CHAPTER 7

Ecological Housing

What use is a house if you haven't got a tolerable planet to put it on?

— Henry David Thoreau

Un-ecological housing: A snapshot

The average-sized single-family home in the United States creates between two and five tons of solid waste through its construction and twice as much greenhouse gases per year as the average car. Construction of buildings consumes one-quarter of all wood harvested. Every year, throughout the world, three billion tons of raw materials are used annually to construct buildings. Buildings consume one-third of all the energy and two-thirds of all electricity used in the United States. Buildings use 40 percent of the world's materials and energy. Almost one-third of newly built or rehabilitated buildings expose their occupants to sick building syndrome. Every hour of the day, 45.6 acres of farmland in the U.S. is converted to development. In 1950, the average size new home built in the U.S. was 983 square feet (about 91 square meters). By 2000, it had grown to 2,265 square feet (about 210 square meters), and contained two stories, two-and-one-half bathrooms, a two-or-more car garage, a fireplace, and central air conditioning.

Combined with these building trends, a suburban pattern of residential development spread out from U.S. urban centers like wildfire after World War II. This pattern basically consists of subdivisions of single-family homes on lots of one to several acres. Each has its own driveway and usually a one- or two-car garage. Much has been written about this pattern of development
that has become, among other things, the poster child for sprawl development that, although decried by planners for decades, is now widely seen as a threat to open space preservation, agriculture, and quality of life.

On the positive side, ecological building, whose design and construction moves toward the sustainability objectives listed at right, is spreading steadily throughout Europe and North America. Ecological, or green, building uses forms of renewable energy for heat and power, instead of fossil fuel. (In this chapter, “green,” “ecological,” and “sustainable” are intended to mean the same—moving toward the four system conditions of the Natural Step framework.) Ecological building uses materials, recycled where possible, which contain few or no toxic substances and constructs compact developments to save open space and reduce car use. It makes use of existing buildings before building new ones and uses water, energy, materials, and space as efficiently as possible.

Coupled with ecological building practices are compact housing development designs that do a better job of fostering social cohesion and a community life. Growing numbers of households, dissatisfied with the isolation of conventional suburban life, are re-finding a sense of neighborhood, connection, and social interaction in these community-oriented developments. This chapter presents some examples from Sweden.

In the housing communities of Understenshöjden and Tuggelite, households joined forces to build homes and neighborhood life consistent with their shared values of ecological living and community. In the town of Övertorneå, the municipal government helped develop ecological housing as part of its path to becoming an eco-community. Pyramiden housing in Stockholm, described later in this chapter, reversed a

ECOLOGICAL HOUSING IS HOUSING THAT:
- Reduces wasteful dependence upon fossil fuels, heavy metals, and minerals that accumulate in nature;
- Reduces wasteful dependence on chemicals and synthetic substances that accumulate in nature;
- Reduces encroachment upon ecosystems; and
- Meets human needs fairly and efficiently.

Derived from the system conditions of the Natural Step framework.

Figure 7.1: As is customary in cohousing and ecological housing design, Understenshöjden’s homes are grouped around paths and common spaces rather than driveways. Cars are parked at the edge of the property.
pattern of vandalism and tenant transience through an eco-renovation that restored nature to a derelict urban neighborhood. The city of Falkenberg’s housing agency adopted green building policies for its publicly owned affordable housing. And finally, the town of Karlstad encouraged private sector development of market-rate eco-condominiums through a life cycle assessment competition that rewarded the most ecological building proposal.

Ecology and community: Understenshöjden, Tuggelite, Övertorneå

In Sweden, ecological housing or an eco-village has a particular meaning. A Swedish ecological housing community or eco-village is known in North America and Denmark as cohousing — a form of residential development where people intentionally come to live together as a community. The idea for this community-oriented housing design originated in Denmark during the 1960s.

In U.S. cohousing and Swedish ecological housing, each household owns or rents their own independent dwelling unit and shares common space that usually includes a community kitchen, dining room, and other facilities where people can cook, eat, and work together. The physical design of these developments supports a community-oriented way of living. For example, units are grouped closely together to allow and encourage interaction among households. Decision making about housing development and management over time usually is consensual. Cohousing and ecological housing developments are found in urban, suburban, and rural settings. Understenshöjden, Tuggelite, and Ruskola Ekoby are three examples of this type of ecological housing community in Sweden.

