base ('000ha)	%	Sales ($million)	%
Farmed Land	2,587		2,224	
Dry Land Production	2,476	96%	1,328	60%
Irrigated Land Production	111	4%	896	40%

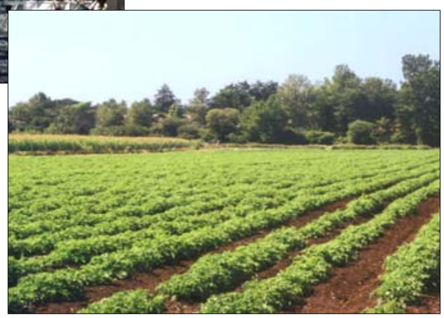
Commodities that normally use irrigation make up only 4% of the producing land while accounting for 40% of the farm gate receipts.

[23] Irrigated land from Census of Ag 2001. Irrigated land sales included field vegetable, all fruits, grapes, nursery and dairy. Indoor agriculture (poultry, hog, mushroom, greenhouse) that also needs access to water was not included. It appears that the methodology is effective as a broad indicator of the need for irrigation for food production.

6.6 Role of Greenhouses in Food Production

Greenhouse production technology is very efficient at producing certain food crops. For a specific commodity, greenhouse production on a square meter basis can be 20 times higher than field crop production. Currently only 3 major vegetable crops are produced in greenhouses - tomatoes, peppers and cucumbers and the products produced in greenhouses tend to be at the `premium' end of the price and quality spectrum. Greenhouse production currently meets 48% of tomato consumption, 150% of pepper consumption and 75% of cucumber consumption in B.C.

The limited number of food crops that can be economically grown in greenhouses in B.C. suggests that both greenhouse and field crop production are needed to meet the quantity and diversity of food needs in B.C.



6.7 Non-Food Production on Farmland

In 2001 the non-food sectors used 150,000 hectares of farmland to produce agriculture products. The sod, floriculture and much of the nursery production need access to irrigation.

Commodity	Hectares in Production
Nursery	42,077
Sod	837
Christmas Trees	6,018
Floriculture	3,000
Horses	100,000
Total	**151,932**

Floriculture greenhouse farms are averaged at 4 hectares in 2001[24] and the horse estimate is from the 1998 Horse Industry Survey.

Land in the Okanagan, Fraser Valley and Vancouver Island is capable of producing a wide range of food products, but the actual use of farmland is market driven. If the demand for food increases and production of specific food crops becomes more profitable for food production than non-food production, the land currently used for non-food production may shift from non-food to food crops.

[24] The number of floriculture producers was used with an estimate of 4 ha per farm.

7. Data Challenges and Future Considerations

A number of data challenges arose when doing this study. The author chose to use readily available sources so the study could be duplicated in the future. The more significant challenges were in estimating consumption statistics and estimating production yields.

Consumption Statistics

Consumption statistics are currently available on a national basis only. There are differences in food preferences between provinces that may affect the estimated food consumption on a provincial basis. Due to the ethnic make-up of B.C.'s population, certain foods are in higher or lower demand than in other provinces and may differ from the national reported amount. This affects the quality of consumption data for non-staple commodities, such as Chinese cabbage, mushrooms and goat meat.

Yield Estimates

The information used for the average yield estimates are not all from the same source. The method used was to first take the most reliable yield estimate provided by Crop Insurance[25], and then to use Ministry of Agriculture and Lands (MAL) planning budgets[26] to fill in the blanks. "Crop Insurance" estimates are assumed to be more accurate (updated) as the entity is paying out money based on these estimates. MAL planning budgets are considered a reliable source as the tool is designed by Ministry specialists to help planning initiatives for B.C. farmers. The issue is that some of the stated average yields are from older sources. Therefore, it is uncertain how reliable these estimates are given recent technology changes in the industry. The estimates used from planning budgets are published between 1988 and 2002 (publication dates vary on a commodity basis).

The two sources use different methods, as the yield estimates are used for different purposes. At this point the two sources are the most accurate information available.

Yield estimates are mostly based on production in the Fraser Valley and Okanagan regions. In addition, average yields differ for processing crops as compared to fresh market sales. This data is not available for all processing crops and for consistency purposes is ignored in this study. It should be noted that only a small percentage of B.C.'s crops go for processing.

A complete list of average yields for crops grown in BC would be an asset for future versions of this study. This data should take into account regional growing/management differences and crops for processing, as crops for processing typically have higher yields.

The estimated waste factors applied to food "Disappearance" data in "Food Statistics" are experimental. Likewise, the methods in which these factors are applied to estimated production are experimental.

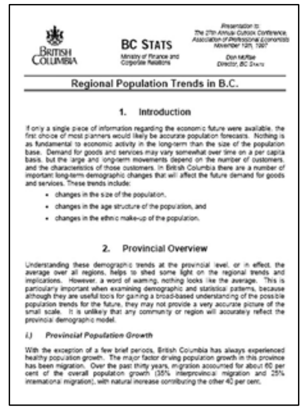
---

[25] The Crop Insurance program is a production insurance program for farmers of specific crops. Farmers pay an annual premium for coverage against crop failure. Payouts are based on `average yields'.

[26] Ministry of Agriculture and Lands did a series of planning budgets (*Planning for Profit*) for different crops and livestock. Part of the planning budget involves estimating production.

The weight per serving for fruits, vegetables and grain products are estimates. The USDA National Nutrient Database is a standard reference; however, matching difficulties between consumption, production, recommended consumption and the database do occur.

"Food statistics"[27] were first published in 1976, and similar studies have been done to note changes in consumer behaviour with the release of new health information. Insight could be gained on a provincial basis by comparing changes in BC production, since farmers typically alter production in response to consumer demand. Further analysis could also indicate how fast BC farmers can respond to changes in consumer behaviour.



British Columbia

BC Stats
Ministry of Finance and Corporate Relations

Presentation to:
The 27th Annual Outlook Conference,
Association of Professional Economists
November 19th, 1997

Don McRae
Director, BC Stats

Regional Population Trends in B.C.

1. Introduction

If only a single piece of information regarding the economic future were available, the first choice of most planners would likely be accurate population forecasts. Nothing is as fundamental to economic activity in the long-term than the size of the population base. Demand for goods and services may vary somewhat over time on a per capita basis, but the large and long-term movements depend on the number of customers, and the characteristics of those customers. In British Columbia there are a number of important long-term demographic changes that will affect the future demand for goods and services. These trends include:

- changes in the size of the population,
- changes in the age structure of the population, and
- changes in the ethnic make-up of the population.

2. Provincial Overview

Understanding these demographic trends at the provincial level, or in effect, the average over all regions, helps to shed some light on the regional trends and implications. However, a word of warning, nothing looks like the average. This is particularly important when examining demographic and statistical patterns, because although they are useful tools for gaining a broad-based understanding of the possible population trends for the future, they may not provide a very accurate picture of the small scale. It is unlikely that any community or region will accurately reflect the provincial demographic model.

i.) Provincial Population Growth

With the exception of a few brief periods, British Columbia has always experienced healthy population growth. The major factor driving population growth in this province has been migration. Over the past thirty years, migration accounted for about 60 per cent of the overall population growth (35% interprovincial migration and 25% international migration), with natural increase contributing the other 40 per cent.

Taking demographics into consideration in this study offers valuable information now and in the future. In a ten year period B.C. will see a major demographic shift. The major variables of the shift will occur as outlined in ***Regional Population Trends in BC***[28], are changes in the age structure, size and ethnic make-up of the population. Measuring these changes can help shed light on how B.C.'s food needs shift with demographics.

8. Methodology and Detailed Analysis

8.1 Consumption and Production Data

Per capita "food disappearance" and "actual consumption" is disclosed in Stats Canada's annual publication, "Food Statistics." Consumption data for 2001 is used in comparison to production data from the 2001 Census. Total B.C. food consumption is based on the reported population of B.C. for 2001 (3,907,740 persons).

Food Statistics refers to "Food Disappearance" as the amount of food available for consumption. B.C.'s food self-reliance, on a commodity basis, is the ratio of B.C. production to "Food Disappearance" data.

The amount of recommended food intake is the amount of food that is actually consumed rather than the amount of food available for consumption. To determine self-reliance on a food group basis, "Food Disappearance" data and B.C. production estimates are adjusted to account for food wastage. These adjustments produce comparable data to Health Canada's recommended food consumption. In "Food Statistics" the consumption data adjusted for food wastage is referred to as "Actual Consumption".

The waste factors used to calculate "Actual Consumption" account for retail, household, cooking and plate loss. The waste factors may vary from year to year. This study used waste factors on a commodity basis for consumption data averaged over three census years, 2001, 1996 and 1991.

[27] Statistics Canada Catalogue no. 21-020-XIE

[28] A publication of B.C. Stats, http://www.bcstats.gov.bc.ca/data/pop/pop/apebc97.pdf

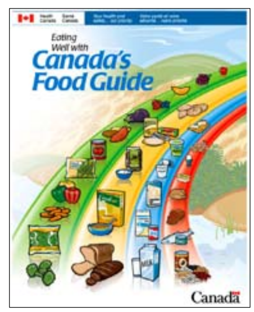
The estimated weight per serving differs on a commodity basis for raw and processed foods. Similarly, for consumption data, processed commodities have different waste factors than fresh products. In order to get production data in the same terms, the percent of production to processing on a commodity basis is estimated. The percent to processed sales for 2001 is applied to estimated production to get the amount of production to processing on a commodity basis. The amount of production that goes to processing is adjusted by a waste factor for comparison to consumption data. The adjustment results in a better estimation of what is actually consumed from what B.C. farmers produce.

B.C. production is estimated by using the reported producing area for 2001 multiplied by the average yields. Average yield estimates are derived from “Crop Insurance” data and Ministry of Agriculture and Lands commodity planning budgets. Yield data from “Crop Insurance” are considered a better estimate and are used when available. Otherwise, the “average” yields from Ministry of Agriculture and Lands planning budgets are used.

Consumption data for fruits and vegetables separates fresh and processed items. To determine BC’s self-reliance on a commodity basis, the processed amounts for fruit and vegetables are converted to its fresh equivalent weight for a fair comparison to production data. This conversion is not necessary for the comparison of recommended consumption and production data as recommended serving sizes differ between fresh and processed goods.

8.2 Food Guide Recommendations

The recommended consumption on a food group basis is from ***Health Canada’s Food Guide to Healthy Eating***. The guide places food into the following four groups: “Grain products”, “Vegetables and fruit”, “Milk products”, and “Meat and alternatives”. Foods that are not included in these groups fall into the “Other” food category. These foods tend to be low in nutritional value and high in fat. Health Canada recommends citizens limit the intake of these foods for obvious health reasons. These items are not included in the approach to self-sufficiency on a food group basis.



The recommended number of servings an individual should consume everyday from the four food groups will vary with his or her activity level, body size, age and gender. For women, it will vary when pregnant or breastfeeding. The recommended daily intake is 5-12 servings of grain products, 5-10 servings of vegetables/fruits and 2-3 servings of Meat and alternative products. For milk products a more personalized recommended number of servings are given. The recommended intake for children 4-9 years of age is 2-3 servings per day. For youth 10-16 years of age the recommended intake is 3-4 servings per day. For adults the recommended intake is 2-4 servings per day, and if breastfeeding or pregnant 3-4 servings per day.

For comparison to production estimates and land needs it is necessary to find an absolute serving size per food group. Health Canada gives a range of servings to indicate to individuals that their consumption levels will vary based on personal characteristics.

BC’s demographics were considered while estimating an absolute recommended number of servings per food group. The main variables taken into consideration are age structure and the gender sex ratio. The 2001 “Average person profile” published by BC Statistics indicates: 25% of the population is less than 20 years of age, 36.3% is 20-44, 25.1% is 45-64, 13.6% is 65 and older, and the mean age is 38.4 years. The population is 51% female and 49% male.

After analysis of demographical information it is concluded that there is not significant evidence to take a number other than the average of the range for the number of recommended servings. The purpose of this estimation is to determine the number of servings that would meet the requirements of the indicated characteristics of the 2001 population.

A weighted average is used to find the average number of servings for milk products. The guide recommends a range of servings for this food group based on age and if pregnant or breastfeeding. The 2001 census profile gives the age distribution. Some age categories are not grouped the same between the food guide and census profile, thus, some estimates were made in the calculations. The 2000/01 birth population is used to give an estimate of the population that is either pregnant or breastfeeding.

For comparative analysis, consumption and production data is converted to servings consumed/produced per day. In order to accomplish this, a weight per serving on a commodity basis is necessary. The Food Guide discloses serving sizes on a weight basis for fluid milk and meat products. For the other groups it is not as clear cut. Refer to “Canada’s Food Guide to Healthy Eating” for serving size descriptions. For instance, the guide indicates that a slice of bread is equal to one grain serving. For conversion purposes, the amount of grain present in a slice of bread is estimated and used as the recommended serving size. The recommended amount for fruits and vegetables is also given as a qualitative description rather than measured by weight. To determine weight per serving on a commodity basis, the USDA National Nutrient Database is used to provide a standard reference. The weight of a recommended serving is estimated based on matching descriptions with the Nutrient database. Refer to the supplement material for more detail on how the tool is applied.

9. Data Tables

BC Food Self Reliance Data Tables

Table 5: Reduction Scenario Assumptions and Outcomes

Theme	Strategy	Description	Emissions Sector	Change Energy Use at 2041 (GJ)	Change in Electricity Use at 2041 (GJ)	Change in GHG Emissions at 2041 (tonnes CO_2e)
Neighbourhoods and Buildings	Strategy 1	Neighbourhood planning	Personal Vehicles	-1,176,100	-254,900	-54,400
	Strategy 2	New development efficiency	NEW Residential Buildings			
	Strategy 3	Existing buildings	NEW Residential Buildings			
Mobility and Access	Strategy 4 Strategy 5 Strategy 6	Alternative transportation Connectivity Transport behavior and mode choice	Personal Vehicles	-1,299,400	41,600	-85,000
	Strategy 7	Low carbon personal vehicles	Personal Vehicles			
Resilient Economy	Strategy 8	Energy efficient industries	Existing Commercial Buildings	-806,400	-440,800	-21,800
Sustainable Infrastructure and Resources	Strategy 9	District energy	NEW Residential and Commercial Buildings in the City Center area	-455,800	-201,100	-51,900
	Strategy 10	Local energy sources	NEW Residential and Commercial Buildings			
	Strategy 11	Waste	Waste			

6.2.2 Scenario Reductions

The results are tabulated in Table 6. For each of electricity, total energy and GHG emissions three comparisons are made:

- **Comparison to the Baseline:** This compares the value to the 2007 level. In these terms reductions are modest in percentage terms – and sometime even increasing in the early years. This result from the fact that the community is growing and reductions and efficiencies made can be overwhelmed by continued growth.
- **Comparison to the Current Policy Trend (CPT):** This compares the results to where the City might otherwise have been – and here the results are promising. Any reductions made help to divert away from the growth trajectory.
- **Comparison on a Per Capita Basis:** The reductions appear most dramatic when presented on a per capita basis. This shows the substantial reductions required of each resident, if the impacts of growth are to be met, and overcome. That is, a small reduction in total energy use, given the population growth, requires a substantial reduction in per capita energy use.

Table 6. Reduction Scenario Results

Year	**2007**	**2010**	**2020**	**2041**	**2050**
Population					
Population	189,333	200,000	224,000	280,000	304,000
% change from Baseline (2007)	-	**4%**	**18%**	**48%**	**61%**
GHG Emissions (tonnes of CO_2e)	**(baseline)**				
Total GHG Emissions	886,103	913,000	831,500	666,500	664,700
Change from Baseline (2007)	-	26,900	-54,600	-220,000	-221,400
% change from Baseline (2007)	-	**3%**	**-6%**	**-25%**	**-25%**
Change from **CPT**	0	0	-74,600	-213,100	-212,500
% change from CPT	0%	0%	**-8%**	**-23%**	**-23%**
Per Capita Emissions (t/person)	4.7	4.6	3.7	2.4	2.2
% change per capita from Baseline (2007)	-	**-1%**	**-21%**	**-49%**	**-53%**
Electricity Consumption (GJ)					
Total Electricity Consumption (GJ)	5,926,916	5,994,400	6,027,000	5,280,700	5,317,200
Change from Baseline (2007)	-	67,400	100,100	-646,200	-609,700
% change from Baseline (2007)	-	**1%**	**2%**	**-11%**	**-10%**
Change from **CPT**	0	0	-198,900	-855,200	-878,400
% change from CPT	0%	0%	**-3%**	**-14%**	**-14%**
Per Capita Electricity Consumption (GJ/person)	31.3	30.4	26.9	18.9	17.5
% change per capita from Baseline (2007)	-	**-3%**	**-14%**	**-40%**	**-44%**
Total Energy Consumption (GJ)					
Total Energy Consumption (GJ)	19,548,808	19,862,000	18,975,000	14,557,200	14,389,500
Change from Baseline (2007)	-	313,200	-573,800	-4,991,600	-5,159,300
% change from Baseline (2007)	-	**2%**	**-3%**	**-26%**	**-26%**
Change from **CPT**	0	0	-966,300	-3,737,700	-3,672,300
% change from CPT	0%	0%	**-5%**	**-20%**	**-20%**
Per Capita Energy Consumption (GJ/person)	103.3	100.7	84.7	52.0	47.3
% change per capita from Baseline (2007)	-	**-3%**	**-18%**	**-50%**	**-54%**

Notes: [1] Values shown in red are comparable to OCP reduction targets of -33% reduction GHG emissions by 2020, -80% reduction GHG emissions by 2050, and 10% reduction energy by 2020, respectively
[2] Totals may not equal the sum of components due to rounding

An Illustrated Guide to

COMMUNITY ENERGY

Exploring the sustainable energy potential of your neighbourhood

www.guidetocommunityenergy.com

FINAL VERSION | May 2013

Reference:

Barron, S, TR Tooke, S Cote, SRJ Sheppard, R Kellett, K Zhang, L Holy, M Sherriff, M vanderLaan (2013). An Illustrated Guide to Community Energy. The Collaborative for Advanced Landscape Planning (CALP).

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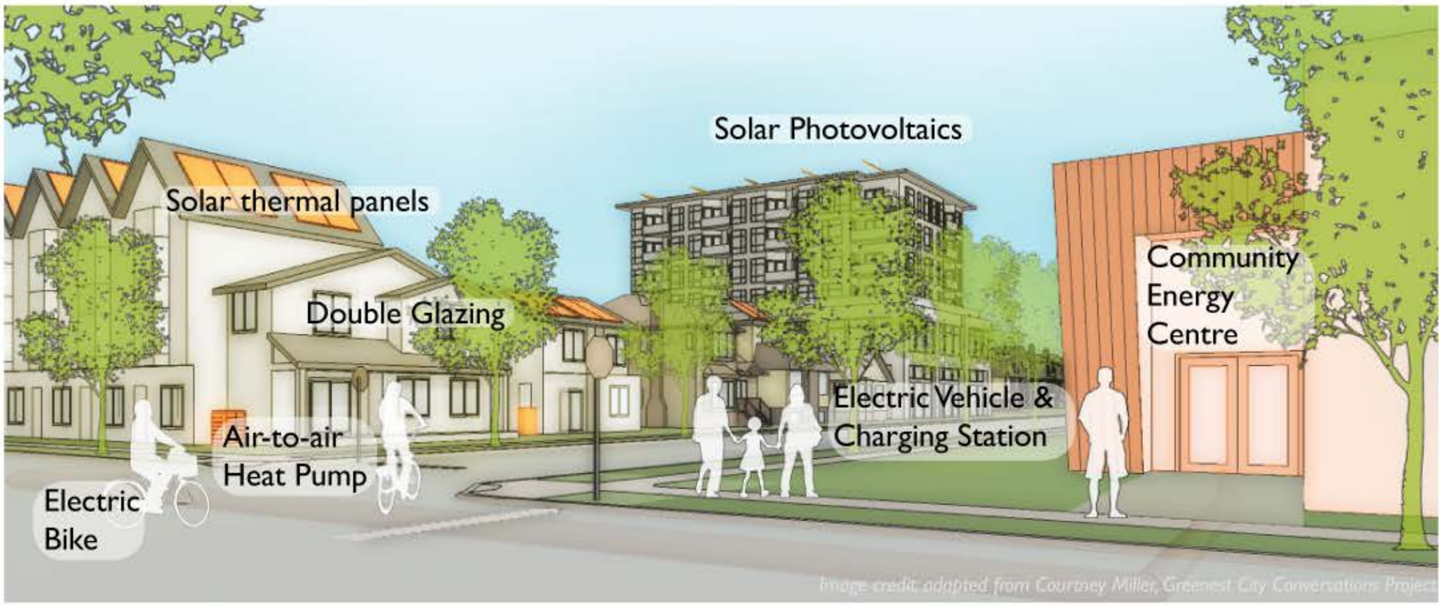
CITY OF SURREY the future lives here.

An Illustrated Guide to Community Energy

With clear and compelling visuals of Metro Vancouver case studies, and new information on regional and local energy resources, this Guide aims to inform citizens about unfamiliar energy options, and stimulate discussion about the energy choices that each community will face.



Orange elements in the image above generate energy to heat and power the community. A community energy centre (at the right) is powered by a renewable energy source.

Imagine a neighbourhood where our homes generate energy and excess energy is shared with the community or is sold to the grid as a source of revenue.

What if Metro Vancouver used sustainable regional renewable energy resources instead of fossil fuels that contribute to global warming?

Imagine neighbours working together to share skills, improve energy efficiency, & reduce energy costs through neighbourhood retrofits.

This guide shows how local involvement in community energy systems can promote more sustainable and secure energy futures, while reducing carbon emissions that contribute to global warming. The guide explains the idea of community energy, which is becoming an important topic for every municipality in British Columbia. Change is coming to neighbourhoods as municipalities try to reduce community-wide carbon footprints and manage rising energy prices, while maintaining their citizens' quality of life.

1.0 Why Do We Need an Illustrated Guide?

1. So citizens can develop more informed opinions on possible energy transformations in our neighbourhoods.
2. For practitioners and community groups to use in their public engagement activities.

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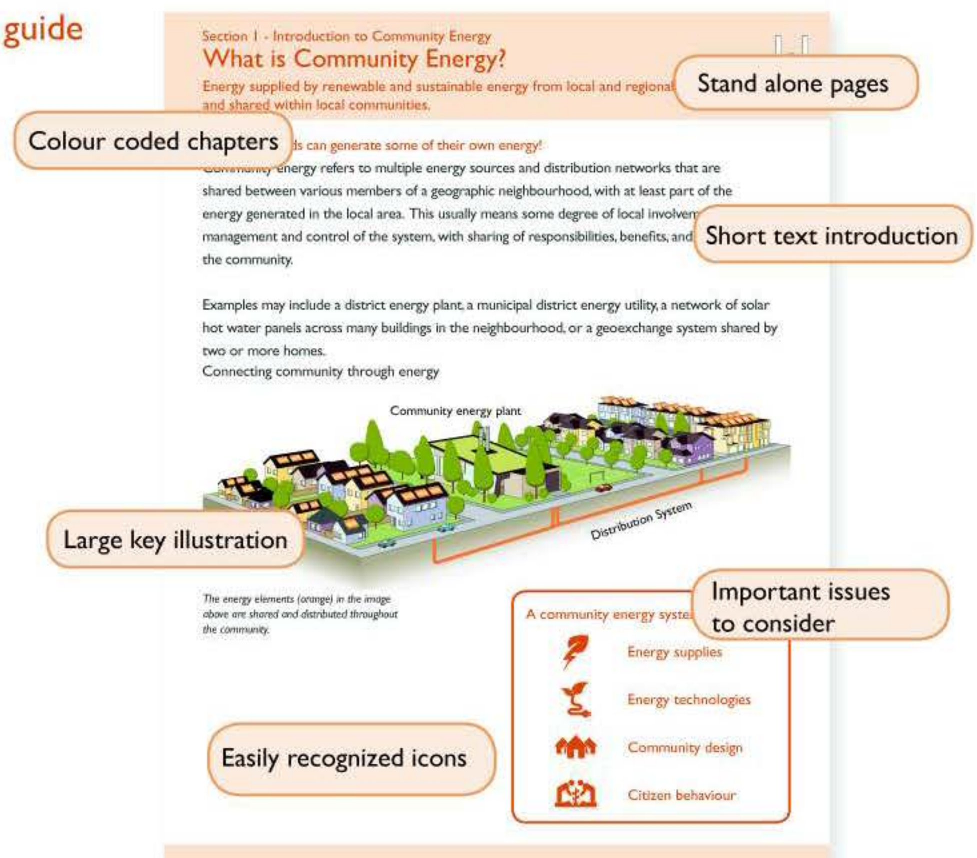
How to use this guide



What is Community Energy?

