Seniors' Affordable Housing

Solar Power Research Project

Prepared for the

Denman Community Land Trust Association

By

Stephanie Slater

Encore Communications
Stephanieslater@telus.net
www.encorecom.ca

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1 - Introduction

The Denman Community Land Trust Association (DCLTA) plans to build an eight-unit housing complex for seniors with the goal of ensuring the units are:

- Comfortable (i.e., residences are both physically comfortable and "home-like")
- Safe (supportive of the physical and health security of the residents)
- Affordable for low-income seniors
- Economical for the association to build and operate

As part of the safety goal, board members articulated that they wanted to ensure the housing units have a back-up source of power – preferably quiet and environmentally friendly – that could provide heat, light and water to residents in the event of a power outage of any duration.

A research project was undertaken to determine if solar energy is a viable option to:

a) Provide back-up power for heat, light and water if the grid is unavailable
b) Meet or support other aspects of the DCLTA's goal of creating a safe, comfortable housing complex that is affordable for its low-income residents and economical for the society to build and maintain

The researcher was asked to assess options for solar energy application in residential properties and what technological advances are predicted for the next two years that may be of relevance to the DCLTA. Regulations and incentives – existing and in development – were also explored, as were similar projects on Denman and Hornby Islands. The researcher reviewed dozens of sources and interviewed eight people.

Research findings show that solar energy is viable for the affordable seniors housing project because it could contribute to the DCLTA's overall goals as well as mitigate the need for back-up power. It is not, however, the most effective or least costly option to provide back-up power for the complex. The research also indicates that solar energy would be most effectively used if the housing project incorporates Passive House Standards, which use passive solar and other design and construction techniques to greatly enhance a building's energy efficiency.

2 - Energy Use and Solar Supply

"If you doubt that solar can work in this climate – ask a tree! They "eat photons" just like [photovoltaic] panels, and clearly do very well [on the B.C. coast]." – Gab Energy[1]

Some people wonder if solar energy is a viable option for the British Columbia West Coast, which is characterized by considerable rainfall, particularly throughout the winter. This concern was valid when solar collection systems were expensive and not nearly as efficient as they are today. However, consider that Germany - one of the leading countries to use solar technology - receives ***1,625*** sunshine hours a year in Berlin[2] while the Courtenay-Comox region receives an average of ***1,926*** sunshine hours a year.[3] (For more information on sunshine data on Vancouver Island and the photovoltaic potential for Denman Island, see Appendix 1)

With the dramatic advances in solar technology over the past decade, accompanied by equally dramatic price drops, solar energy is most definitely a viable option for the Denman Island climate. This assessment applies not only to the physical climate but to the energy climate as well. Between 2010-2013 BC Hydro increased electricity rates by over 20%.[4] Annual increases that will compound to 29 per cent are planned between 21014 and by 2019. [5]

An example of solar production levels and typical household energy usage comes from GabEnergy, a registered non-profit society based on Gabriola Island that works with communities in B.C. to explore, plan, develop, and operate alternative and renewable energy systems:

> On Gabriola Island we average about 1,940 hours of sunshine per year which means that for every 1,000 watt of panels installed, the user will get between 1,000-1,200 kilowatt-hours (kW.h) of electricity… [T]he average house here consumes approximately 12,000 kW.h annually although much depends on the size of the house, construction and insulation, method of heating, appliances, lighting, and habits of the occupants.[6]

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[1] http://www.gabenergy.com/photovoltaic-system/

[2] City of Vancouver Passive Design Toolkit, page 12, http://vancouver.ca/files/cov/passive-home-design.pdf

[3] Current Results – Weather and Science Facts, http://www.currentresults.com/Weather/Canada/British-Columbia/sunshine-annual-average.php

[4] Regional District of Nanaimo, Renewable Energy Introductory Guidebook, Regional District of Nanaimo Dec., 2013, P 3.

