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Rural Alternative Energy & Resiliency

Guide to Eastshore Energy Sources

Micro-hydropower systems: a buyer's guide. 2004. Ottawa: Natural Resources Canada.

Offers guidance on assessing economic viability of micro-hydro in individual situations. Presents several common styles of micro-hydro systems. Canadian reference used in pre-feasibly planning process.

Davis S. 2003. Microhydro: clean power from water. Gabriola Island (BC): New Society Publishers.

Gives information on incentives and regulations in Canada and British Columbia. Provides extensive list of case studies including successes and failures. Easy reading, color images, tables and quizzes to determine energy potential and requirements of a project.

Handbook for developing micro hydro in British Columbia. 2004. [Vancouver (BC)]: BC Hydro.

Helpful as most up-to-date resource on this subject published by BC Hydro. Due to changing nature of technology and regulations parts of handbook could be outdated.

Keeping in the heat. 2007. Ottawa: Natural Resources Canada.

Presents information for Canadian homeowners on basics of energy conservation in the home. Includes building materials, air leakage control, roofs and attics, insulation, upgrades to windows and doors and operating the house. Well-organized with simple, clear diagrams and illustrations throughout.

Biomass calculator. Retrieved online 2013. Green heat initiative. Quesnel BC. Online: www.greenheatinitiative.com/biomass_calculator.aspx

Estimates savings which could be gained by switching to biomass for heating in your home. Requires you input current costs for heating, type and quantity of fuel used, and the size of current heating system.

"It is accepted that the most cost effective gains in energy management are achieved through energy conservation and improved efficiencies. These can be as simple as lowering thermostats, cleaning wood stoves annually, dusting refrigerator coils, weather stripping and increased insulation."
Quote: Robert McCrea, Selkirk College Renewable Energy Program.

Design Tips for New Homes:

Referenced from Selkirk College Renewable Energy Technology Program Manual. Instructor Robert McCrea. Used with permission of Robert McCrea.

- Basements should use insulated concrete forms. Basements or on-grade floor slabs should be underlain with a minimum of 2" of high density polystyrene insulation.
- Exterior walls should use staggered stud design. For example, 2x4 studs staggered at 12" centres between 2x8" top and bottom plates. This would reduce heat loss by permitting continuous insulation of a minimum 3.5" thickness behind studs and 7" between studs.
- Roof overhangs should be three feet wide on north and south sides to reduce summer solar heat gain.
- Windows should be limited on north facing walls.
- The side with the greatest number of windows should be south facing.
- All windows should be high efficiency double-glazed with a heat reflective coating on the interior.
- Heat recovery ventilation should be installed in all new homes.

Inside:

Our Resource	Our Power
Conserve	start with conservation
Water	micro hydro community electricity
Sun	solar heat or electricity
Wood	efficient automated wood heat
Earth	heat found underground
Wind	not likely feasible here

Kootenay Lake Eastshore is rich in natural resources. Sunlight, water, and forest can each provide the energy needed to light and heat homes and businesses.

This is especially relevant as electricity prices continue to rise; there has been a cumulative 9.9% increase since 31 Dec, 2012.[1]

The money spent in Fortis increases could instead be invested in the community through renewable energy start-up's, beginning to gain autonomy from the grid, and generating income to reinvest. The Eastshore could own and operate its own renewable, clean energy generating

Community-owned renewable energy projects can also create stable employment, through maintenance and monitoring. The technologies presented in this booklet were chosen for their ability to draw on these resources efficiently, with less impact on the local environment.

By focusing in on this small group of technologies the booklet aims to highlight the possibilities in our natural surroundings. This at the same time as we address issues of long-term grid stability, and explore independent management of our own generation of energy.

Each technology has varying degrees of feasibility, and this is outlined in its description, as well as general information for those who are unfamiliar with renewable energy.

[1].Fortis BC online media centre: retrieved 8 Jan 2014. 6.6% increase 1 Jan 2013. 3.3% increase 1 Jan2014.

Mountain ranges are not usually good places for wind energy generation owing to surface roughness (trees) which results in friction, and the topography of mountains which slow winds and cause turbulence.

