



The Solar Colwood Story

This document is for all those interested in the Solar Colwood story, especially local governments considering their own community energy and emissions initiative. It is intended to encourage, inform, and improve the delivery of community energy conservation and renewable energy programs. Our focus is on our story and what we learned that we can share with others.

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Executive Summary

Solar Colwood was a demonstration of whole community change towards energy conservation and renewable clean energy. Thanks to support from the Government of Canada's Clean Energy Fund, the City of Colwood, British Columbia (BC) worked in partnership with First Nations, academia, utilities, senior governments, local businesses, and residents to save energy and reduce greenhouse gas emissions through solar and energy efficiency upgrades.

Between June 2011 and March 2015, Solar Colwood offered incentives and building-science based advice to residents and businesses for energy saving and renewable energy upgrades, including solar hot water systems, ductless split heat pumps, electric vehicle charging stations, solar photovoltaics, and smart home monitoring systems.

Through the program, Colwood

- Became a Canadian leader in per capita solar retrofits and the City of Colwood redefined itself as a regional and provincial leader in energy conservation and renewable energy in BC.
- Implemented innovative and replicable approaches to community-wide energy programs, including a registered installer network for solar hot water and heat pumps, point of sale rebates, and robust monitoring and quality assurance.
- Achieved reductions of 37% and 43% for energy consumption and greenhouse gas (GHG) emissions respectively among study participants – higher savings than in previous community energy programs in the province.

While Solar Colwood has come to an end, distinct elements of the Solar Colwood program are already being replicated in various communities across the province. Additionally, Colwood has ambitious energy and emissions targets to reach, and will take the lessons learned from the Solar Colwood experience to inform its future strategies.

Project Development

Background

Colwood is a rapidly growing city with a current population of just over 16,000 that is expected to double to over 33,000 in the coming decades.

In 2007, Colwood signed on to the BC Climate Action Charter, and the following year struck a Task Force on Energy and Emissions (TFEE) with representatives from City council, staff, the WestShore Chamber of Commerce, Royal Roads University, energy efficiency professionals, and developers. The Task Force developed our Community Energy and Emissions Plan, which showed that although a focus on efficient new home construction would be very important in our rapidly growing community, retrofits of existing buildings would also be necessary in order to reach our Climate Action Charter commitments. In other words, each existing building must reduce its GHG emissions by more than 33% in order to reach our overall target.



The Task Force sought innovative means to reach these savings. Natural Resources Canada's Clean Energy Fund's Renewable and Clean Energy Demonstration Project represented an important opportunity for Colwood, along with many partners, to support innovation in reaching our energy and emissions targets and to share our findings with others.

Objectives

Solar Colwood was a multi-faceted program with the following objectives:

- To reduce Colwood's energy and emissions footprint through the use of energy conservation and clean, renewable energy sources;
- To reduce energy costs and increase energy security for residents;
- To foster and support skill development and jobs in Colwood and local First Nations, and to stimulate the local green economy;
- To study the impacts of a "mass" approach to installing solar/clean energy technologies, including the best approaches to social diffusion and to getting these ideas to "go viral";
- To demonstrate how Colwood is a "green learning university city", willing to learn about and try new approaches;
- To raise awareness of the benefits of energy conservation and use of clean energy sources through community outreach programs and through arts and cultural outreach;
- To demonstrate to others that there is a strong business case for making clean energy decisions;
- To demonstrate a utility model for financing clean energy technology in new and existing homes thus creating and providing a business model that can be adopted by other utility companies and local governments to ensure the rapid spread of these beneficial technologies in a way that will not happen under current financing models; and
- To improve Colwood's resilience to energy restrictions or interruptions, and to reduce the burden/demand of Colwood's requirements on provincial resources outside of Vancouver Island.

Initial Stages

A full year of planning occurred between confirmation of federal funding and the public launch of Solar Colwood. Building strong support amongst staff and council was an important first step. The program

benefited from champions in staff and council who could influence across departments (finance, engineering, building inspections, planning, etc.) because Solar Colwood had implications for many of the City's operations. The City also consulted widely with potential partners (most of whom later became program partners) to develop a robust and effective approach, learning from the experiences of others.

A committee with representation from the City and the growing list of partners was struck to help make decisions. The Committee contracted initial program development from former Solar BC staff, consulted with potential solar installers, and recruited new partners and secured in-kind contributions.

Partners and Funding

The Solar Colwood Program was founded on a collaborative approach and would not have been possible without the support of many different partners. The partners below, along with many other industry experts, provided advice and best practices for our program design, and supported Solar Colwood with financial and in-kind contributions.

[The T'Sou-ke Nation](#) are 'the most solar community in Canada', having completed extensive solar thermal and solar PV installations in their community (near Sooke, BC) through the T'Sou-ke Solar project. T'Sou-ke contributed program advice and several experienced installers to assist with the solar installations.

[Royal Roads University](#) provided research that supported program development and implementation, and shared its results widely. Faculty research projects included measuring the energy saving results of Solar Colwood participants and studying the attitudes towards promoted technologies and barriers to solar adoption. Through the [Office of Sustainability](#) and the [School of Environment and Sustainability](#), students worked on projects that support the collaborative efforts between the City of Colwood and the other Solar Colwood partners.