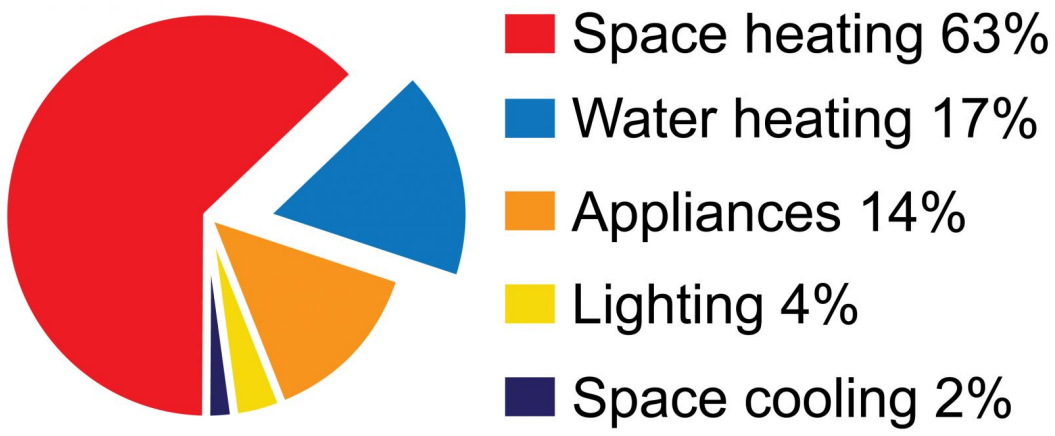
[5] http://www.cbc.ca/news/canada/british-columbia/bc-hydro-rates-to-increase-28-per-cent-over-5-years-1.2440437

[6] http://www.gabenergy.com/faq-pv/

In assessing the usefulness of solar technologies, it is helpful to first look at the average energy consumption of a household. Consider the 20-year data chart from Natural Resources Canada (below). While all the factors noted above by GabEnergy will alter the outcome for each household, a residential unit of conventional construction that is occupied by one senior could be expected to have an even higher percentage of space heating use (given that it takes approximately the same energy to heat a unit for one person as for two or more). In any case, space heating consumes by far the largest percentage of energy in Canadian residences of conventional construction, with water heating and appliances a distant second and third.

It makes sense, then, that the design of any new residential complex gives a priority to reducing energy expended – especially on heating.

Residential energy use in Canada by activity, 2010



Source: *Energy Efficiency Trends in Canada 1990-2009, Natural Resources Canada*.[7]

[7] http://www.nrcan.gc.ca/energy/products/categories/water-heaters/13735

3 - Passive House, Active Energy Efficiency

"Energy efficiency is the greatest form of new energy we have." – City Green Solutions

While advances in solar energy systems and applications are remarkable and exciting, solar energy is not step one for a building project. The first step is to lower energy consumption by eliminating waste energy and reducing energy loss. "This can be achieved primarily through improving the performance of the building envelope." [8]

New build residential projects are not constrained by existing structures, materials and appliances, leaving them open to incorporate the highest levels of thermal efficiency standards offered by how the building is positioned on the site, as well as design, material selection and construction techniques. This level of standards is offered by Passive House (PH) design.

"Passive House is an objectively verified route to sustainable buildings, *achieving 80-90 per cent energy savings over conventional construction."*[9] [writer's emphasis]

> Passive House design relies upon the shape and orientation of the building, a high performance heat recovery ventilation system, high performance windows and doors, insulation, and an airtight envelope to create outstanding thermal comfort and indoor air quality, while consuming a fraction of the energy required by most modern buildings. It is by far the world's highest thermal performance standard; requiring so little heat the building can be heated primarily by "passive" sources such as direct sunlight and heat gains from existing appliances and building operations.[10]

PH standards create buildings that offer thermal comfort and a high standard of indoor air quality while minimizing operating costs. The extra cost of materials such as additional insulation and high-performance windows is offset by the ability to eliminate costly heating systems and by long-term energy savings.

While Passive Houses in northern climates are built with minimal heating systems (typically a small heat pump or baseboard heater) these heat supply units are generally supplemental because "exposure to the winter sun provides much of the heat needed in the winter... ***Even if the electricity were***

[8] Renewable Energy Introductory Guidebook, Regional District of Nanaimo Dec., 2013, Page 4
[9] http://www.bernhardtpassive.com/construction-info/
[10] http://www.bernhardtpassive.com/construction-info/

turned off, indefinitely, the interior temperature will always remain livable, and most likely comfortable, even in the coldest, wettest weather."[11] [writer's emphasis]

When referring to the Natural Resources Canada data that shows that space heating typically makes up 63 per cent of Canadian household energy consumption, the opportunity to reduce that consumption by as much as 80 – 90 per cent through the application of PH principles is striking.

The DCLTA has also indicated that access to natural sunlight within the seniors' housing units is essential in order to promote occupant comfort. PH techniques support the effective use of daylight and they can be further supplemented by careful attention to a concept called "daylighting," where the use of materials such as solar tubes, solar shelves, roof monitors and reflective blinds enhances the presence of daylight within a residence while reducing the need for artificial lighting, along with its attendant energy consumption.[12]

See appendix 2 for a detailed list of the benefits offered by Passive House design.

