Land, Water, Energy, Resource Use

A Systems Approach: Understanding Our Fourth Affordable Housing Development

LOPEZ COMMUNITY LAND TRUST

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A Systems Approach:
Understanding Our Fourth Affordable Housing Development

A Dream of Houses, Diana Luhn Bower

Common Ground, A Co-op Neighborhood
Completed on Lopez Island, Washington in 2009

Funded in part by Washington State Department of Ecology
Solid Waste and Financial Assistance Program
Public Participation Grant Program

LOPEZ COMMUNITY LAND TRUST

PO Box 25 • Lopez Island, Washington 98261
www.lopezclt.org

Founding Purpose of the Lopez Community Land Trust:

A. Acquire and hold land in trust in order to provide for permanently affordable housing. Homes shall be built and lands shall be used in an environmentally sensitive and socially responsible manner.

B. Provide permanently affordable access to land for such purposes as quality housing, sustainable agriculture and forestry, cottage industries and co-operatives by forever removing the land from the speculative market.

C. Develop and exercise responsible and ecological practices, which preserve, protect and enhance the land's natural attributes.

D. Serve as a model in land stewardship and community development by providing information, resources and expertise.

Introducing Lopez Community Land Trust's (LCLT's) fourth development: *Sustainable Community Homes,* consisting of eleven single family residences comprising the *Common Ground* neighborhood, LCLT's office and two studio rental apartments. In addition to the buildings, the project showcases strawbale construction, a rainwater system, rain gardens, solar photovoltaic and solar thermal systems.

Follow these icons throughout:

PASSIVE SOLAR

ACTIVE SOLAR

INDOOR ENVIROMENTAL QUALITY
(includes sound quality, views outside, building envelope, and indoor air quality)

RESOURCE USE

LOCALLY SOURCED

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"Those who contemplate the beauty of the earth find reserves of strength that will endure as long as life lasts."

–Rachel Carson

In Celebration of Lopez Community Land Trust's
20th Year Anniversary

This work is dedicated to the whaledreamers and
all those who live in balance.

20
YEARS OF
UNLEASHING THE
POWER OF
COMMUNITY

PROJECT OVERVIEW

Follow these icons throughout:

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RESOURCE USE

LOCALLY SOURCED

INTRODUCTION

by Sandy Bishop, LCLT Executive Director and Project Manager

Sandy Bishop & Pamela Pauly, problem-solving, as usual.

In November 2005, I was reflecting on a speech by William McDonough, the world-renowned architect, designer and author of the book *Cradle to Cradle,* a manifesto calling for the transformation of human industry through ecologically intelligent design. McDonough asked a question: "How do we love all the children of all species for all time?". He was speaking in the context of development and explaining the Hannover Principles, a set of nine principles that he and his colleague, Michael Braungart, had developed.

In many ways they reflect Seven Generation decision-making, the Native American approach to planning that takes into consideration the long-term future health and well-being of land and community before any major decisions are made. The Hanover Principles begin with responsibility to the future and map out a blueprint for our times. As we began our fourth neighborhood development, I asked myself how Lopez Community Land Trust could act on these principles given our limited budget, non-profit status, reliance on volunteer labor, and few staff.

March 2006 Design Charette

LCLT was incorporated in 1989 and had built three previous neighborhoods of affordable housing when we embarked on our fourth. We remained passionate about community-based affordable housing but we had learned too much about the harmful effects of development and knew we had to try harder to lessen our impact.

Slowly but surely, the way was revealed. In March 2006 we held a three-day design charrette and invited designers and practitioners from all disciplines of housing and land development. During those three days we set the tone and guiding principles for the fourth neighborhood, *Common Ground*.

In the bottom-line reality of the market place, there is lip-service and a desire towards all things "green" but the hardcore facts remain the same—most of the materials available and the day-to-day practices within the industry are not sustainable. Adhering to a principled discipline of development became a grueling and expensive day-to-day task.

In the publication, *Environmental Building News*, Volume 14, Number 10 - October 2005; "Getting to Zero: The Frontier of Low-Energy Buildings," the question was asked, "What Does it Take to Get to Zero?"

When I read the answer: "You have to start pushing and doing a lot of things simultaneously. It's expensive and it's complicated," I made a copy of the quote, enlarged it and pinned it to the bulletin board, then surrendered to the process, knowing we were in for a long, hard push.