[Camosun College Pipe Trades Department](#) is a local provider of Industry recognized training in the fields of plumbing, refrigeration, geothermal heating technician and solar thermal systems installer. Camosun College also provided training through the [Solar Thermal: Entry Level Course \(see video\)](#) to prepare technicians for the [North American Board of Certified Energy Practitioners \(NABCEP\)](#) exams. They assisted with technical aspects of the Solar Colwood Program.

[Horizon Technologies](#) is a company that designs, develops, integrates and consults on Smart Grid and energy-efficiency related systems for prominent manufacturers, utilities, government agencies, developers, architects and builders. Along with their partners, TerraFirm Energy Management, IslandTransformations.Org Educational Society, Energy Solutions for Vancouver Island Society, Habitat Design + Consulting, The Pacific Institute for Climate Solutions, they are providing technical advice and support to Solar Colwood on the smart homes aspect of the program.

[BC Hydro](#) provided technical advice and funding support for a wide range of program elements, including incentive funding, marketing support and trades training support for the ductless split pump program and the Home Loan Pilot Program. They also provided technical support for the electric vehicle portion of the project and are leveraging their wide array of existing Power Smart Programs for commercial, government and residential customers in Colwood. Lastly, BC Hydro's Smart Metering and Infrastructure Program will continue to complement the energy efficiency retrofits and energy conservation efforts.

[FortisBC](#) provided technical advice to the program. Some homeowners also accessed grants available from FortisBC for energy efficiency improvements.

[Ministries of the Province of British Columbia](#) offered technical advice on several aspects of the program development. In addition, the Province's LiveSmart program made grants available to reduce the cost of other energy-efficient retrofits, complementing Solar Colwood's solar hot water incentives.

[SolarBC](#) is a former program of the BC Sustainable Energy Association. The organization has helped homeowners, governments, businesses, First Nations and schools across British Columbia to install solar hot water technology and has worked to set up the infrastructure –including training, regulatory changes, awareness programs, and a network -- for the installation of solar hot water systems across the province. SolarBC designated Colwood as one of 32 “Solar Communities” in October 2010.

[The Canadian Solar Cities Project](#) provided recognition to the Solar Colwood program, identifying Colwood as the second Canadian Solar City.

[The WestShore Chamber of Commerce](#) assisted with community outreach and education, and its LiveSmart BC Advisors provide energy assessments and advice to businesses.

[Vancity's Bright Ideas](#) home financing provided a way for people to take out a low-interest, long-term loan, effectively paying for the retrofits from their energy savings. Borrowing was available for up to 10 years with loans starting at \$3,500 up to \$20,000.

[The New Car Dealers Association of BC](#) represents more than 350 new car dealers throughout the province. They support the promotion of electric vehicle use in BC, and provided Colwood with advice on identifying EV charging locations.

[The Capital Regional District](#) promoted home and business energy retrofits throughout the Capital Region through a [Solar CRD](#) campaign.

(League Assets was initially a partner, but their new construction plans did not come to fruition as part of the Solar Colwood program.)

Program Design

Solar Colwood was designed as a “learning project” to build on past experiences and innovate with new approaches to overcome barriers and move the whole community to adopt renewable energy and energy efficiency technologies.

Selection of Technology

Solar Colwood was not just about solar energy – we supported a wide range of energy efficiency and renewable energy technologies.

The neighbouring T’Sou-ke First Nations’ Solar Project was an inspiration for the Solar Colwood program. T’Sou-ke had demonstrated that solar hot water and solar PV systems were good options for our region. At the time, solar thermal systems were understood to have a much better payback than solar PV systems; hence our almost exclusive focus on solar hot water.

Initially, the Solar Colwood program planned to focus on encouraging the adoption of solar hot water (aka solar thermal), geo-exchange, and energy efficiency technologies, including smart home/smart grid opportunities for new construction and retrofits. Thanks to support from BC Hydro, we were able to add incentives for ductless heat pump retrofits to the program offers. When the Province of BC came out with incentives for Clean Energy Vehicles and charging infrastructure, we were also able to add “top-up” incentives for charging infrastructure and net-metered solar photovoltaic systems. We provided free energy and water savings kits suitable for homeowners and renters. We also provided discounted EnerGuide home evaluations and promoted the LiveSmart BC Small Business Program, in order for home and business owners to benefit from the prioritized building science upgrade advice and access to incentives for upgrades from other programs such as ecoENERGY Retrofit – Homes, LiveSmart BC Efficiency Incentive Program, and the Home Energy Rebate offer from BC Hydro and FortisBC.

Regulatory Arrangements

Each promoted technology had different regulatory implications.

Solar Hot Water Systems and Installers

To ensure safe, quality solar hot water installations, the City of Colwood, through the Chief Building Inspector and City Engineer, conducted a thorough review of prospective installers and types of solar hot water systems, developing a list of Registered Installers and incentive-qualifying systems.

There are many solar hot water systems available on the market. Our program aimed to ensure quality and encourage innovation, and as such, included both established and new solar hot water systems. We considered applications from systems that had undergone CSA testing for the entire system (CSA F37), or, if they had not undergone that certification, we required CSA-approved components and an engineer stamped drawing of the system as a whole.

