



National Center for
Healthy Housing

Green Housing Series:

The Advent of a Green Community



Children laughing and running around new play areas while parents keep a watchful eye, socializing in shaded areas. Well-maintained buildings, picnic shelters with grills, and groomed landscaping lend themselves to hosting events, even weddings! These are signs of a healthy community and what a visitor to Viking Terrace might see now that renovations are complete on this 60-unit complex. What they might not notice are the numerous healthy, energy-efficient and environmentally-friendly changes Southwest Minnesota

Housing Partnership (SWMHP) incorporated into the property's renovation to transform it into an affordable, green community.

The Viking Terrace Green and Healthy Affordable Home Project, a partnership between the National Center for Healthy Housing (NCHH) and the SMHP, is one of the first studies to demonstrate how green, energy efficient and healthy renovations impact residents and operations of an affordable housing complex. The study evaluates the benefits of green building by

assessing the health of residents, housing conditions, and building performance pre- and post-renovation.

Viking Terrace

In 2005, when SWMHP first saw Viking Terrace it was a rundown complex, badly in need of major repairs: dilapidated buildings, a dangerously overloaded electrical system, leaking roofs, damaged foundations from bad drainage, siding falling off leaving only

Viking Terrace At-A-Glance

Owner/Developer: SW Minnesota Housing Partnership (SWMHP)

Architect: I & S Architects and Engineers

General Contractor: Wilcon Construction

Research Team:

- Center for Sustainable Building Research (CSBR)
- Greater Minnesota Housing Fund
- National Center for Healthy Housing (NCHH)
- Southwest Minnesota Housing Partnership

Research Funding:

- Blue Cross Blue Shield Foundation of Minnesota
- Enterprise Community Partners
- US Environmental Protection Agency

Key Green Elements:

- High efficiency geothermal heating and cooling system
- Enhanced insulation of building envelope
- ENERGY STAR appliances
- Water conserving appliances and fixtures, such as dual flush toilets and low-flow shower heads
- Whole Unit ventilation system, including continuous bathroom ventilation
- Low-VOC paints sealants and adhesives
- Metal roof
- Cement-board siding
- Interior finish materials with recycled content
- On-site recycling of demolition and construction materials
- Radon, testing, monitoring and remediation
- Increased green space surrounding complex buildings



house wrap to protect the buildings from the weather, unworkable windows, unsanitary carpets and a parking lot pocketed with cracks. But SWMHP saw buildings with “great bones.” Today, Viking Terrace is a green, healthy community serving low-income families in the southwest corner of Minnesota.

Viking Terrace is a microcosm of Worthington, a small town of just over 11,000 residents where the low cost-of-living and good schools attract many new immigrants. It is a very diverse community: twenty different languages and dialects can be heard on its streets at any given time. Although the first waves of immigrants were met with some community uneasiness, Worthington has become a very welcoming community, embracing the many different cultures and striving to work through misunderstandings and language barriers.

Located within an established Worthington residential area, Viking Terrace is located close to public transportation, retail and other services. The community buildings, with their neutral palette of tans and beiges, blend into the surrounding neighborhood well. Mimicking Worthington’s diversity, approximately one-third of Viking Terrace residents are white, one-third are Ethiopian or Eritrean, with the rest of the residents a mix of ethnicities, primarily Hispanic and Vietnamese. Many residents are employed at the nearby Swift meat packing plant.

Originally built in 1974, Viking Terrace is a three-building property whose previous owners had deferred maintenance for years. It was cut off from the surrounding community and living conditions within the units were abysmal. There was water damage, pest problems, broken appliances and structural issues throughout. When SWMHP purchased the property, the owners were in default and significant financial restructuring was needed to rehabilitate the complex and maintain its affordability.

Viking Terrace provided a roof—albeit a leaky one—over the heads of its residents, but that was all. Tenants kept to themselves and did not socialize. The small playground and basketball hoop were dark and uninviting, and not conducive to social engagement. There was no place to sit and socialize with neighbors or watch the kids at play. There was no sense of “community.”

In 2004, SWMHP was looking for a Worthington property to rehabilitate as a low-income housing tax credit project. Initially, SWMHP intended to do a quick rehab job to restore the livability of the property and keep it affordable. Although some energy efficient measures were planned, there was no intention of renovating the property to green standards. Fortunately, for SWMHP and Viking Terrace residents, Enterprise Community Partners approached the non-profit developer with a proposal to use the complex as a green demonstration project.

Southwest Minnesota Housing Partnership

SWMHP is a non-profit community development corporation serving fourteen counties in the southwest corner of rural Minnesota. Formed as a 501(c)(3) in 1992, it has developed, financed or rehabilitated more than 4900 housing units since its creation, and invested more than \$210 million into the region.