During construction we had an eclectic team approach: there were homeowners, interns, volunteers, staff and sub-contractors all working together on the site. It was a combination of vision, good design, generous donors and the flexibility, dedication, hard work and skill of those in the field that allowed this project to grow and flourish.

In this manual we share the design principles and technologies used as we worked to get close to our vision of "Getting to Zero." We hope others will learn from our success as well as from our shortcomings and we look forward to learning even more from those who surpass us. With that in mind, please read the Hannover Principles and let them inspire and serve.

The first Hannover Principle says:

1. Insist on the rights of humanity and nature to coexist in a healthy, supportive, diverse and sustainable condition. (Notice we used the word "insist", which clearly doesn't mean "please hope that someone else will do if for you").

The rest of the principles create the framework and focus for intelligent design:

2. Recognize interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognize even distant effects.
3. Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry and trade in terms of existing and evolving connections between spiritual and material consciousness.
4. Accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems and their right to coexist.
5. Create safe objects of long-term value. Do not burden future generations with requirements for maintenance or vigilant administration of potential danger due to the careless creation of products, processes or standards.
6. Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes, to approach the state of natural systems, in which there is no waste.
7. Rely on natural energy flows. Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.
8. Understand the limitations of design. No human creation lasts forever and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor, not as an inconvenience to be evaded or controlled.
9. Seek constant improvement by the sharing of knowledge. Encourage direct and open communication between colleagues, patrons, manufacturers and users to link long-term sustainable considerations with ethical responsibility, and re-establish the integral relationship between natural processes and human activity.

The Hannover Principles are succinct and elegant and speak of a sophisticated yet common sense approach. We recognized that as a small isolated non-profit, we could not adhere to them in the strictest sense but the threads of the principles are woven throughout our fourth neighborhood. We are a better-informed community for having woven the spirit of these principles into the tapestry of our development, *Common Ground*. They served as a beacon of light that called us to explore beyond the safe shores of typical affordable housing practices. We turned our denial of impending global peril into affordable housing action that also helps sustain a healthy world beyond our neighborhood.

For more info:

www.mcdonough.com/principles.pdf

http://en.wikipedia.org/wiki/Hannover_Principles

GETTING TO ZERO: OUR NET-ZERO ENERGY GOAL

Guiding Principles and Definitions

- The community and building team defined "Net-Zero Energy" as an annual balance of consumption and actual on-site energy production within five years of first occupancy.
- We wanted to make this a fun challenge - getting to net-zero energy use - by combining low energy-use building techniques with renewable energy production.
- We wanted to raise the bar by challenging the design team to reduce energy use by up to 48% through passive solar design features.
- Education and direct feedback are essential. Meters were placed inside each home and financial incentives reward those who use less.

Specific Measures

- Passive solar orientation and extensive energy, shade, and shadow modeling
- Shading and insulation of windows to prevent overheating and minimize heat loss
- Thermal mass to retain and temper heat
- Envelope improvements including insulation beyond code (including strawbale walls and R-50 in the ceilings)
- Advanced air-sealing techniques and testing measures to confirm effectiveness
- Demand-reduction strategies including selection of only ENERGY STAR® lighting and appliances
- Clothes drying outside the home
- Solar hot water systems
- A 3-kilowatt net-metered photovoltaic system for each household
- A wind-metering tower was used to collect data during 2006 and 2007. As part of a five-year plan, LCLT may install a wind generator depending on actual energy usage monitored and funds available.

CONSERVATION

Homeowners are learning specifics about conservation that will aid them in reducing their average monthly bills, including:

- Use of 'night shades' during cool weather to keep warm air in the homes at night
- Turn lights off when not in use
- Use low-energy settings on appliances
- Maintain compact fluorescent or other energy-efficient bulbs in all light fixtures
- Monitor household energy use with meters located within the homes and changing daily habits to help get to net-zero

UNDERSTANDING HOUSEHOLD USE AND RENEWABLE ENERGY PRODUCTION

What is Net-Zero Energy? Definitions vary, but essentially the phrase refers to buildings that produce as much power as they use. LCLT uses a calendar year - from May 1 through April 30 - as the period of time for measuring production and usage. This is the same definition our electric power utility uses for all grid-tied net metering systems.