UNDERSTENSHÖJDEN ECOLOGICAL HOUSING

Located on the outskirts of Stockholm, about a 20-minute transit ride from the city’s center, is a housing community called Understenshöjden (Eoon’-dehr-stehns-heeu’-dehn). Here, about 180 people of various ages
and household types live in 44 households on almost eight acres of land. In 1990, these households joined to co-design, co-build, and co-live in a housing community that would reflect mutually held values of ecological building and living styles. Housing prices in the Stockholm region had risen rapidly in the 1980s, and these families wanted to stay in the area and bring up their children here. They knew they would need larger units as their families grew. They also wanted to build their homes in a way that, while providing comfortable living quarters for them, would not be resource wasteful either to build or to occupy and maintain. Their vision was to live ecologically — to live within nature’s capacity to support not only their needs but also those of future generations.

Understenshöjden is one of about 30 to 40 ecological housing communities in Sweden. According to some Understenshöjden residents, Swedish ecological housing focuses more on shared ecological values than social ones, compared with Danish and U.S. cohousing where social values are more often the founding principle. For instance, ten years after they first moved in, the residents of Understenshöjden began to enlarge the small kitchen in their shared community building in order to cook and share community meals. In contrast, shared cooking and meals is a cornerstone of most United States and Danish cohousing developments.

Green features

In first designing their site and homes, the Understenshöjden group worked with a socially and ecologically minded architect. As with many, if not most, cohousing developments, the design process was a participatory one, involving all prospective households in design decisions. With the architect’s help, Understenshöjden residents decided to design their future homes in groups of attached rowhouses and townhouses. Thirty-seven units would be two-story attached homes; seven would be one-story flats. The average area of each home was about 1,000 square feet. No two interior designs were the same. Since 44 homes is considered to be large for an ecological or cohousing community, dwelling units were designed in several clusters of 10 to 12 homes that created different neighborhoods, although residents initially saw this more for easier shared building, maintenance, and cleaning than for creating social neighborhoods. Townhouses and rowhouses surround open areas, allowing parents to watch children as they play and allowing residents to chat and wave to each other as they pass by. Cars are parked, not next to every home, as in a conventional residential subdivision, but in a parking area at one side of the property. This allows homes to be grouped more
closely together, again encouraging more spontaneous social interaction as well as more open space. Unit clustering is a primary design feature of cohousing developments and ecological housing.

Clustering the units in groups made it possible to leave several natural wooded areas and a wildflower meadow on the property. A walking path was created along the edge of the grounds for residents of the larger neighborhood, as well as the residents of Understenshöjden, to use and enjoy.

Nowhere on the site are there any fences. The group also deliberately decided not to build playgrounds since they believed there were too many over-planned play areas in Sweden. Instead, natural areas remain, with the addition of simple playthings, such as a small boat for children to scramble in and out of and a climbing rope in the middle of a birch glade.

All buildings and homes are oriented to the south to take most advantage of the sun’s warming energy. Situating the buildings with a forest at their north side helps protect them from the cold. Solar thermal panels provide hot water and heat from April through September. A community heating system using a wood pellet-fired boiler provides heat through the dark winter months. Water heated with either solar or biomass power is piped from a single boiler to all buildings. Each group of homes has its own thermal tank that stores the solar-heated water. As a backup system, Understenshöjden is connected to Stockholm’s district heating system. Building materials were carefully selected, avoiding toxic substances, chemicals, and products whose production and transport involved fossil fuels. Plastic materials, that involve all these things, were eschewed. Newspaper-based cellulose insulates the buildings. Interior painting used egg-based paints. In contrast, conventional paint is made with chemicals that emit harmful volatile organic compounds (VOCs) contributing to sick building syndrome.⁹

Exterior wooden walls were protected with an iron compound as a wood preservative rather than conventional wood preservatives that contain arsenic that can leach into the soil and groundwater and into skin when
touched. Gravel was used on the access road and parking area instead of concrete and asphalt whose production is heavy on fossil fuels. Gravel is also a porous surface, allowing rain to sink into the earth and replenish groundwater. In the entire development of Understenshöjden, no product or material derived from fossil fuels was ever used.