PH Trend

PH principles are being adopted around the world and by 2016 all new construction in Europe will be required to meet the Passive House standard. In Canada, the Canadian Passive House Institute (CanPHI at www.passivehouse.ca) is a non-profit educational organization that provides training and support to the construction industry to create and use materials, techniques and components for Passive House projects.

Some Canadian municipalities are promoting PH, for example, the City of Vancouver is doing so as part of its Green Vancouver initiative. The city is working to reduce the amount of energy consumed by new homes, with the goal of making all new buildings carbon neutral by 2030.[13] The city has produced a Passive House Toolkit that is enclosed with this report and also available online at: http://vancouver.ca/files/cov/passive-home-design.pdf

On Vancouver Island, the Bernhardt Passive Home in Saanich is the island's first – and so far only - certified Passive House (www.bernhardtpassive.com). Bernhardt Contracting is now building a six-unit strata in Victoria using PH principles.

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[11] http://vancouver.ca/home-property-development/green-building-and-renovating.aspx
[12] City of Vancouver Passive Design Toolkit, page 26, http://vancouver.ca/files/cov/passive-home-design.pdf
[13] Ibid.

PH certification is an international standard and while there is no need for the DCLTA to acquire this certification for the seniors' housing project, it is important to note that PH design requires "refined architectural/engineering planning and detailing throughout the building envelope" that is not typically applied in Canadian construction, where "not a single building envelope detail in the current Canadian Building Code is thermally adequate to attain Passive House performance."[14]

It will therefore be important to have the DCLTA housing plans reviewed by a consultant trained in PH requirements. Such a service is available from the Victoria-based City Green Solutions organization. City Green Solutions (www.citygreen.ca) is a non-profit energy efficiency organization that supports British Columbians in reducing energy use in homes and buildings.

City Green can review DCLTA's architectural and mechanical drawings and conduct energy modeling of one (or all) of the duplexes as well as provide energy performance consulting, upgrade recommendations and air tightness coaching. City Green Solutions can also help its clients access utility grants (about $800 for each unit).

Recommendation: That DCLTA incorporate Passive House standards into the project design in order to utilize passive solar and other PH techniques.

This would entail a review at the planning stage by an organization such as City Green Solutions to assess plans and conduct energy modeling.

See Appendix 3 for service and price quotations from City Green.

[14] http://www.passivehouse.ca/faq/

4 - Solar Energy – Best Application

Solar energy is not new. What is new, and a game changer for many interested in "green energy," is the rapid decline in the cost of solar panels in recent years, and a growing recognition of how this technology can play an important role in an integrated energy approach.[15] – GabEnergy.

Passive House design can readily be combined with green energy systems such as solar energy. Solar technology can be used for hot water systems or for power systems. [16]

4a - Solar Hot Water

Solar hot water systems convert sunlight into heat through solar collectors usually mounted on the roof. As the sunlight passes through the collector's glazing, it strikes a material that converts the sunlight into heat while the glazing prevents the heat from escaping. Water, or a water and antifreeze solution, carries heat from the collectors through a heat exchanger to a solar storage tank, which holds domestic hot water for subsequent use.

A solar storage tank typically works in conjunction with a traditional hot water tank or on-demand heater, since weather affects solar hot water production. The traditional tank then becomes a back-up to the solar tank.[17]

Solar water heating used to be considered the most cost-effective use of solar energy but that has changed with the dramatic decrease in the cost of photovoltaic panels. While a solar hot water heater can still be a cost-efficient use of solar energy for large households with a high use of hot water, for households with only one or two residents - like the DCLTA seniors' housing units - it is now considered more cost-efficient to invest in photovoltaic panels and apply the energy for all household power needs, including heating an electric hot water heater[18] (which could either be a well-insulated tank or an on-demand heater). This approach eliminates the need for two solar energy systems: one for hot water and one for energy.

PV systems require less maintenance and parts replacement than solar hot water systems. In addition, net metered PV systems are more efficient because extra power goes into the hydro grid at any time, whereas once solar

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[15] GabEnergy http://www.gabenergy.com/photovoltaic-system/

[16] There is a sun pump that offers both but it is not yet efficient and affordable enough to warrant consideration for the DCLTA project.

[17] City of Vancouver Passive Design Toolkit, http://vancouver.ca/files/cov/passive-home-design.pdf PP 12 - 13

[18] http://www.gabenergy.com/hot-water-system/

hot water systems are up to temperature, there is no way to use any extra heat.[19]

Recommendation: That the DCLTA invest in photovoltaic energy systems rather than solar hot water systems.