Example of a mini turbine, UK

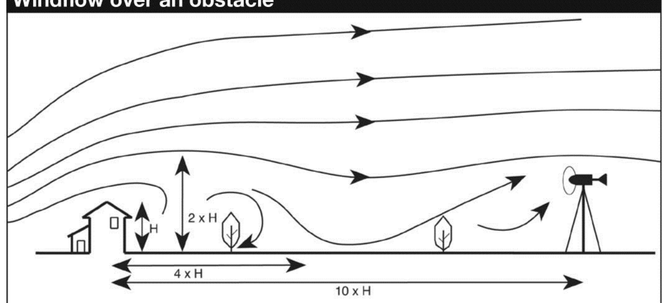
Wind works to generate electromagnetic energy by spinning a blade attached to a turbine. Technology has progressed in recent years and new developments in turbine and blade design mean wind can be harnessed for energy in a wide range of different topographies, but not yet mountains.

The exception is turbines on mountain tops which can be worthwhile considering, particularly when the mountain top is already accessible by road and within reach of either energy storage facilities (batteries), or a point of connection to the utility grid.

Since 2011, wind speed data has been gathered at Yasodhara Ashram with an anemometer. The anemometer was mounted in the Ashram's garden, near the centre of about 2 acres of cleared farm land. The data collected revealed that wind speed here is sufficient to spin an average wind turbine 2% of the time, or a mini turbine (rated at 2.5 m/s) approximately 10% of the time. These results showed that it is unlikely a turbine would produce enough energy to offset its capital cost within its lifetime.

Anemometer

Windflow over an obstacle



The zone of turbulence actually rises as the flow progresses downstream. If the obstacle is a building, then it should not block the prevailing wind. If you have a block of trees near the site, then you may find better wind above the trees than away from them.

The Ashram's anemometer is available to be relocated to collect a sample years' worth of data at a hilltop location such as at the Peak of Bluebell Mountain.

When there is an adequate area of diggable soil (not bedrock), Geoexchange is a good source for alternative heating and cooling. This resource is especially viable with new homes or developments when pipe can be laid at the same time as a buildings foundation, reducing cost of installation significantly.

Geoexchange works on the principle that within a few feet of the surface, the earth remains a nearly constant temperature year round. In winter the ground is slightly warmer, and in summer slightly cooler than the air. Geoexchange simply moves and compresses the low grade temperature difference (heat or cooling) from the earth for use indoors. This is done by running heat transfer fluid through thermally conductive pipe. The fluid stays in the pipe at all times and only heat is absorbed from the earth.

There are two categories of systems: horizontal and vertical loops. Horizontal loops (as in the image to left) involve pipe laid horizontally and require more space, but are less expensive to put in. This heat and cooling technology is often installed into new schools where the exchange pipe can be laid directly under playing fields during construction.

A vertical loop system has pipe that is laid into one or more vertical boreholes which can be upwards of 100 meters deep. The advantage is that there is much less space needed; however vertical systems are more costly because of the need for drilling equipment.

For further information, tutorials and a resource listing of professionals: www.geoexchangebc.com

Conservation of energy is the place to start. With any type of energy, the less you use, the less you need to pay for or find replacement for in case of outage.

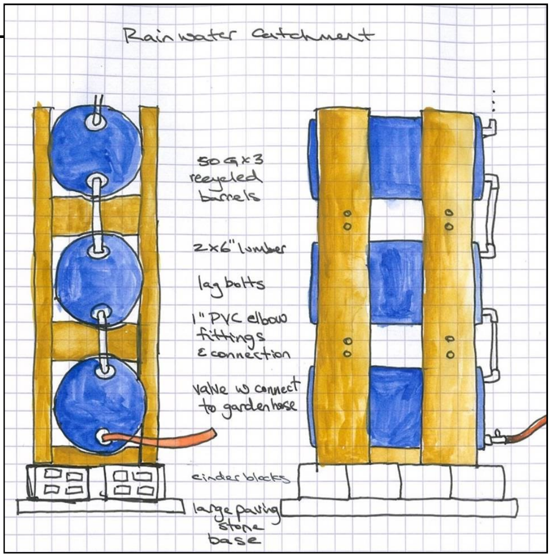
Common losses of energy are heat through building envelope, and inefficient appliances. Enerstar appliances can be sought to replace their predecessors as they break down. A home energy audit would show where energy is used and where it is lost unnecessarily.

Heat loss is common and preventable, increases demand on heaters, and costs money year after year. In the manual "**Keeping the Heat In**," referenced on the recommended reading page, practical DIY improvements are suggested. Also at the back of this booklet are a few handy design tips intended to help plan new and very well-insulated houses.

Using water, in most cases, requires pumping water, which uses energy. Behavioral changes like taking shorter showers will help, especially combined with low -flow appliances and fixtures such as faucets and shower heads which use less water while providing the same service.