Understenshöjden residents wanted to be self-sufficient in energy use and waste disposal on their site. All households separate recyclable solid waste and materials. Food scraps and garden weeds are composted on the property. All homes have urine-separating toilets that do precisely what their name suggests. Urine is piped to an underground tank and collected periodically by a truck for use in agriculture research. Elsewhere, farmers pick up the urine that is diluted with water and used for fertilizer. Urine is basically a mixture of nitrogen and phosphorus — two key ingredients needed for plant growth. It is sterile and one of the best fertilizers when diluted with water.10 Understenshöjden also installed a plumbing system that would allow the reuse of gray water — water from sinks, showers, and dishwashers — for plant irrigation or toilet water, when municipal officials agree to issue the permit for this system.

Unit prices

Since families initially moved into Understenshöjden in 1990, only three units have turned over. The average original home price was about US$30,000, which could be reduced by another US$5,000 to 10,000 if the owners contributed sweat equity in constructing their dwelling. Recently a unit sold for US$250,000 — about nine times the original purchase price.

TUGGELITE ECOLOGICAL HOUSING

Tuggelite (Teugg'-eh-lee'-teh), in the town of Karlstad in Värmland County, was the first ecological housing community in Sweden, founded and developed in 1984 by a group of Göteborg students who were fellow antinuclear activists. As of 2001, 30 adults and 40 children live at Tuggelite.

The town of Karlstad supported the ecological housing concept and the residents' plan for development. The municipality worked with the group to identify a suitable site for the community. Although the planning and permitting process took three or four years because abutting neighbors were initially resistant, the development was finally approved and constructed.
Inspired by Tuggelite’s success, Karlstad town officials have since been promoting green design.

Green features

Tuggelite’s 16 one- and two-story homes are laid out in five rows that face south. This passive solar design, including large windows and greenhouse porches, contributes 10 to 15 percent of daytime dwelling heat. Air heated by the sun in the greenhouses circulates through the entire home. Carefully designed overhanging roofs provide shade from the higher overhead sun in summer without blocking light. Concrete walls provide thermal mass that absorbs solar heat during the day and releases it at night. There is an unwritten rule that no pesticides or fertilizers will be used anywhere on the property.

A centralized wood pellet-fired boiler and solar collectors provide heat and hot water for all the units. The solar collectors provide 50 percent of heat consumed. There is a backup oil burner. Electricity for most residents comes from a nearby windmill. Residents can own shares in a cooperative that owns and operates this windmill. Each share provides 1000 kilowatt hours per year.

As in Understenshøjden, some Tuggelite residents use urine-separating toilets; others use conventional ones. Some homes are recycling and reusing graywater from sinks and showers for plant irrigation.

Community life

Tuggelite’s community building has a kitchen, eating area, sauna, spinning room, and a TV room. An orchestra with several resident members rehearses here weekly. During its first 12 years, Tuggelite rented its community building to the Town for a daycare center attended by children from both outside and inside the community. Meanwhile, Tuggelite residents used the center at night. Groups of families get together to eat every four or five days.

There are three or four all-day community workdays spread throughout the year. Similar to Amish barnraising, it is seen as important to work together.
The whole community also eats together on these days. If older or disabled people can’t do their share of work, others will take up their share. Five alternating teams handle weekly grounds and maintenance duties.

Tuggelite community decisions are made by consensus. While this takes more time, residents of Tuggelite and other cohousing communities consider it to be a real social strength. Tuggelite’s ownership structure is a hybrid of a cooperative and a condominium. For example, the association carried the bulk of the mortgage taken to construct and develop the community, while each household made payments to cover their share. Since then, the mortgage has been divided into sixteen different mortgages, one for each household to pay.

RUSKOLA EKODY ECO-VILLAGE

The Ruskola Ekoby (Reu’-skoo-lah Ehko-bih) eco-village, in the town of Övertorneå, grew out of that town’s eco-municipality journey. One of the founding purposes of Ruskola Ekoby was to attract people back to a town that had lost population to the city. This exodus of citizens had eroded Övertorneå’s civic life and cohesion as a community.