In 2006 LCLT contracted with Dana Brandt of Ecotech Energy Systems to evaluate the concept. Using recorded data from three existing LCLT communities and information from existing "net-zero energy home" projects, an energy requirement estimate was made for LCLT's fourth neighborhood, *Common Ground*. LCLT reviewed the information and determined there was a good chance of meeting the net-zero energy goal. We researched further, finessed the information, and then adjusted as needed given our budget, skills and timeline. What follows is a brief overview of our priorities and goals:

Conservation And Efficiency

First priority in striving for net-zero energy was given to conservation and efficiency. This required addressing each type of energy use individually and developing strategies to lessen energy consumption through education, conservation, capitalizing on solar energy and choosing and using efficient appliances and equipment. Each home has six primary energy use categories: space heating, domestic hot water, appliances, lighting, cooking and laundry. OPALCO, our local electric utility co-op, has a set of charts showing appliance usage estimates in kWh and cost. (See "Data Used for Solar Domestic Hot Water Calculations", page 18).

A typical solar domestic hot water system can reduce water heating demand by as much as 75%. Our engineer calculated savings of 45-65% using the Thermomax solar water heater based on our latitude and climate data. The space heating demands of the homes were dependent on design and construction. Great efforts were made to capture and retain solar heat. Detailed computer simulations were used to evaluate the designs, and estimates were that we could meet 40-50% of our space heating requirements with our passive solar design.

It simply isn't possible, however, to calculate in the "human factor" with complete accuracy. Personal preferences, lifestyles and habits result in a wide range of energy consumption from home to home. In the first month of energy-use monitoring at the *Common Ground* neighborhood, household usages ranged from 150-kilowatt hours to over 800. Education plays a significant role. One household reduced their energy usage in half simply by installing an energy monitoring device (TED, The Energy Detective) that tracked down phantom loads and helped them change their personal habits. It cannot be overemphasized that education and direct feedback to the occupants determines the success of net-zero energy homes. Conservation first is a must.

RENEWABLE ENERGY PRODUCTION

All of the above considerations and design guidelines are aimed at lowering the community's energy requirements as much as possible. However, conservation and efficiency alone will not meet both the community's energy needs and the goal of net-zero energy use.

In order for *Common Ground* to be net-zero energy, the remaining energy required is generated by a 3 kW photovoltaic (PV) system for each home. (See the Solar Electricity section for specific information about the system being installed.)

SPACE HEATING

Promoting Heat Gain and Retention

First priority for heat gain are passive solar elements incorporated into this project by:

- Orientating the homes from east to west, with most glazing facing solar south.
- Optimal depth of each home is near 20'.
- Window glazing was selected and sized for capturing solar energy in the S, E, and W and keeping heat inside on the N.
- Concrete slab thickness was calculated to provide sufficient thermal mass to store and temper the gathered heat.

- Roof overhangs provide shading from the high summer sun to help avoid overheating.
- Trellises provide a structure for deciduous vines that shade in summer and allow solar gain and daylighting in winter.
- Cellular blinds offer shade in summer and prevent heat loss at night.
- Constructing a tight, highly insulated envelope (including walls, windows, floors and roof) that avoids thermal bridging of walls via studs.
- Specifications were based on computer modeling of the home designs.
- Conservation! See the Energy Conservation Basics section.

Energy Efficiency

Heat pumps are very energy efficient active heating systems; they are also much more expensive to purchase, maintain and install. Several factors, including initial cost, the small size of each home, avoidance of fossil-fuel use, and ambient noise levels led the team to select highly efficient electric radiant heaters instead.

The ConvectAir individual units allow homeowners to turn down the thermostats in some areas, such as bedrooms, while maintaining a higher temperature in living areas. These efficient electric wall heaters were chosen to allow programmable, room-specific temperature selection with several modes:

Mode Setting

"SUN" is standard setting. By setting the thermostat to a temp-erature and leaving the sun on, the heater will only turn on when the temperature drops below the setting. If the room warms up, the heater will automatically turn off.

"OFF" is used in the summer season when heat is not needed at all. Turning the unit off will avoid any 'phantom' or small electrical draws.

"SNOWFLAKE" is for frost control. When leaving the home during cold spells when it could potentially freeze, frost control protects the plumbing and appliances from freezing.

"MOON" represents a night setting. At night, switch the mode to the moon to automatically reduce the temperature by 4 degrees F. In the morning, switch it back to the "SUN". Do not change the thermostat setting when using the "MOON" setting.