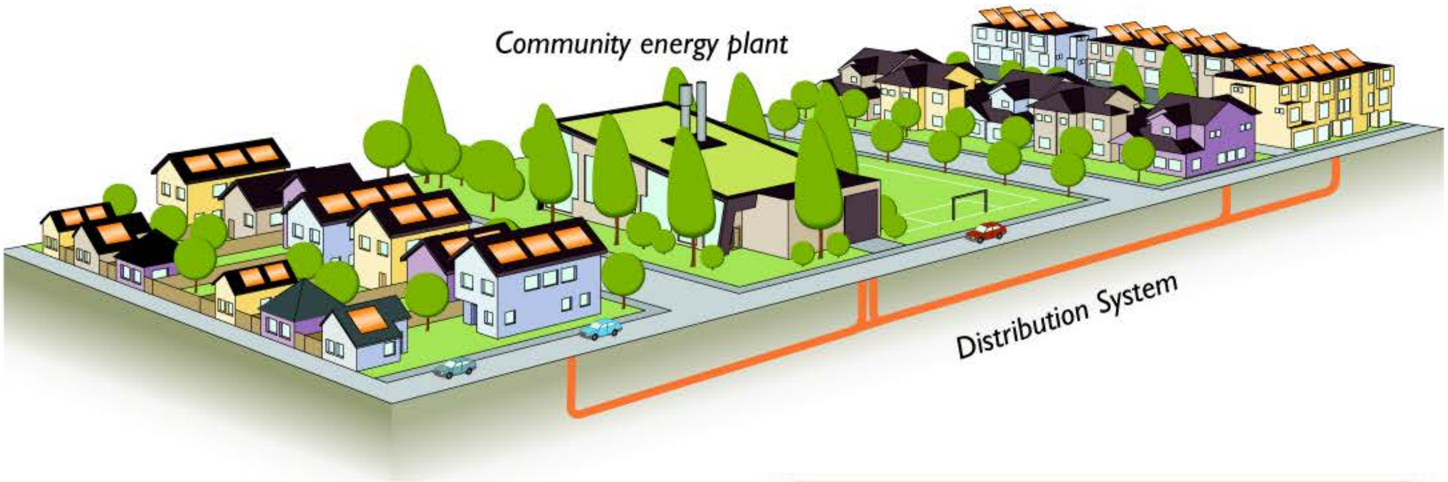
Energy supplied by renewable and sustainable energy from local and regional sources and shared within local communities.

Neighbourhoods can generate energy.

Community energy refers to multiple energy sources and distribution networks that are shared between various members of a geographic neighbourhood, with at least part of the energy generated in the local area. This usually means some degree of local involvement in the management and control of the system, with sharing of responsibilities, benefits, and impacts among the community.

Examples may include:

- a district energy plant run by a local utility, municipality or citizen co-operative
- a network of solar hot water panels installed on many buildings in the neighbourhood
- a geoexchange system shared by a few homes



The energy elements (orange) in the image above are shared and distributed throughout the community..

Transportation uses a significant amount of energy, and contributes over half of our regional greenhouse gas emissions. Transportation is not the focus of this guide, but should be integrated into community energy planning and engagement.

A Community Energy System Includes:

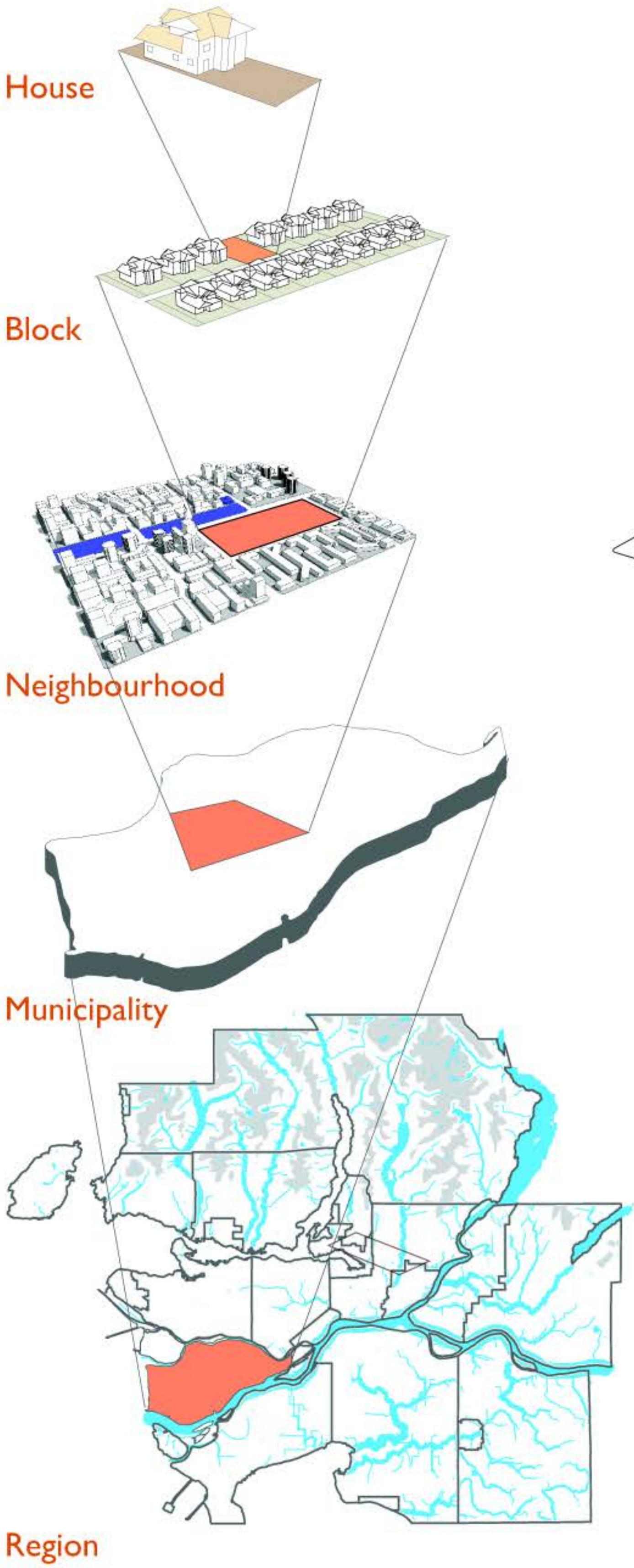
Energy Technologies

Community Design

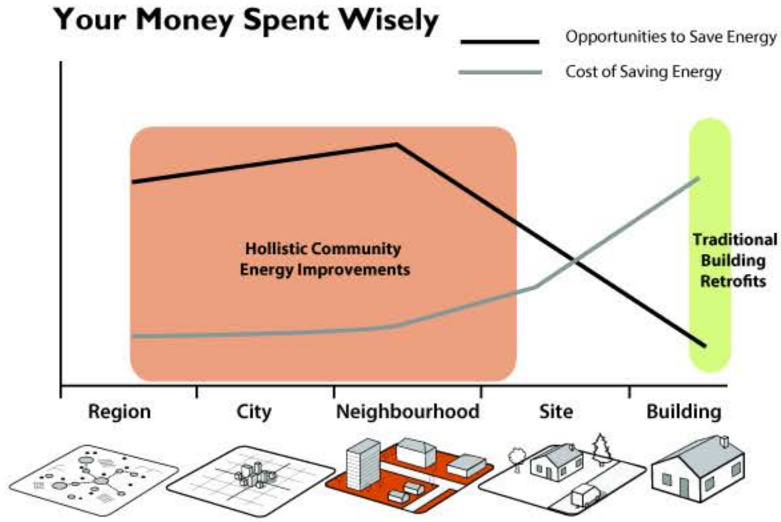
Citzen Behaviour

1.2 Layers of Community

Community Energy applies to a range of scales, from a small collection of houses, to a region providing local renewable energy resources.



This guide focuses on the region, neighbourhood, & block scales.



Various Scales of Community Energy:

Energy is a community concern. As the graph above shows, the neighbourhood scale has the highest opportunity, and lowest cost to save energy.

Source: adapted from Community Energy Planning 'a tool to combat climate change,' presentation by Paul Bouman, BC Hydro

Why is scale important?

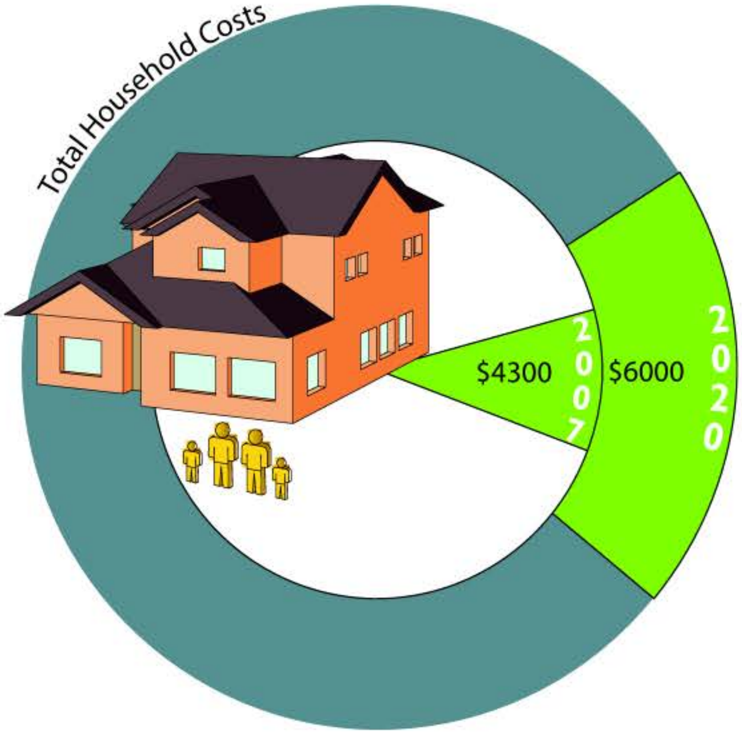
Transmission Losses

Energy Security

Environmental Accountability

Local Economy

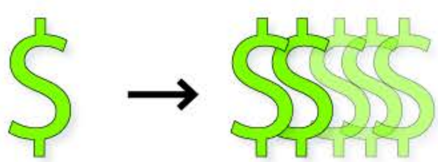
A community energy system based on renewables can be less vulnerable to global energy markets, because after the initial investment operation costs remain generally low.



Projected increase in household energy costs by 2020.

Citizens of Surrey could collectively spend more than $1.3 billion on household energy by the 2020.

What if this money stayed in the community?



One dollar spent locally

can provide local economic benefits 2-5 times the original amount.

Source: communityenergy.org

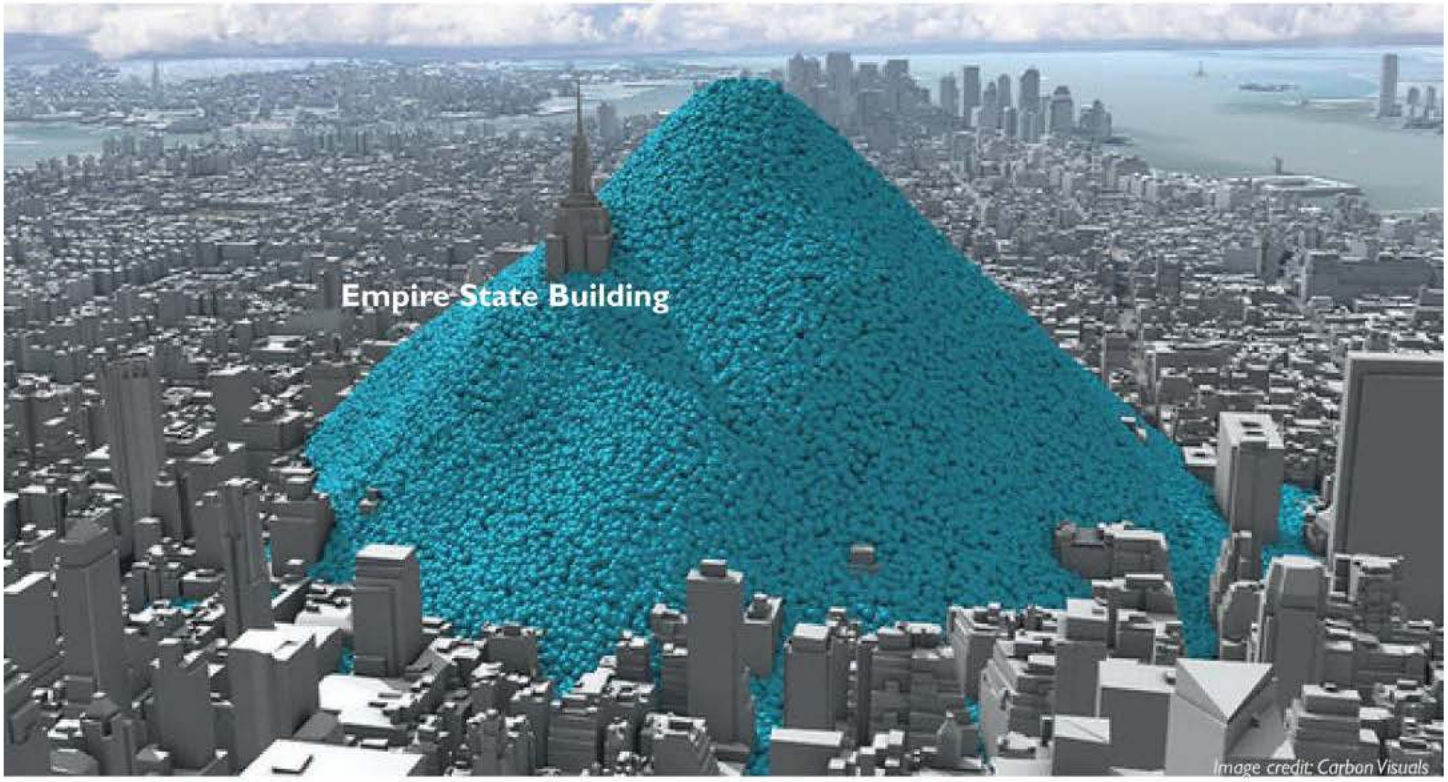
Why is community energy important for the local economy?

- Stable Energy Prices
- Control of Local Energy Supply
- Local Economic Benefits

1.4 Climate Change

Fossil-fuel energy resources release greenhouse gases that cause global warming and endanger current and future generations.

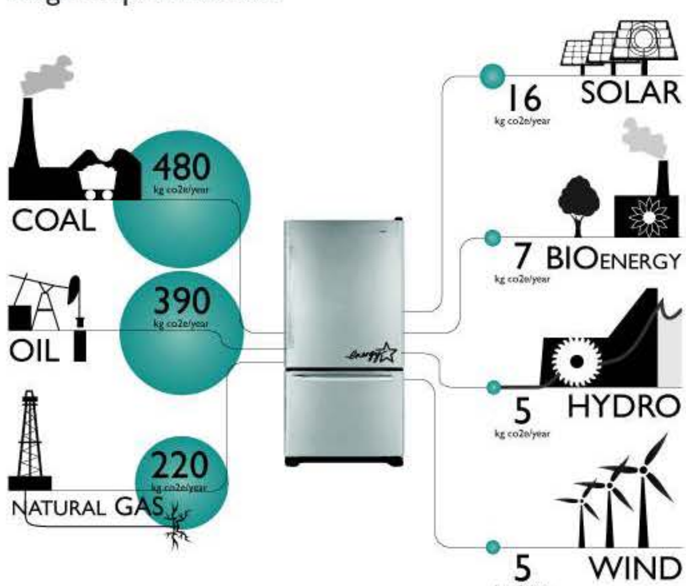
Imagine if we could see the CO_2 a community produces in a day.



This image of New York shows one day's CO_2 production - each bubble represents one tonne of CO_2

We can work together to mitigate climate change by making more efficient use of community energy and switching to renewable sources to reduce carbon emissions. Most municipalities in BC have pledged to reduce their community-wide carbon footprints by up to 80% by 2050.

How much greenhouse gas emissions is your fridge responsible for?

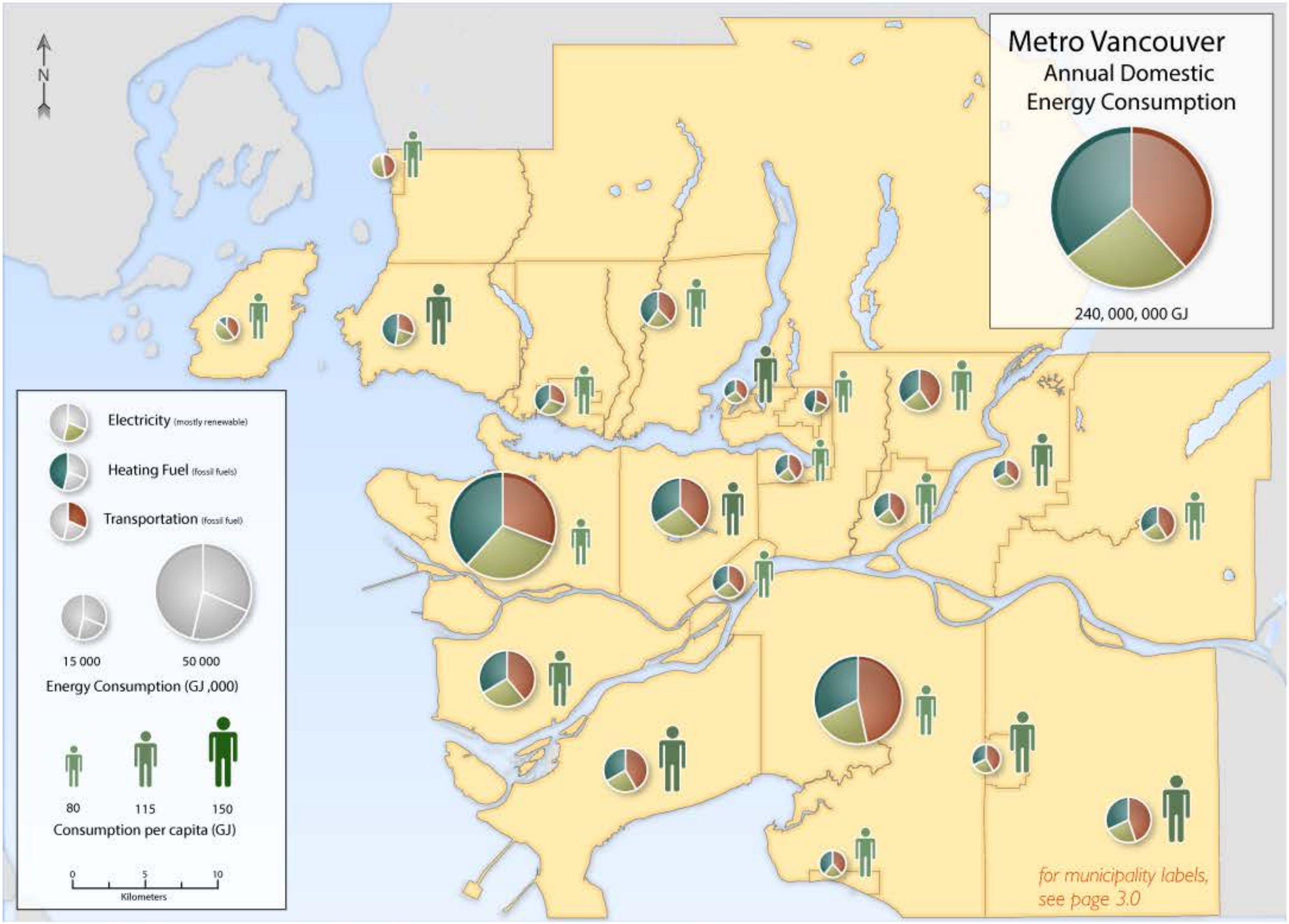


Sources of greenhouse gas emissions in your city:

- Burning Fossil Fuels
- Agriculture
- Waste & Landfills

How Does our Region Use Energy?

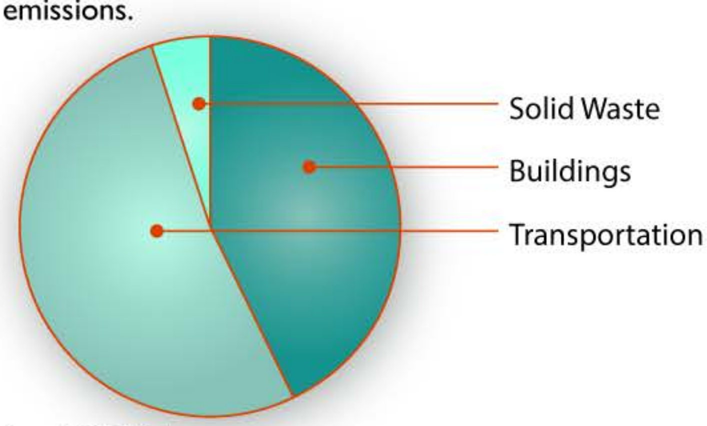
Communities across the region use different total amounts of energy for electricity, heating, and transportation. We also consume different amounts of energy per person across the region. How much do you use?



Municipalities with higher density and lower vehicle use tend to use less energy per person.

Regional greenhouse gas emissions sources

Buildings account for over 40% of regional carbon emissions.



Source: 2007 CEEI data

Why is climate change important in Metro Vancouver?

Local Impacts

Provincial and Local Reduction Targets

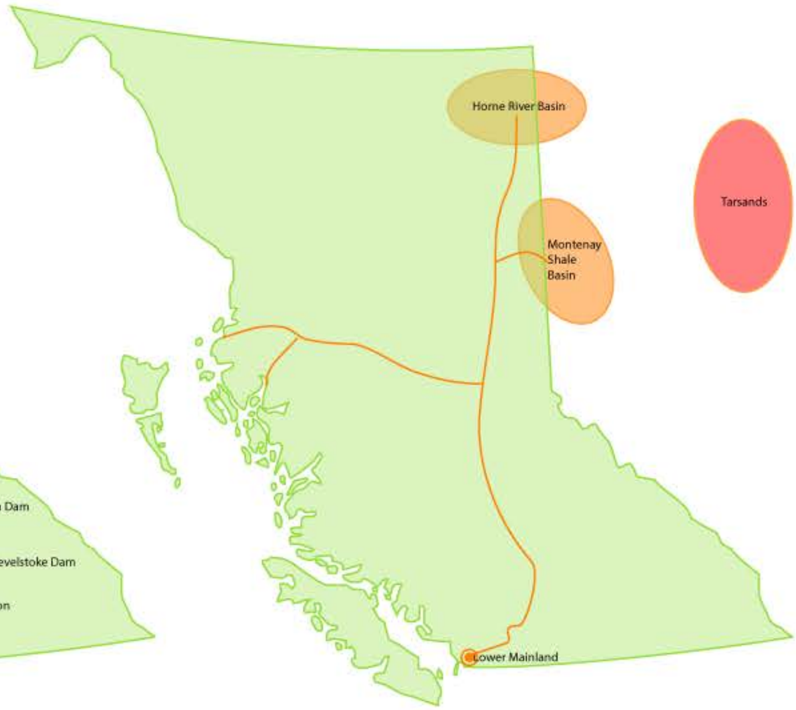
Local Solutions

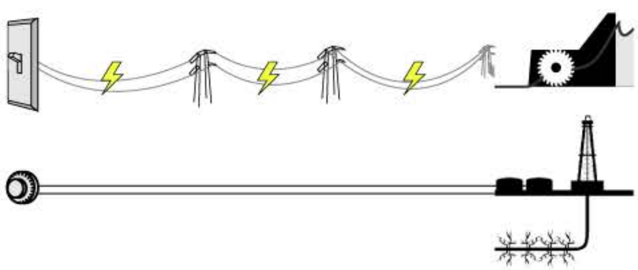
1.6 Where does Energy Come from in BC?

Much of the energy currently used in Metro Vancouver homes comes from remote suppliers in BC and Alberta, at least 400-1000 kilometers away.

Hydro Transmission

Natural Gas Routes





These long distance transmission lines and pipelines are vulnerable to losses, leaks, and disruptions that can be exacerbated from worsening climate change related events. Hydro-electricity is a renewable, low carbon energy source, but oil and gas are not.

Metro Vancouver is also crossed by railways & pipelines shipping coal & oil for export to other countries, & bringing oilsands oil for use in our vehicles.