Övertorneå’s municipal government first bought land for the eco-village development, then subdivided this land, selling nine individual lots at reduced prices to participating households. Families were allowed to subdivide their lots one more time, if they wanted to build smaller adjacent homes for children and aging parents.

Brought together through their interest in living in an eco-village, the nine households initially did not know each other. First, they all took part in education sessions about ecological ways to build homes, ecological ways of living, and why this is important to society. When the sessions ended, participants asked for more learning about ecological living and its relationship to global trends.

Figure 7.6: Prospective residents of the Ruskola Ekoby village designed their own ecological homes with the help of a “green” architect.
A democratic design process

Both Ruskola Ekoby's site design and building design became democratic processes. The prospective homeowners worked with a well-known Swedish "green" designer and Övertorneå's town planner, Torbjörn Lahti, to set overall goals for the eco-village and plan how these could be achieved. The designer and planner realized that buying a house is one of the biggest life decisions a household makes. They saw their job as design professionals was to offer possibilities for people to develop their own ideas — essential in any truly participatory design and planning process. The starting point for the design process, therefore, was finding out how the householders wanted to live.

In discussions among the householders, architect, and town planner, key words emerged that became guiding design principles for Ruskola Ekoby. Residents said they wanted to live in a development that was designed like an "old village," meaning a neighborhood designed according to the traditional and historical pattern of northern Swedish villages and hamlets where home life and work life were integrated and several generations of families lived in close proximity. The old village idea also stood for local democracy, coming from the thousand-year-old tradition of villagers governing themselves without feudal lords, kings, or other masters.

Self-sufficiency emerged as another guiding principle. To the greatest extent possible, households wanted to be self-sufficient in heating their homes, growing their food, and meeting other basic needs. Out of this desire came a plan to set aside common land, surrounded by the homes, where families could cultivate gardens and tend animals together. Homes were designed to be heated with wood that could be harvested in and near the site. In 1989, the first house was built. Now, nine more families with children in the local school live and work in Övertorneå.

From urban slum to urban gardens

Pyramiden Apartments

In a densely populated, formerly run-down and risky neighborhood of Stockholm, six seven-story former tenement buildings are noticeable for their pink exterior and lush green landscaping. As one walks through the grounds of this development, called Pyramiden (Pee-rah-mee'-dehn), one can observe butterfly gardens, a meadow garden, and rabbits hopping about in large airy cages. A compost bin stuffed with grass and garden cuttings sits next to a garden filled with brightly colored flowers. Several play areas for
children and cozy sitting areas for adults are scattered throughout the site, connected by paths. Bicycles and bicycle racks are everywhere.

Several years ago, these same buildings, held by more than ten different owners, were poorly maintained and plagued with vandalism, a high apartment turnover rate, and social problems among the tenants. One by one, a city non-profit housing corporation purchased these troubled buildings and teamed up with another non-profit organization, the Swedish Society for the Protection of Nature. Together, these organizations undertook an eco-renovation of these properties, creating over 300 mixed-income, subsidized, affordable rental housing units in a restored natural setting.

One of the first steps was to tear down all the fences and walls separating the properties to create open space and gardens. To involve residents in the eco-renovation, a written survey was first sent out to all tenants asking them what they wanted to see happen in the renovation. When this didn’t generate much response, small groups of residents were organized to discuss problems, new ideas, and come up with suggestions and projects. More people got involved. Teenagers, who had been a big source of the vandalism problems, were hired in the summer to remove old shrubs and

Figure 7.7: Formerly run-down tenements in Stockholm now provide affordable housing and a garden atmosphere for mixed-income inner-city residents.

Figure 7.8: A rabbit hutch on the grounds of Pyramiden provides enjoyment for adults and children alike.
put in new soil. The young people were invited to plan their own landscape. Out of this collaboration emerged, among other projects, a youth-run bicycle rebuilding and rental enterprise. Bikes are painted with rainbow colors

Figure 7.9: All the fences on the property were torn down to create gardens and sitting nooks, such as this one, for all residents to enjoy.

Figure 7.10: This knoll, in the center of the development, was restored as a natural area for indigenous plants and grasses. In the winter, children use it for a sliding hill.

and loaned free to Pyramiden residents. The teenagers also built a beautiful stone patio.