The ideal solar hot water installers would be those with the highest certification levels available (e.g. [NABCEP Solar Heating Installer Certification](#), plus Red Seal Plumbing qualifications), extensive experience with solar hot water installations, and excellent customer service record (e.g. A+ Rating with the Better Business Bureau). Because solar is an emerging industry, this level of training and experience was not common at the beginning of the program. Solar Colwood provided up-front training for installers, and also provided scholarships for continued training and certification exams.

In response to feedback from installers and building and plumbing officials, Solar Colwood required proof of permit and successful inspection before paying out incentives to installers.

The City reduced its plumbing permit fees for solar hot water installations.

Solar Photovoltaics

Colwood facilitated the installation of solar PV systems by adopting a policy under which Solar PV panels may be installed on the roofs of buildings within the City of Colwood without a building permit provided the installations comply with a [list of criteria](#). Ground based installations were not included in the program to avoid the requirement for an environmental assessment that would be triggered for federal grants.

Ductless Heat Pumps

No changes to heat pump bylaws were required in Colwood. Many jurisdictions in BC have bylaws restricting the installation of heat pump due to noise concerns. These bylaws should be reviewed, as

improvements in heat pump technology may have rendered these restrictions unnecessary and counter-productive to meeting energy saving and GHG reduction goals.

Smart Home Technology

The early implementations of the Smart Home technology for Solar Colwood involved registered electricians needing to install equipment inside a customer's circuit breaker panel in order to gather whole house energy information. This approach was both expensive and time consuming, and was complex from the regulatory point of view. A major thrust of the Smart Home component of Solar Colwood was to simplify and reduce the cost of this process. After working on several approaches, the Smart Home system ultimately settled on using a simple interface box that communicates to a Smart Meter. Now, most products can be placed on existing shelves/tables or plugged into power outlets, with some only needing a simple screw mount or other simple installation.

Incentives

Experience in British Columbia and throughout North America shows decisively that financial incentives for energy upgrades are necessary – at least in the short term – to generate higher levels of program participation and deeper energy savings than other approaches.

We heard from installers that short-term incentives are difficult to respond to as they require rapid expansion and contractions of their operations. Solar Colwood was designed as a medium-term program (three, then extended to four years) with larger incentives upfront to motivate adoption, followed by decreasing incentive levels over time. The intention was to taper what might have otherwise been a “boom and bust” experience for installers.

Since the Solar Colwood program aimed to incite whole community change, we designed our program to have something for everyone, no matter the building or budget. In this way, a diversity of energy and greenhouse gas saving upgrades opportunities were available, relevant and achievable for all residents and businesses. This “Something for Everyone” approach was accomplished by:

- Promoting all available government and utility energy conservation incentive programs for new construction and retrofits of residential and commercial buildings.
- Solar Colwood incentives for solar hot water, ductless heat pumps, electric vehicle charging stations, solar photovoltaic, and smart home monitoring systems were available to:
 - a. retrofits and new construction.
 - b. single family homes, multi-unit residential buildings (MURBs), commercial, and public buildings of all types.
- Solar Colwood provided free energy and water saving kits that were suitable for all residents, including:
 - a. renters and owners, overcoming the split incentive barrier.
 - b. low-income residents as well as those who can afford upgrades, overcoming cost barriers to participation.

Processes

Registered Installers and Point of Sale Rebates

Solar Colwood based our incentive process on a Registered Installer and Point of Sale Rebate approach, which we believe offered significant benefits compared to incentives that are paid to homeowners several weeks or months after upgrades are complete.

Solar Colwood's Registered Installer and Point of Sale Rebate Process included:

- A list of Registered Installers who had gone through a screening process to assure that installers have appropriate certification/accreditation, insurance, and track record.
- An online platform for submitting and viewing customer reviews of Installers, to further help participants choose an Installer.
- Pre-qualification for incentives through incentive tracking numbers.
- Payout of incentives directly to installer after installation complete and homeowner sign off, and, in the case of solar hot water systems, building inspector sign off as well.

Benefits to Participants:

- Reduced upfront cost of undertaking an energy upgrade
- Reduced or eliminated need to access financing
- No wait for a rebate cheque
- No uncertainty as to whether the upgrade will qualify for rebate
- Simple: Contractors handle most of the incentive paperwork and contractors are motivated (required) to put the correct information on the invoice to ensure that they receive payment for the rebate.

Benefits to Contractors:

- Ability to offer product to the homeowner at a lower price (as the rebate will already be deducted).
- Certainty as to upgrade rebate eligibility.
- *Tip: Input from contractors indicates that Point of Sale rebates are only of benefit to the contractor if the rebates can be paid out quickly, e.g. within 2 weeks.*

Benefits to the Program:

- Information on program uptake quickly and readily available, allowing for more accurate project rebate spending forecasting.
- Pre-emptive quality assurance through ensuring eligible systems installed by reliable and honest installers.
- Option to not provide tracking number for rebate (if there is an ongoing or pending issue with an installer).
- All paperwork filled out by contractors who quickly became proficient rather than individual homeowners rapidly reduced errors in paperwork.
- Fewer payees for incentives reducing work required of finance staff.
- Stronger program link with both the homeowner and installer.