Major Current Energy Supplies in BC

Electricity (90% Hydro)

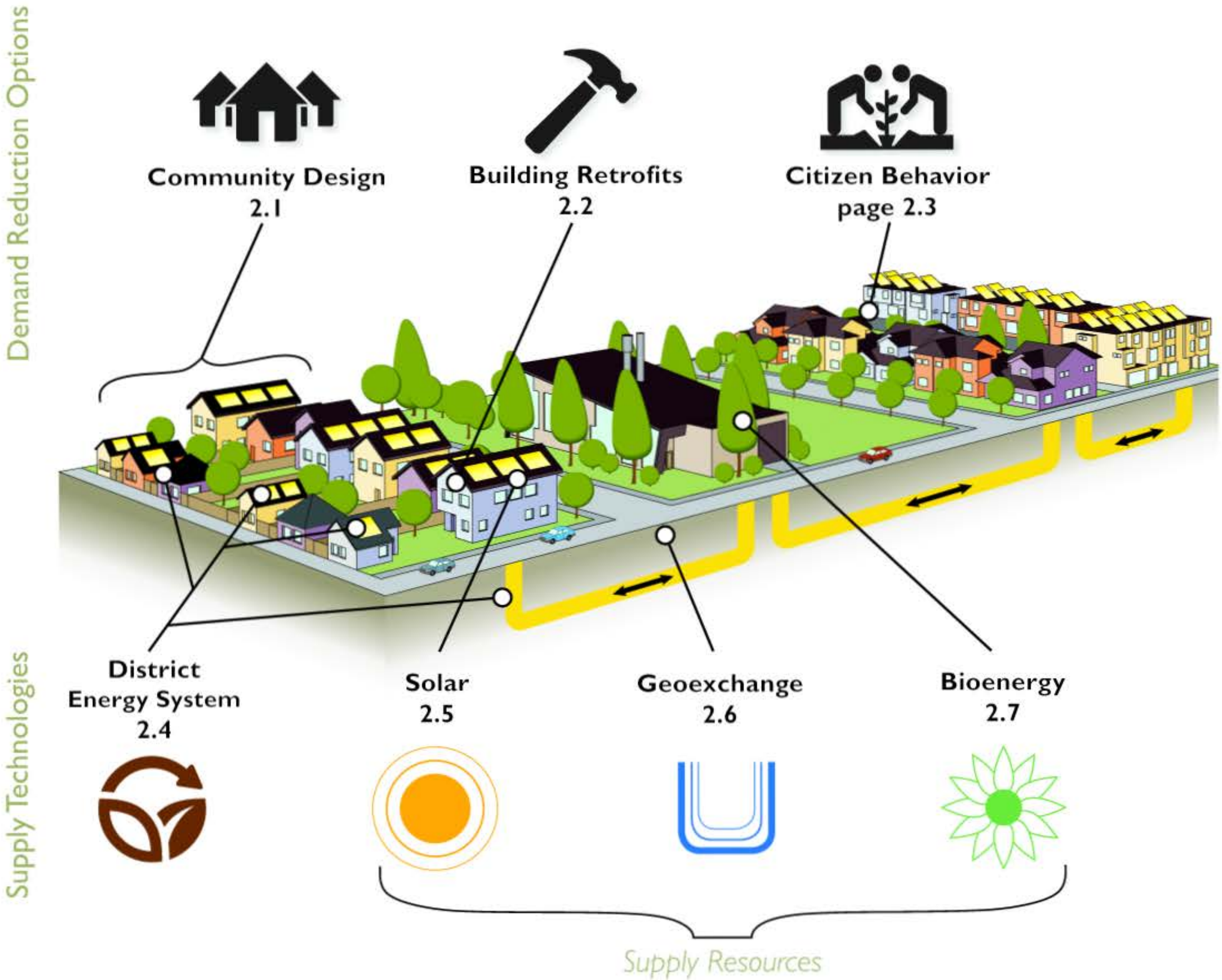
Natural Gas

Oil Imports

Section 2 - Basic Concepts - A Visual Glossary

This chapter provides a visual glossary of key concepts, components, and types of Community Energy.

Components of a Community Energy System:

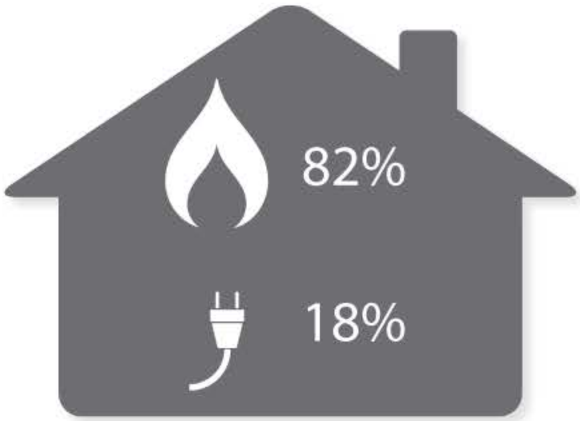


*Note: This section includes an overview of key renewable energy supplies, see **A1** for a comprehensive list of technologies.*

2.0b

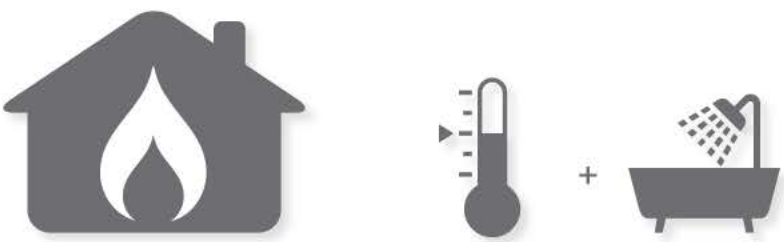
Residential Energy Demand

People use energy to provide services such as lighting, heat, cooling, and refrigeration. The energy services demanded in a typical household are shown below.



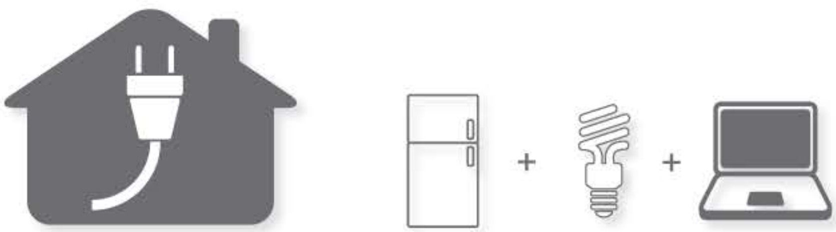
A typical household in Metro Vancouver requires about 60 megawatt hours of energy each year (electricity & thermal)

A typical household comprises 2.8 people and a floor area of 288 m^2 (>3,000 ft^2)



78% of thermal energy is used to heat space

22% of thermal energy is used to heat water



Electricity is used to power appliances, lights and devices such as electronics

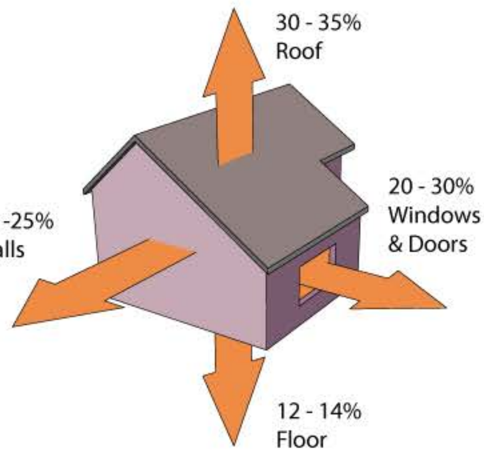
Community Design

2.1

The way a community is designed has a major impact on the amount of energy it uses & its carbon footprint.

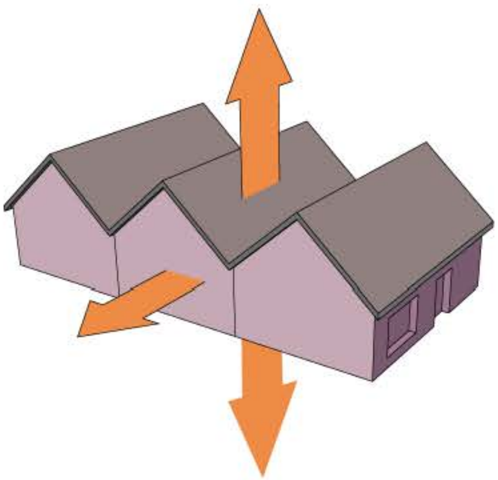
Conserving heat in our communities depends on design factors such as building density, building size, orientation, and amount of windows.

Reducing Energy Loss Through Shared Walls



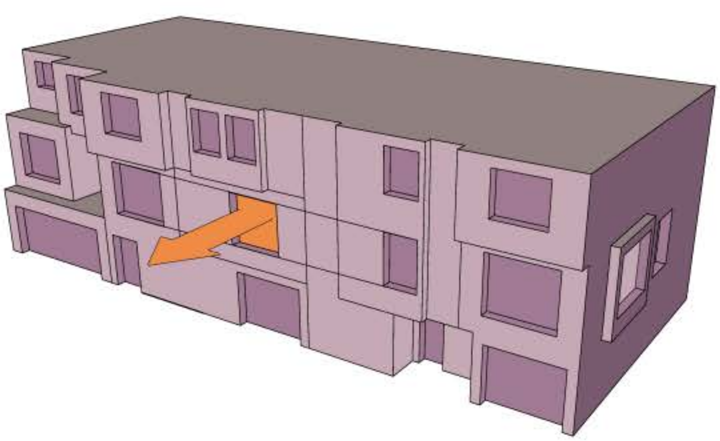
Detached buildings

- Often one family in a large space
- Many exposed walls (large surface area)



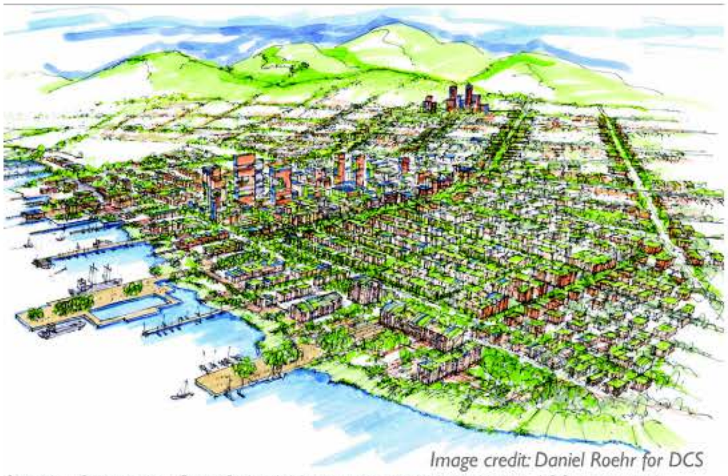
Attached buildings

- More shared walls
- Multiple families sharing heat
- Compact surface area



Issues to Consider:

- Density
- Dwelling Size
- Transit Access
- Landscape



Sketch of what the City of North Vancouver could look like in 100 years with greatly reduced greenhouse gas emissions.

Workshop participants discuss future visions for the city.

City of North Vancouver 100 Year Vision

The City of North Vancouver and the University of British Columbia Design Centre for Sustainability (UBC-DCS) teamed up to prepare a 100 Year Sustainability Vision for the City.

The plan looks at challenges and opportunities for promoting sustainable future development. This long-range vision aims to guide the City's community design toward carbon-neutral status by 2107, the City's 200th anniversary.

The visioning process addressed community design issues such as:

- compact, complete neighbourhoods
- 5 minute walking distances
- location of district energy plants
- mixed residential and commercial uses
- jobs/housing balance
- per capita carbon emissions

Learn more:
cnv.org/server.aspx?c=3&i=541

Density

Increased density has many benefits. For example, more people have access to transit, live in attached buildings with shared walls and district energy systems become more cost effective.

Dwelling Size

Smaller dwelling units generally use less energy to heat and operate.

Access to Transit

With increased density, more people can live close to transit, which in turn supports increased transit options and availability.

Landscape

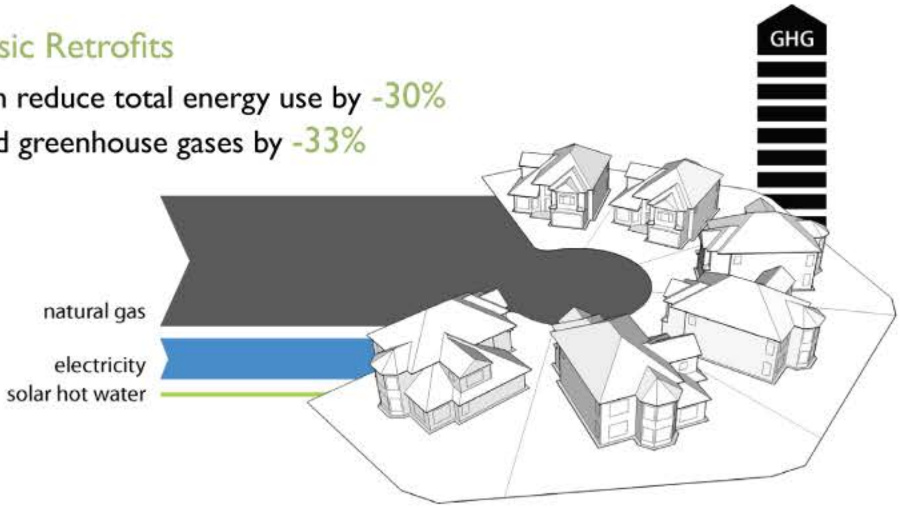
The way we design our landscape can affect the energy performance of our buildings. For example, trees along the south facade of a house can help cool buildings in the summer.

Retrofits

Much energy can be saved by bringing existing buildings up to new, more efficient standards.

Basic Retrofits

can reduce total energy use by -30%
and greenhouse gases by -33%



Key strategies used to achieve energy reductions

- increase insulation
- reduce air infiltration
- upgrade furnace
- switch to solar or on-demand hot water
- energy efficient appliances
- compact fluorescent/LED lighting

Major Retrofits

can reduce total energy use by -75%
and greenhouse gases by -80%

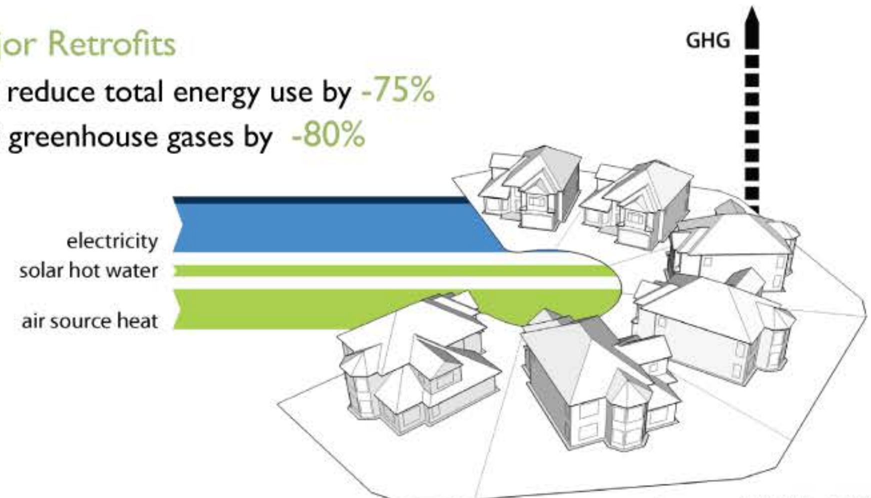


Image credit: N Miller, CALP

Key strategies used to achieve energy reductions

- major insulation increase
- heat recovery ventilator
- window upgrades
- upgrade to super high efficiency furnace or heat pump
- solar hot water or an on-demand system
- energy efficient appliances
- compact fluorescent lighting

Most of the buildings that will be here in 2050 already exist.

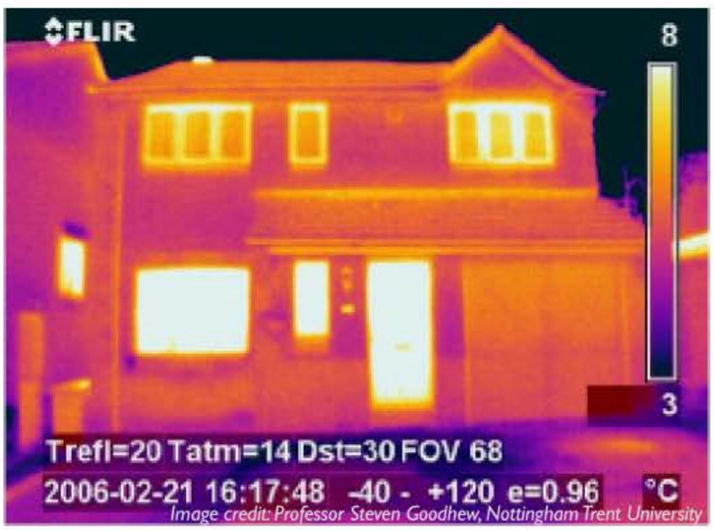
Issues to consider:

- Costs
- Practicality
- Livability
- Community Support

All information on this page is from the following report:
http://calp.forestry.ubc.ca/files/2010/02/CALP_REIBC_Retrofit-Challenge_Final_Report.pdf
Authors: Ellen Pond, Duncan Cavens, Nicole Miller, and Stephen Sheppard

Retrofits
Case Studies

Residences on Eagle Island



Thermal image taken outside of home revealing locations of heat loss in the home.

Eagle Island Community Retrofit Project

is an example of how action on climate change can become more achievable and scale up when conducted at the neighbourhood level. Eagle Island is a community of 30 homes, located within the District of West Vancouver. A community champion led the neighbourhood through a retrofitting process, encouraging every neighbour to undergo a home energy audit, and then follow through with making their homes more energy efficient through such measures as adding better insulation, updating furnaces and draft proofing.

By making the activities fun (hosting parties and dinner meetings), using thermal imaging in the audit, and working as a group rather than as individuals, the residents of Eagle Island managed to increase the efficiency of 26 homes on the island. Spill-over from this initiative has residents considering more options for reducing their carbon footprint, such as switching from diesel-power to electric boats (main method of transportation to the island). The success of this initiative was supported by the District of West Vancouver & local businesses, and has grown into the "Cool Neighbourhoods" movement, carrying out similar programs in other North Shore communities (notably Blueridge and Horseshoe Bay).

Learn more:

mc-3.ca/eagle-island

http://www.townsfortomorrow.gov.bc.ca/

Pacific Institute for Climate Solutions White Paper on Thermal Imaging. (Cote et al., 2013)

Cost

Retrofits come at a range of costs, from a few hundred dollars for basic retrofits such as increasing insulation, to thousands of dollars for major retrofits, such as upgrading windows. Various rebate schemes are available to reduce costs.

Practicality

Some retrofits do not require major changes to buildings, while others require modifications to the building walls and roof structure.

Livability

While all retrofits will make the building more livable, construction during retrofitting impacts building residents and neighbours.

Community Support

It helps to see other neighbours retrofitting their properties and to share expertise, tools, & materials. Some neighbourhoods form "buyers clubs" to negotiate bulk discounts from local building suppliers

Citizen Behaviour

What can we do as citizens and neighbourhoods to conserve energy and support good, climate friendly, community design?

Conserving energy is just as important as where we source our energy from. Above are some suggestions about where we might be able to reduce energy use. What else can we do as a community in our homes, at work, at school and at play?

Learn More:

More guides and tips, go to:
http://www.bchydro.com/guides-tips.html
http://www.bchydro.com/news/conservation/2012/energy-future-conservation-vision.html
http://www.toolkit.bc.ca/

Issues to Consider:

- Costs
- Feedback
- Making Time

Image credit: Winnie Hwo

REaDY Summit at Steveston-London Secondary School April 2012

Logo designed by students for the summit.

Richmond Earth Day Youth Summit (REaDY)

On April 21st 2012, the Richmond Student Green Teams, with support from the School Board and Richmond City staff, led and facilitated the Richmond Earth Day Youth Summit (REaDY) at Steveston-London Secondary School. Winnie Hwo of the David Suzuki Foundation writes, "[it]…was more than just a way to celebrate the 42nd Earth Day, it was also a time for REaDY Summit participants to learn and talk about what the future holds for our environment. Their conclusion — the Earth is in worse shape today than 42 years ago and the time to take action is now!"

This collaboration between youth, NGO and municipal representatives reveals the importance of working together as a community towards raising support, momentum and awareness for sustainability issues. For example, Ian Bruce, of the DSF's Climate Change and Clean Energy Team led a group visioning session about what a sustainable neighbourhood and transportation future might encompass.

Learn More:
davidsuzuki.org/blogs/climate-blog/2012/02/richmond-earth-day-youth-summit-2012/

Costs

According to BC Hydro, energy efficiency and conservation measures cost as little as one-fifth to one-eighth the cost of other new clean resource options, on average.

Feedback

When people can actually see the energy they are using, they tend to use less. Easy to see monitoring displays help people understand how they are using energy, enabling them to make decisions on how to conserve.

Making Time

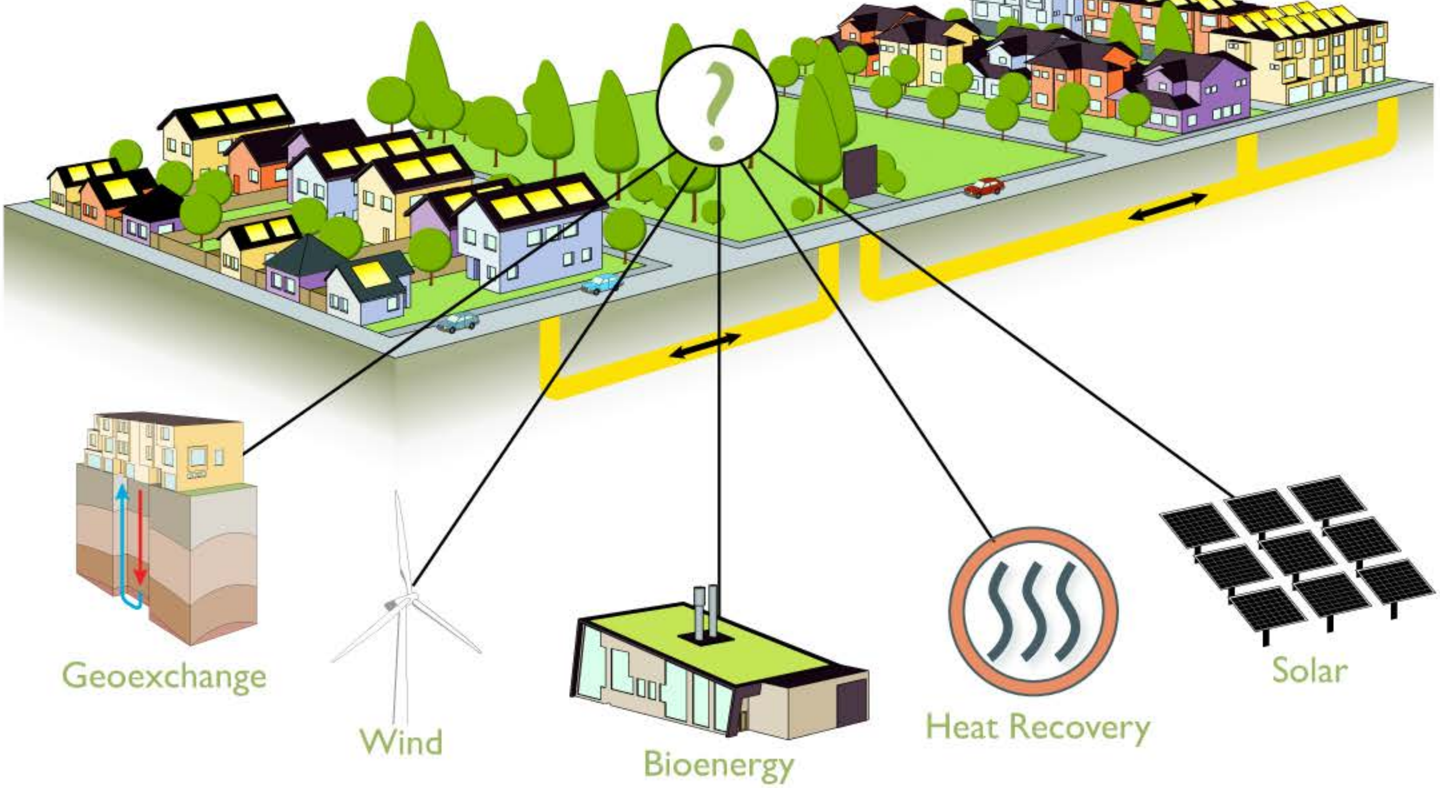
Creativity is needed for scheduling time together with busy members of the family & neighbourhood to discuss how they can conserve energy and reduce carbon footprints … try combining the energy saving conversations with other fun social activities

District Energy Systems

A district energy system generates heat and sometimes electricity for distribution to local users (homes and businesses).

District energy is more energy efficient than using individual building furnaces for neighbourhood with adequate density, and therefore reduces greenhouse gas emissions, especially when using renewable supplies.

Potential District Energy Sources



District Energy can provide both

Heating

&

Electricity

District Energy uses piping or a micro grid to distribute heat or power from a central neighbourhood plant or dispersed network. A micro grid is a local system of electricity generation, energy storage, and users that is also connected to the traditional large-scale grid.

Issues to Consider:

- Aesthetics
- Air Pollution
- Health
- Costs & Revenues

District Energy Systems

Case Study

Image credit: Google Street View


Image credit: NR Can

Drake Landing Solar Community

is a 52-house neighbourhood in Okotoks, Alberta. It is heated by a district system designed to store solar energy underground during the summer months and distribute the energy to each home for space and water heating needs during winter months. Solar energy is captured all year by an 800-panel garage mounted array.

The system fulfils 90% of each home's space heating requirements from solar energy, which means they rely much less on fossil fuels. The reduction in greenhouse gas (GHG) emissions has been calculated to be approximately 5 tonnes per home per year.