Sitting areas were developed in the gardens to encourage people to sit and get to know each other. The gardens were designed to attract birds, insects, and butterflies. A meadow garden was created for indigenous wildflowers and plants in danger of becoming extinct. In the winter, kids slide down the small hill in this meadow garden. Residents manage the compost used for the gardens.

Pyramiden has an onsite daycare center for children living inside and outside the development. There is a community recycling room from
which a private company collects recyclables for resale. All residents must recycle. Residents also are involved in ongoing management decisions of the development.

Pyramiden is now a successful development property of 307 rental apartments and 36 condominiums. It has become a most desirable place to live. From rapid unit turnovers, there is now a 15-year waiting list of people wanting to move in. The average market rent for a two-bedroom apartment is US$500 per month. Some tenants receive rent subsidies. Pyramiden’s experience has demonstrated to skeptics that involving residents in rental housing management is economically sound. Vandalism has been reduced, as have unit turnovers. This, of course, saves money. Pyramiden’s residents now hardly ever move out.11

A town encourages green development

BRANDMÄSTAREN ECO-CONDOMINIUMS

The town of Karlstad (Kahl'-stahd) in Värmland County owned a one-acre piece of land in a very desirable and marketable location within its municipal boundaries. Both Karlstad and its town planner wanted to increase the supply of housing in town and also to encourage sustainable, or “green” design of new development. Led by the town planner, Karlstad’s municipal government decided to issue a formal request for proposals to private developers for the most sustainable design plan to build housing on the site. The developer who submitted the winning proposal would be selected to purchase the municipal land and develop the housing. Because of the good location and marketability of the property, the town knew there would be a strong response from developers.

The town planner, who had already developed green design standards for Karlstad, designed the request for developer proposals and the competitive evaluation process that would be used to select the most ecologically sound development proposal. He chose a life cycle analysis as the methodology on which to base both the proposal criteria and the evaluation process. A life cycle analysis examines all phases of a product or material and asks questions, such as: Where did this product come from? What materials and energy were used in its fabrication? How much energy is used in its transport to the site? How much energy will be saved or expended over time by its use? When its useful life is

Figure 7.11: The Brandmästaren condominiums were developed using a life cycle analysis method to produce the most ecologically compatible design and construction approaches.
over, can it be recycled? Is it or its by-products biodegradable, and free of toxics?

The life cycle analysis method, assuming a life cycle of 100 years, was applied to four aspects of development design, beginning with the larger planning context of how well the proposal fits with the character of the neighborhood and the town. The other aspects analyzed were building design, energy system design, and other ecological features. Proposals were scored on a points system according to the analysis results for each of these planning and design components.

The town received five proposals from developers. The winning proposal, which was developed and is occupied today as the Brandmästaren (Brahnd'-meh-stahr-chn) condominiums, consisted of 25 dwelling units contained in five buildings that are arranged around a courtyard and open space on the one-acre site. This proposal used a massive wood construction building approach where laminated layers of inexpensive wood create thick, well-insulated floors and roofs. This also resulted in a healthy indoor environment and abated noise. Bolts and nails were used instead of glue to reduce toxic chemical use and allow for eventual deconstruction and recycling of building parts. This construction method scored much higher on the town’s life cycle analysis evaluation than did proposals that specified steel or concrete as primary building materials.

Other building materials were selected to create the healthiest possible indoor air quality. Insulation made with foam glass and cellulose was specified instead of chemical-based insulation. Coconut fiber was used to insulate and seal joints instead of synthetic, high-chemical-containing foam. All windows are triple-glazed to reduce energy loss.

Natural materials were used where possible. Bathrooms were constructed of brick as a deterrent to moisture, according to the town planner. Mineral materials were used rather than organic substances that absorb moisture. Every home in every building has its own fresh air ventilation system, with fresh air piped to every room. Indoor plant terrariums further clean and purify indoor air. Kitchen larders are ventilated with cold air from the basement. This design feature builds
upon the traditional cold cellar concept, keeping food cool and complementing the energy-reducing effect of high-efficiency refrigerators. Each home has an open-air louvered bay window for drying clothes. A “smart” heating system heats up when residents come home and goes down when they leave.

Earthen roofs absorb rainwater and cool and insulate the buildings. This type of roof scored well in the life cycle analysis, since the grass and sedum plantings offset the loss of onsite vegetation from building construction.

