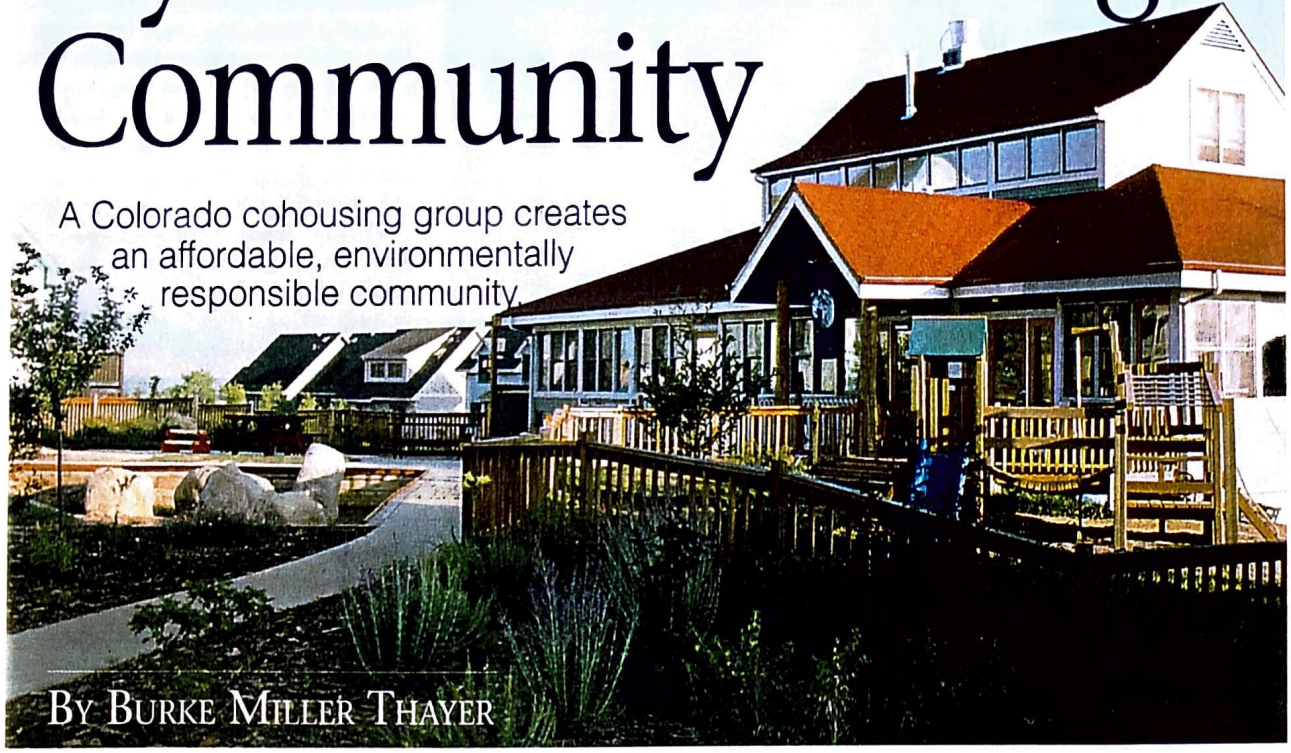
Nyland CoHousing Community

A Colorado cohousing group creates an affordable, environmentally responsible community.



By Burke Miller Thayer

The daylit Common House provides a central meeting place for the Nyland community.

The Nyland homes are excellent examples of how energy-efficient and environmentally sound homes can be built economically and profitably in large-scale multi-home subdivisions.

This is the third in a series of six SOLAR TODAY articles describing successful sustainable energy buildings throughout the U.S. The series is part of the Buildings for a Sustainable America Education Campaign, co-sponsored by ASES and the Passive Solar Industries Council. This article was written for the Office of Building Energy Research, U.S. Department of Energy (DOE), through the National Renewable Energy Laboratory in Golden, Colorado, a DOE national laboratory.

In 1989, the first few members of the Nyland CoHousing group began meeting to talk about their dreams of an affordable, environmentally responsible, energy-efficient community. The group consisted of families with common ideals about the kind of community they wanted to live in—one that would combine a more environmentally sensitive lifestyle with expanded community responsibilities and involvement.