District Energy Systems range in size from serving a single apartment complex or multiple single family homes, to serving a whole neighbourhood (such as the Lonsdale Energy Corporation in the City of North Vancouver).

Learn more:
dlsc.ca/

Aesthetics

Citizens are often concerned with how a new District Energy plant or rooftop facilities will look in their neighbourhood. Many local examples show that good design can result in a community feature, rather than an eyesore.

Air Pollution

Air pollution from some renewable fuel supplies can be of concern to local residents. Strict industry standards & regional restrictions are in place to ensure that air pollution & reduced visibility is not a major issue.

Health

Perceived health effects from air pollution, noise, night lighting, or other irritants can be reduced through good design, but should be monitored. Educational campaigns about these issues should be implemented when District Energy is proposed.

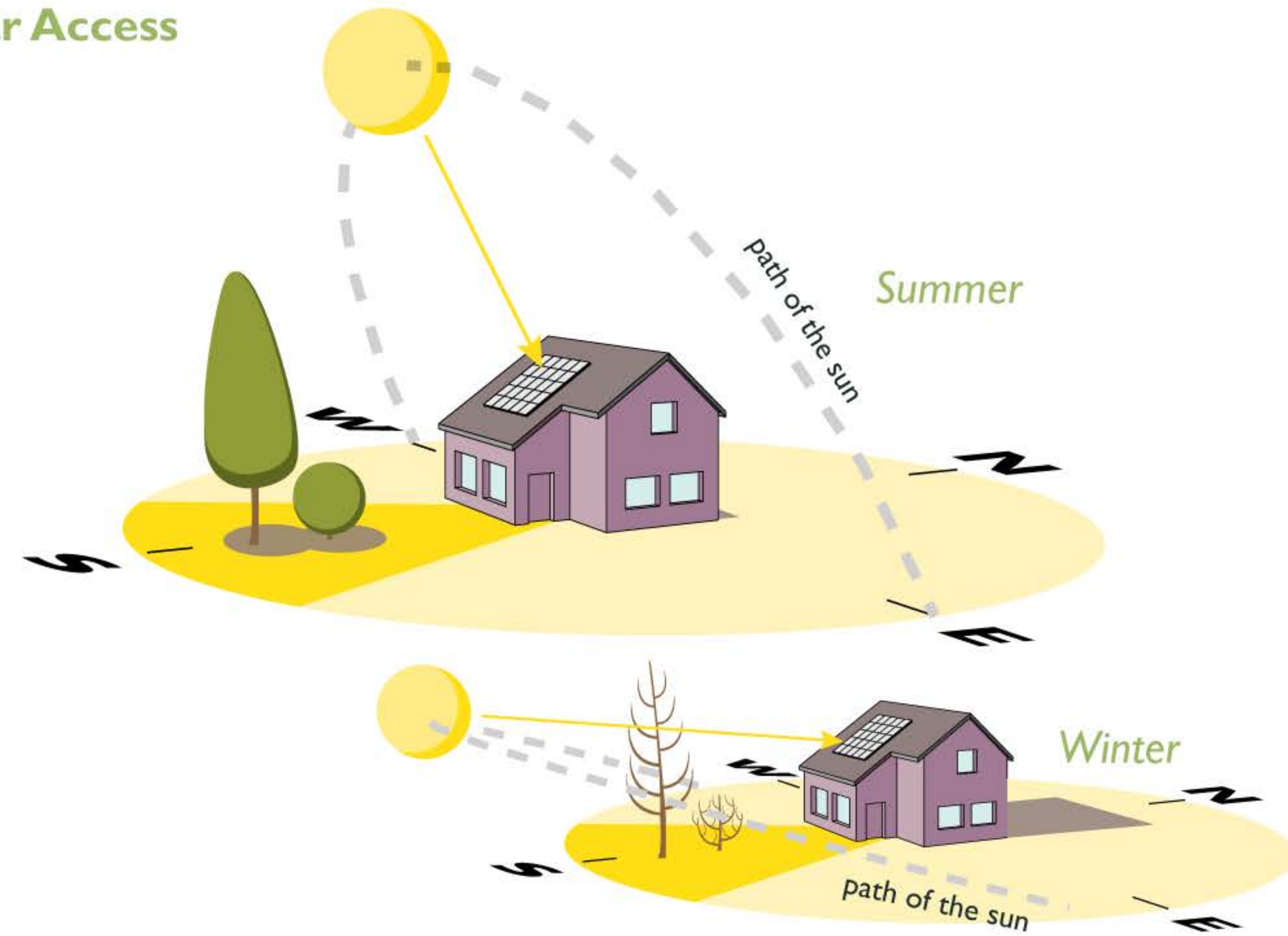
Costs

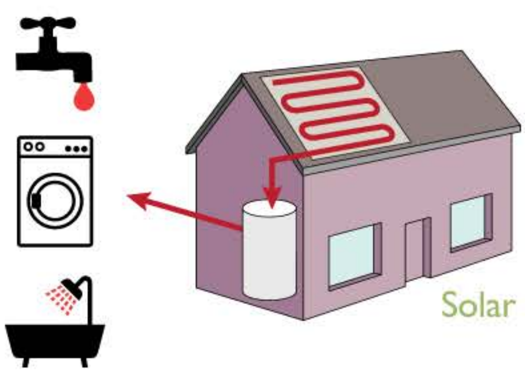
District Energy systems come in a range of costs. Much of the costs are up-front costs for new buildings and infrastructure. Actual energy supply costs are often low. Some cities are building District Energy utilities to provide long-term revenue.

What Is Solar Energy?

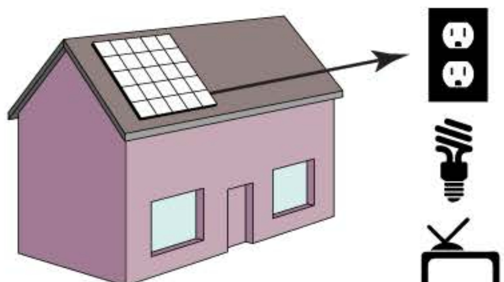
Solar (energy from the sun) can provide energy to buildings using proven systems such as Solar Photovoltaic (PV) and Solar Thermal Energy.

Solar Access





Solar Hot Water



Solar PV

Issues to Consider:

- Costs/Savings
- Cloudy Weather
- Shade
- Maintenance

Solar Energy

Case Studies

Sum-SHA-Thut, Sooke, British Columbia

The T'Sou-ke Nation is a small First Nation community located on the very southern tip of Vancouver Island. The community has completed a 75-kilowatt solar power installation, which is the largest in B.C. to date. The project is called Sum-SHA-Thut, the Sencoten term for "sunshine".

The T'Sou-ke solar power installation generates electricity from photovoltaic panels. They have also installed solar thermal panels on 37 (out of 86) homes to pre-heat hot water, further reducing energy consumption and their carbon emissions.

Learn more:

greenmuze.com/climate/energy/1315-tsou-ke-nation-solar-project-.html
turtleisland.org

See also:

District of North Vancouver Solar Calculator
http://geoweb.dnv.org/applications/solarapp/

SolarBC
http://www.solarbc.ca/

Costs

Costs per kilowatt hour range from:
11-23¢ for a solar farm,
19-38¢ for rooftop hot water,
30-45¢ for rooftop photovoltaic

Current BC Hydro prices are about 7¢ per kWh.

Intermittency

The energy produced by a solar panel changes throughout the day and year depending on sun angles and cloud cover. A large uptake of solar technologies would require careful management of the energy system.

Shade

Shade from trees and buildings will affect the energy produced from a solar panel. To ensure the maximum energy output of a solar installation some jurisdictions in California have laws that prohibit shading of neighbouring solar panels.

Maintenance

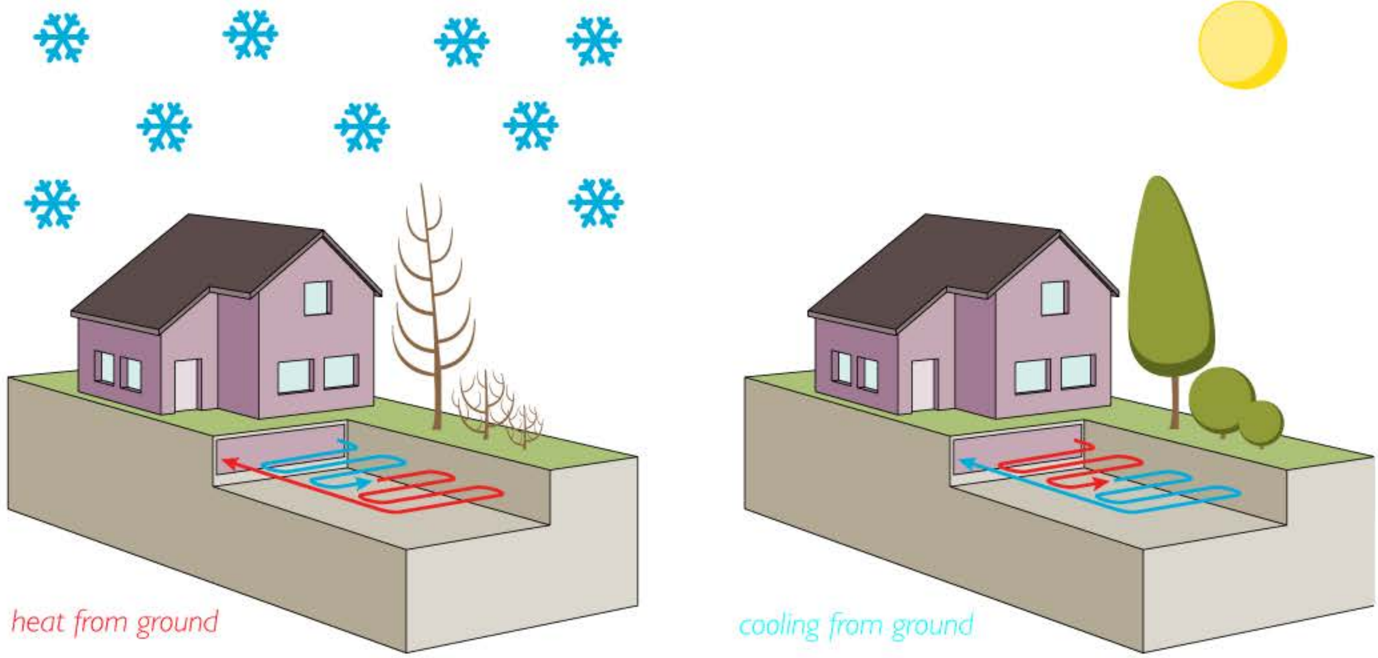
Solar panels require some maintenance for removing dust and snow. If the panels are not maintained, the energy output of the technologies can be reduced and economic viability can be compromised.

What Is Geoexchange?

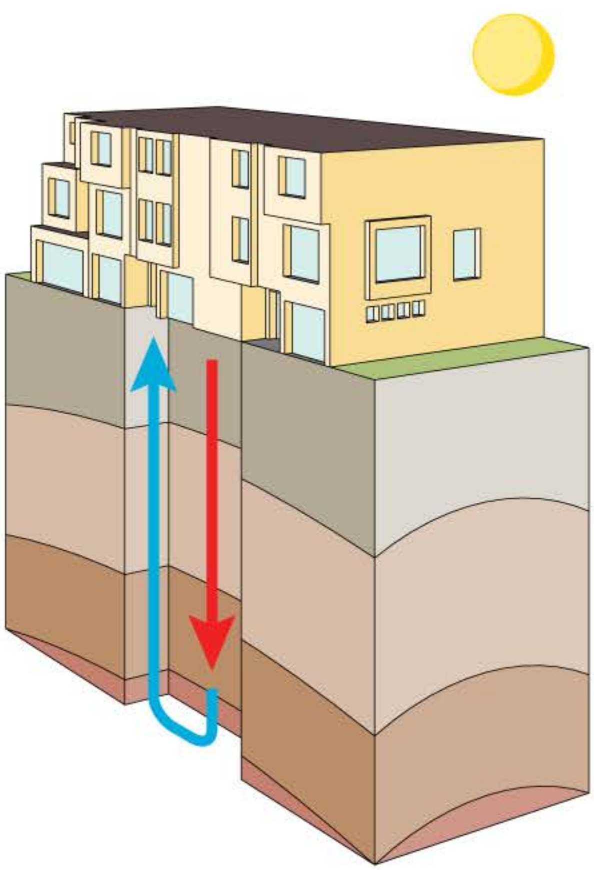
Geoexchange takes advantage of the relatively stable temperature just below ground to provide heating or cooling in buildings using similar technology as your refrigerator.

Heat in Winter, Cool in Summer

Horizontal System



Vertical System



Horizontal vs. Vertical systems

Pipes can be laid horizontally (above) to provide heating/cooling to homes with space around them, or can be drilled vertically into the ground (below), where space is more limited. Note that geoexchange requires electricity to work.

Issues to consider:

- Costs/Savings
- Scale
- Retrofits

What Is Geoexchange?

Case Studies

Interior of Energy Centre building

The City of Richmond has constructed its first city-owned district energy utility with a vertical geoexchange system. The first phase, developed in partnership with Oris Geo Energy Ltd., uses thermal energy from the ground to heat and cool new residential units currently being built in Richmond's West Cambie neighbourhood. It could cut local production of greenhouse gas emissions by 200 to 600 tonnes annually.

The first phase is expected to cost $3.5 million to construct and $80,000 to operate annually at full capacity. All of these costs will be recovered over time through user rates, and will place no burden on Richmond taxpayers who are not serviced by the utility.

Laying the pipes in the ground

Learn more:

richmond.ca/news/city/districtenergy.htm

http://gibsons.ca/geoexchange-district-energy-utility

Costs

Vertical systems are more expensive, but can become cost effective at higher building densities. Both systems reduce or eliminate costs & price fluctuations of natural gas or other non-renewable heat sources.

Scale

Geoexchange works at a range of scales, from the household to the neighbourhood.

Retrofits

Horizontal geoexchange fields can take up a lot of space, so may be difficult to install in areas that are already developed and have mature trees. Existing home heating systems must also be compatible with the geoexchange heat pumps.

What Is Bioenergy?

Bioenergy describes the energy contained in biological material, such as wood, crops, manure and garbage.

BC has large natural biomass resources that can be used to produce energy at the individual level (eg. high-efficiency wood stoves), farm level (eg. biogas), or in district energy plants.

Bioenergy Plant

Biofuel sources

Bioethanol: Fermentation of starch crops
Biodiesel:Vegetable oils and animal fats
Biogas: Methane from anaerobic digestion of organic waste or syngas from wood.

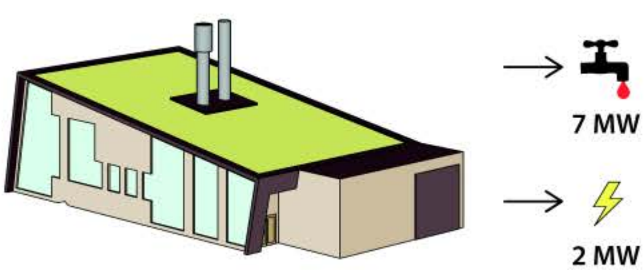
Biomass sources

Forestry waste
Construction wood waste
Fuel crops, dried manure & stemwood
Garbage
Charcoal, Biochar

The difference between bioenergy and fossil fuels:

Burning bioenergy releases carbon that has been sequestered from the atmosphere, and therefore can be considered carbon neutral*. In contrast, burning fossil fuels releases carbon that has been buried beneath the earth for millions of years, releasing additional carbon into the atmosphere.*

Bioenergy can produce heat and/or electricity



Building architecture and energy output in the example above are modelled after UBC's bioenergy plant.

Issues to Consider:

- Costs/Savings
- Air Pollution
- Fuel Source Quality
- Increased Traffic

What Is Bioenergy?

Case Studies

Image Credit: Northern Development BC

Baldy Hughes Therapeutic Community, near Prince George, BC

When the therapeutic community began operations at their current site, it soon became apparent that meeting their heating requirements with propane would be costly - both in monthly fuel costs and carbon taxes.

In response, the community pursued funding for installation of a community bioenergy heating system. This $1.3 million project, replaced the propane boilers with a biomass system that uses wood pellets as fuel. The wood pellets are made from low-cost carbon-neutral wood by-products available in the area.

The system has exceeded their expectations reducing heating costs by 75%.

Image Credit: John Newcom

Dockside Green, Victoria, BC

A wood-fired combined heat and power plant will provide heat and hot water to the entire development. This, along with the hydropower-based electricity, will reduce the carbon footprint of the development.

Learn more:

seatoskygreenguide.ca

northerndevelopment.bc.ca/explore-our-region/success-stories/baldy-hughes-invests-in-a-community-bioenergy-heating-system/

nexterra.ca/files/pdf/Project Profile_UBC 20120912_EMAIL.pdf

Costs/Savings

Costs per kilowatt hour range from:
9-13¢ for a biomass plant,
15-50¢ for biogas plant

Current natural gas prices are about 9¢ per kWh.

Air pollution

Metro Vancouver has very strict air quality standards, that must be met when installing a bioenergy plant. UBC's Nexterra bioenergy plant filters out virtually all particulate matter.

Fuel Source Quality

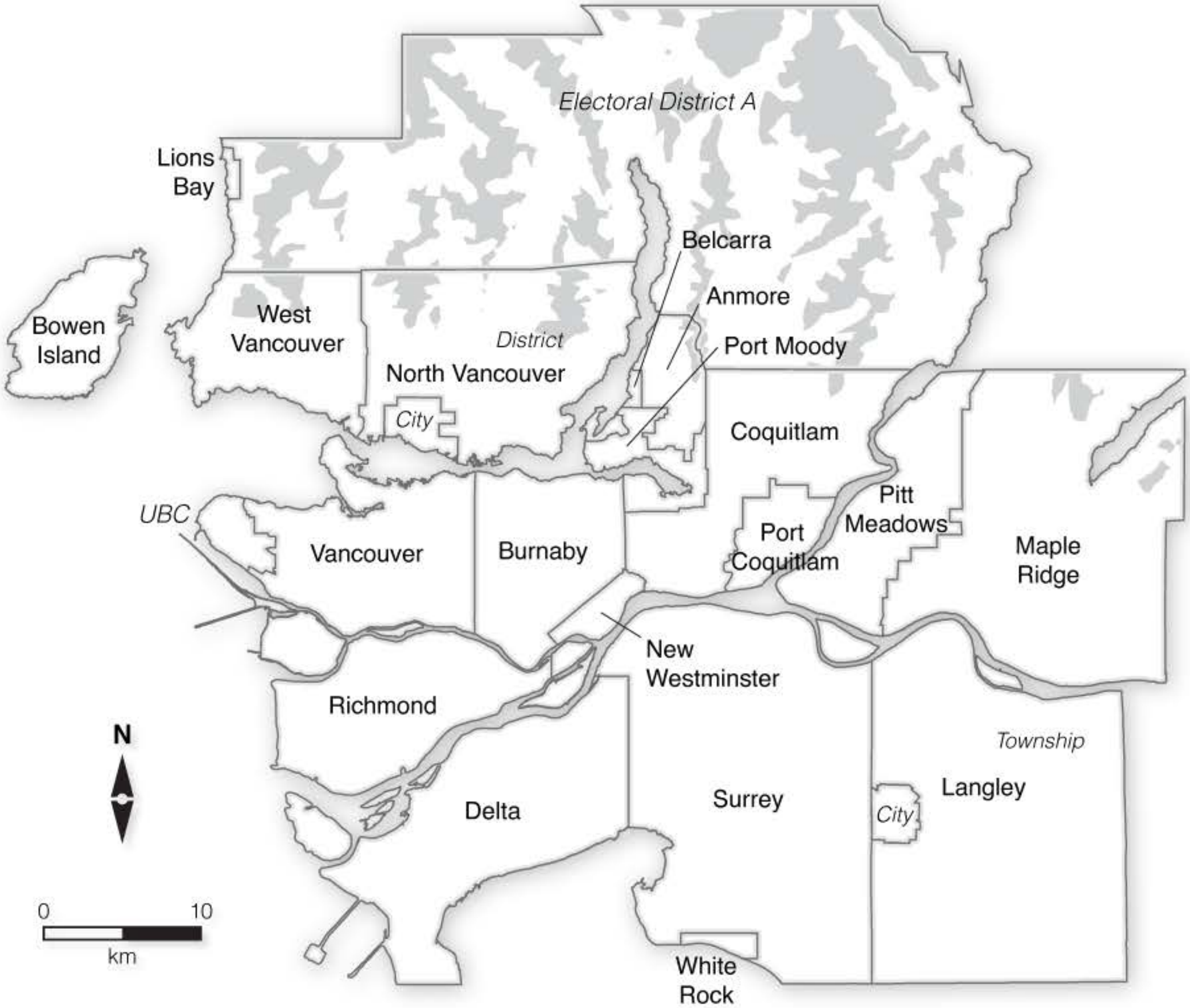
The fuel source must be free from contaminants, & be of consistent low moisture content, etc.

Increased Traffic

A medium-sized district energy plant is supplied by two trucks per day. This requires careful siting to avoid quiet residential streets.

Section 3 - Regional Renewable Energy Resources

This chapter provides an inventory of the potential capacity of select renewable energy resources across the region, and describes issues arising from the associated technologies.



The region of Metro Vancouver comprises 22 municipalities, one electoral area, and one treaty First Nation.

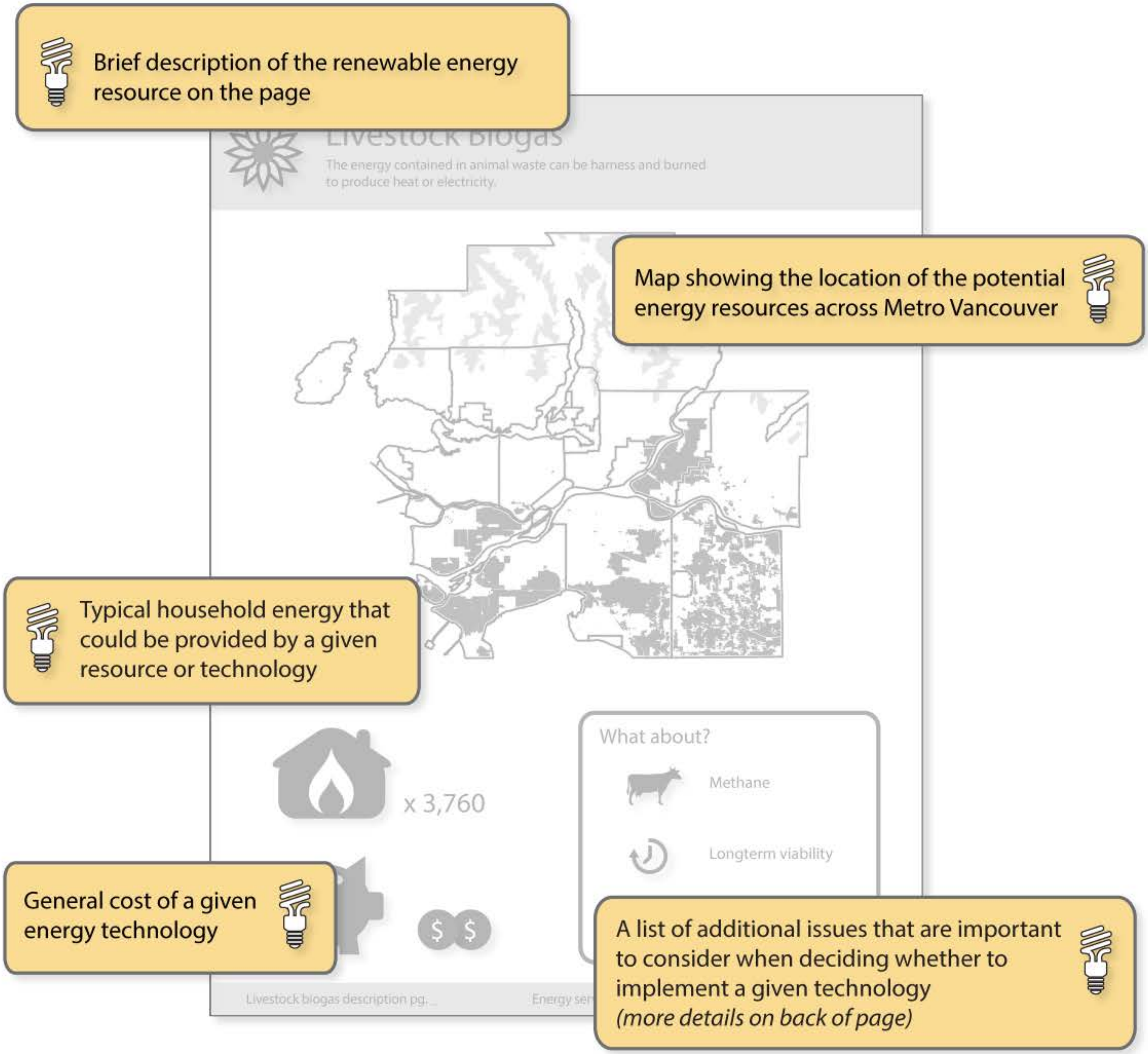
The resources inventoried in this section provide an overall snapshot of the physical potential for renewable energy generation in Metro Vancouver. They do not reflect constraints of economic viability, social acceptability or current regulations. Existing data from various sources are analyzed and mapped using new techniques suitable to communicating energy resources at the regional scale.