4b - Solar Power Overview

"Solar technology has improved dramatically in the past decades and systems are very simple to install and use." Dave Nead, General Manager, GabEnergy

Solar power is generated with photovoltaic systems, also known as solar PV. They convert sunlight into electricity. PV cells are made from layers of semi-conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers. The stronger the sunshine, the more electricity is produced. Groups of cells are mounted together in modules, also known as panels, which can be mounted on the roof or on the ground.

Solar PV performance is measured in kilowatt hours, or kWhs. This refers to the amount of energy produced by the panel and is represented as kW per square metre of panel surface.[20]

Solar modules are available in many sizes, voltages and formats. The most commonly used modules are rigid and mounted to frames either on the roof or on the ground. There are other higher cost options that include thin film panels that look like roofing tile or laminated modules, which are flexible solar panels bonded directly to the roof.

Solar PV modules are virtually maintenance-free and long lasting, with a lifespan of 25 years or more (as much as 40 years according to observations and projections based on installations in the U.S. and Europe[21]).

With solar PV systems, the price varies depending on how much energy the homeowner would like to generate. Today in B.C., the average current installed system price per watt for a direct grid-tie system is just under $4 per watt, having dropped from $12 per watt five years ago, due to the increased demand for solar PV worldwide.[22] Systems planned and supplied by GabEnergy, which acts as a wholesale re-seller of PV panels, are less than $3 per watt installed. [23]

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[19] Mackenzie, Bruce, Solar Power at Central Park Strata, 909 Pembroke, page 2

[20] Renewable Energy Introductory Guidebook, Regional District of Nanaimo Dec., 2013, P 59

[21] http://solardirectcanada.com/solar_faqs.php#TwoSides

[22] City of Vancouver Passive Design Toolkit, http://vancouver.ca/files/cov/passive-home-design.pdf P 62

[23] Dave Nead, General Manager, GabEnergy, telephone interview Sept. 2015 with Stephanie Slater

One solar module takes up about 18 square feet. Twenty to 22 modules (approximately 400 square feet) would provide a 5 kw system that would produce 5,000 – 6,000 kw/year with net metering (see next section for further information on net metering). If the DCLTA units were built with PH principles, a 5 kw system would likely cover all or most energy demand from one housing unit.

4b-1 – Solar Power: Net Metering and Backup Power Systems

The majority of solar users are still hooked into the power grid. Their panels generate most of their energy and the electricity produced by their local hydro company supplements it.[24] This is called a grid-tie or net metering system. In grid-tie with battery back-up systems, energy is also stored in battery banks, for emergency situations. When systems operate apart from the utility grid they are considered off-grid systems.

Grid tie is the most straightforward of all three systems because the power grid acts as a free back-up system. The accounting system applies the summer solar surplus to the winter deficit.[25]

This is how BC Hydro describes the process:

> As a net metering customer, when you generate more electricity than you use, you receive a credit to your account that is applied against your future electricity use. At your anniversary date, if you have an excess generation credit remaining on your account, BC Hydro will pay you at the published rate of 9.99 cents per kWh.[26]

Grid tie systems are the most efficient and economical way to use solar power, however, when the grid goes down the system shuts down for safety.

These are the back-up options:

Hybrid system – solar batteries - Batteries provide back-up power in the event of an outage. This system reduces the overall efficiency of the solar power panels because energy is diverted to keep the batteries charged rather than supplying energy to the unit – or going into the grid for credit. Batteries

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[24] http://canadianhomeworkshop.com/6828/tips-tools/go-solar

[25] City of Vancouver Passive Design Toolkit, http://vancouver.ca/files/cov/passive-home-design.pdf P 50

[26] https://www.bchydro.com/energy-in-bc/acquiring_power/current_offerings/net_metering.html?WT.mc_id=rd_netmetering

will only provide power for several days, depending on demand, as they are not re-charged while the grid is down. Batteries last 15 – 20 years with regular maintenance and would cost approximately $20,000 to $25,000 for a project such as DCLTA's.

Micro grid system – The use of a second inverter and a relay system allows the solar panels to re-charge solar batteries in the event of a power outage. This would add 10 – 15% to the cost of a hybrid-battery system and have the same efficiency impact of diverting energy to keep the batteries charged.

Hybrid system – generator - A small propane or diesel-powered generator could provide indefinite back-up power for the time the grid may be out. One generator could probably serve all eight of the planned DCLTA units for a cost of approximately $5,000. It could be located in a soundproof building that could even be buried and it could be programmed to start automatically in the event of a power outage.