Once established, the Nyland group hired the team of Wonderland Hill Development Company and designer Matt Worswick to work with them toward their community and housing goals. Four years later, they had created a unique subdivision of 42 single family homes in Lafayette, Colorado, and had become the largest completed cohousing development in the country. The homes, subdivision layout and commonly owned buildings and land reflect the Nyland residents' top priorities of community, affordability and energy efficiency/environmental responsibility.

The Nyland Community includes more than 20 acres of shared open space, a solar-heated greenhouse, a workshop and a 6000 ft^2 (557 m^2) Common House. The Common House provides a focal point for social interaction, optional shared evening meals and child

The sun-tempering accounts for some of the savings while adding nothing to the cost of the home.

care. By design, the Nyland development is impressively energy- and resource-efficient while remaining affordable. The Nyland homes are excellent examples of how energy-efficient and environmentally sound homes can be built economically and profitably in large-scale multi-home subdivisions.

Energy Conscious Design

In creating the basic design for the Nyland homes, Worswick recommended high insulation levels in the walls and ceilings. The homeowners chose wet-spray cellulose insulation over fiberglass batts for two reasons. First, cellulose is made mostly from recycled paper. Secondly, the highly dense and overlapping fibers help achieve tight seals, especially at rim joists and in odd-shaped framing cavities. The building code in Boulder County specifies a minimum of R-19 walls and R-30 ceilings. In the Nyland homes, the 2 x 6 (5 x 15 cm) stud-framed walls have an R-value of 24, and the ceilings are insulated to an R-42. The walls in finished (i.e. heated) basements at Nyland are insulated to R-13 and in unfinished basements to R-5.

To further reduce heating and cooling loads, the builder, Wonderland Custom Builders, took care to reduce air infiltration with caulking, foam sealant and airtight gaskets around electrical outlets. Double-hung, double-pane low-e windows (R-3) are used throughout the community instead of the thermal pane double glazing (R-2) typical of comparably priced tract home construction.

Wonderland also reduced lumber usage and increased the amount of insulation by using optimum value framing techniques, in which they spaced the studs, joists and rafters every 2 feet (.6 meter) instead of every 16 inches (.4 meter). To further conserve lumber, they used manufactured joists and oriented strandboard sheathing. Most Nyland homes are joined to 1 or 2 others under a common roof, although the adjoining walls are spaced a few inches apart to preserve privacy. This arrangement saves materials and energy and uses land efficiently.

Because the residents also wanted to take advantage of solar energy for heating, the designer and developer integrated passive solar design concepts into the community layout and building design. The streets and pedestrian paths run east/west, and the houses have a north/south orientation. In many cases, owners chose to maximize their window area on the south side for solar gain. Sometimes, however, other considerations dictated less than optimal window placement.