Energy Resources Inventoried

- Rooftop Solar
- Run-of-River Hydro
- Industrial Recovery
- Livestock Biogas
- Sustainable Forest Biomass

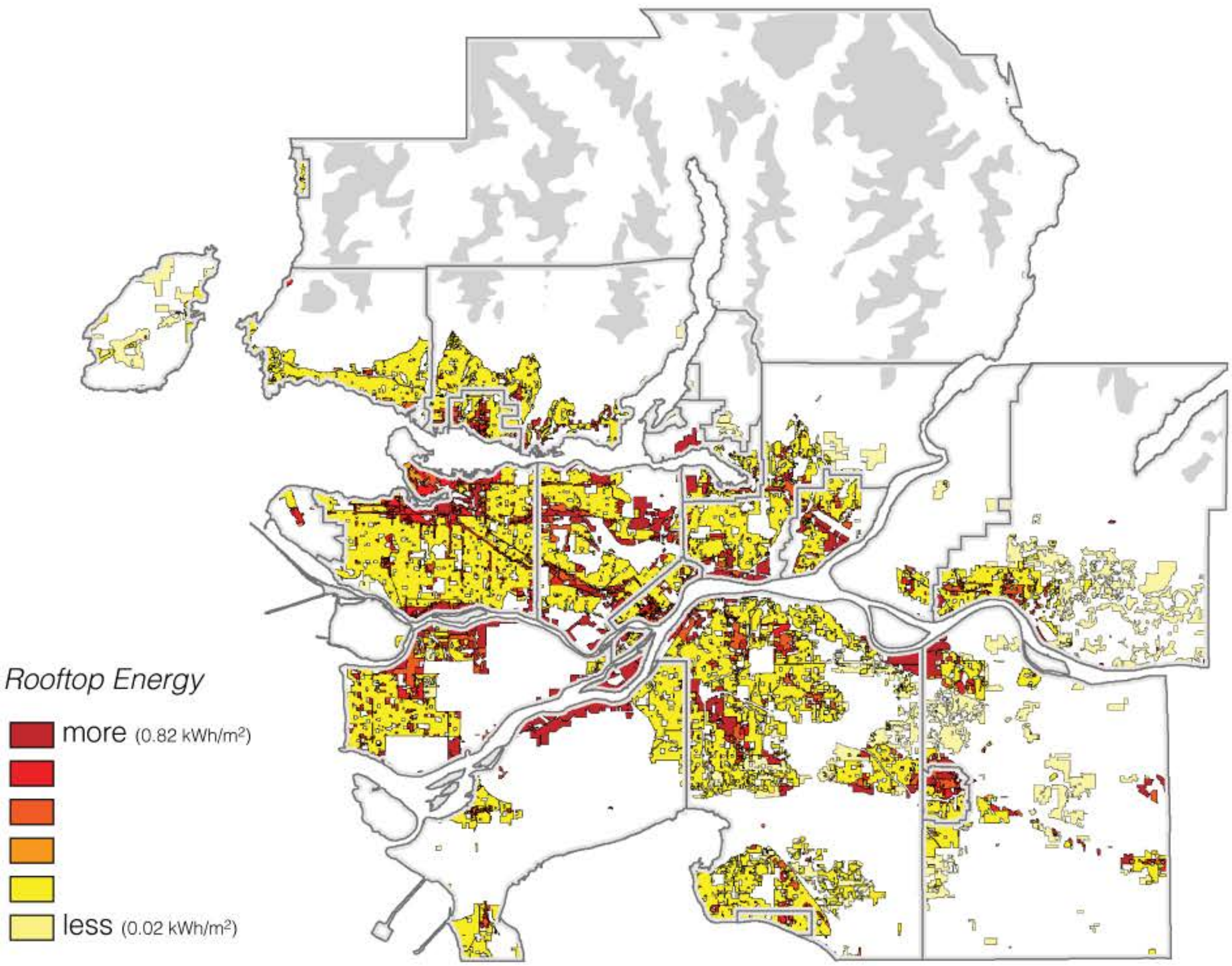
How To Use This Section

Outlined below is a general description of the layout of this chapter and how to think about the information.



Rooftop Solar

Solar energy can be collected using panels to produce hot water or electricity. Here the energy on the south-facing (or flat) portion of exisiting roofs is assessed.



for municipality labels see page 3.0

could heat up to
650,000
typical households

or

could power up to
900,000
typical households

costs range between
19 - 45 ¢
per kWh

Issues to Consider

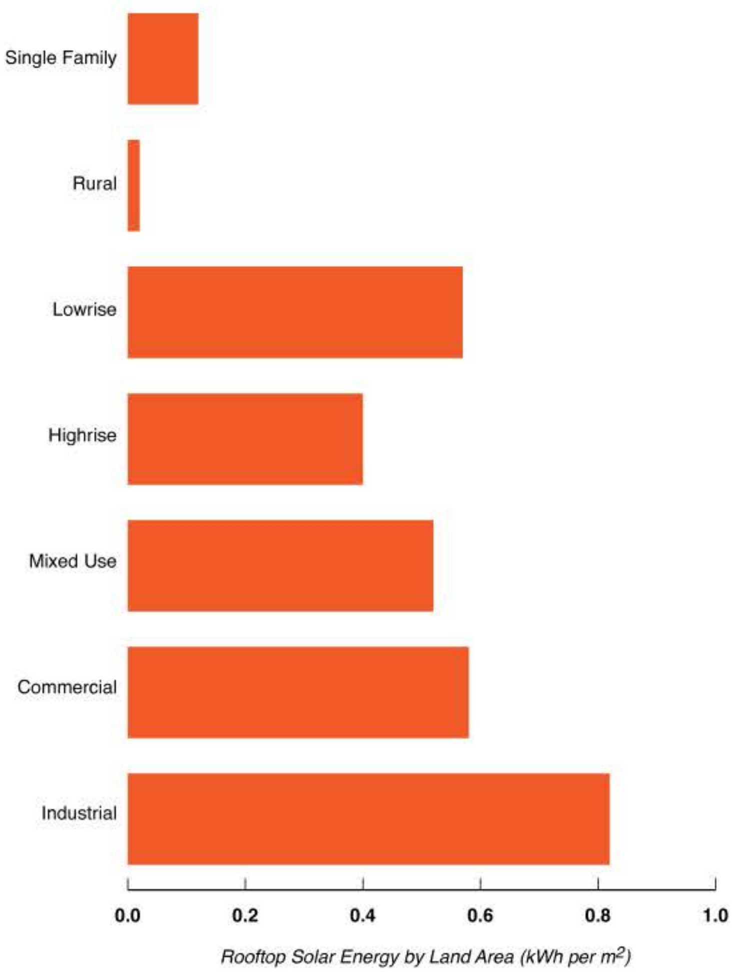
- Intermittency
- Shade
- Maintenance

see over

3.1b ...More Information

Source: University of British Columbia
Rooftop solar energy was assessed using the typical built form found in Land Use Classes across Metro Vancouver. The analysis considers roof shading, orientation and atmospheric effects.

South-Facing Rooftop Solar Energy by Land Use Type



Local Example

Vancouver Airport's Solar Hot Water System

In 2003, the Vancouver Airport installed 100 solar panels on the roof of the domestic terminal building. The system uses evacuated tube solar collectors to absorb solar energy and transfer the heat to water.

The panels heat over 3000 liters of water every hour, which has led to a 25% decrease of natural gas use in the terminal.

The cost of the project was about $500,000 and the airport reports energy saving of more than $100,000 a year. Furthermore, by reducing natural gas use, the airport has also managed to lower its carbon emissions.

Intermittency

The energy produced by a solar panel changes throughout the day and year depending on sun angles and cloud cover. This intermittency in energy output requires consideration of additional energy technologies to supply energy when the sun is not shining.

Shade

Shade from trees and buildings will affect the energy produced from a solar panel. To ensure the maximum energy output of a solar installation some jurisdictions in California have laws that prohibit shading of neighbouring solar panels.

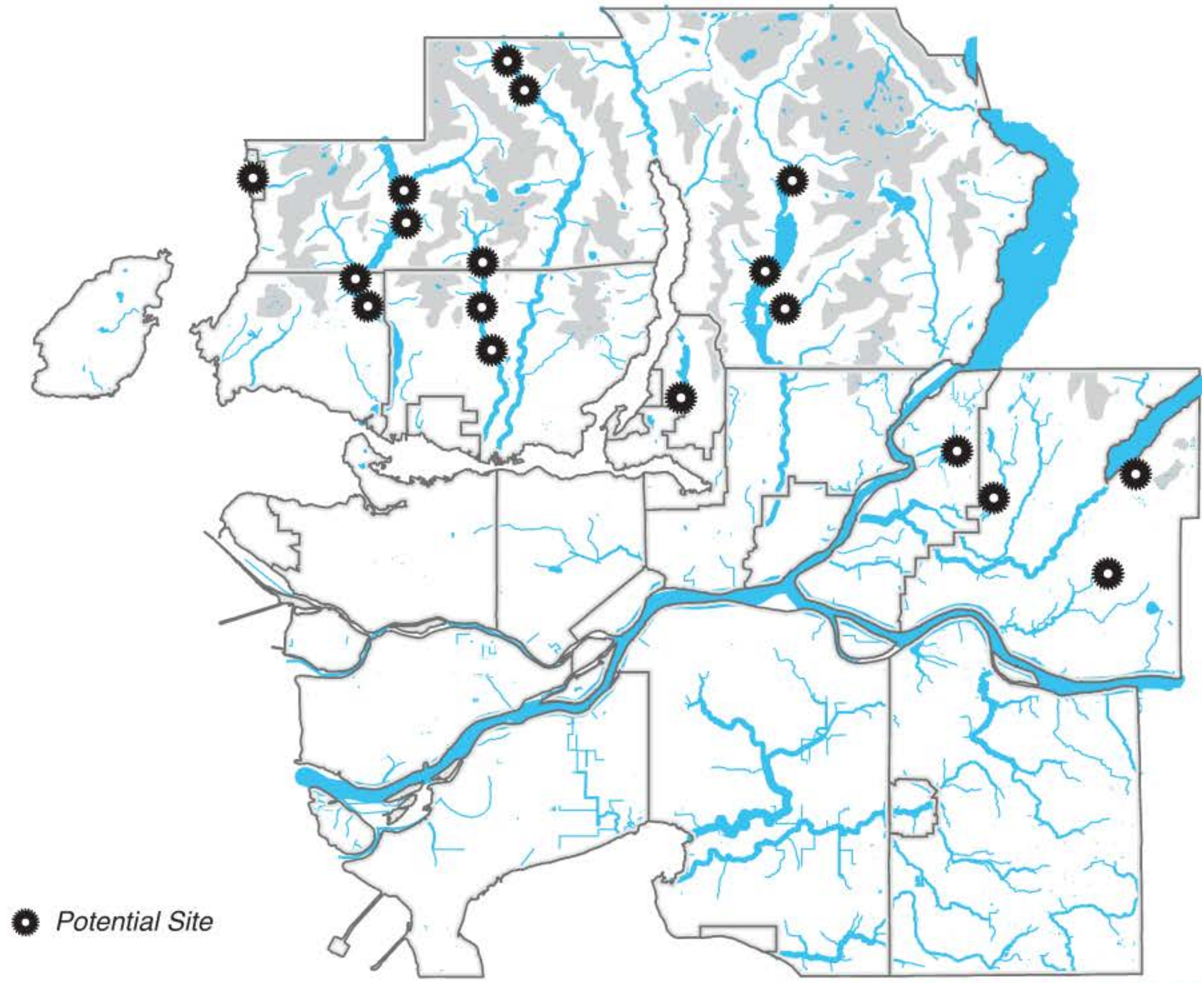
Maintenance

Solar panels require some maintenance for removing dust and snow. If the panels are not maintained, the energy output of the technologies can be reduced and economic viability can be compromised.

Run-of-River Hydro

3.2

Run-of-river technologies generate electricity by harnessing the energy from water flows in streams and rivers, without the use of large dams.



for municipality labels see page 3.0

could power up to

7,500

typical households

costs range between

6 - 14 ¢

per kWh

Issues to Consider

Fish Bearing Streams

Protected Areas

Recreation

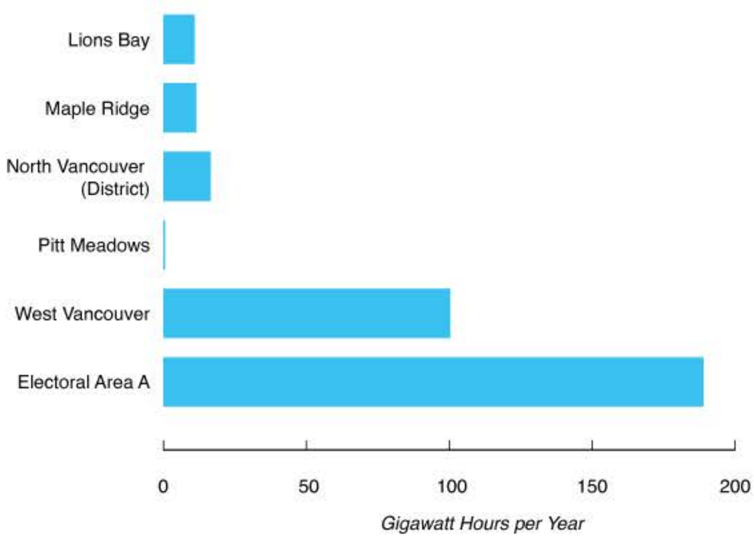
see over

Note: Potential Run-of-River sites were provided by BC Hydro

3.2b ...More Information

Source: BC Hydro
Potential Run-of-River Hydro locations and electricity generation potential were gathered from the BC Hydro Resource Options Mapping (ROMAP) database

Potential Run-of-River Hydro Energy by Municipality



Local Example

Fitzsimmons Creek Run-of-River Project

The Run-of-River facility at Fitzsimmons Creek in Whistler began generating electricity in January 2011.

The Run-of-River project diverts water flow from the creek to run a turbine that produces electricity, before returning the water to the creek.

The project has the ability to produce over 33 GWh of energy per year, which is enough to power Whistler Blackcomb's summer and winter operations.

The length of stream where the project was installed is not a fish bearing area of the creek, and the weir was constructed to maintain minimum water levels.

Fish Bearing Streams

To minimze impacts on native fish populations, Run-of-River projects can be installed upstream of fish bearing reaches. The assessment of potential sites in Metro Vancouver accounts for known fish bearing streams.

Protected Areas

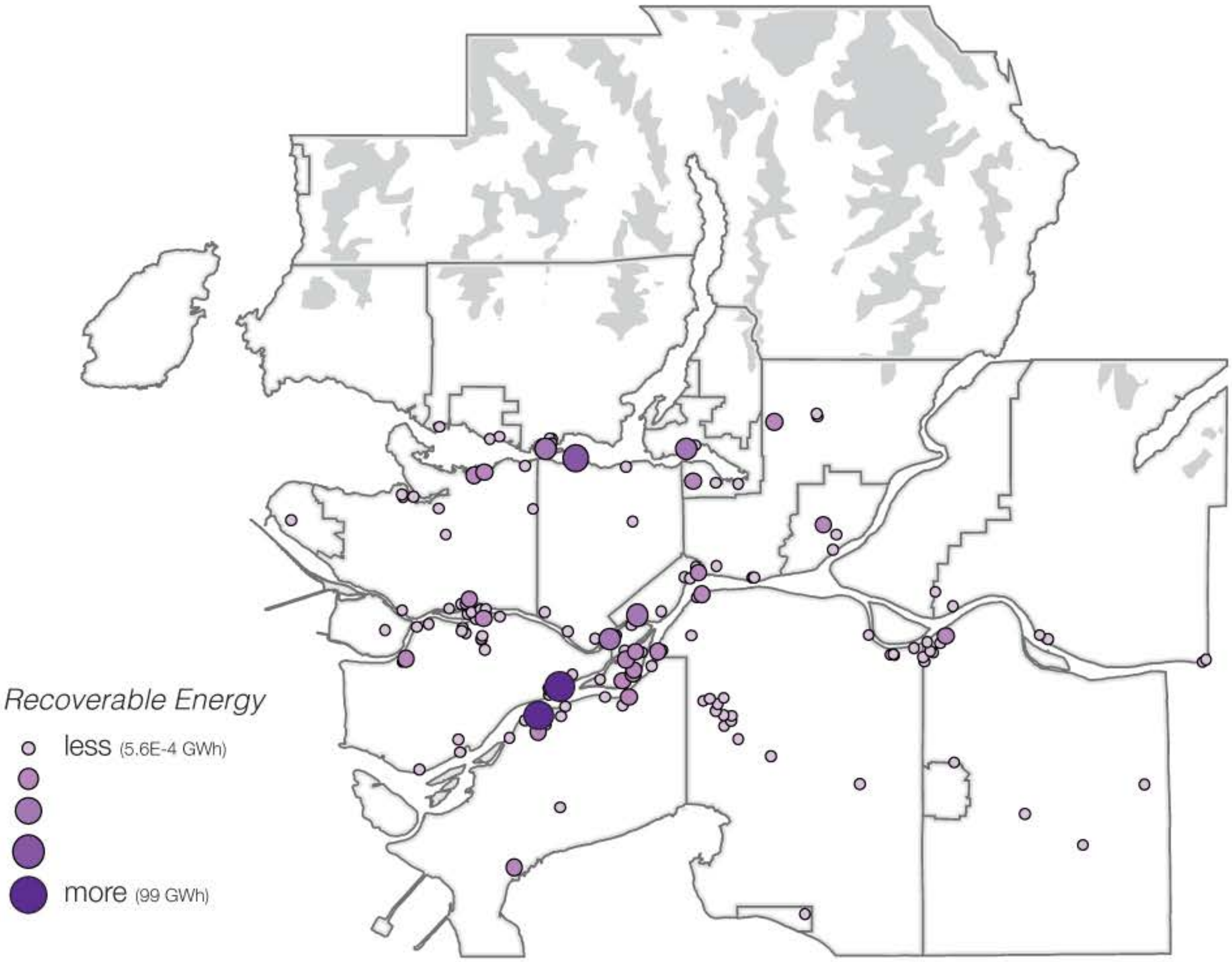
Many of the potential run of river sites in Metro Vancouver are located in protected areas, designated as watersheds for drinking water or recreational areas; this raises key policy and public acceptance issues.

Recreation

Many recreationists enjoy using creeks and rivers for activities such as kayaking, canoeing and fishing. However, there are opportunities for recreation and energy production to co-exist on the same stream. Various conditions are often negiotiated during project planning.

Industrial Energy Recovery

Energy generated during industrial processes can be captured and reused, or shared with nearby buildings.



for municipality labels see page 3.0

could heat up to

7,500

typical households

costs are variable, many technologies generate revenue

Issues to Consider

Air Quality

Longterm Viability

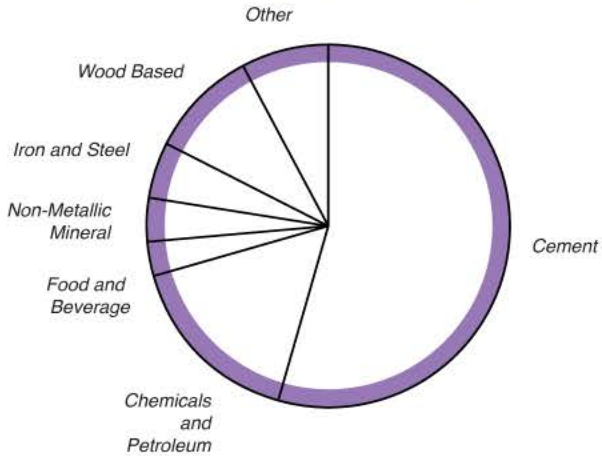
Siting & Infrastructure

see over

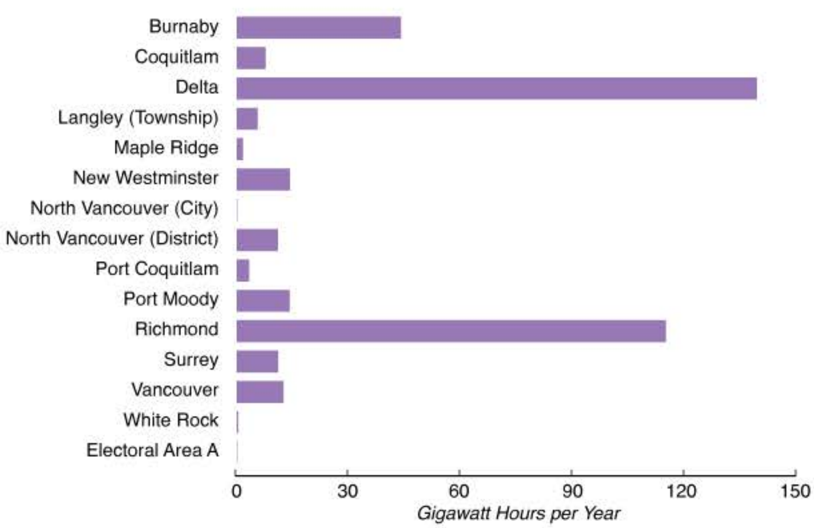
3.3b ...More Information

Source: University of British Columbia
Industrial heat recovery was assessed using major gas consuming industries in Metro Vancouver and their associated NAICS class as a reference for published heat recovery factors.

Potential Regional Heat Recovery by Industry



Potential Heat Recovery by Municipality



Local Example

Metro Vancouver's Waste-to-Energy Facility

In 1988 Metro Vancouver installed a Waste-to-Energy Facility in Burnaby, BC. The facility takes 25% of the region's garbage (285,000 tonnes) and turns it into heat and electricity.

The energy provided from the facility generates enough energy to power 16,000 households.

Since the incoming garbage is burned to produce energy, its volume is reduced by more than 75%. Much of this waste can then be recycled or reused, resulting in a total of about 4% of the initial volume of garbage ending up in a landfill.

Note: Additional waste-to-energy facilities were not considered in the estimate of industrial recovery potential.

Air Quality

Recovering waste heat has little to no air quality impacts. Converting waste to electricity requires burning, but modern technologies remove most of the pollutants before they enter the atmosphere.

Longterm Viability

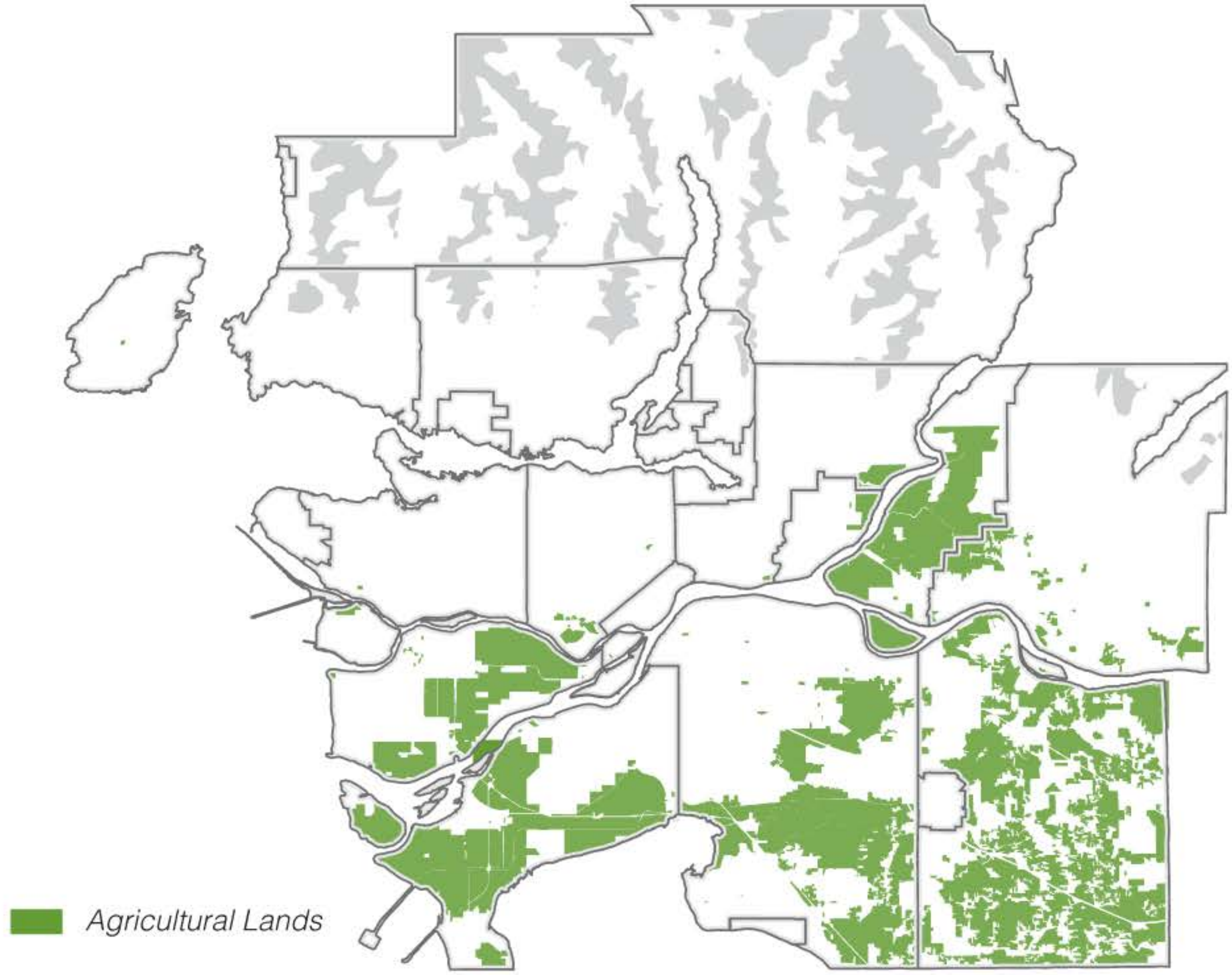
The implementation of energy technologies that use waste heat or waste materials must consider potentially competing waste reduction initiatives that may limit the availability of waste fuels over long periods of time.