Recommendation: That DCLTA plan to install a net-metered PV system with a generator backup.

Option: Arrange a cost/benefit assessment of a generator back-up and a micro grid system when the housing project reaches the design stage. The contractor engaged to design the PV system can be asked to cost both options, in terms of equipment and labour as well as environmental implications, which exist for batteries and fuel as well as – to a lesser extent – PV panel manufacture.

4b-2 Solar Power – Planning

Planning a solar power system entails first assessing design load, i.e. the annual estimated energy consumption for each unit. Design of a grid-tie system is based on planning inputs to needs based on fall and spring usage.

Planning also entails a physical site analysis that assesses the sun exposure, obstructions, space, factors for determining a roof versus ground mount, wind, structural issues, visual impacts, neighbours, bylaws, security and other considerations specific to the site.

Site: The site proposed for the DCLTA housing unit is large and not overly shaded with trees. The planned orientation of the units will be south – southwest facing, although the proposed roof design has an east-west orientation and a curved surface.

Roof or Ground Mount: Roof mounts are generally preferred over ground-mounted systems as they don't take up ground space, are less expensive to install than ground mount systems - which require more equipment and

trenching – and they are generally less shaded than a ground-mounted system.

Roof mounts are usually selected for new construction projects where the building can be sited and the pitch and orientation of the roof designed to allow solar panels to face the sun long enough to produce maximum energy. New construction also mitigates the need in future to remove a solar system in order to replace an aging roof. A metal roof, for instance, will last 25 years or more. No bolting penetration is needed when attaching a solar system to a metal roof. A metal roof is also good for rainwater catchment systems.

While a metal roof makes the most sense for a new build project, PV systems can be installed on any type of roof and roof load is not an issue for any roof surface.

The draft design for the DCLTA project has a curved-surface roof with an east-west – rather than south-north – orientation. A roof-mounted system on this design would have to be raised, which is not recommended due to the additional issues of requiring more space (due to shading caused by raised panels), wind, and extra labour costs. Raised roof PV panels would also block out much of the roof design.

Recommendation: That the DCLTA install roof-mounted PV panels on a re-designed plan that features a north-south orientation and a straight surface that is flat or sloped north-south.

Options: install a ground-mounted system (that would likely be located south of the units) and/or build a covered parking area and install a roof-mounted system on the roof.

Planning support: GabEnergy, a non-profit society that works with B.C. communities to plan, develop and operate alternative and renewable energy systems, can provide a solar system design for a $250 fee. GabEnergy has assisted in installing 25 systems on the Gulf Islands, both residential and non-residential.

It can also order units for wholesale price plus 5% fee. Systems generally come from Sentinel Solar in Toronto. All solar cells in the world are made offshore, however, Sentinel's systems are assembled in Canada (sufficient to qualify for Ontario-made designation). Cost is about $15 higher per solar module than those assembled off-shore. These units are robust and have been tested in saltwater environments. They come with 25-year third-party insurance guarantees.

Clients arrange their own electrical (GabEnergy has done considerable work with Osprey Electric out of Parksville. On Denman Island, at least two people have received certification in solar system installation). The final price is less than $3 per watt installed, so a 5 kw system that would produce 5,000 – 6,000 kw/year with net metering would cost about $18,000 per unit ($144,000 for all eight units).
On Hornby Island, the Hornby Island Community Economic Enhancement Corporation has costed a 6-kW grid-tied system at $26,670, excluding contingency, with a 25-year payback anticipated. [27]

On Denman Island, Sheldon Rempel at Earth Club Factory sells PV panels at a low markup in order to promote the environmental goals of the business. Panels come from ZEDfactory, a UK-based zero emissions consultancy that has partnered with Himin Solar in China. ZEDfactory also makes a solar roof that the DCLTA may wish to consider.

Sheldon does not do systems design or installation and he does not provide inverters.

Recommendation: That the DCLTA have GabEnergy create a solar system design for the housing project and then call for proposals to supply and install the system.

Assessment criteria could give greater weight to local proponents if DCLTA wants to support the Denman economy.

[27] P5, Request to Access Community Works Funds to Support Hornby Island's Transportation and Energy Initiative, Hornby Island Community Economic Enhancement Corporation, May 14, 2015

5 - Regulatory and Incentive Environment

While governments around the world are mandating and encouraging energy sustainability strategies, particularly for new buildings, it seems unlikely there will be substantial changes in programs and policies by the time the DCLTA is ready to build the seniors' project in 2017.