Program Delivery Contracts

The City contracted out day-to-day program management, outreach, and accounting tasks, but nonetheless significant staff and council time was dedicated to ensuring the success of all of the elements of the Solar Colwood program.

Program Implementation

Program Scope

The award-winning Solar Colwood was designed to reduce both community and corporate greenhouse gas emissions and to demonstrate whole community change towards energy conservation and renewable clean energy. Between June 2011 and March 2015, we engaged in the following activities:



Municipal Showcase: Demonstrating leadership in solar technology, Colwood's Fire Station was equipped with solar thermal and solar PV systems that are now providing us with renewable energy, reducing our greenhouse gas emissions and shrinking our energy bills. Other municipal showcase items include a solar energy learning and demonstration centre and public EV charging station informational displays.



Solar Thermal and Energy Retrofits: Solar Colwood encouraged energy saving and renewable energy actions in homes and businesses in Colwood. From April 2014 to March 2015, incentives for solar hot water systems were also made available throughout the Capital Region.



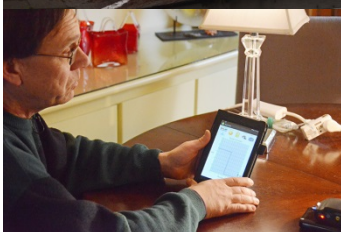
Electric Vehicle Charging Infrastructure: Colwood installed public electric vehicle charging infrastructure, and provided incentives for homes and business to install charging infrastructure and net-metered solar photovoltaics.



Research and Monitoring: Royal Roads University studied many aspects of the program, including energy savings based on utility data, perceptions of adopters and non-adopters of the promoted technologies, and the diffusion of solar and energy efficiency information across generations.



Training: Solar Colwood provided solar installation training for members of the local T'Sou-ke First Nation, and solar scholarships for training and examinations for all interested installers and students through Camosun College and the North American Board of Certified Energy Practitioners (NABCEP).



Smart Home and Smart Grid: Locally developed Smart Home technology designed to promote energy conservation behaviour through providing instant energy usage feedback and control to homeowners completed several phases of product development and field trials during the Solar Colwood program.

Outreach

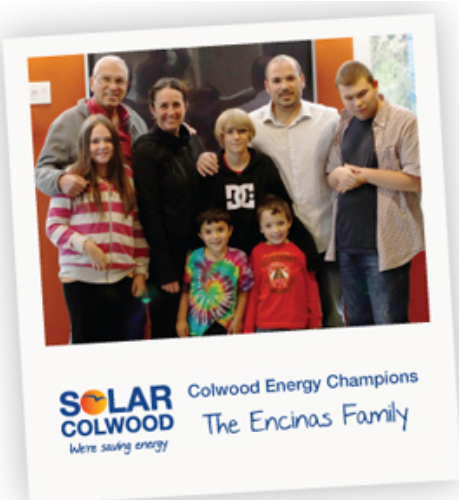
Effective outreach was necessary to drive whole community change. Some highlights of our outreach activities include:

- Profiled community “energy champions”— demonstrating participant leadership and buy-in and telling the individual story.
- Implemented very successful earned media campaigns, with over 120 earned media stories.
- Performed 87 solar site visits for homes and businesses.
- Coordinated six very successful solar home tours to show the community how their neighbours were benefitting from solar and energy efficiency upgrades.
- Worked with partners, installers, energy advisors, and community groups to spread the word.
- Conducted door-to-door outreach for over 1500 targeted homes.
- Supported the arts community through participation in and sponsorship of prizes for art shows.
- Participated in many community events and hosted numerous Solar Colwood celebrations and information sessions.



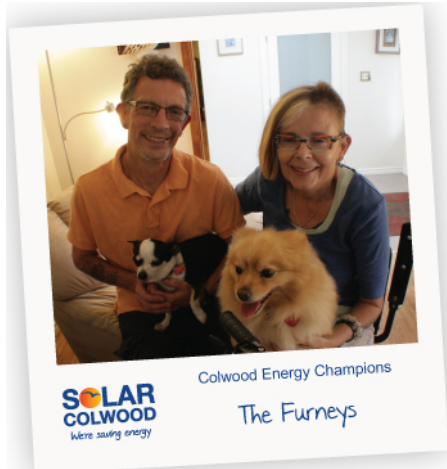
“It’s a huge difference. Our electrical usage has gone way down and there are no cold zones.
I’m enjoying it.”

-David Tyler, Solar Colwood Energy Champion



“Our Hydro bill is a credit of about \$960 this month, because we’re using much less energy than our equalized payments were anticipating.”

-Keith Encinas, Solar Colwood Energy Champion



“In winter, we have a nice warm home, with quiet, comfy heat. No draughts no more! With reasonable, predictable bills! What's not to like?
-Linda Furney, Solar Colwood Energy Champion

Personalized Building Science Support

Access to advice from an energy advisor or energy coach has been demonstrated to help participants achieve greater savings in a more cost effective manner than they would achieve without expert advice.