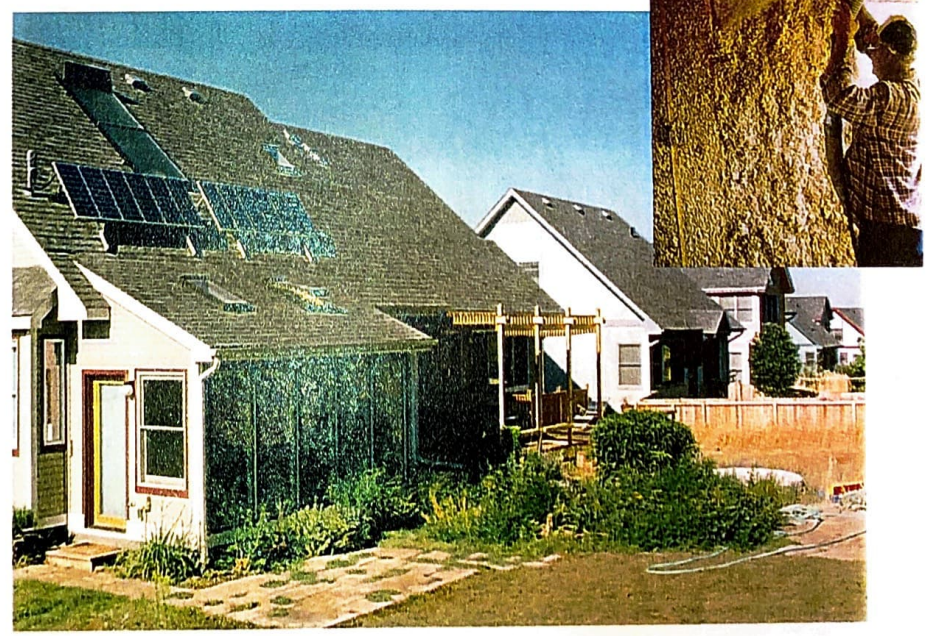
The 1440 ft² (134 m²), 3 bedroom Nyland home owned by David Lowell and Kimeri Brown is one example of simple and straightforward strategies that any large-volume home builder could implement to significantly reduce heating loads and costs. Dave's and Kimeri's second floor master bedroom has a dormer with two large windows facing south. Their decision to orient the room to the south was a deliberate effort to increase solar gain. Going by the rough window openings, the home's total south-facing glazing is 111 ft² (10.3 m²), which is about 8 percent of the floor area. This ratio of south glazing to floor area is about right for a "sun-tempered" home with no additional thermal mass. (Thermal mass absorbs the heat from the winter sun during the day and slowly releases it at night). The Lowell/Brown home is part of a cluster of three units, so their west wall adjoins that of their neighbor. Because there are no windows on the west side of their house, Kimeri and Dave added more window area on the east, for a total of 104 ft² (9.7 m²), and they have a minimal 34 ft² (3.2 m²) of glazing facing north.

All the homes at Nyland are similar to the Lowell/Brown home in that they integrate the two most cost-effective strategies to reduce energy use—an energy-efficient building envelope (foundation, walls, roof, windows, doors) and some degree of sun-tempered design. Some of the residents took advantage of additional solar features as add-on options. Several families added sunspaces, two installed solar water heaters and one resident is using photovoltaics to provide a portion of his electricity.

Energy Saving Equipment

The builder installed 90 percent efficient, direct-vent, condensing, forced air natural gas furnaces in all the Nyland homes. The direct-vent feature is a plus for indoor air quality. Each home has a programmable thermostat to help reduce energy use. The water heaters are efficient gas-fired units, and there are no wood or pellet stoves. The community members also decided not to install refrigerated air conditioning to avoid CFC emissions. Instead, some of the homes are equipped with whole-house fans or ceiling fans.

The Nyland residents chose to use natural gas instead of electricity for their ranges and clothes dryers.



Nyland homes are clustered in groups of 2 or 3 single-family units, with south-facing orientation. One unit (foreground) incorporates sunspace, solar water heating and photovoltaics.

Inset: A subcontractor installs wet-spray cellulose insulation in 2x6 wall cavities.

They also used compact fluorescents and tube fluorescents for some of the lighting. The community has significantly reduced water usage by installing low-flow toilets and shower heads and aerated faucets, and by landscaping with native, drought resistant plants.

Energy Performance

On one level, the Nyland project is the story of an entire 42-unit subdivision that is remarkably energy efficient. On another level, the individual Nyland homes demonstrate how solar design combined with an energy-efficient envelope (i.e. foundation, walls, roof, windows and doors) can cost-effectively reduce heating bills in single family homes built on a production housing scale.

The Public Service Company of Colorado (PSCO) has recognized the Nyland CoHousing Community as an "Ideal Energy Community," and calls it "the most energy-efficient residential development in the state of Colorado." Wonderland estimates that the total average energy savings for the 42 Nyland homes over typical construction in Boulder County is about 50 percent. These savings result from energy conscious choices regarding the building envelope and orientation as well as from more efficient plumbing, heating and electrical appliances and fixtures. When compared to data provided by PSCO on actual average energy consumption of homes built in 1988 and 1989, the Nyland homes use an average of 62 percent less natural gas and 33 percent less electricity.