Volunteer crew off-loading 165 solar PV panels

For more info:

www.buildinggreen.com

www.ecotechenergy.com

www.convectair.com/us

Thermostat Setting

- Set the thermostat to the desired temperature during the day for each room.
- Try "3" for sleeping areas and "4" or "5" for living areas.
- Setback Setting is for use with the optional programming system.
- A locking pin is included. This can be helpful if there are small children in the house. See the manual for directions.

APPLIANCES - ENERGY EFFICIENCY

- ENERGY STAR® rated appliances are available at most standard retailers, and have been installed in the homes for all refrigerators, washing machines, and water heaters. Electric ranges are not rated, as they require too much energy to be considered efficient. Try solar cooking!
- Most significantly, the use of appliances has been limited to what is deemed most essential.
- Use clothes dryers sparingly.
- The use of solar ovens and sun drying clothes is encouraged.

Data Used for Solar Domestic Hot Water Calculation

THERMOMAX

SOLAR COLLECTORS

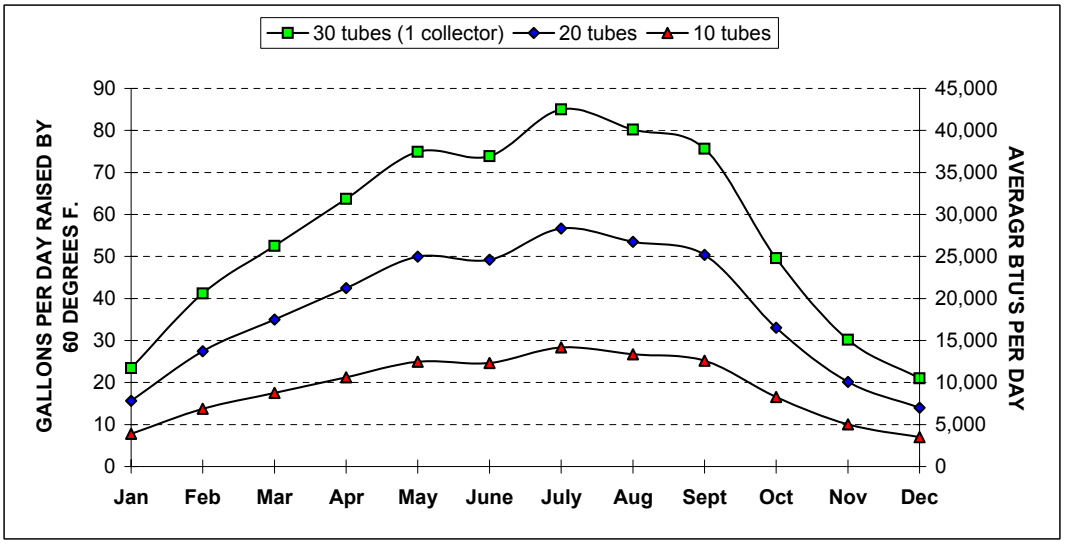
Victoria, BC

System Sizing Guide

Latitude:	49	Degrees
System Tilt	49	Degrees
Orientation	180	Degrees

	Mean daily Radiation *		Average Daily Thermomax Output ** BTU's and US Gallons heated by 60F					
	MJ/ sq.m	BTU/ sq.m	10 Tubes 1 square meter		20 Tube Collector 2 square meters		30 Tube Collector 3 square meters	
			BTU	Gallons	BTU	Gallons	BTU	Gallons
Jan	5.886	5,583	3,908	8	7,816	16	11,724	23
Feb	10.335	9,803	6,862	14	13,724	27	20,586	41
Mar	13.180	12,501	8,751	18	17,502	35	26,253	53
Apr	15.991	15,167	10,617	21	21,234	42	31,852	64
May	18.802	17,834	12,484	25	24,967	50	37,451	75
June	18.542	17,587	12,311	25	24,622	49	36,933	74
July	21.339	20,240	14,168	28	28,336	57	42,504	85
Aug	20.129	19,092	13,365	27	26,729	53	40,094	80
Sept	18.983	18,005	12,604	25	25,208	50	37,811	76
Oct	12.450	11,809	8,266	17	16,532	33	24,799	50
Nov	7.574	7,184	5,029	10	10,058	20	15,086	30
Dec	5.270	4,999	3,499	7	6,998	14	10,497	21
Annual Mean	14.054	13,330	9,331	19	18,662	37	27,993	56
Annual Totals BTU		4,866,579	3,406,605	6,813	6,813,211	13,626	10,219,816	**20,440**
						Gallons Heated in 25 years		**510,991**

* Radiation figures from "Solar Radiation Data Analysis for Canada 1967-1976"
** Collector efficiency 70% of average daily radiation.