Coiled PEX pipe warms water

There are many creative ways to reduce energy use. In the photo to the left, thermally conductive PEX pipe is coiled on a rooftop, and water running through it is warmed naturally during the summer months for an outdoor shower. A tap allows the pipe to be drained and disconnected in winter.



Another example of creative conservation is shown in the illustration to right. Rain is diverted from a roof and collected in rain barrels to be used for garden watering later on. Used barrels are often free from car washes, or food-safe barrels can be bought online and in some garden supply centres.

Online resource for more conservation ideas : instructables.com

Micro Hydro Energy

The Eastshore has plenty of water and potential pressure from downhill flow which could be used for micro hydro electric generation. Expert advice would be needed to determine feasibility and potential of individual schemes.

Micro hydro refers to very small (micro) hydroelectric power plants which generate electricity by diverting a portion of water from the waterway, without damming. These facilities benefit from the ability to generate electricity dependably, day and night, differentiating them from many other renewable energy sources like solar or wind.

Criteria for Suitable Waterway:

- Persists year round
- Is not habitat for fish or at risk species
- Has significant downhill drop between intake and turbine locations
- Is accessible by road

Formal hydrological assessment typically takes at least one year and includes environmental assessment and percentage of water to divert whilst preserving ecosystem health.

When a suitable site is available, this is a highly reliable alternative source of energy. The start up costs are high but revenue from a well-planned project would continue for decades.

Potential generating capacity of a site can be estimated by approximating head, as well as flow of water available through a yearly cycle. Having an estimate of these things saves money and time, ensuring a site can be successful before bringing paid professionals onto a project.

Head refers to the vertical drop between an intake and the generating station (see diagram on opposite page). This can be roughly estimated with topographic maps when available, or measured by triangulating slope distance and angle with a clinometer (device which measures vertical angles).

Kootenay area hand-built micro hydro

There are techniques to manually approximate flow, but the most accurate data is collected over one or more years with an installed weir and regular monitoring (see photo on opposite page: Yasodhara Ashram weir).

As an example of possibilities here, Riondel has two creeks which provide drinking water to the town. Pipes supplying water can sometimes have turbines added at pressure-reducing valves, reducing costs significantly as much of infrastructure (intake at creek and pipes) is in place. Of these two creeks in Riondel, Indian Creek is a fish bearing creek, which would make environmental approval of a new structure more complicated. Hendrix Creek is not listed as fish-bearing. Either of these existing systems may be assessed for integration of micro hydro. In addition, any other year-round creek could be assessed for potential starting now, with the installation of a weir.

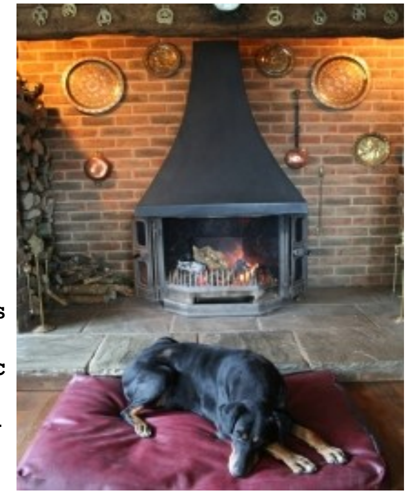
The weir at Yasodhara Ashram (image, opposite page)
is available for installation elsewhere in the community.
Contact Jayne Boys or Paris Marshall Smith; Yasodhara Ashram 250 227 9225

Biomass Heat

Biomass heat is generated by the burning of biological matter; wood is the fuel looked at here, but biomass can refer to any biological matter including other plant material, wastes, industrial by-products, etc. Wood Pellet heat is definitely a financially sound option on the Eastshore; most household pellet boilers and stoves are expected to pay themselves through savings (over electric heat) within 4-10 years.

Wood in the form of compressed pellets or logs is clean burning and energy dense, and generates more heat per cubic foot than cord wood or chips. With pellets, heating can also be automated so that a space is kept at temperature determined by a thermostat.

Difference between stoves and boilers: stoves are space heaters primarily, and most effective with open floor plans. Boilers are integrated into home heating systems. A pellet boiler can replace an oil or electric boiler and heat by means of radiant floors, baseboard radiators and any other hydronic circulation heating systems.