Solar Colwood facilitated access to personalized third party professional advice in a number of ways, including:

- Providing free solar site visits which include a "Solar 101" presentation, a shading analysis of the roof, data collection about water consumption and heating in the home or business, onsite advice and support from a professional energy advisor and a customized report showing solar hot water suitability and return on investment estimates.
- Promoting free business energy assessments (through provincial or utility programs when available).
- Promoting home energy assessments and providing discounts for them.
- Providing full-time ongoing technical and administrative support through a phone and email hotline and an accessible program delivery team, which includes a ‘participant energizer’ who assisted program participants and contractors and the City of Colwood at any point in the process.
- Providing technical support for the setup and operation of the Smart Home technology.

Quality Assurance and Measurement

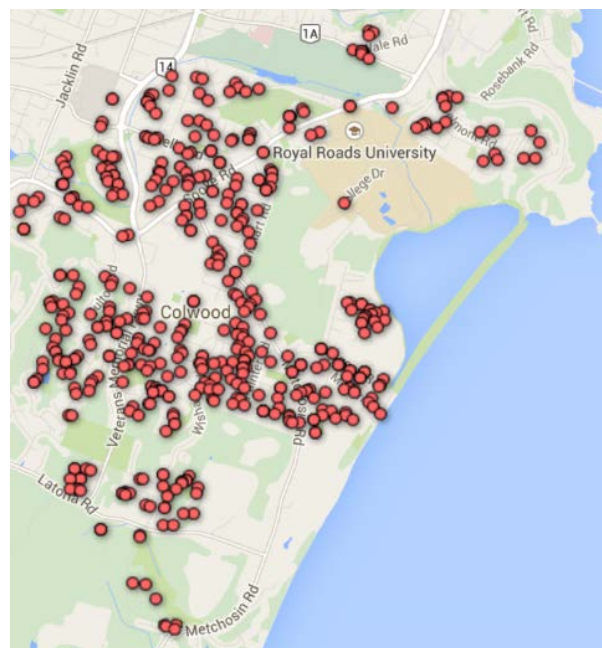
Solar Colwood implemented a comprehensive quality assurance and result measurement process. This process included:

- Updating our incentives process to require proof of permit and successful plumbing/building inspection before issuing incentive to installer.
- Performing “Solar Checkups” (offered to 100% of solar hot water system adopters in Colwood) which included an on-site visual inspection and, when possible, diagnostic tests of the solar hot water system, interviews with homeowners about their experiences with performance and maintenance required, and follow up with installers to address any identified issues.
- All participants were invited to opt-in the Solar Colwood Royal Roads University Monitoring Program, which analyzed participants’ utility bills to measure the changes in energy consumption before and after their home energy upgrade.
- Participant surveys and online installer reviews.

Results

Widespread Community Change

During the Solar Colwood program, over 500 residents accomplished over 1,000 energy saving or renewable energy actions at home, at work, and on the road. We had participation from renters, homeowners, businesses, institutions, and, of course, the City itself. If you walk down any street in Colwood, it's likely that at least one household on the block is now enjoying more affordable energy bills, more comfortable heat, and more control over their energy future thanks to Solar Colwood. Not only that, but neighbours have met neighbours through solar home tours and solar socials organized by Solar Colwood, contributing to a new renewable and conservation culture in Colwood. In short, for the City of Colwood and many of its residents this energy conservation culture has become part of their self-identity.



Increased awareness of the benefits of energy efficiency, solar energy, and electric vehicles did not stop at Colwood's borders, but has spread throughout the region thanks in part to the Solar CRD program and the widespread media coverage of the Solar Colwood program.



Canadian Leader in Solar Retrofits

Colwood is now a Canadian leader in per-capita solar thermal retrofits, second only to the T'Sou-ke First Nation among current community solar retrofit programs we are aware of across the nation. In Colwood, 39 private solar hot water systems received Solar Colwood incentives. The expansion to the Capital Region in 2014 allowed for the installation of 41 additional systems, resulting in a total of 82 private solar hot water systems across the entire Capital Region.

Successful Ductless Heat Pump Program

Ductless heat pumps proved to be a very popular technology in Colwood, with 100% of available incentive funds fully allocated for the installation of 120 heat pumps well before the project's end. The strong demand for this technology was likely driven by the quick payback period of this upgrade, combined with the improved thermal comfort of heat pumps compared to electric baseboards.



Growth in Electric Vehicle Infrastructure

Colwood is now a place where you can find people powering their vehicles with solar electricity they've harvested on their own rooftops.

- Six public vehicle charging stations were installed by the City of Colwood.
- 12 homes have installed EV charging stations, with 7 of these households also installing net-metered solar PV systems.
- One business and one shopping mall have installed EV charging stations.
- One institution has installed three EV charging stations.

Training and Experience for Clean Energy Installers

Eleven T'Sou-ke Nation members became CanSIA certified solar installers. The training and work experience provided through Solar Colwood not only provided skills and jobs in solar installation, but also provided encouragement and confidence for trainees. For many the solar certificate was the first training certificate they had achieved in their lives. Although not employed in the solar industry currently many were employed in a large solar project in Vancouver and in the early stages of Solar Colwood.