On the individual unit level, the Lowell/Brown home is a good example of how Worswick and Wonderland combined sun-tempering with an energy-efficient envelope to cut the space heating load almost in half for less than 1 percent additional cost. A computer generated "base-case" tract home (i.e. the same design as the Lowell/Brown home with minimum efficiency standards and no attention to solar) would require about 36,000 Btu/ft²/yr (409 million joules/m²/yr) for heating. Due to higher R-values and tighter construction, the total heating load calculated for Dave's and Kimeri's home is only 26,000 Btu/ft²/yr (295 million joules/m²/yr). The sun-tempered design reduces that load by an additional 25 percent to 19,500 Btu/ft²/yr (221 million joules/m²/yr). This means that the Lowell/Brown home's heating requirements are 46 percent less than those of a typical tract home.



The Lowell/Brown home is "sun-tempered," a no-cost option for saving energy and money.

Measured in Dollars

The largest dollar savings on energy in the Nyland homes come from the energy-efficient, passive solar design and construction techniques Worswick and Wonderland applied to the building envelope. Based on the calculated heating load for the base-case tract home, the natural gas bill for space heating (separate from water heating and cooking) would be $365/yr. The same calculation for the Lowell/Brown home is $198/yr, which is a 46 percent ($167/yr) savings.

For Kimeri and Dave, the cost of having a sun-tempered, energy-efficient envelope is reflected in somewhat higher mortgage payments. Their lower energy bills, however, more than make up for the higher cost of the mortgage. The added annual cost of the energy efficiency upgrades, for example, is about $1,190, which translates to an extra $109 per year on their 30-year, 8.38 percent mortgage. But because they are saving $167 each year, Dave and Kimeri are realizing a net savings of $58 ($167 minus $109) from the sun-tempered, efficient envelope alone. The sun-tempering accounts for $14 of this savings while adding nothing to the cost of the home.

The actual dollar savings for the Nyland homes reflects the complete package of energy-saving features in addition to the solar and energy-efficient envelope (see sidebar, page 32). Due to the synergy of all these features combined, when compared to average actual energy consumption for recently constructed homes in the surrounding area, the Nyland homes are saving an average of $562 per year for an average additional cost of $2,500 per unit. This yields a simple payback of about 4.5 years, or a 22 percent return on investment.

The Intangibles

Dave and Kimeri are saving an enviable amount of money (between $500 and $600) each year by living in an energy-efficient, sun-tempered home. And yet the value of their environmentally friendly home goes beyond the dollars they save each year. When the other energy- and resource-saving aspects of the Nyland houses and community are combined, the relatively low environmental impact of the total community is impressive. (See sidebar, page 32 for some of the environmental benefits.)

In addition to these tangible economic and environmental benefits, there is also an intangible aspect to the environmentally sensitive approach to building and living at Nyland that is impossible to measure. David Lowell speaks for many of the Nyland residents when he says "it is worth a lot me to be able to live in a home and community that more closely reflects my environmental and social values." There are many satisfying aspects of Dave's commitment to the Nyland CoHousing project. As he puts it, "we agreed to make environmentally sensitive decisions, which has been rewarding in and of itself. It's often hard to feel like you can make a difference for the environment as an individual, and this was an opportunity to do that." Lower

energy bills are nice, but what counts most to Dave is that his actions, individually and together with his neighbors, are making a difference. ✪

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The ASES/PSIC Buildings for a Sustainable America Education Campaign is a nationwide effort to make policymakers, building professionals and consumers more aware of the benefits of applying sustainable energy principles to building design and construction. These benefits include increased affordability, more jobs, less environmental impact, reduced energy consumption and improved health.

Here's how the Nyland CoHousing Community stacks up:

Energy
Approximately 50 percent overall reduction in total energy use.