Initially we were concerned about the cost of going green, but grants from Enterprise and Minnesota Green Communities helped. So did learning how short the payback period would be for some of the green elements. For example, because the geothermal system will pay for itself in about nine years, we'll be saving money in the long run.

—Jorge Lopez, Sr. Project Manager, SWMHP

Why Green?

Low-income people tend to be disproportionately impacted by asthma, other respiratory illnesses and a myriad of general health problems related to poor housing conditions. Building to green standards is especially important when rehabilitating affordable housing because it not only extends the affordability of the home by using durable, long-term materials and lowering utility bills, but it can also help improve residents' health, effectively lowering healthcare costs.

The Green Partnership

One of SWMHP's major hesitations in going green was cost. The Minnesota Green Communities (MGC) stepped up to the plate with essential grants to help SWMHP incorporate green elements into the project. MGC fosters the creation of affordable, healthier, and more energy-efficient housing by supporting housing production that has clear energy reduction goals, employs environmentally-friendly materials, and promotes resident health.

SWMHP and their architects, I&S Architects and Engineers, conducted a physical assessment of the complex to identify potential green elements. The property's flat roofs were causing significant leaking so gabled roofs were suggested, inadequate air flow and insulation were contributing to mold so a ventilation system was proposed. Using Enterprise Green Communities criteria, water and energy efficiency goals and targets for unit ventilation were set, and a list of renovation materials created. The project team evaluated each element according to expected payback period, estimated on-going maintenance costs, value to LEED certification, and of course, environmental, energy and health impacts.

By the time renovation plans were complete, the project included installation of a geothermal heating and cooling system, ENERGY STAR windows and appliances, dual flush toilets, pitched roofs, environmentally-friendly siding, improved landscaping, play areas and picnic shelters, and a high quality ventilation system. It is anticipated that the upgrades will reduce energy consumption and water usage at Viking Terrace approximately 40 percent, and provide better indoor air quality for residents and improved access to outdoor facilities.

Incorporating green products and technologies into the project added approximately \$900,500 to the renovation costs. The addition of geothermal was one of the biggest ticket items. It was chosen, in large part, because of its low maintenance and operating costs, which are one-third to one-half less than traditional gas heating. SWMHP calculated a ten-year system payback, but the payback period will most likely be much shorter as the calculation did not consider renovation upgrades that tightened the buildings' envelope or increases in gas costs. More importantly, the investment return will accrue for many years. At \$480,000 it added substantial upfront costs and, regardless of the long-term benefits, was nearly pulled from the plans. Without funding from Enterprise, it would have been cut.

Testing performed during renovation found the presence of radon, which led to radon mitigation being added to the renovation plans late in the process. Since standardized protocols for testing and mitigating radon in multi-family projects did not exist, SWMHP recruited several specialists to design the radon mitigation strategy. The strategy was tested on one building and monitored to ensure its success before being installed on the last two buildings.

SWMHP was already deep in the planning stages when it decided to go green, so there were few opportunities to integrate residents into the renovation decision-making process. However, to minimize the disruption for residents, the renovation was completed one building at a time and residents were provided details about the enhancements to ensure they understood how the changes might impact them and what type of benefits they could expect.

Green and Healthy Affordable Home Project

SWMHP's decision to go green also presented the opportunity to conduct the first-ever evaluation of the impact green building has on the health and well-being of low-income housing residents. The Viking Terrace Green and Healthy Affordable Homes Project, conducted by the National Center for Healthy Housing (NCHH) and the Center for Sustainable Building Research (CSBR), examined conditions at Viking Terrace to determine if green, healthy housing upgrades improved residents' health and energy efficient measures achieved their intended savings and consumption goals.

Housing standards used for the study were the upgrades SWMHP applied from the Enterprise Community Partners' Green Communities criteria, including installation of a ventilation system, low-VOC paints and finishes, sealing to reduce moisture intrusion and air leakage, and installation of energy-efficient windows.

NCHH launched the Green and Healthy Affordable Home Project at a 2006 Fall Celebration. Letters inviting Viking Terrace residents to attend the event and participate in the project were sent to the 54 occupied units. Thirty-one (31) households comprised of fifty-two (52) adults and thirty-one (31) children under the age of 18 agreed to participate in the study.