The newfound confidence and enjoyment of earnings shifted the culture around employment on reserve. Almost all the individuals who had been laid off due to a downturn in Forestry and Fishing industries previous to the training are now working in a wide range of jobs (some as employees and some self-employed) thanks to the support and empowerment offered through the Solar Colwood experience.

Additionally, four solar installers or students from the wider community received Solar Colwood scholarships for the North American Board of Certified Energy Practitioners (NABCEP) Entry Level Solar

Thermal Exam.

Survey responses from installers indicated that they considered the program was very helpful at driving demand for their business. Based on dollars spent on upgrades, we estimate over 30 jobs were created for installation of Solar Colwood incentivized measures (not including promoted measures in ecoENERGY/LiveSmart/HERO programs).



Support for Canadian Technology Development

Solar Colwood directly supported the development of the “Smart Home For Us” system. This unique monitoring and management system improves energy literacy and reduces energy waste and was designed by Horizon Technologies, a local Smart Home/Smart Grid and energy-efficiency company. Thanks to advances made during the Solar Colwood program, Horizon Technologies is playing a leadership role in this rapidly growing market.

Solar Colwood indirectly supported the development of the CamoSun solar hot water system through driving local demand for solar thermal technology, working with the developers on regulatory issues, assisting with media about the launch of the system and providing quality assurance on systems installed. This system was designed by a local company, Pacific Solar Smart, with assistance from Camosun College, and is assembled locally for local installation.

Energy and Emissions Savings

The original energy and emissions targets for Solar Colwood were exceeded. The energy upgrades incentivized and promoted by Solar Colwood collectively resulted in:

- Modelled energy savings of 4.96 million kWh/year - enough to power 182 average homes in BC.
- Modelled greenhouse gas reductions of 651 tonnes of CO₂e/year - the equivalent of taking 119 cars off the road each year.
- Modelled cost savings on utility bills amount to a collective \$525,552 per year at today’s utility prices.

Royal Roads University’s Monitoring Program found that all of the households in the study group experienced a reduction in energy consumption over the study period, which was at least one year before and after upgrades.

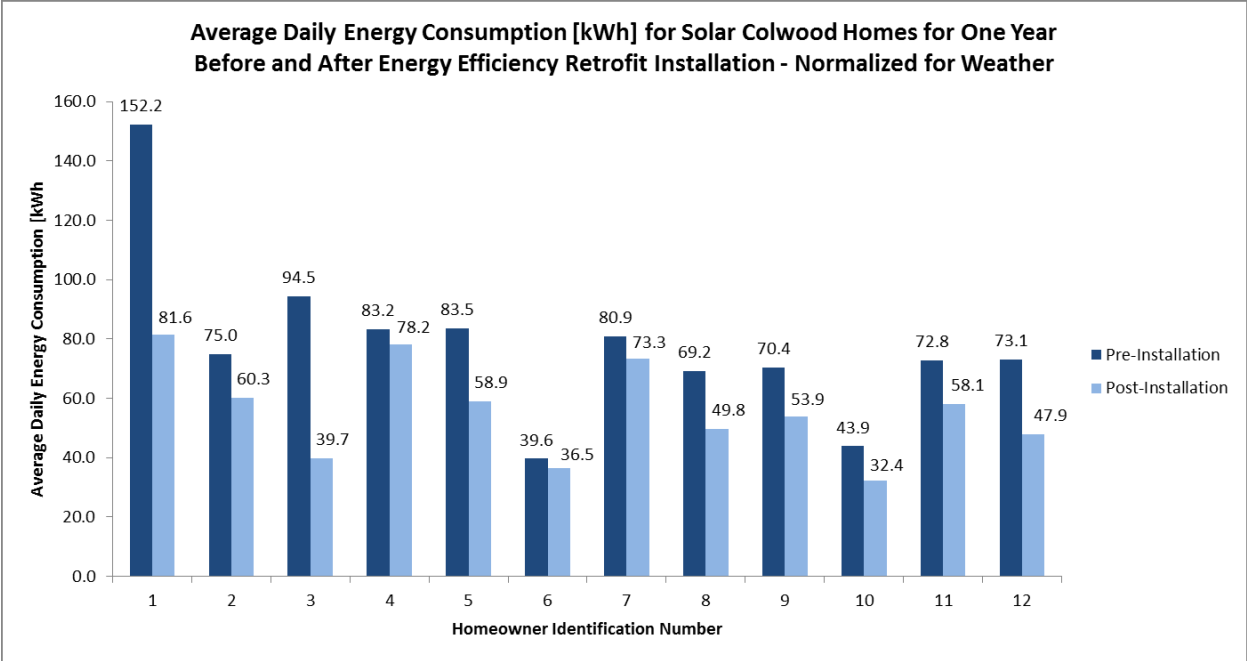


Figure 1: A comparison of the average daily energy consumption in the households in our study group before and after the installation of energy efficient technologies through the Solar Colwood program.

On average, households experienced a 26% reduction in energy consumption in the first year after the installation of energy efficiency retrofits. Households that continued to supply our team with utility data for at least two years after installation were found to have reduced energy consumption by an average of 37% since installation.

In comparison, when incentives were available from both ecoENERGY and LiveSmart BC programs, participating single family homes achieved an average energy savings of 15-28%. The higher average energy savings from the study participants may have been the result of participants completing multiple upgrades and installing solar hot water, along with changed behaviour due to perceiving themselves as energy leaders in the community.