Siting & Infrastructure

Delivering waste industrial heat to buildings requires the construction of new infrastructure such as underground pipes. Since heat dissipates quickly, the proximity of the buildings to the industrial heat source must also be considered.

Livestock Biogas

The energy contained in animal waste can be harnessed and burned to produce heat or electricity.



for municipality labels see page 3.0

could heat up to
3,500
typical households

or

could power up to
17,000
typical households

costs range between
15 - 50 ¢
per kWh

Issues to Consider

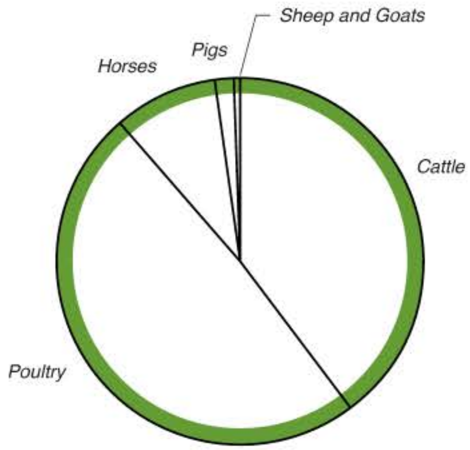
- Methane
- Longterm Viability
- Infrastructure

see over

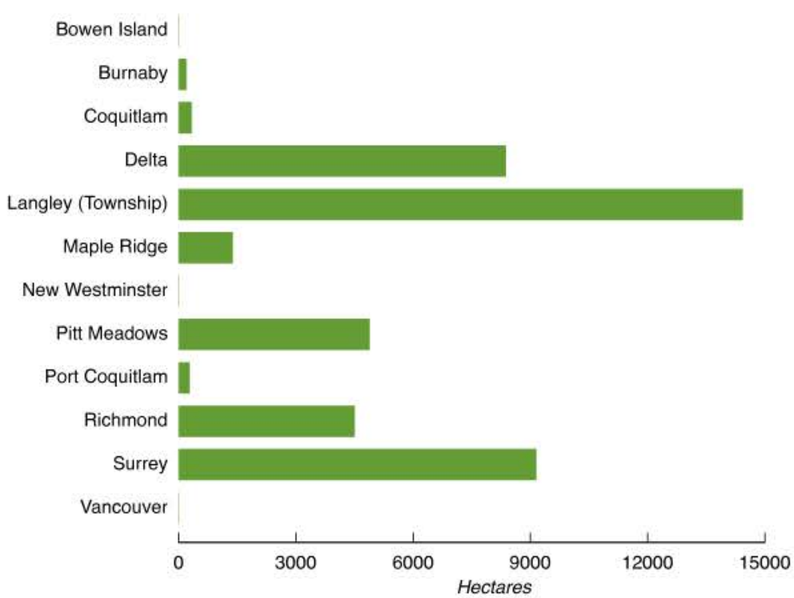
3.4b ...More Information

Source: University of British Columbia
Livestock biogas energy was assessed using livestock headcounts from the Canadian Agricultural Census with published manure mass and methane recovery factors by livestock type.

Biogas by Livestock Type



Agriculture Land by Municipality



Local Example

Bakerview EcoDairy's Anaerobic Digester

In 2011 Bakerview EcoDairy in Abbotsford, BC installed a small-scale on-farm anaerobic digester that converts cow manure into electricity. The digester can generate 60,000 kWh of electricity per year, enough to power more than 5 typical households in Metro Vancouver.

In addition to the electricity that the digester generates, the system also provides heat, fertilizer and cow bedding for use on the farm.

Further benefits of the digester include reductions of water pollution, odours and methane emissions (a potent greenhouse gas).

Methane

Livestock manure contains high amounts of methane, a greenhouse gas with over 20 times the warming potential of CO_2. By capturing the methane from manure and burning it produce it energy, global warming impacts can be reduced, since the methane is converted to CO_2 before being released to the atmosphere.

Longterm Viability

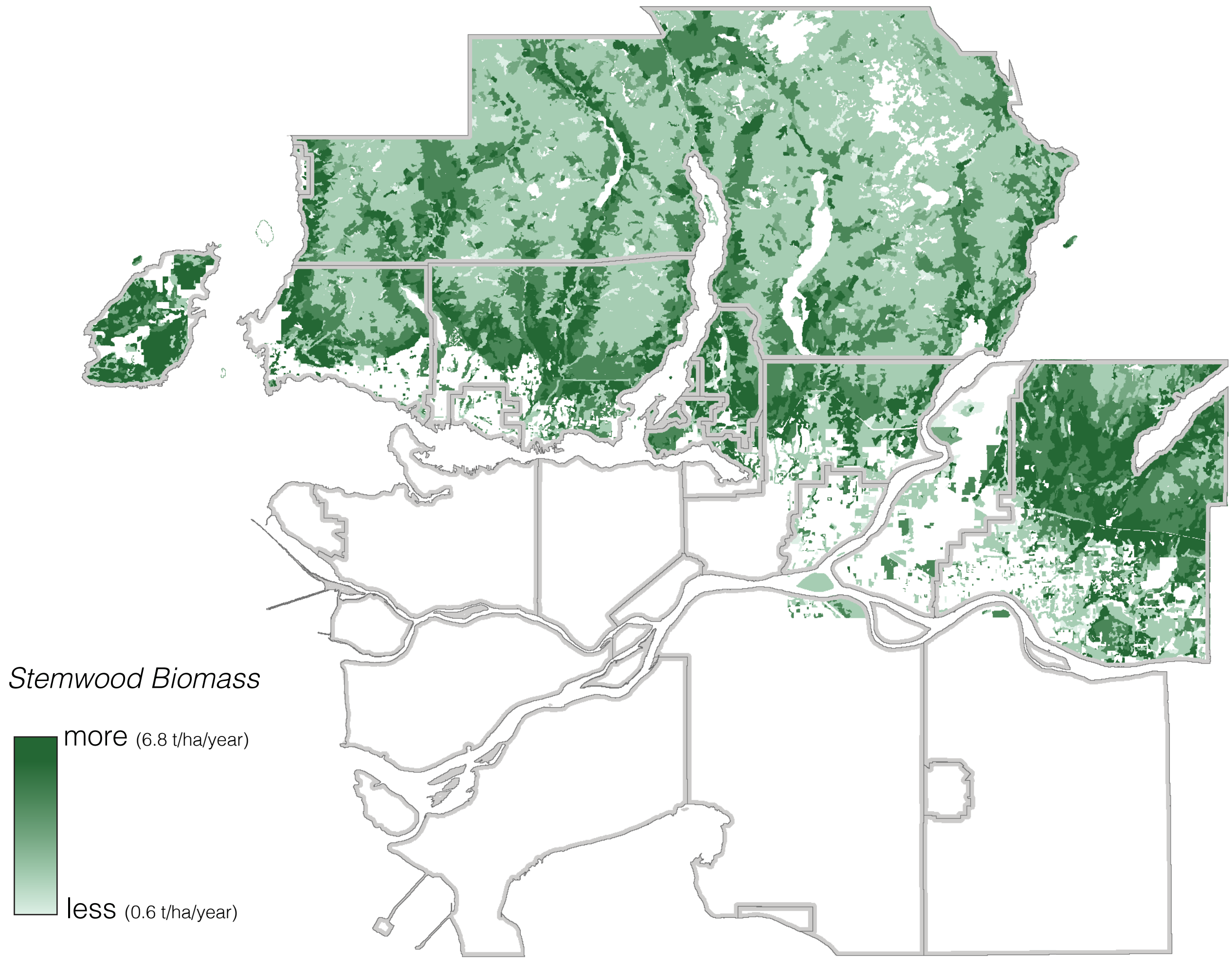
The implementation of energy technologies that use animal waste must consider future changes to agricultural lands and livestock husbandry to ensure an adequate availability of manure fuels.

Infrastructure

Generating and delivering gas and electricity from livestock wastes requires consideration of new transmission infrastructure such as underground pipes and electric lines, as well as transportation of manure to the energy generating or processing facility.

Sustainable Forest Biomass

Sustainably harvested forest biomass can be used as a fuel for generating heat or electricity.



for municipality labels see page 3.0

could heat up to
24,000
typical households

or

could power up to
26,000
typical households

costs range between
6 - 14 ¢
per kWh

Issues to Consider

Protected Areas

Views

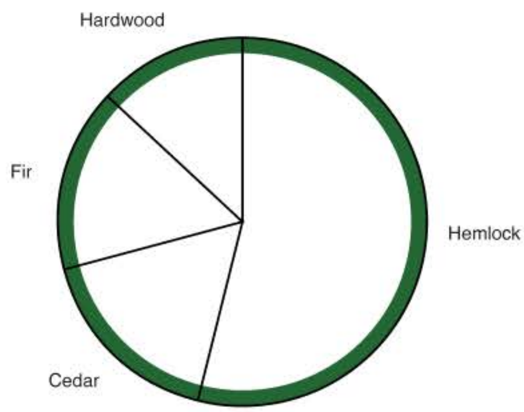
Sustainable Harvests

see over

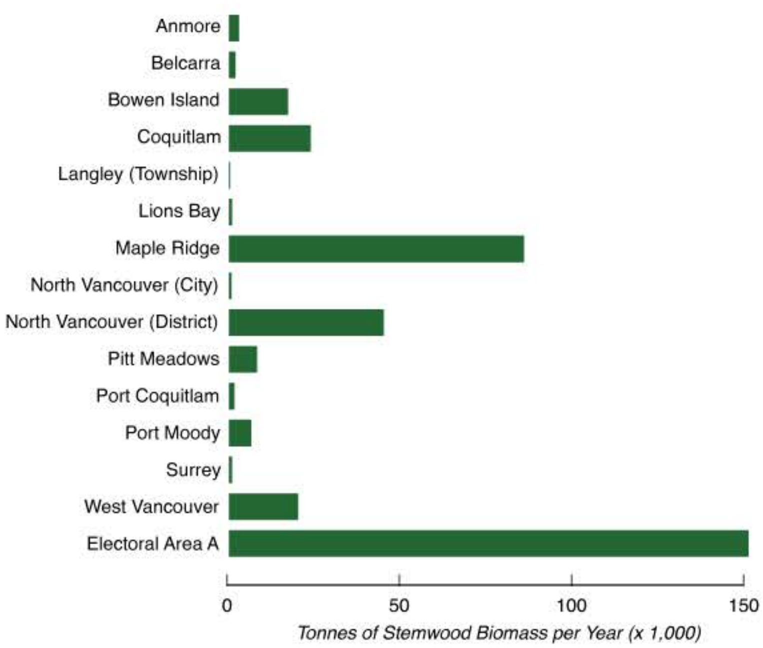
3.5b ...More Information

Source: University of British Columbia
Sustainable forest biomass was assessed using the FORECAST model. A selection harvest of stemwood on a 50 year rotation was selected to maintain the quality of the existing forests.

Regional Biomass by Tree Types



Potential Forest Biomass by Municipality



Local Example

University of British Columbia's Biomass Power Plant

In 2012 the University of British Columbia installed a biomass power plant that uses waste wood from regional sawmills to produce heat and electricity.

The plant can produce enough electricity to power over 1,500 households. The heat from the plant is used to provide thermal energy to nearby buildings on the university campus, reducing UBC's natural gas consumption by 12%.

Other biomass sources used to run biomass plants could be gathered from park trimmings, fire fuel removal, wood wastes from logging activities, clean construction wastes and stemwood from fast-growing plantations.

Protected Areas

Much of the potential timber in Metro Vancouver is located in protected areas, designated as watersheds for drinking water or recreational areas. This raises key policy and public acceptance issues.

Views

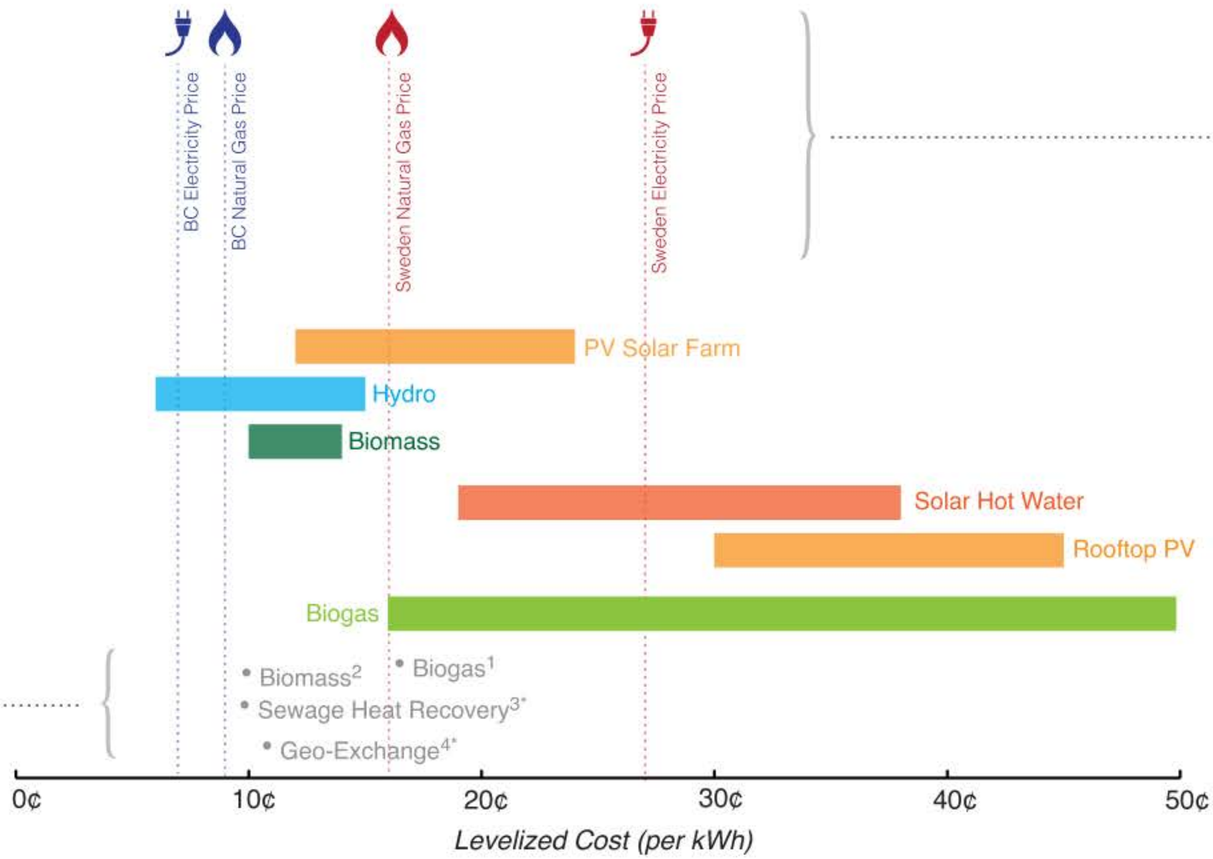
Harvesting trees to provide biomass energy resources could have an impact on the view of forests in Metro Vancouver. However, partial cutting techniques and good design can mimize these visual impacts.

Sustainable Harvests

Harvesting can be designed to maintain soil quality and carbon, local habitats and ecosystem services. The assessment of biomass here assumes selection harvesting of stemwood on a 50 year rotation, which could be coordinated with fire protection strategies.

Energy Costing

The Levelized Cost of Energy estimates technology lifetime costs including capital, labour and financing, relative to the total energy they will generate.



Local Examples

1 In 2011 **Bakerview EcoDairy** in Abbotsford, BC installed an anaerobic digester to convert cow manure into electricity.

2 In 2012 the **University of British Columbia** installed a biomass power plant that uses clean wood waste from regional sawmills to produce heat and electricity.

3* The **South-East False Creek** neighbourhood utility in Vancouver recovers heat from sewage, which is used to provide hot water to local residents.

4* The **PCI Marine Gateway** neighbourhood utility has been proposed to provide heating and cooling for residents of the Marine Gateway Development in Vancouver. The system will heat and cool buildings using a closed-loop geo-exchange system (with natural gas backup).

** Utility rate used as cost*

Pricing Energy & Carbon

The price paid for energy in British Columbia reflects technology installed long ago, such as our hydroelectric dams. Various policies including our carbon tax and clean energy requirement also affect energy prices.

Aging infrastructure and new procurement to meet increased demand will require that we pay more for our electricity.

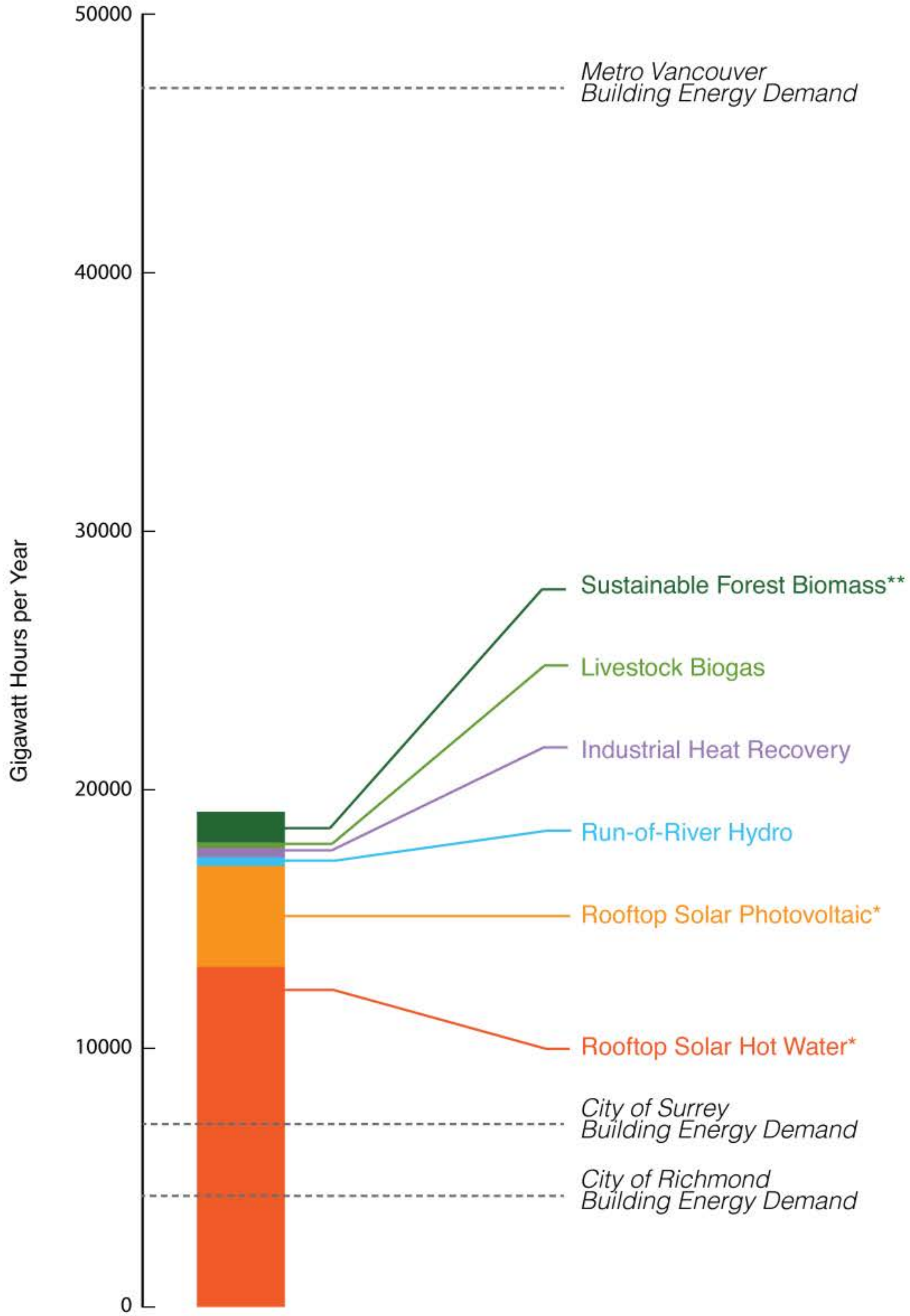
Although natural gas prices are currently low in North America, they are likely to increase and adding a price to carbon emissions in order to account for the costs of global warming will impact gas prices.

British Columbia currently has a carbon tax of $30 per ton. In comparison, Sweden, with a similar climate, hydroelectric infrastructure and biomass resource pays $150 per ton.

Since Sweden implemented its carbon tax in 1991, carbon emissions have gone down but their economy has grown more than 50%.

3.6b Energy Resources Compared

The graph below compares the assessed sustainable energy resources in Metro Vancouver (bars) against building energy demand (lines)



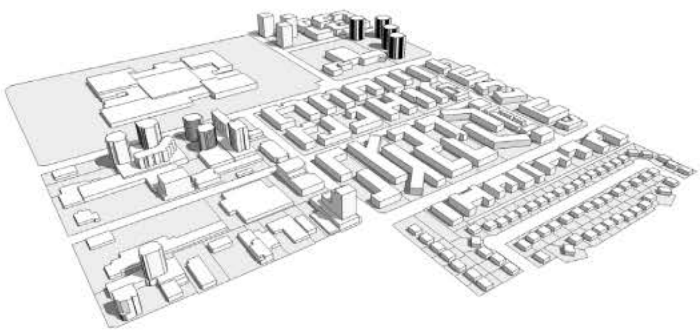
* Rooftop solar assessment makes a simple assumption that of half of south facing roof space is used for photovoltaic and the other half for solar hot water

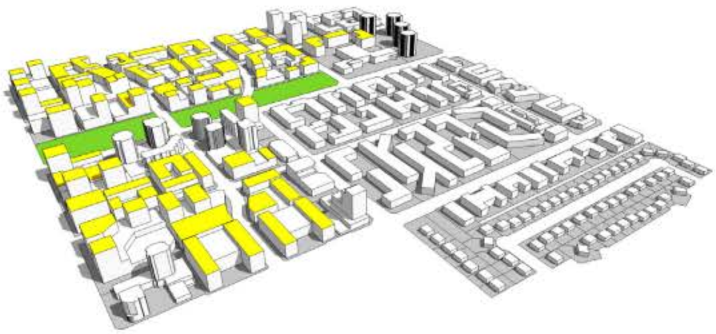
** Biomass potential considers heat energy. Electrical energy would be about 290 Gigawatt Hours per Year

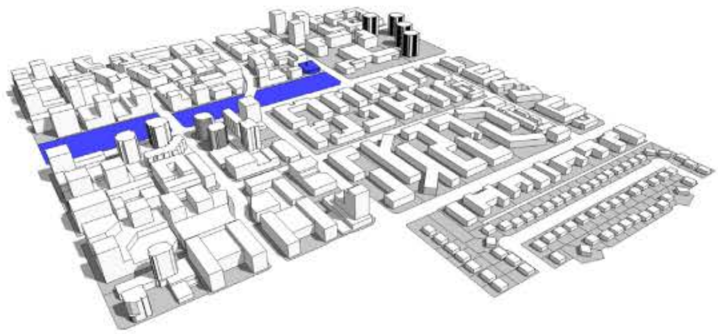
Section 4 - Urban Neighbourhood Energy Scenarios 4.0

Richmond Case Study

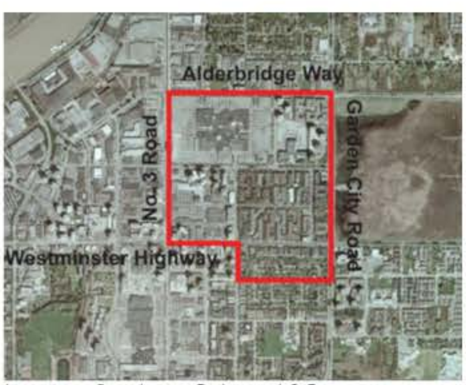
This Case Study explores some generic options for reducing energy consumption and greenhouse gas emissions in a neighbourhood redevelopment situation such as Lansdowne Mall in Richmond BC.