Fortis/BC Hydro offers some new building utility incentives and these are described in further detail in Appendix 3 (City Green Solutions proposal). The net cost of receiving this incentive is offset by the cost of achieving the required standards. It is useful as a cost-neutral means of ensuring optimal energy efficiency, however.

In British Columbia, some municipal governments are setting energy efficiency goals and standards for new buildings. The general approach currently is to provide encouragement and information in the form of resources, although mandatory standards are being introduced for new buildings in particular and, to a lesser degree, for renovations. See Appendices 5, 6 and 7 (included with this report as separate files) for:

- Passive Design Toolkit for Homes, City of Vancouver
- Renewable Energy Introductory Guidebook developed for homeowners by the Regional District of Nanaimo.
- Guide to environmentally friendly building and renovating in the Southern Gulf Islands, Islands Trust

The Comox Valley Regional District developed a Sustainability Strategy in 2010 that sets a goal of developing a toolkit of green building incentives to encourage developers to adopt green building practices. So far, energy sustainability activities implemented under the strategy have included a home energy incentive program that subsidized energy efficient residential renovations (a pilot project for 80 households was fully subscribed and is no longer available, with no plans to offer it again) and four solar photovoltaic systems installed in public sector buildings for demonstration and tracking purposes.

No activities are planned in the next few years that would affect the DCLTA project.

The Islands Trust regulates construction activities on Denman Island. Affordable housing and supporting environmentally sustainable practices are two of the long-range goals for the Denman Island trust plan but no specific activities are planned that would affect DCLTA's utilization of solar technologies.

On Hornby Island, the Hornby Island Community Economic Enhancement Corporation has requested funding from the Comox Regional District (Federal

Gas Tax Funds, GTF, delivered in B.C. through the Community Works program) to install a 6 kW solar demonstration PV system on the roof of the free store building at the Recycling Depot (a building owned by the regional district). The proposal would also include studying the feasibility of starting an Alternative Energy Co-op or Investment Vehicle as a scalable model for local energy production.

The proposal says: "Our goal is to implement projects that are cost-effective and that build community capacity and assets, entice private investment, and serve as a demonstration of post-carbon infrastructure viability."[28]

The Hornby proposal is due to be considered by the CVRD in October, 2015 and, if approved, the system would be installed by early 2016.

Eligible project categories under the GTF include community energy infrastructure and non-capital investments in capacity building initiatives so there is a possibility that the DCLTA could make a similar proposal – incorporating a community education component – through DenmanWORKS.

On Denman, a small group is working on a project to install a solar PV system on the roof of the Community Hall. The project is in the very early stages and no funding has been requested, though presumably a request would go through the Gas Tax Funds as administered by DenmanWORKS.

Recommendation: That the DCLTA liaise with Islands Trust, the CVRD and DenmanWORKS to stay updated on local initiatives and programs that may support the renewable energy component of the housing project.

Recommendation: That the DCLTA assess whether it is desirable to incorporate a robust community education and leadership component into the project.

An education and leadership component may attract funding – although it is by no means assured. It may also enhance support for the project's re-zoning application.

[28] P3, Request to Access Community Works Funds to Support Hornby Island's Transportation and Energy Initiative, Hornby Island Community Economic Enhancement Corporation, May 14, 2015

6 – Summary

In summary, the research shows that solar energy is viable for the affordable seniors housing project because it could contribute to the DCLTA's overall goals of creating housing that is comfortable, contributes to a safe physical environment for residents, and protects residents from rising utility costs.

Solar energy would be most effectively used in buildings that incorporate Passive House Standards to greatly enhance a building's energy efficiency.

A PV grid-tie power system would be the most effective application of solar energy for the DCLTA housing project. While there are solar battery systems that can provide back-up power in the event of a power outage, a generator powered by diesel or propane offers the most effective and least costly option to provide back-up power.

There are few, if any, regulatory or technological changes expected in the next two years that would affect the project.

Summary of recommendations:

1) That DCLTA incorporate Passive House standards into the project design in order to utilize passive solar and other PH techniques.

2) That the DCLTA invest in photovoltaic energy systems rather than solar hot water systems.

3) That DCLTA plan to install a net-metered PV system with a generator backup.

4) That the DCLTA install roof-mounted PV panels on a re-designed plan that features a north-south orientation and a straight surface that is flat or sloped north-south.

5) That the DCLTA have GabEnergy create a solar system design for the housing project and then call for proposals to supply and install the system.

6) That the DCLTA liaise with Islands Trust, the CVRD and DenmanWORKS to stay updated on local initiatives and programs that may support the renewable energy component of the housing project.