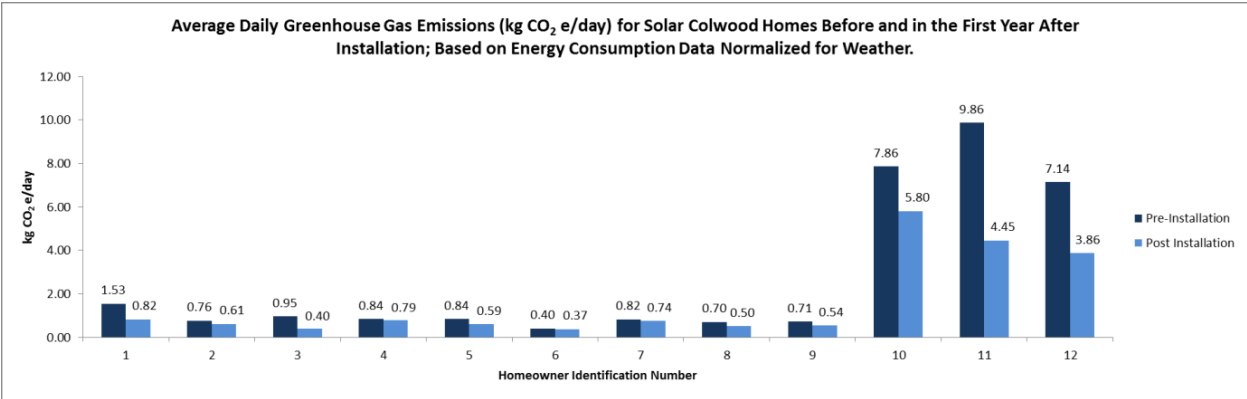


Figure 2: A comparison of the average daily GHG emissions before and in the first year after the installation of energy saving technologies.

The Monitoring Program also found that all of the households in the study group experienced a reduction in greenhouse gas emissions produced as a result of energy consumption over the study period. In the figure above, the first 9 homes were primarily heated with electricity; the last three homes were primarily heated with natural gas. Study participants reduced GHG emissions by an average of 37% after the first year. Households that continued to provide data over the entire study period were found to have reduced emissions by 43%.

Solar energy production and energy efficiency improvements in Colwood are delivering many local and global ecological benefits, including:

- Reduced need for additional BC Hydro infrastructure (e.g. dams and transition lines) and extraction of natural gas and heating oil, with their associated ecological consequences.
- Reduced greenhouse gas emissions, which can deliver global benefits now and in the future through reduced climate impacts, and will benefit the City of Colwood by reducing future carbon offset costs.
- Reduced local air pollution through conversion from gas-powered to electric vehicles will benefit local residents, especially those who suffer from respiratory illness.
- Reduced water consumption by 11.4 million litres every year (thanks to the free Tap by Tap energy and water saving kits), will deliver improved water quality to residents thanks to higher water levels in the reservoir.

Economic Benefits

Solar Colwood achieved financial benefits for participants. Already, collective reduced energy costs from upgrades incentivized and/or promoted by Solar Colwood are estimated to be over half a million dollars (\$525,552) every year at current energy prices.

The business case for the installation of solar hot water heating systems, solar PV, PV4EV, ductless heat pumps, free energy and water saving kits, and the additional energy efficiency upgrades eligible for incentives from other programs we promoted differs depending on the building's suitability for the technology and the behaviours of occupants. Solar Colwood provided customized analysis on the costs and energy savings achieved from the upgrades we provided incentives for, and presented specific business cases for each participant. We also provided discounted home energy evaluations so that residents could make informed choices about how upgrade for energy savings in the most cost-effective way.

From the City's point of view, the business case for the overall Solar Colwood program is very good. The project generated almost \$2.7M of in-kind activity to support the program which was combined with NRCan grant monies of \$1.6M and almost \$10k from the City of Colwood for a total economic benefit toward energy savings and to the City of Colwood of almost \$4.4M.

Increased Energy Security and Resilience

Reducing our energy demand and producing energy locally for a good rate of return increases our energy security in terms of increased affordability. It also improves our energy resilience in the face of power interruptions, during which we can now meet some of our energy needs with locally produced solar energy that can be shared with the grid and also stored in electric vehicle batteries for use during times of low solar productivity.

Awards and Recognition for Colwood

The Solar Colwood program has "put Colwood on the map" in new ways, drawing new residents and businesses to the community, earning 7 local and international awards, drawing interested researchers

from near and far, and generating positive media attention with over 120 media stories featuring the technology, people, and accomplishments of Solar Colwood.

Date	Award	Granting Body
December 2014	Community Energy Builder Award Finalist	Quality Urban Energy Systems of Tomorrow (QUEST)
October 2013	Public Sector Land Award	Real Estate Foundation of British Columbia
September 2013	Climate and Energy Action (Community) Honourable Mention	Community Energy Association of BC
September 2013	Community Excellence Award for Leadership and Innovation in Climate Action	Union of British Columbia Municipalities
February 2013	Canadian Solar City	Canadian Solar Cities Project
January 2013	Earth Hour City Challenge Finalist	World Wildlife Federation
September 2011	Climate and Energy Action Award (Partnerships)	Community Energy Association of BC, in partnership with BC Hydro and Royal Roads University

Excellent Quality Assurance Results

The in-depth quality assurance/quality control performed in the Solar Colwood program found that 100% of the systems examined were performing as expected, and there was overall excellent customer satisfaction with installers and systems. These findings will benefit the reputation of the solar industry in the years to come.