How can a city centre neighbourhood transition to a community that uses less energy and supplies most of its energy from local renewable sources?



Location of study site, Richmond, BC.

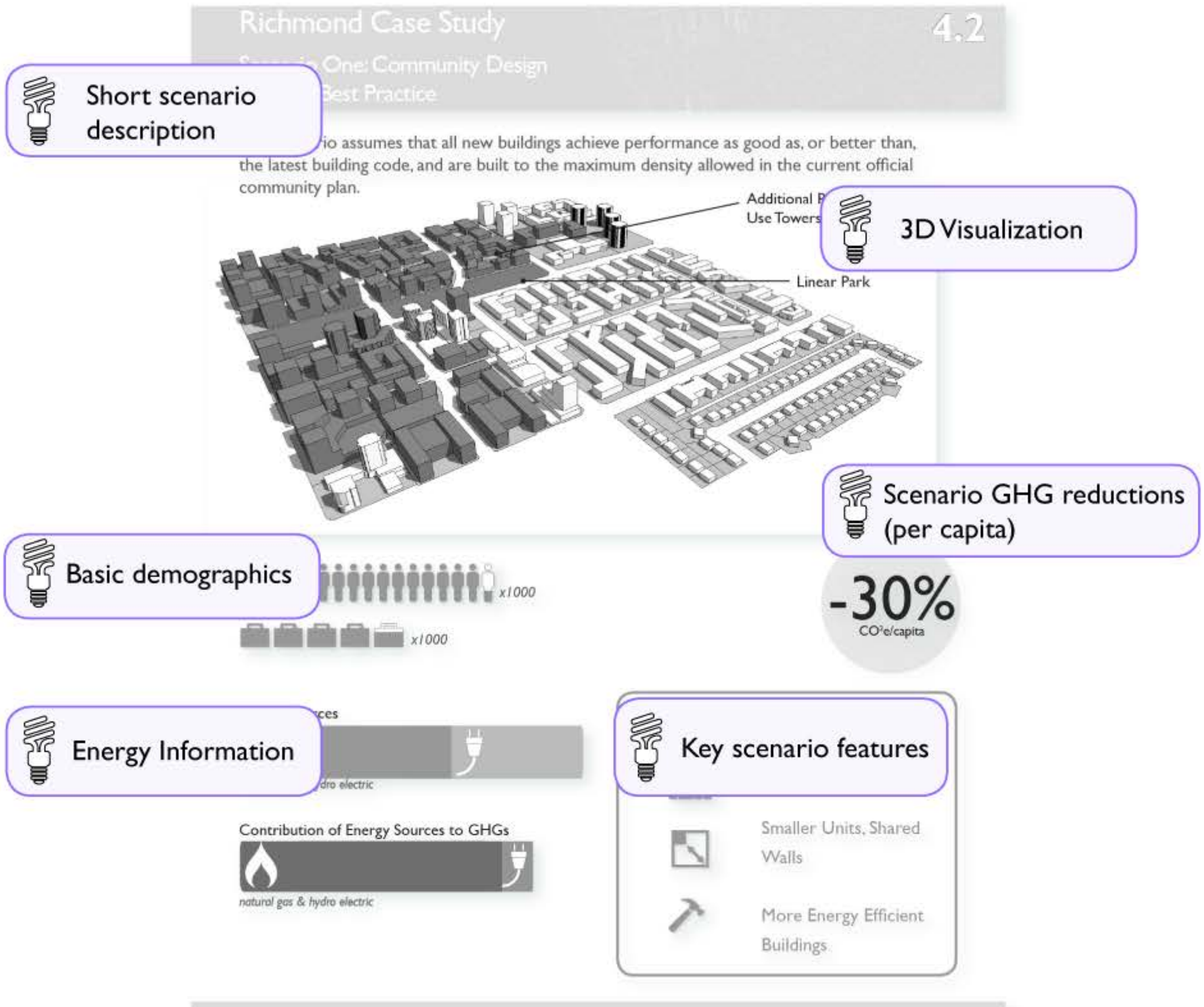
Scenarios:

Existing Conditions	**0.77** CO_2eT/person/yr
Current Best Practice	**-30%** per capita residential GHG
+ Building-Level Renewables (Solar)	**-38%** per capita residential GHG
+ Shared Energy	**-72%** per capita residential GHG

Per capita greenhouse gas reductions estimated for the scenarios based on energy modelling by UBC.

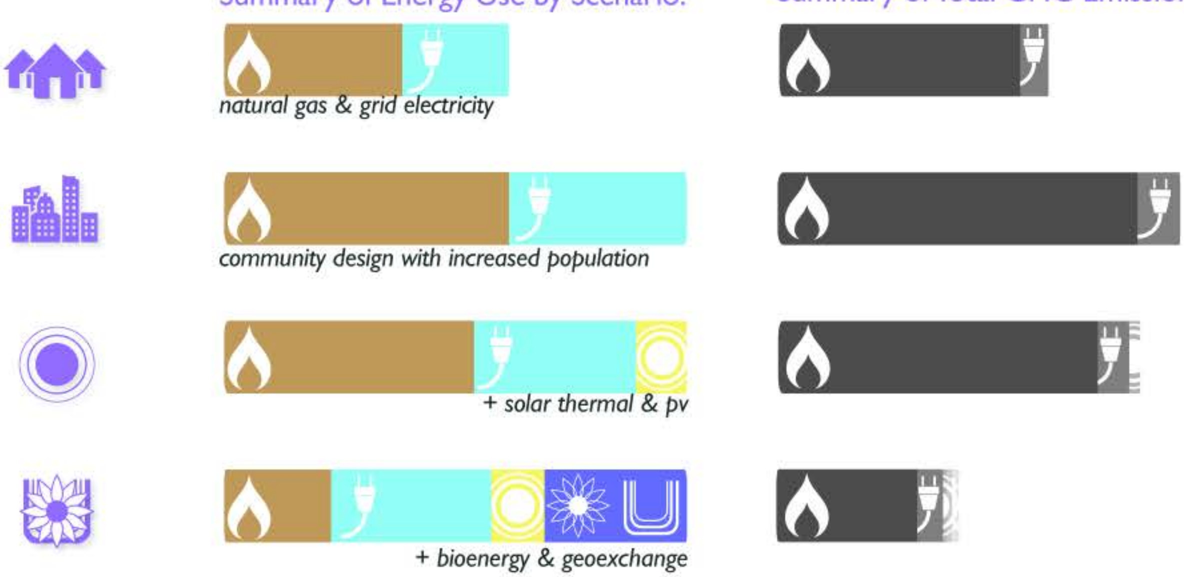
4.0b How to Use this Section

Outlined below is a general description of the layout of this chapter and how to explore the information.



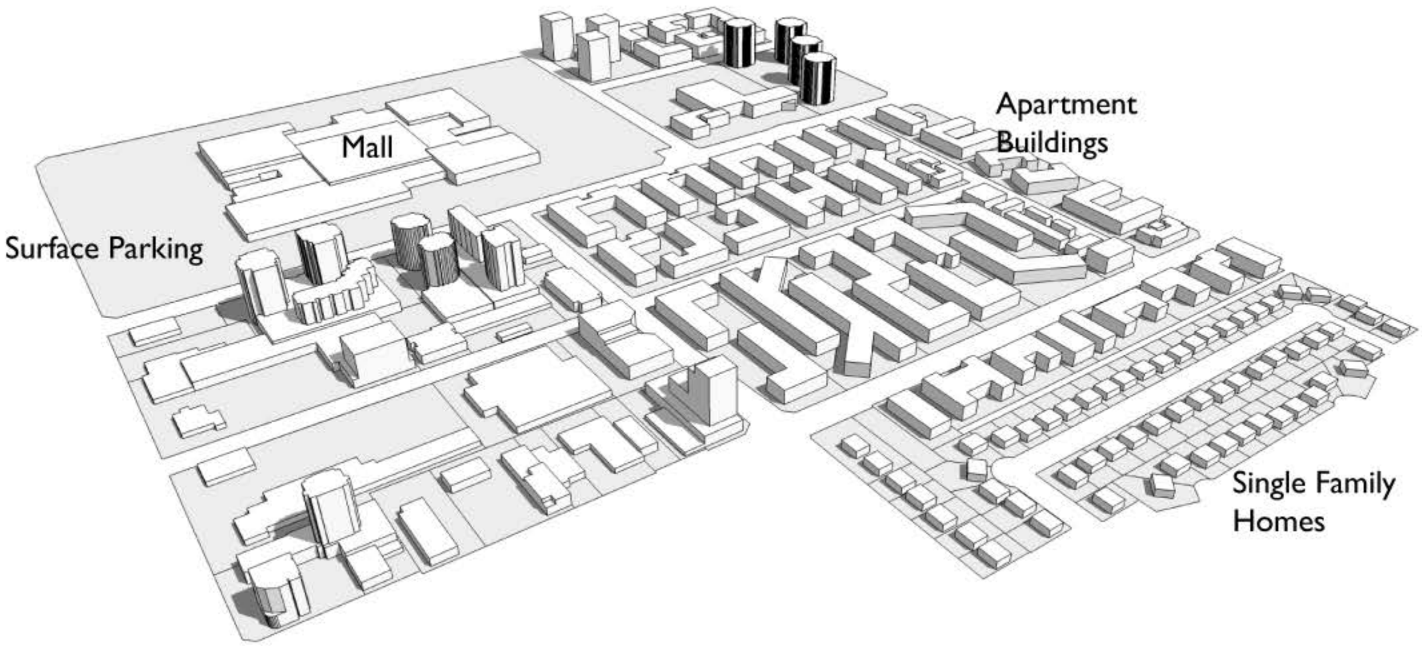
Summary of Energy Use by Scenario:

Summary of Total GHG Emissions by Scenario:



Richmond Case Study

Existing Conditions



Population
x1000

Jobs
x1000

0.77
$CO_2eT/person$

Energy Sources

natural gas & grid electricity

Contribution of Energy Sources to GHGs

natural gas & grid electricity

Existing Conditions:

- Extensive Surface Parking
- Low Density
- Many Buildings with Low Energy Efficiency

4.1b Richmond Case Study

Current Conditions

This neighbourhood is centred around an existing mall with large surface parking lots. Residential density is relatively low for an urban neighbourhood, and existing buildings are not energy efficient.

Total Residential Energy Consumption

164,000 GJ/yr

108,000 GJ/yr + 56,000GJ/yr

Total Residential Greenhouse Gas Emissions

5,900 tonnes CO_2e

Existing Conditions:

Extensive Surface Parking
Large surface parking lots do not provide any energy benefits and contribute to heating the neighbourhood in the summer.

Low Density
The area has low residential density compared to other urban areas in Richmond.

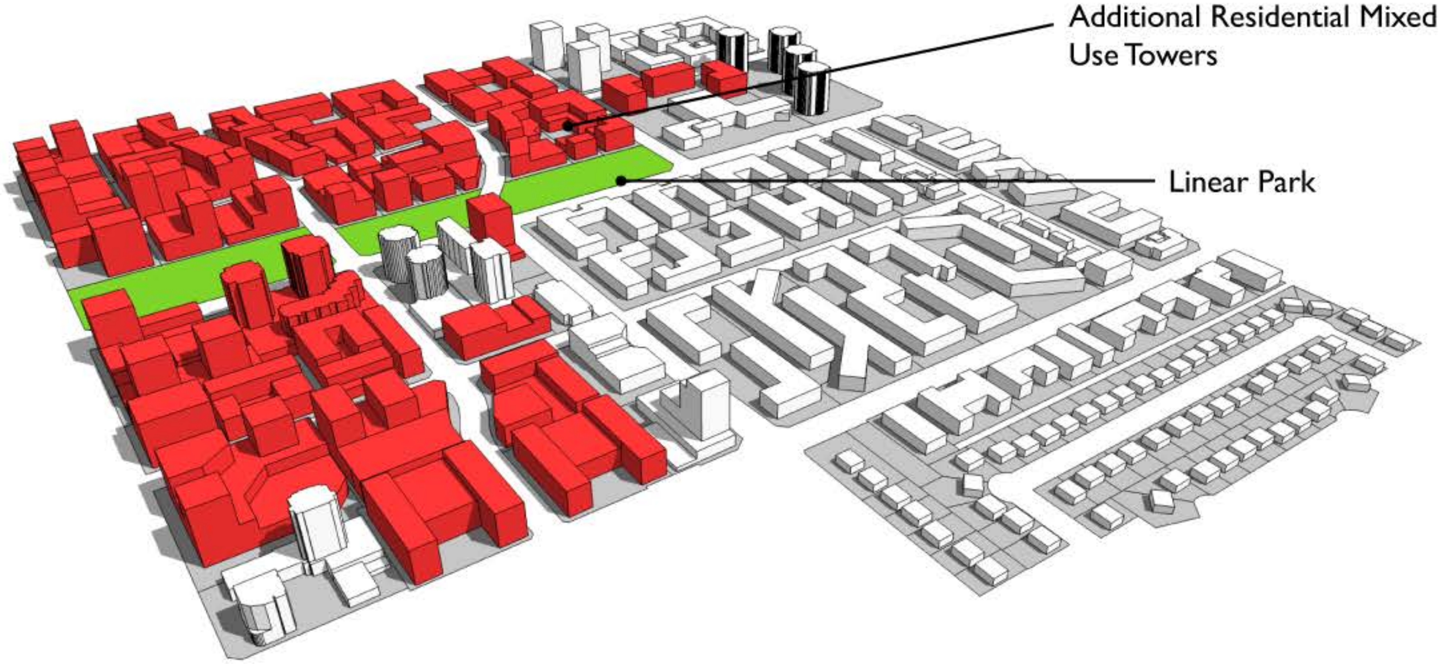
Many Buildings with Low Energy Efficiency
Many buildings are older with less insulation, lower efficiency furnaces and windows.

Richmond Case Study

4.2

Scenario 1: Community Design
Current Best Practice

This scenario assumes that all new buildings achieve performance equal to the latest building code, and are built to the maximum density allowed in the current official community plan.



Population
x1000

Jobs
x1000

-30%
CO_2e/capita

Energy Sources

natural gas & grid electricity

Contribution of Energy Sources to GHGs

natural gas & grid electricity

Scenario 1 Key Moves:

Add Buildings

Smaller Units, Shared Walls

More Energy Efficient Buildings

4.2b Richmond Case Study

Scenario 1: Community Design

This neighbourhood develops to become compact and complete, with extensive mid-rise mixed use buildings complemented by a new large park. More jobs locate within the neighbourhood, and it is more walkable for residents. All of these changes greatly reduce per capita carbon emissions.

0.54
CO_2eT/person

Scenario 1 Key Moves:

Add Buildings
Under utilized land is developed at the maximum allowed density.

Smaller units, shared walls
New units are in highrise buildings and are smaller on average than current units in the study area.

More efficient buildings
New buildings achieve more energy efficient building standards, such as ASHRAE 90.1

Total Residential Energy Consumption

256,000 GJ/yr

160,000 GJ/yr + 96,000GJ/yr

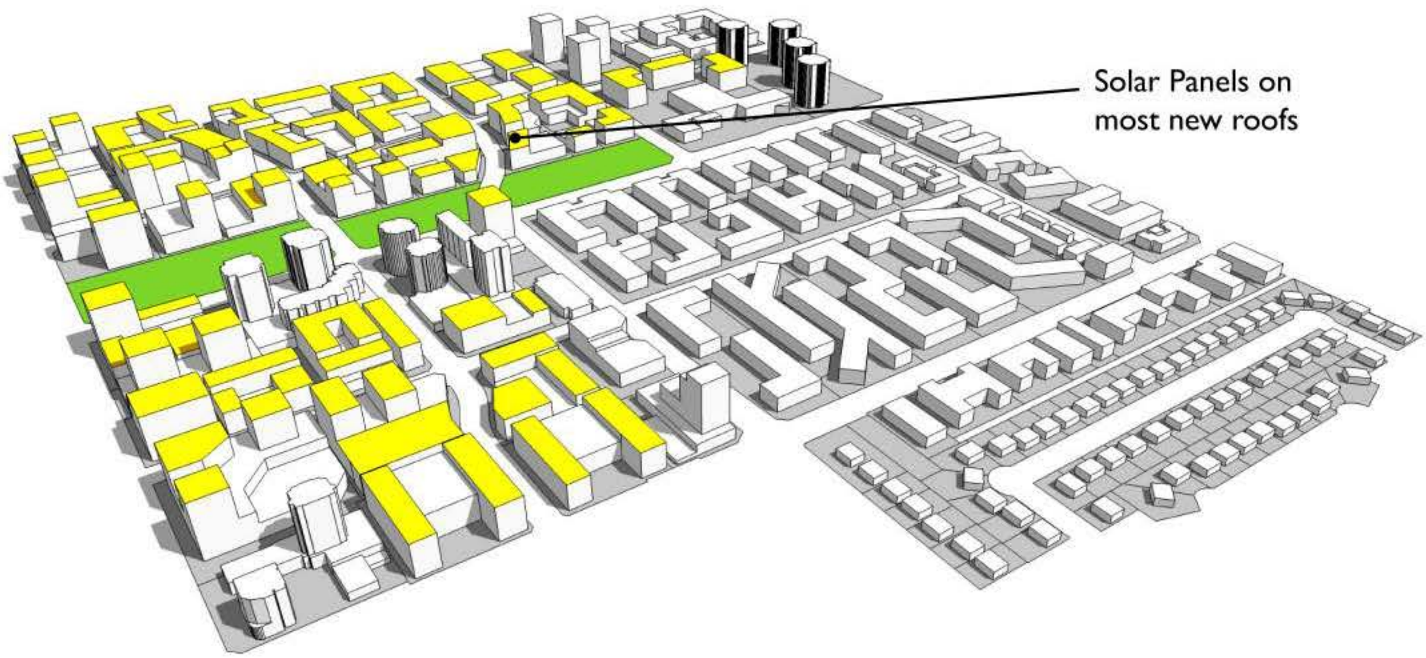
Total Residential Greenhouse Gas Emissions

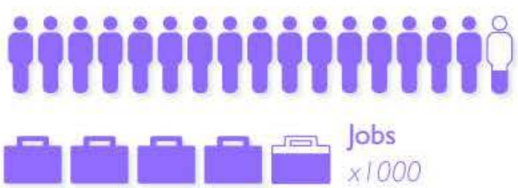
8,800 tonnes CO_2e

Richmond Case Study

Scenario 2: Building-level Renewables

This scenario shows the opportunity for individual buildings to supply renewable energy. Solar energy technologies were selected because of the amount of available roof space.





-38%
CO_2e/capita

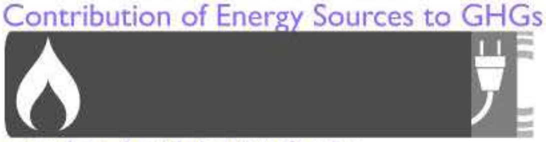
Scenario 2 Key Moves:

- Add Rooftop Solar
- 50% Solar Hot Water
- 50% Photovoltaic

Energy Sources

natural gas & grid electricity & solar

Contribution of Energy Sources to GHGs



natural gas & grid electricity & solar

4.3b Richmond Case Study

Scenario 2: Building-level Renewables

Solar panels can be integrated with the design of new buildings to reduce visual impact from ground-level and minimize shading from nearby buildings. Using solar energy further reduces per capita carbon emissions.

0.48
CO_2eT/person

Total Residential Energy Consumption

256,000 GJ/yr

141,000 GJ/yr + 92,000GJ/yr + 22,000GJ/yr

Total Residential Greenhouse Gas Emissions

7,800 tonnes CO_2e

Scenario 2 Key Moves:

Rooftop Solar
Solar panels cover 90% of all new roofs, which is 25% of the roof space of the study area

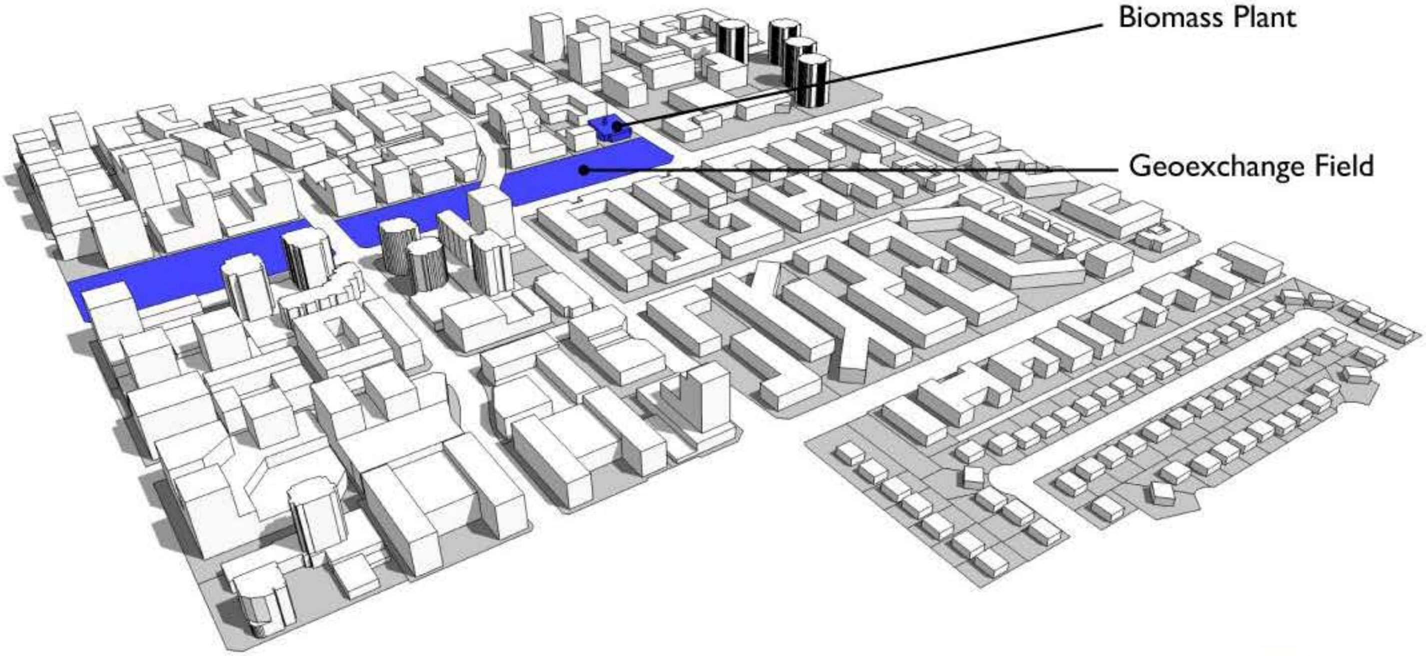
50% Solar Hot Water
Solar thermal produces 18,000 gigajoules per year

50% Photovoltaic
Solar photovoltaic produces 4,600 gigajoules per year

Richmond Case Study

Scenario 3: Shared Energy

This scenario shows the opportunity for community renewable energy systems. Geoexchange locates in the linear park, and a bioenergy district energy plant locates within the community.



Population
x1000

Jobs
x1000

-72%
CO_2e/capita

Energy Sources

natural gas & grid electricity & solar & bioenergy & geoexchange

Contribution of Energy Sources to GHGs

natural gas & grid electricity & solar & bioenergy & geoexchange

Scenario 3 Key Moves:

- Geoexchange added
- Biomass Plant added

4.4b Richmond Case Study

Scenario 3: Community Options

Geoexchange is located underground and out of sight in the linear park. A bioenergy plant is located within the community on a major street for access and can be integrated with surrounding building design. This scenario greatly reduces per capita and total carbon emissions.

0.21
CO_2eT/person

Total Residential Energy Consumption

256,000 GJ/yr

56,000 GJ/yr + 92,000 GJ/yr + 22,000 GJ/yr + 40,000 GJ/yr + 43,000 GJ/yr

Total Residential Greenhouse Gas Emissions

3,400 tonnes CO_2e

Scenario 3 Key Moves:

Geoexchange
The geoexchange provides 76,000 GJ of energy per year, half of which goes to residential uses.