3181 Kingsley St., Victoria, B.C. V8P 4J5 **Tel: (250) 721-4360** **Fax: (250) 721-432**
www.solarThermal.com ***Patrick@solarThermal.com***

ARCHITECTURAL DESIGN OVERVIEW

ARCHITECTURAL CONSIDERATIONS:

The design path to developing a sustainable community neighborhood was complex and demanding. In March 2006, LCLT convened a three-day community design charrette. The results of the charrette guided the design team and helped focus efforts on three basic goals. (see LCLT's *Design Charrette Scrapbook*, www.lopezclt.org).

1. Integrated, inclusive, and collaborative process (feedback required)
2. Cost effective, natural, durable, and constructible infrastructure and building systems
3. Net-zero energy on an annualized basis.

These three general goals guided the decision process as Mithun, the architectural firm, applied sustainable principles to the layout and design of the neighborhood, taking advantage of the energies and resources the site had to offer. Mithun's team worked with LCLT to use the site's ecology and solar, water, and wind energies to provide the basis for simple, elegant, and responsive building forms that would speak to sustainablity.

Each home is provided with feedback systems for energy and water use so operability can become more efficient and affordable over time. Community reporting, summarizing, and management of this feedback is essential in order to minimize waste and maximize resource efficiency.

The passive solar design aspects guided design decisions towards simple shed roof expressions to gather the light and warmth of the sun into the public areas of the homes. During deep winter, when and if we get sun, it can strike the plaster over the back strawbale walls and provide additional heat inside when it is most needed. Private areas of the homes are sheltered under simple gable roofs that reduce volume and express the quieter use of these areas. Deep overhangs were originally designed to protect the walls from rainy weather in winter and temper the sun entering windows in summer, but wide overhangs were reduced due to budget constraints and the goal to maximize passive solar gain on cool spring days. Consequently, management of the shades and operable windows will play an important role in keeping things comfortable on those few hot days of summer in the Pacific Northwest.

Water conservation is addressed both at the community level and within the individual homes and offices. Rainwater is harvested and redistributed for laundry and toilet flushing. The 38,000 gallon above-ground catchment tank and the retention

pond are visible, useful, and interesting elements in the community fabric. Each plumbing fixture is equipped with low-flow features, toilets are dual flush, and the home is equipped with meters that show and measure real time use of a valuable resource.

Small square footages were essential to obtaining our sustainability goals and helped the team afford higher quality, more durable and often lower maintenance materials such as metal roofing, cedar shingles and low-e, high solar heat gain co-efficient windows with insulated fiberglass frames. The finished concrete slab serves the integrated function as thermal mass for the passive solar design. On any moderately sunny day through most of the year the slab will become an additional heater that reduces the need for electric heat and increases the solar fraction that the occupants get for free (with a little effort managing shades). Though compact, each home includes a small area at the front door to remove shoes and help keep the home clean and dry. "Small is beautiful", in that the occupants and design team can reduce demand for active heating, construction materials, and maintenance time.

The advanced hybrid envelope design was an investment that helped the building and design team minimize the mechanical systems. The envelope provides an exceptionally tight air and moisture barrier that helps manage the variability of climate outside. The strawbale walls approach R-40 on two thirds of the exterior walls and at the perimeter and the ceiling areas approach R-50, which is also super insulated for our relatively mild climate. The frame walls are insulated to approximately R-23 and express the qualitative difference of energies falling on the sunny side of the homes. This high-performance envelope directly reduces energy consumption for all the years the homes are in use. The *Common Ground* community uses these savings to enhance other aspects of the site and achieve their net-zero energy goals.

Last but not least are the ENERGY STAR® specification choices for appliances, light fixtures and the quiet, high quality fans that provide ventilation in wet areas. A whole-house fan provides fresh air to occupants, especially during winter when windows are closed. All these items reduce overall energy consumption and provide the basics for an efficient, low cost indoor environment with good air quality.

Finally, our path is to integrate LCLT, the design team, and the occupants in a positive relationship that fosters the use and understanding of the factors influencing the site and encourages continual upkeep of the homes.

For more info:

www. mithun.com

www.mcdonough.com/cradle_to_cradle.htm

www.ecotechenergy.com

www.buildinggreen.com

www.smallisbeautiful.org