7) That the DCLTA assess whether it is desirable to incorporate a robust community education and leadership component into the project.

Appendix 1 – Sunshine Data and Photovoltaic Potential Data

Vancouver Island Sunshine Data

Average amount of sunshine yearly 1981 - 2010
Percentage sun is the usual percentage of daylight hours with bright sunshine.
Hours gives the total hours of bright sunshine that's normal during a year.
Days are the typical number of days annually with any measurable sunshine.[29]

% Sun	Place	Hours	Days
40	Courtenay - Comox	1926	287
41	Nanaimo	1940	295
33	Port Alberni	1611	273
31	Port Hardy	1462	283
35	Tofino	1668	273
44	Victoria - Sidney	2109	308

Denman Island PV potential (kWh/kW)

This gives a simple estimate of how much AC electricity in kilowatt-hours (kWh) is expected to be generated on average over the lifetime of a typical grid-connected photovoltaic system (without batteries) per unit of photovoltaic system rated DC power in kilowatts (kW) at Standard Test Conditions (STC). PV potential values are given as totals for each month and for the entire year.[30]

	South-facing vertical (tilt=90°)	South-facing, tilt=latitude	South-facing, tilt=lat+15°	South-facing, tilt=lat-15°
January	39	40	42	36
February	46	50	51	47
March	69	87	84	85
April	70	103	95	107
May	68	114	100	123
June	63	114	98	126
July	70	124	107	136
August	75	120	107	126
September	87	115	109	114
October	65	75	75	71
November	42	43	45	39
December	36	35	37	31
Annual	731	1020	950	1040

[29] Current Results – Weather and Science Facts, http://www.currentresults.com/Weather/Canada/British-Columbia/sunshine-annual-average.php
[30] Source: Natural Resources Canada http://pv.nrcan.gc.ca/index.php?n=2143&m=u&lang=e

Appendix 2 – Passive House Benefits

- Much better indoor air quality – comfortable humidity levels, low CO2 levels because of comfort ventilation, with optimum ventilation flow rates calculated for each room

- Increased thermal comfort – highest level of interior comfort of any building, with all surfaces equally warm (including the windows), no drafts (ever), no setbacks, no temperature swings

- Superior sound insulation – extraordinary air tightness levels, triple-pane glass and thick insulation also provide superior sound insulation – Passive Houses are very quiet indoors!

- Almost-unbelievable energy efficiency – 80-90% better than standard construction, with simply no need for a conventional heating system

- More durable – detailed and advanced design, better building components, proven building science

- Almost no maintenance – very simple mechanical systems compared to normal construction

- Resilient – the most resilient construction standard anywhere, which maintains livable conditions even during power or fuel outages, relies very little on any mechanical systems

- Sustainable – because of very low energy consumption and durable construction

- Versatile – Passive Houses can be built in any climate zone and applied to any building type, utilizing a wide variety of building materials and methods

- Internationally embraced – already over 40,000 units in more than 35 different countries … with numbers growing rapidly from China to Abu Dhabi to Alaska

Source: Canadian Passive House Institute
http://www.passivehouse.ca/benefits/

Appendix 3 – Service and Price Quotations from City Green Solutions

Contents of Sept. 9, 2015 email from Torsten Ely of City Green Solutions to Stephanie Slater, researcher for DCLTA. City Green Solutions (www.citygreen.ca) is a non-profit energy efficiency organization that supports British Columbians in reducing energy use in homes and buildings.

Thank you very much for sending the plans and details. City Green Solutions is pleased to present you with a couple of quotes for this project. To provide you with the energy efficiency evaluation for the Denman Community Land Trust Association's (DCLTA) seniors affordable housing project the cost will be $950 plus GST. The evaluation includes energy modelling of one of the duplexes, envelope performance consulting, upgrade recommendations and airtightness coaching (but not testing). There is no site visit component in this quote.

We could also model each unit separately and help you access utility grants (about $800 for each unit). This would include an EnerGuide rating evaluation and an Energy Star for New Homes enrollment. Please see below for details.

EnerGuide Rating System:

1. EnerGuide "P File" Evaluation:
    - Modelled EnerGuide Rating using HOT2000 energy modelling software for plans as presented
    - Report with option packages for reaching higher EnerGuide targets
    - Consultation session on report
2. EnerGuide "N File" Evaluation, including a site visit by a Certified Energy Advisor post construction for:
    - Data collection for EnerGuide assessment of mechanical systems used
    - Blower Door Test to confirm air leakage in the homes
    - Issuing of final EnerGuide Rating label and report
3. Cost for the EnerGuide Rating System evaluations, as described above is $450 +GST per home.