Biomass Plant
The biomass plant provides 85000 GJ of energy per year, half of which goes to residential uses

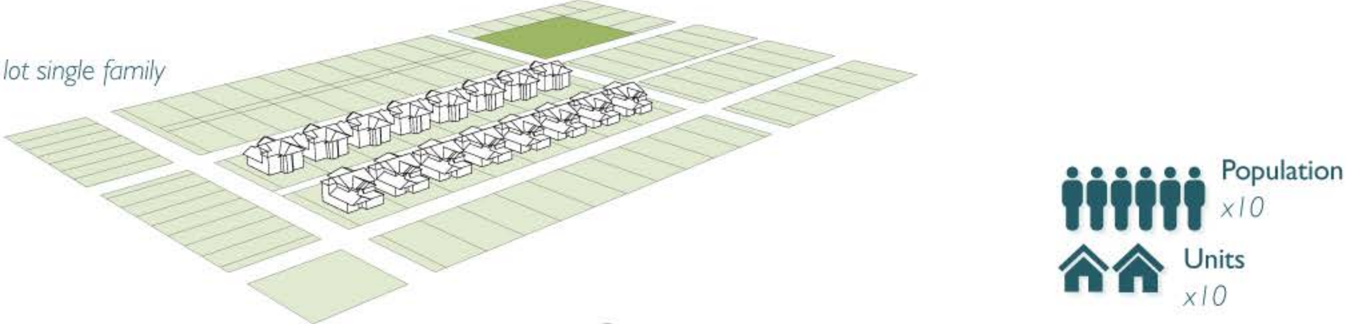
Section 5 - Suburban Block Energy Scenarios

Surrey Case Study

This case study explores reducing energy consumption and greenhouse gas emissions using different community designs and addition of renewable energy resources for a residential block in Surrey BC.

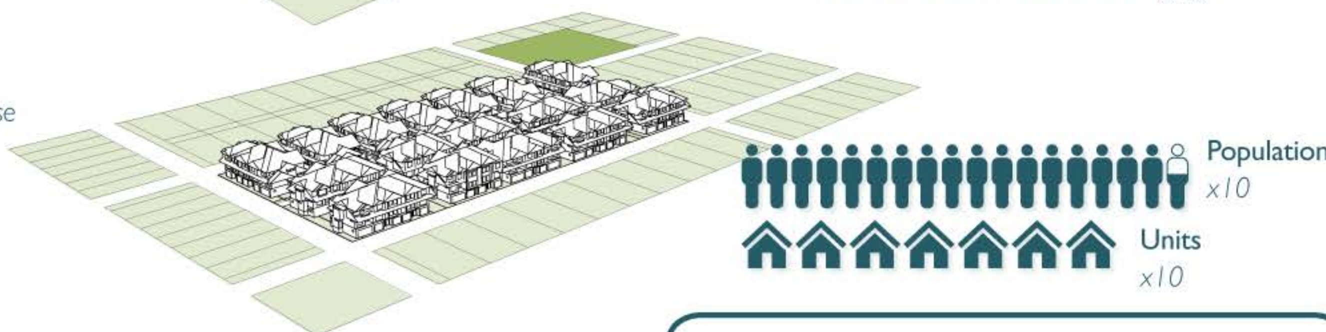
Housing Types

Large lot single family



Small lot single family

Rowhouse



The same block is compared using three different housing types. Each housing type is modeled to determine its current energy use and greenhouse gas emissions. Feasible renewable technologies are then modeled for each housing type to determine their potential energy supply and greenhouse gas emissions reductions:

- solar for roofs which are solar ready
- geoexchange and district energy in nearby parks or rights-of-way.

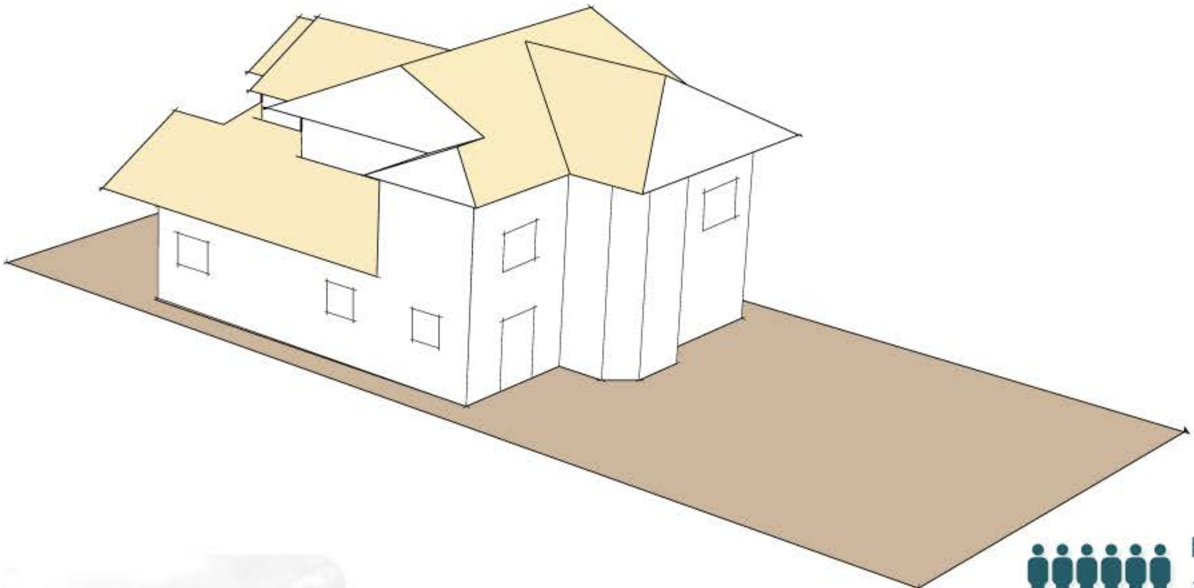
Three housing types:

- Large Lot Single Family
- Small Lot Single Family
- Rowhouse

5.1 Surrey Case Study

Large Lot Single Family

A typical large lot single family home in Surrey could reduce its reliance on external energy sources by incorporating solar photovoltaic and solar hot water panels.



Population
x10

Units
x10

105 *GJ/household/yr*

2,200 *GJ/block/yr*

Greenhouse Gas Emissions

Current Emissions

0.98
CO_2eT/capita/year

Emissions with Solar Panels

0.67
CO_2eT/capita/year

32%
reduction

Issues to Consider:

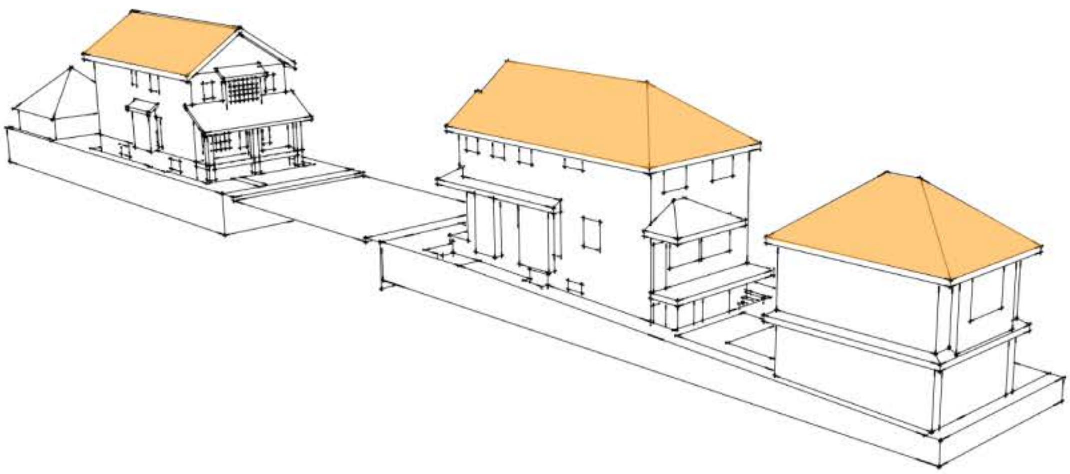
- Roof Design + Area for Solar
- No Shared Walls
- Large Building Size for Space Heating

Surrey Case Study

Small Lot Single Family

5.2

A typical small lot single family home could reduce its reliance on external energy sources by incorporating solar photovoltaic and hot water panels and a community geoexchange system.



Population x10

Units x10

67 *GJ/household/yr*

4,000 *GJ/block/yr*

Greenhouse Gas Emissions

Current Emissions

0.80 *CO_2eT/capita/year*

Emissions with Solar Panels

0.27 *CO_2eT/capita/year*

58% reduction

Emissions with Solar Panels + Geoexchange

0.09 *CO_2eT/capita/year*

89% reduction

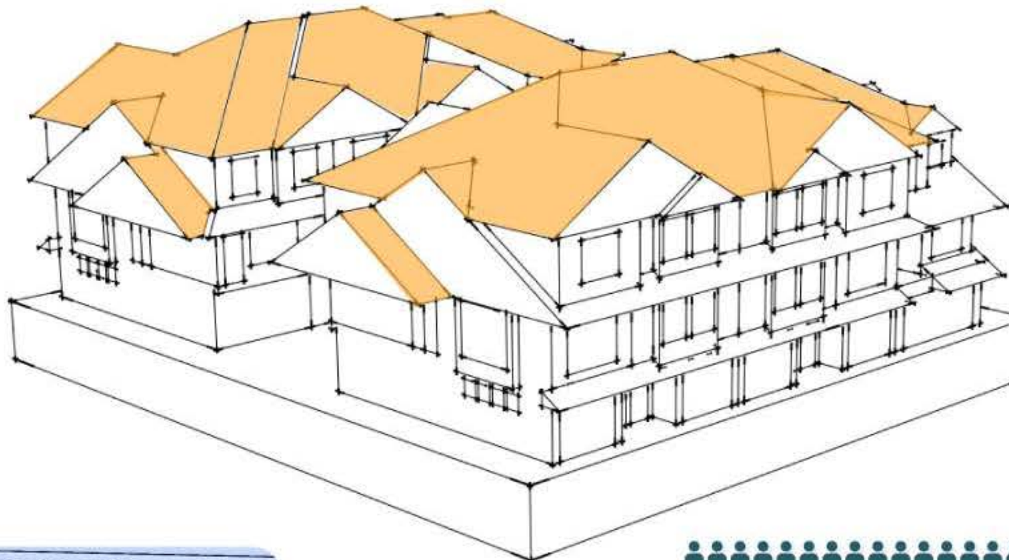
Issues to Consider:

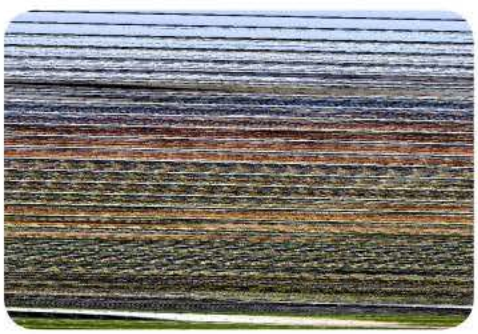
- Roof Design + Area for Solar
- Smaller Buildings + Suites
- Adequate Density to Support Shared Geoexchange System

5.3 Surrey Case Study

Rowhouse

A typical rowhouse in Surrey could reduce its reliance on external energy sources by incorporating solar photovoltaic and hot water panels and connecting to a community geoexchange system.





87 *GJ/household/yr*

6,000 *GJ/block/yr*

Greenhouse Gas Emissions

Current Emissions

0.75 CO_2eT/capita/year

Emissions with Solar Panels

0.32 CO_2eT/capita/year

58% reduction

Emissions with Solar Panels + Geoexchange

0.09 CO_2eT/capita/year

88% reduction

Issues to Consider:

- More Shared Walls
- Roof Design & Area for Solar
- Adequate Density to Support Shared Geoexchange System

Surrey Case Study

Housing types compared

Housing Type	Energy Supply	Greenhouse Gas Emissions

Large lot single family

block population 60

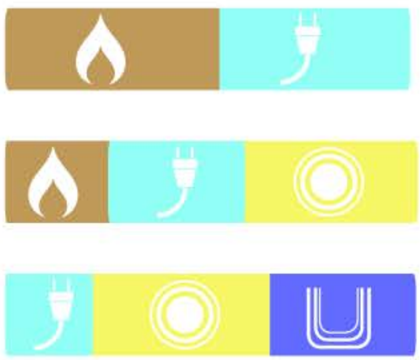
0.98 tonnes CO_2e/capita/year

32% reduction

40.2 *tonnes CO^2e/block/year*

Small lot single family

block population 135



0.80 tonnes CO_2e/capita/year

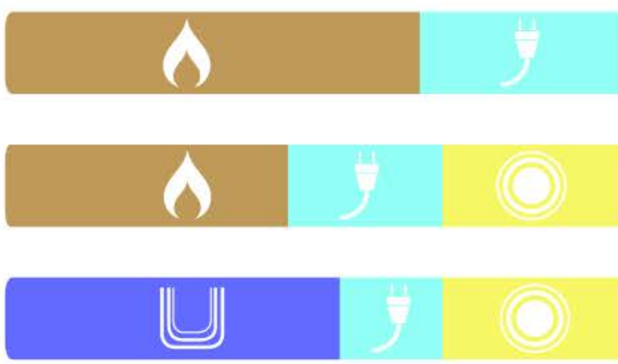
58% reduction

89% reduction

12.2 *tonnes CO^2e/block/year*

Rowhouse

block population 175



0.75 tonnes CO_2e/capita/year

58% reduction

88% reduction

15.8 *tonnes CO^2e/block/year*

These scenarios show that:

- Large lot single family homes are much less energy efficient than smaller homes and higher density neighbourhoods.
- Per capita carbon emissions are lowest with rowhouse designs
- Solar energy can substantially reduce carbon emissions with all building types,
- Shared energy systems such as geoexchange can almost eliminate carbon emissions (both per capita and total) with higher density community designs, sufficient to meet BC's community-wide GHG emission reduction targets.

6.0 Links and Resources

Where does the guide go next?

If the possibilities visualized here for community energy are to be realized, co-operation between various levels of government, citizens and businesses will be required. Important issues such as the economics of renewable energy installation and home retrofitting, and the feasibility of developing local energy resources, need more analysis and policy development. The next version of the Guide will address some of these issues, as well as other renewable energy sources not yet covered. It will also go online to become more accessible and interactive, as the **iWISE (interactive Web-Interface for Sustainability Energy)** project. This will give municipalities, neighbourhoods, and citizens more visual learning tools with which to explore, animate and query regional energy information, as well as more visualization examples for practitioners to use in community engagement and planning on energy projects.

Links and Resources:

General website resources:

- Community Energy Association | http://www.communityenergy.bc.ca
- Livesmart BC | http://www.livesmartbc.ca
- Fraser Basin Council | http://www.fraserbasin.bc.ca/spc_home.html
- Climate Action Secretariat (CEEI) | http://www.env.gov.bc.ca/cas/mitigation/ceei/
- BC Hydro | http://www.bchydro.com/powersmart/local_government_district.html
- Collaborative for Advanced Landscape Planning (CALP) | http://calp.forestry.ubc.ca/
- ElementsDB | http://elementsdb.sala.ubc.ca/

Community energy references:

- The Rough Guide to Community Energy. Clark, D. & M. Chadwick (2011) Rough Guides Ltd., UK. http://www.roughguide.to/communityenergy/
- Sustainable Energy – Without the Hot Air. MacKay, D.J.C. (2009) UIT Cambridge, UK. http://www.inference.phy.cam.ac.uk/sustainable/book/tex/cft.pdfv

Community engagement references:

- Having the Climate Conversation. ICLEI (2012) Canada http://www.icleicanada.org/programs/adaptation/item/4-having-the-climate-conversation
- Local Climate Change Visioning and Landscape Visualizations: Guidance Manual. (Pond, E., et al. 2010) UBC http://calp.forestry.ubc.ca/viz-guidance-manual/
- Visualizing Climate Change: A Guide to Visual Communication of Climate Change and Developing Local Solutions. Sheppard, S.R.J. (2012) Routledge, UK. http://www.routledge.com/books/details/9781844078202/

Conclusion and Next Steps

What should I know about community energy?

This Guide has tried to explain what Community Energy means, what it looks like, and why we should care about it, including:

- its importance in reducing our dependency on fossil fuel supplies that contribute to global warming
- improving local energy security and reducing longterm energy costs
- enhancing quality of life
- meeting adopted municipal sustainability targets
- sharing the responsibilities of energy production, benefits and costs locally

Every community in BC needs to do its share if we are to transition to a safer, more sustainable future.

What can I do in my community?

- Use the Guide and its compelling graphics to help build energy literacy among your own family, friends, and neighbours. Talk about what it might mean to your neighbourhood if you worked together (see the Eagle Island story on page 2.2b).
- Get involved in the urgent decisions to be made on local energy issues that will affect you and your kids. Take part in an informed dialogue within neighbourhood, municipal, and regional planning processes.
- Give us feedback on the guide:

  Email: Rory Tooke, Project Manager | *trtooke@alumni.ubc.ca*

  Web: Guide Blog | *www.guidetocommunityenergy.com*

Clean Technologies

A wide range of technologies are available to produce energy or to help reduce its use.

GENERATION

SOLAR
- Concentrating Solar Thermal
- ★☆ Photovoltaic
- ★☆ Domestic Hot Water

HYDRO
- Storage Hydro
- ★ Run-of-River Hydro
- Pico Hydro

BIOMASS
- ★ Timber
- Crop
- ★ Manure

WASTE
- ★ Industrial Recovery
- Waste-to-Energy
- Sewage Heat Recovery

GEOTHERMAL
- Natural Convection Systems
- Enhanced Geothermal Systems

ACTIVE HEAT TRANSFER
- ☆ Ground-Source
- Air-Source
- Water-Source

WIND
- Turbine

OCEAN
- Tidal
- Wave
- Current
- Thermal
- Osmotic

NUCLEAR

CONSERVATION

BUILDING MATERIALS
- Insulation
- Windows
- Ventilation

ENERGY DEVICES
- Compact Fluorescent Lighting
- Programmable Thermostats
- Energy Efficient Appliances

DESIGN
- Passivhaus
- Shared Walls
- Shade Trees

BEHAVIOUR

★ Assessed for the region in chapter 3

☆ Assessed for case studies in chapters 3 & 4

Glossary

Joule (J)- is a derived unit of energy, work, or amount of heat in the International System of Units. The other popular unit of power is the "horsepower". The conversion is that one horsepower = 756 Watts. A 100-HP car would be able to turn a 75,600 - Watt electrical generator, or 75.6 kilowatts.

Gigajoule (GJ)- is a metric term used for measuring energy use. It is equal to one billion (109) joules. Six gigajoules is about the amount of potential chemical energy in a barrel of oil, when combusted.

Watt- is a derived unit of power in the International System of Units, named after the Scottish engineer James Watt. The unit, defined as one joule per second, measures the rate of energy conversion or transfer.

Kilowatt hours (kWh)- a unit of energy equal to the work done by a power of 1000 watts operating for one hour.

Megawatt hour (Mwh)- A megawatt is a unit for measuring power that is equivalent to one million watts. A megawatt hour is equal to 1,000 Kilowatt hours (Kwh). It is equal to 1,000 kilowatts of electricity used continuously for one hour.

EV Charging Station- The facility that provides battery charging for EVs (electric vehicles). Many new installations provide electricity from wind and solar sources.

Greenhouse Gas (GHG)- is a gas in the Earth's atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone.

Greenhouse Effect- A popular term used to describe the heating effect due to the trapping of long wave (length) radiation by greenhouse gases produced from natural and human sources.

Carbon Dioxide Equivalent (CO_2e)- a measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide (CO2) as the reference.

Conversions:

1 J = 0.0003 Wh

1 Wh = 3600 J

Sources

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Chapter Two:
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Chapter Three:
Rory Tooke, David Dodge: Green Energy Futures

Chapter Four:
Kevin Jingyi Zhang, Sara Barron, Lukas Holy

Chapter Five:
Mesa Sherriff, Sara Barron, City of Surrey

"Energy Alternatives" to the Site C Dam Harold Steves, BScAg, City Councillor, Richmond, BC

1. "Can BC's farmers feed our growing population?"

B.C.'s Food Self Reliance, a 2006 report by the BC Ministry of Agriculture and Lands, says "Farmland with access to irrigation will have to increase by 92,000 hectares, or 49% over 2005 levels." (attachment 1 p2)

5% of BC is arable but only 1.1% is irrigated farmland fertile enough to grow vegetables and small fruit. It's mostly in the Fraser Valley and South Vancouver Island, both threatened by urban development, and in the Peace River threatened by the Site C Dam. In 1973 we produced 86% of our vegetables, today only 43%. The fertile irrigable Peace River farmlands are essential to help provide the 92,000 hectares necessary to feed our growing population in a time of climate change, food scarcity and food uncertainty.

2. Loss of carbon storage and sequestering:

The forested land of Site C plays a major role of storing carbon and the agricultural land is also a potential carbon sink. Using BC Hydro estimates forested and agricultural lands are capable of sequestering 70,000 tonnes of CO_2 per year. If the dam proceeds the carbon stored over the centuries will also be continually released at the rate of 75,000 tonnes per year. Instead of offsetting greenhouse gases, by putting excess power on the market, the development of Site C will set back the development of solar and other clean alternative energy sources.

Conclusion: The highest and best use for Site C is Agriculture and Forestry.

3. City of Richmond "Community Energy and Emissions Plan"

The City of Richmond's "Community Energy and Emissions Plan" (2014) outlines plans to provide community energy and reduce greenhouse gas emissions. Richmond's population is expected to grow by 80,000 people to 280,000 people by 2041. Richmond has adopted community wide energy and emissions targets to reduce GHG Emissions 25% below 2007 levels and Energy Use 11% below 2007 levels by 2041. Other Cities have similar plans which will result in a net reduction of energy needs in BC by 2041.

Projected Electricity consumption (GJ) **2007 0%** base (5,926,916 GJ)

2010 +1% increase (5,994, 400GJ);

2020 +2% increase (6,027,000GJ);

2041 -11% reduction (5,280 700GJ);

2050 -10% reduction (5,317,200GJ) (attachment 2)

The estimate for 2041 is based on a reduction of 896,800GJ due to energy efficiencies and Richmond's DEU and an increase of 41,600GJ due to change to EV transportation for a total reduction of 855,200GJ. (attachment 3)

4. “Lulu Island District Energy”

District Energy in Richmond is being developed by Lulu Island District Energy, a municipally owned District Energy Utility. The Alexandra DEU began operating in 2012 to serve 3,000 residents and 3.9 million sq ft of residential, commercial, office and institutional space. It is a geo-exchange system providing heating, cooling and hot water and replaces electric baseboard heaters in modern apartments. New buildings in the area are required to connect. The Oval DEU provides space heating and hot water to seven multifamily developments and will serve 2.7 million sq ft. Other major DEU projects being considered are North City Centre (8 million sq ft.) Main City Centre (6.3 million sq ft.) Existing multi residential buildings located close to high density development will connect to district energy systems. As Richmond densifies more DEU facilities will be added.

Richmond Community Energy and Conservation utilizes local energy sources rather than electricity, natural gas and vehicles using power from far away. Richmond is presently constructing a massive new recreational complex and a new main fire-hall, both with solar roof-tops. We are also investigating re-use of waste heat from wastewater and industrial facilities, more efficient technologies, retrofitting, insulation, power bars, heat recovery ventilators, community heat exchangers at swimming pools & rinks; solar hot water, geo-exchange, photovoltaic solar panels and micro-turbines. These actions support BC Hydro’s “mandate” to encourage conservation and to develop local alternative electricity sources that reduce the burden on the Provincial generation and transmission system. We don’t need excess power from site C.

Richmond is investigating the effectiveness of solar thermal systems on single family dwellings and considering giving incentives for solar air heating and ventilation. A recent condominium complex added $12,000 for rooftop solar to the cost per $800,000 condominium. City staff estimate that solar costs and hydro costs will be equal in 5 to 10 years. However, when loss of food security and forest sequestering, plus flooding of habitat and First Nations Lands are factored in, costs are equal now. If built, Site C will be obsolete in 5 to 10 years.

5. BC Building Code, “Net Zero Ready”:

An improved BC Building Code by the BC government has established targets to improve the energy efficiency of commercial and residential buildings, including “Net Zero Ready” by 2032. Increased densification of buildings will result in lower residential building energy consumption. Buildings of the future will provide their own energy. Why would BC Hydro and Site C want to hold back changes recommended in the BC Building code?

Richmond estimates that by 2025 all new buildings will be “Net Zero”. With energy price swings, owner awareness, and demographic turnover of housing stock by 2050 most existing buildings will have had major renovations that dramatically reduce their external energy needs and carbon emissions.

6. “Metro Vancouver Community Energy”

Community Energy in Metro Vancouver can produce twice the power of the Site C Dam. The “Illustrated Guide To Community Energy” produced by Dr. Stephen Sheppard and a group of UBC scientists, has analyzed the potential for energy alternatives in Metro Vancouver. Additional maps are provided online at C.A.L.P showing the best potential locations for energy alternatives in the region. (attachment 4))

Alternative Sources Of Energy include:

Roof-Top Solar -generating enough power for 900,000 households,

Run-Of-River – 7,500 households;

Industrial Heat Recovery – 7,500 households;

Livestock biomass – 17,000 households;

Forest Biomass – 26,000 households;

Existing Metro Vancouver Waste To Energy – 16,000 households;

Richmond Geo-Exchange - 12,000 households, increasing as Richmond densifies.

Total Metro Energy Alternatives : 986,000 Households.

Total Site C power : 450,000 Households

Metro Vancouver is capable of producing twice as much power as the 450,000 households of power that Site C could produce. No additional transmission lines are required. Unlike Site C it is truly “clean” and green. It is time to embrace the future and leave outmoded mega-projects of the past behind. Site C is not the power of the future.