All storm water is recycled on the site. Residents use a pump in the courtyard for water to irrigate gardens and plants. Rainwater is collected in tanks and piped to this pump.

For increased security purposes, all buildings have vestibules for package deliveries, but only residents can enter the rest of the building. To encourage residents to use their cars less, bike racks are placed under a porch next to the front doors.

The Brandmästarens development was designed and sold as market-rate priced condominiums. Condominium buyers purchased these units because of their comfort, attractiveness, and building quality, not particularly because of the development’s ecological features, says the town planner. The town of Karlstad succeeded in an original project objective — to demonstrate that market-rate housing can be ecological and sellable at the same time.\textsuperscript{12}

Greening affordable housing

**FAL肯BERG’S COUNCIL HOUSING**

To make sure that its housing residents will live in a healthy, toxic-free environment, FaBo, the city-owned housing agency of Falkenberg, is overhauling its entire approach to building. Falkenberg’s council housing, subsidized to be affordable to low- and moderate-income households, is going green.

As in the U.S. and other countries, Swedish construction methods in the 1960s and 1970s brought about a rash of sick buildings — where mildew, mold, or toxic chemicals in building materials contributed to illnesses of its occupants. (For more information about sick buildings, see Chapters 8 and 10.)

FaBo and the city realized that changing to ecological building practices would better safeguard the health of housing residents and also save the city the substantial building remediation costs to correct conditions that create unhealthy interior living space. Toward this objective,
FaBo and Falkenberg’s municipal government changed building design and construction practices to aim in more ecological directions. First, the housing agency and the city undertook education and training in ecological building for all staff responsible for overseeing building quality. FaBo and the city changed building permit application procedures and materials specifications and weve environmental questions into development design review and construction specifications. Creating a healthy interior environment with a guaranteed airflow and installing systems to capture and reuse waste energy became two of the city’s highest building priorities for affordable housing. These new ecological building standards were to be applicable not only to council housing but also to all publicly constructed buildings in Falkenberg.

In 2001, FaBo set two-year goals for water and energy consumption in council housing based on the 1997 levels: reduce clean water use by 15 percent; fossil fuel use by 30 percent, and energy consumption by 10 percent. These goals were part of Falkenberg’s city-wide plan to reduce energy use and convert to renewable energy sources. Today, the FaBo municipal housing agency is certified according to the ISO 14001 internationally recognized environmental operating standards. (See Chapter 5 for more information about Falkenberg and its renewable energy initiatives and Chapters 8 and 10 for information about ISO 14001.)

North American examples
Cohousing communities are also springing up in Canada and the United States. In Canada, as of 2003, 11 cohousing developments were either forming or occupied. In the United States, 60 occupied cohousing communities and almost 90 others forming or building were located in 33 of the 50 states as of the same date. Often, municipalities have helped make possible the development of cohousing communities through such actions as removing local regulatory barriers to cohousing or helping in finding a site. For example, the Town of Amherst, Massachusetts made a parcel of town-owned land available for development, writing a request for development proposals for closely grouped residential dwellings and conservation of open space. This action brought about the development of the Pioneer Valley cohousing community.

U.S. municipalities are finding that affordable housing and green building approaches are not mutually exclusive but, rather, compatible goals. For example, in the Cass Corridor neighborhood of Detroit, a community-based development organization saved an eight-story building from demolition,
converting this into 27 rental apartments for low-income households while using green building techniques. The decision to rehabilitate rather than demolish the Architects Building, financed with the help of low-income housing tax credits, prevented 800 tons of masonry and debris from being dumped in a landfill. Many construction by-products were sorted, recycled, and reused in other construction. New materials were selected for a high recycling content. The completed building has recycling chutes on every floor, allowing tenants to easily sort and recycle as many as eight separate waste streams.

As another example, Erin-Ellington Homes, developed by a community development corporation in a Boston inner-city neighborhood, provides 50 affordable rental units that reduce energy and water use by 40 percent, while costing 25 percent less to build than comparable new construction. Cities such as Austin, Texas; Denver, Colorado; and Santa Monica, California, have developed green building programs providing incentives for homeowners and builders to create homes and buildings that save water and energy, use recycled materials, and cut down on solid waste.