Utility Incentives for Energy Efficient New Home Construction:
Up to $800 from FortisBC and BC Hydro is available for energy efficient new homes built to the ENERGY STAR for New Homes standard (ESNH) when you work with an energy advisor. Alternatively, there are stand-alone natural gas appliance rebates from Fortis for high-efficiency natural gas products (no energy evaluations required).

1. Summary of Requirements for ESNH Utility rebates: (For full details, visit FortisBC and BC Hydro)
    a. Building permit issued on or after January 1, 2015.
    b. ENERGY STAR qualified Fenestration and Door Systems
    c. HVI certified HRV/ERV
    d. Minimum Airtightness 2.5 ACH at 50 Pa for detached homes, 3.0 ACH at 50 Pa for attached homes
    e. 400 kWh/year of Eligible Electrical Savings
    f. EnerGuide 81
2. Process (in addition to the EnerGuide Rating Service):
    a. Builder registers for ENERGY STAR® for New Homes Initiative in Canada
    b. Advisor enrols home in ENERGY STAR initiative
    c. Mid-construction: advisor performs site visit and checklist
    d. Completion: advisor completes ENERGY STAR checklist and utility incentive paperwork at the time of the final site visit.
3. Cost (in addition to the EnerGuide Rating System quoted above) for ESNH enrolment and mid-construction site visit is $500 +GST per unit. You may waive the mid-construction site visit, which would lower the cost to $200 +GST per unit.

The quoted fees are based on the understanding that City Green Solutions would have access to up-to-date architectural and mechanical drawings in .pdf format. Additional requested work that falls outside the scope of this quote will be invoiced and calculated on a time ($100 hourly rate) and materials basis. You will be notified of work that falls outside the scope of this quote.

If you have any questions, please be in touch.

All the best,
Torsten

Torsten Ely, Dipl.-Ing., CEM
Senior Building Energy Analyst
Thermographer, Level II ASNT
Certified Energy Advisor (New & Existing Homes)
"Energy efficiency is the greatest form of new energy we have."

City Green Solutions
214-620 View St.
Victoria, BC V8W 1J6
Phone: 250-381-9995 Ext: 120 or Toll Free: 1 866-381-9995
torsten.ely@citygreen.ca
www.citygreen.ca
www.facebook.com/citygreensolutions

Addendum: These two follow-up questions were answered on Sept. 14, 2015:

Q: Would the project qualify for the utility incentives even though Fortis does not serve Denman Island?

A: Power Smart incentives for building energy efficient homes - Option 1: For ENERGY STAR® qualified homes applies to both natural gas (Fortis) and electrically-heated (BC Hydro) single-family detached homes, duplexes, and townhomes/rowhomes that meet the ENERGY STAR for New Home Standard, and for laneway homes that meet an EnerGuide rating of 82 or above.

Q: What is the advantage of going through the EnerGuide Rating and then the Utility Incentives process? The cost of the process appears to be about the equivalent of the grant, so what advantage will it offer DCLTA and the residents of the housing? If the society has had your energy efficiency evaluation, wouldn't they and their builder have the info they need to achieve these energy standards? Is the rating process a measure to provide assurance that the standards are and will be met?

A: You are correct. The difference is that although the EnerGuide provides you potentially with the info the utility incentives process forces the implementation. However there is still the option to have only one duplex analysed in more depth as per first option in the proposal.

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Interviews

Researcher Stephanie Slater interviewed the following people for this project:

Arbour, Daniel, Hornby Island Economic Enhancement Corporation.

Busheikin, Laura, Islands Trust representative, Denman Island, 250-218-3216, lbusheikin@islandstrust.bc.ca

Ely, Torsten, Senior Building Energy Analyst, City Green Solutions, 250-381-9995 Ext: 120 or Toll Free: 1 866-381-9995, torsten.ely@citygreen.ca

Milne, Robin, Islands Trust Planner, Denman Island, 250 247-2203 milne@islandstrust.bc.ca

Nead, Dave, General Manager, GabEnergy, daveongabe@shaw.ca.

Rempel, Sheldon, Owner, Earth Club Factory, Denman Island, 250-335-2688

Rombough, Wind, Resource Centre Coordinator, DenmanWORKS! Denman Island, 250-335-3170, denmanresource@gmail.com

Zbarsky, Michael, Manager of Transit and Sustainability, Comox Valley Regional District, 250 334-6037