NCHH conducted interviews one to four months after residents moved into their renovated apartments and again a year to eighteen months later. The project baseline was established during initial interviews when residents were asked about conditions in

Viking Terrace Before and After



their previous home versus their newly renovated home. Health questions measured residents' general health, as well as asthma and other respiratory illnesses, home injuries, allergies, headaches and mental health. Questions also addressed basic housing characteristics; demographics; cleaning practices; smoking history; respiratory, cardiovascular and mental health; physical injury; and mobility. To ensure that Viking Terrace data would be comparable to national statistics, questions were drawn primarily from the annual National Health Interview Survey conducted by the Centers for Disease Control and Prevention (CDC) and the U.S. Department of Housing and Urban Development's (HUD) National Survey of Lead and Allergens in Housing.

NCHH also completed a visual baseline assessment of the housing units using a checklist drawn from HUD's Public Housing Assessment System. The assessment included observations of the property site, the exterior of the buildings, the interior common areas, and each enrolled unit. Major deficiencies and construction-related issues were shared with SWMHP to be incorporated into the renovation and with CSBR for building performance testing.

Finally, during the baseline visit, NCHH also provided trainings to help residents understand the benefits of the Viking Terrace's green renovations and ways to maintain the effectiveness of the project's energy, environmental and healthy upgrades. Residents were given ideas about how to reduce energy consumption and, using materials adapted from HUD's Help Yourself to a Healthy Home, how to maintain healthy homes according to the seven principles of healthy housing.

CSBR conducted the building performance evaluation in two post-renovation phases. Phase one consisted of a physical examination of the building envelopes benchmarked against national and state building standards and Green Communities criteria. Phase two, which lasted for approximately 18 months, consisted of tracking and observing the indoor environment in relation to personal comfort, health and building science guidelines to monitor the effectiveness of the system upgrades. Twenty percent of the Viking Terrace households participated in the evaluation.

CSBR's assessment included evaluating the performance of the ventilation system; post-renovation radon testing; air testing for total volatile organic compounds (TVOC); monitoring water and energy usage and costs, indoor air quality, and inter-unit air mixing; measuring life-cycle assessments; and monitoring long-term temperature and humidity. Some monitoring was done on an on-going basis, while some was done through quarterly sampling to capture seasonal changes.

Key Renovation Outcomes

Health

NCHH's baseline assessment found that Viking Terrace residents were generally in good health before the renovation: only two children and adults in six units had a history of asthma, and a third child had respiratory problems. Immediately after their homes were renovated, Viking Terrace adults experienced significant improvements in general health, chronic bronchitis, hay fever, sinusitis and asthma. Hypertension also was significantly reduced. Although not all showed statistical significance, there were also major improvements in children's general health, with a decline in respiratory allergies and ear infections.

A majority of the residents reported that their homes were much more comfortable since the renovation, and much easier to keep clean. Although the Viking Terrace complex was never prone to much crime, 40 percent of the participating residents also indicated an increased sense of safety after the renovation.

The landscaped grounds and renovated play areas, with lots of new equipment, encourages the children to play outdoors more often, regardless of the weather, which has increased their physical activity.

Economic

SWMHP preserved much needed affordable housing while creating a healthier, more energy efficient, and environmentally-friendly place to call home. The quality of the materials used in the renovation helped reduce maintenance calls significantly. Utility bills within the complex are lower and costs associated with on-going operations have declined dramatically. Some of the savings from system upgrades will be difficult to compute until the systems' upfront costs have been recovered.

The economic benefits gained by "going green" are in addition to the fact that rental costs for the apartments themselves remain affordable to low-income residents: four apartments are affordable to families earning 30% of the area median income (AMI); forty-seven apartments are affordable to those earning 50% AMI; and the remaining nine are rented at market rate. Additionally, SWMHP intends to work with Worthington Housing Authority to accept Section 8 vouchers as units become available. Today the complex is fully occupied with a waiting list.

Environmental/Energy

Cold wind no longer blows through cracks in the windows and dust no longer accumulates throughout the apartments and Viking Terrace residents are happy with their toasty, warm renovated

apartments. Viking Terrace buildings were made considerably tighter with weather sealing, improved siding and upgraded insulation. The tighter building envelopes improved moisture control and energy efficiency significantly.

Follow-up visual assessments completed eighteen months after renovation found no visible evidence of mold, nor many visible defects in construction or maintenance.

Before the renovation, air exchange in Viking Terrace units basically occurred as a result of air leakage from duct work, unsealed windows and doors, and faulty kitchen and bath exhaust ventilation systems. With tighter buildings post-renovation, a good ventilation system was especially important. Ventilation tests indicate that fresh air delivery and distribution have greatly improved since the renovation.