Environment
The 42 single family homes at Nyland are using an average of 33 percent less electricity than other recently built homes in the Lafayette area. This eliminates the following power plant emissions each year:
SO_2 — 627 lbs (285 kg)
NO_x — 576 lbs (262 kg)
CO_2 — 176,000 lbs (80,000 kg)
Virtually all of the heating savings at Nyland displaces natural gas, which is a plentiful and relatively low-polluting resource in the short term. In the long term, energy benefits will become more significant as natural gas supplies dwindle and become more environmentally costly to extract. In the larger environmental picture, compared to conventional housing subdivisions, the Nyland Community uses less water, recycles more of its solid waste, grows more of its own food and does less driving.

Affordability
Building envelope alone: Compared to base-case, Lowell/Brown home saves an estimated $167 per year in space heating bills at an added cost of $1190. The simple payback is about 6 years. Annual savings is $58 on combined mortgage and energy bills from day one.
All energy efficiency features combined: Compared to average actual energy consumption for recently constructed homes in the area, Nyland homes save an average of $562 per year at an average additional cost of $2,500 per unit. The simple payback is about 4.5 years.

Jobs and Economy
Because Nyland residents are spending less on utility bills and transportation fuel, they have more money to spend in the local economy, which creates more jobs. Money spent on energy efficiency particularly creates jobs in the construction and manufacturing industries, both of which are more labor intensive than the energy industry.

Health and Productivity
There are health benefits for the Nyland residents derived from the reduced stress of living in a community that values energy and resource efficiency, and where people are feeling empowered to act on their environmental values. By reducing electricity consumption, the Nyland Community is also helping to mitigate the health impacts of air pollution from coal-fired power plants. EPA studies at Nyland have found that the absence of attached garages has had a positive impact on indoor air quality.

Nyland Project Details

Project Description: Lowell/Brown Residence, Nyland CoHousing Community
Designer: Matt Worswick, Synergy Design
Builder: Wonderland Custom Builders
Location: Lafayette, Colorado
Size: 2 story, 3-bedroom, 1440 ft² (134 m²)
Selling Price: $145,000 (includes part ownership of common land, buildings)
Date completed: December, 1992
Heating Degree Days: 6200
Cooling Degree Days: 680

ENERGY PERFORMANCE OF BUILDING ENVELOPE

	Base-case	Lowell/Brown	Percent Reduction
Heating load before solar contribution	41,000 Btu/ft²/yr (466 million joules/m²/yr)	26,000 Btu/ft²/yr (295 million joules/m²/yr)	37%
Heating load after solar contribution	36,000 Btu/ft²/yr (409 million joules/m²/yr)	19,500 Btu/ft²/yr (221 million joules/m²/yr)	46%

Percentage of heating load provided by direct solar gain: 25 percent
Auxiliary heating system: 90% efficient, direct-vent, condensing, forced air natural gas furnace

SOLAR FEATURES
- south-facing glass (8 percent of floor area)

ENERGY EFFICIENCY/CONSERVATION FEATURES
- R-42 ceiling (wet-spray cellulose)
- R-24 walls (5.5 in. wet-spray cellulose, optimum value framing)
- R-5 basement insulation (cellulose)
- Caulk and sealing package (.32 air changes per hour)
- Double glazed low-e windows
- Reduced-flow plumbing fixtures
- 90 percent efficient furnace
- Compact fluorescents
- Setback thermostat
- Efficient water heater

ADDED COST OF SOLAR DESIGN/ENERGY EFFICIENT ENVELOPE

Wet-spray cellulose insulation	$870
Low-e windows	$320
Orientation/window placement	$0
Total	$1190

NATURAL GAS COSTS

	Base-case (estimated) (78% efficient furnace)	Lowell/Brown (estimated) (78% efficient furnace)	Lowell/Brown (actual) (entire efficiency package)
Space Heating:	$365/yr	$198/yr	
Water Heating:	$161/yr	$134/yr	
Combined Heating:	$526/yr	$332/yr	
Total Natural Gas (includes stove, dryer)			$307/yr

ENVIRONMENTAL/HEALTH FEATURES
- Reduced in water consumption
- Community recycling center (25,000 lbs/yr)
- Community greenhouse, composting
- Pedestrian oriented community layout
- 25 percent reduction in vehicle use
- Recycling construction waste
- Efficient use of lumber through optimum value framing
- Avoiding refrigerant air conditioning systems