Pellet Stove

Pellet Boiler

About pellet supply: There are stoves and boilers which can burn wood chips as well as pellets; these are labeled 'flex-fuel'. It is also possible to acquire a small scale pellet compressor, make pellets, and have assurance of price stability and long-term supply.

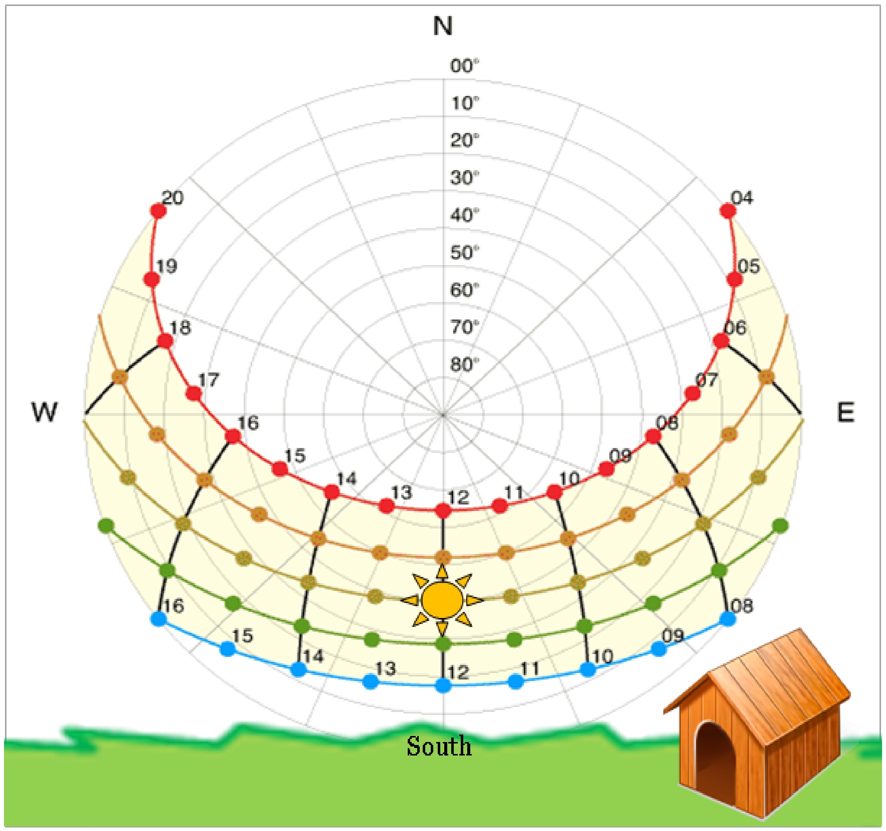
On carbon neutrality, Pacific Carbon Trust (PCT) identifies wood pellets as a by-product of the forestry industry and rates pellet heating as carbon neutral. PCT's calculation is based on net-gain of CO_2 in the atmosphere: Plants use solar energy to absorb carbon dioxide via photosynthesis, and burning the resultant biomass CO_2 is returned back into the atmosphere and stored energy is released as heat. Note however that PCT does not account for shipping of pellets, or differentiate for sustainable growth and harvest practices in this calculation.

Stoves, pellets and expert consultation are available at Grey Creek Store, Grey Creek.

Effects of Shading on PV module.

% of One Cell Shaded	% Loss of Module Power
0 %	0%
25 %	25 %
50 %	50 %
75 %	66 %
100 %	75 %
with 3 cells shaded	93 %

Sun Path Diagram for 50° latitude, approx location of the Eastshore



These diagrams can be used to estimate shading for a particular location throughout the year.

Weir at Yasodhara Ashram measures flow. This weir is available for relocation.

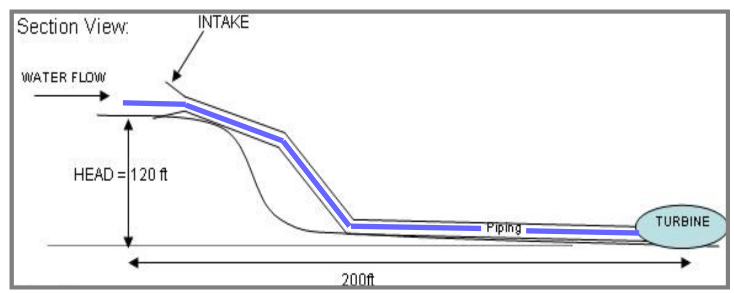


Diagram describing head.