Challenges

Large Upfront Costs and Long Payback Periods

While there is a solid business case for solar hot water systems and other energy retrofits for suitable buildings in Colwood, home and business owners are still reluctant to invest their money upfront to benefit from savings in the long term. Future programs must continue to experiment with measures to overcome this barrier.

Replication and Optimization

While Solar Colwood has come to an end, distinct elements of the Solar Colwood program are already being replicated in various communities across the province. Additionally, Colwood has ambitious energy and emissions targets to reach, and will take the lessons learned from the Solar Colwood experience to inform our future strategies.

The Solar Colwood program was fortunate to have access to significant levels of funding for the development of a diverse range of program activities which may not be the case for communities seeking to build on the Solar Colwood experience. Communities can choose to implement parts rather than the whole of the Solar Colwood program, such as utilizing the energy champion model of encouraging social diffusion or incorporating both renewable energy and energy efficiency measures in their community energy programs.

Program Design Tips

- Build on the experience of others. There are many good ideas and good programs out there.
- Take an adaptive learning approach! You will not get it all right from the beginning. Every community is different.
- Having support and champions on council and among staff is essential. All departments must be on board – especially Finance, Building, Planning and Engineering.
- Installers, suppliers and energy advisors are a valuable resource for marketing these types of program.
- Create a detailed questionnaire for installers and suppliers that want to be registered with the program. Check BBB and other sources. Check all the references offered. Ask for more if not satisfied. If something doesn't seem believable to you about an installer or supplier keep asking for evidence. Verify the evidence. Be tough and do not allow anyone in that makes claims that exceed other participants but cannot be verified.
- Get legal advice to ensure that during the process of inviting and registering installers you are at no time creating a contract with them. It is your program and your privilege to let in who you want.
- Get legal advice about the paperwork for incentive claims to ensure that it is clear to homeowners that their contract is with their supplier not you and that you make no guarantees. Then do everything you can to “guarantee” good quality.
- Whole community change toward renewable technologies takes time. Public understanding of the benefits of solar technology can take years to develop. Advances in installer training and operational efficiency don't happen instantly. For local governments aiming to encourage the development of emerging industries, long-term support is highly recommended.
- Use building science and a whole-home approach to help participants prioritize energy efficiency and renewable energy upgrades to get the best results in the most cost-effective way.
- Having solar and building science expertise on the delivery team is very useful.
- Complete a Privacy Impact Assessment (PIA) and any other relevant privacy measures (e.g.: Information Sharing Agreements) with all necessary parties before program launch. Consider making information sharing a condition of grant eligibility.
- Quality Assurance and measurement of results is an essential part of any community energy program. Public confidence in the quality is a make or break issue.
- Retrofit financing did not have high take-up, despite a concerted promotional effort. The results of BC home energy financing programs to date indicate that financing do not appear to motivate energy saving upgrades on their own, but may assist some interested participants with completing upgrades.
- Doing home energy retrofits is complex for most homeowners – they need handholding and support. Financial support is only part of it. Find an energetic and knowledgeable “Participant Energizer” and you will make a big difference to the success rate.
- Renewable energy, energy efficiency and smart home technology is rapidly evolving. Stay up to date and keep your program flexible in order to respond to changes.
- Working with developers takes a long lead time and plenty of patience. You need to be in at the beginning but that means there is no guarantee the project will go to completion. Be prepared to accept failure and move on. Find a developer that believes the renewable energy will be a marketing asset.

Climate Action Tips

This decade is of crucial importance for reducing greenhouse gas emissions in order to avoid catastrophic climate change. To help meet climate action goals, future community programs could be optimized to achieve greater GHG reductions than Solar Colwood. Approaches could include:

- Incorporating low-cost, low-barrier measures to achieve quick GHG reductions in a large number of buildings, such as the [Tap by Tap program's](#) free high-efficiency water fixtures. In the Solar Colwood program, of the directly subsidized energy saving actions, the high efficiency fixtures delivered the largest and most cost-effective share of GHG reductions.
- Focusing on switching from the most to least GHG intense energy sources (e.g. oil to electric heat pump or internal combustion engine vehicles to plug-in electric vehicles powered by solar electricity).
- Building incentive programs to reward greenhouse gas reduction results rather than specific technology adoption. For instance, Solar Colwood provided the same incentive for solar thermal upgrades regardless of the backup water heating source's GHG intensity, but a program seeking to maximize greenhouse gas reductions could provide larger incentives to buildings with gas powered backup water heating.

Conclusion

The Solar Colwood program showed that there is a business case for the featured renewable energy and energy efficiency technology at a community level, and that the adoption of these measures brings many community advantages including reduced greenhouse gasses, improved energy security and resilience, local job creation, and economic benefits.