Photovoltaic (PV) solar panels generate electrical energy. PV is a simple, time-tested technology, and builds on a virtually untapped resource: sunlight. The panels use light to generate electricity in summer and winter (with snow clearing), on sunny and cloudy days, and even from the light of a full moon. The main prohibiting factor in BC is price of the panels, though community grants and other funding can be pursued for start-up.

Image: Parvati House, Yasodhara Ashram

Are PV panels right for you?

Here's an example to help you understand the costs and benefits of PV. In the image above, grey squares represent a hypothetical area of PV needed in order to:

- Generate approx.10,000 kWh per year
- This is $900 of electricity per year. As Fortis prices rise this number is higher.
- Offset 60 kg of CO_2 emissions per year. (Source: PCT)

Installed, this system costs $32,650

PV panels need a well-thought out location. There are three main points to consider. These are outlined below.

Aspect: More or less south-facing. Racking can position panels southward on west or east sloped roofs *(see photo Ashram solar thermal panels, next page)*. Ideal tilt of panels is near latitude, 49 to 50° .

Available space: Standard sized panels are 2.6 x 5.25 ft. Most traditional arrays need to have all panels identically oriented & pointed for inverter functioning.

Shading: One partially shaded cell can reduce power production of a module up to 75% *(see table on page 9).*

PV arrays are either set up to operate off-grid - storing power in batteries; or connected to the utility grid: grid-tie. With grid-tie, a purchasing contract is made with Fortis, who then install a bi-directional meter to measure power fed in, and buy it on par with current rates.

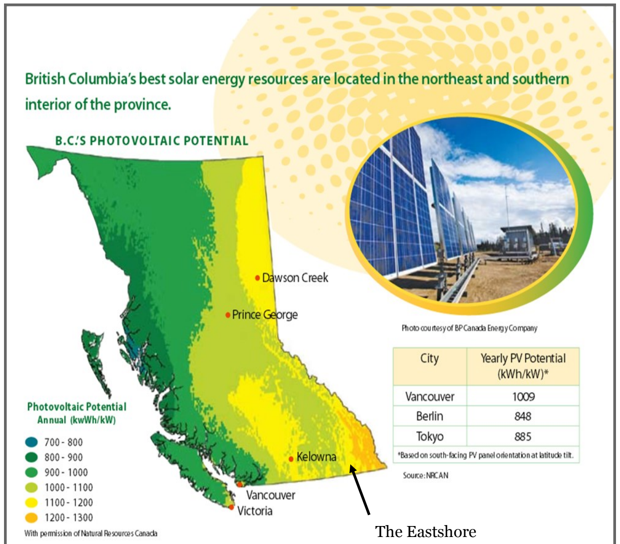
Grid-tie makes the most sense if you have access to the grid. However, if your panels are connected to the grid and you want to have power while grid power is out, you will need batteries to store the power. Batteries can be pricey, and an anti-islanding inverter which switches to battery power to prevent Fortis lines from being energized during power outages, protecting line workers.

Photovoltaics are entering the mainstream market and it is now possible to buy kits from Canadian Tire or Walmart fairly cheaply. These kits are handy for camping, but have lower efficiency so not suitable if you hope for financial payback.

Resource for more information: energyalternatives.ca

Solar thermal panels can typically supply over 50% of heat needed for hot water or space heating in a building. Solar thermal has the benefit of a lower start-up cost than other technologies, and sizable annual return through savings on heat. Because of this most systems pay themselves off within 10-20 years, making them a very good option for the Eastshore.

The image at right shows solar potential in BC, with orange being highest solar resource. Also notice comparisons to Berlin and Tokyo where solar thermal is more widely used than in Canada.



City	Yearly PV Potential (kWh/kW)*
Vancouver	1009
Berlin	848
Tokyo	885

BC, and the East Kootenay region in particular, have excellent solar resources, meaning either solar thermal or photovoltaic installations are exceptionally productive.

Solar thermal panels work by circulating anti-freeze solution to move ambient heat in the air to hot water tanks or radiators indoors. Direct sunlight is not necessary and hence these panels are less severely affected by shading than photovoltaic panels, although performance is still optimized in full sun conditions.

Solar Thermal panels at Yasodhara Ashram

A back-of-the-envelope quote given to Yasodhara Ashram for solar thermal panels estimated that for $10,000 two buildings (roughly 4,000 sq. ft. combined) could have half their heat requirement met by solar thermal panels (quote received August 2013). This would approximate to a payoff period of less than 6 years.

Solarbc.ca is an excellent resource for information on Solar Thermal technology.