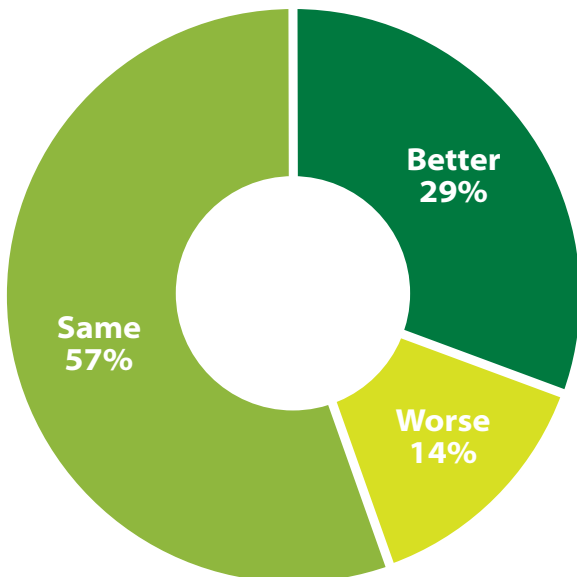
CSRB analyzed utility bills to determine the overall energy use and water consumption at Viking Terrace and found that, post-renovation, there has been a 46 percent reduction in total energy use and an estimated 39% reduction in CO2 emissions.

CSRB also found that levels of most volatile organic compounds (VOCs) are well below minimum health risk reference levels post-renovation, although high levels of benzene were found during one round of sampling in a couple of units. The high level may be due to a resident smoking in the apartment as benzene is a component of tobacco smoke. Short-term testing by CSRB indicated that the active mitigation system implemented by SWMHP has reduced the radon levels below EPA limits.

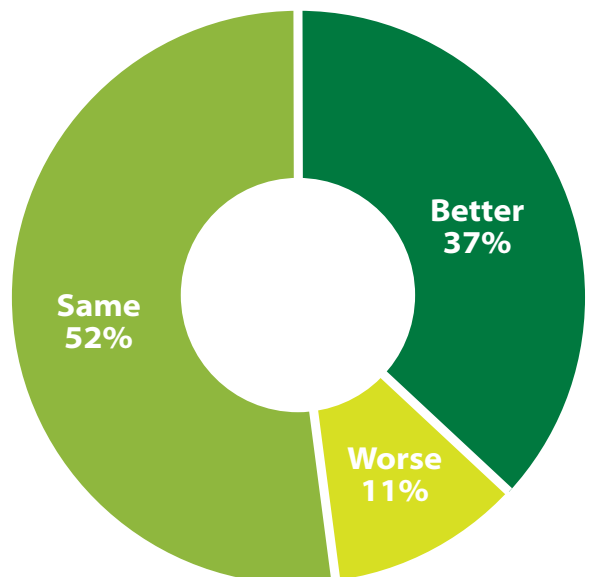
Social

SWMHP's landscaping of Viking Terrace with the addition of walkways, grilling shelters and improved play areas have been crucial to improving social connections at Viking Terrace. Pre-renovation there was little interaction between residents and

Child's Health Compared to When in Old Home



Adult's Health Compared to When in Old Home



Additional Green Costs

Metal Roof	84,000
Flooring	25,000
Carpet	27,500
Front-loading Washers	600
Dual-flush Toilets	3,000
Water Conservation Devices (i.e., low-flow shower heads)	5,100
Ventilation System	120,000
Geothermal	630,000
Light Sensors	3,900
Total	\$899,100

when it did occur. The common spaces SWMHP created during the renovation allows the groups to meet on neutral turf. The playgrounds provide an opportunity for resident children to play together and get to know each other at an early age.

Lessons Learned

- Integrating residents into the renovation project can improve the whole process. Affordable housing developers should use charrettes and incorporate key stakeholders into the project long before construction begins, and keep them involved throughout the process.
- Many new “green” systems are not intuitive. Systems such as geothermal require training for property management and maintenance staff to ensure proper system maintenance and care.
- Energy audits conducted prior to renovation can help target areas that need extra attention and provide essential information about existing systems.
- Depending upon the region, radon testing and, as necessary, mitigation, should be incorporated into renovation plans to reduce costs and avoid construction hurdles late in the process.

NCHH brought a better understanding of healthy housing and healthy living to Viking Terrace residents. They helped residents understand what green upgrades were incorporated into the renovation, and more importantly, why they matter.

—Jorge Lopez, Sr. Project Manager, SWMHP

- A cost/benefit analysis should be done to determine the value of different levels of green certification. This analysis should then be made available to potential investors and funders.
- Integrate green planning into project feasibility and pre-development process and incorporate all green materials and systems into construction drawings to ensure accurate bidding.
- Assimilate recycling and on-site conservation into on-going construction practices.
- Conduct ventilation and environmental testing throughout the renovation process to detect problems early and ensure systems perform as intended.
- Provide residential education and trainings to ensure that the green renovation achieves its desired impact and provides the most efficient return on investment.
- Learn how cultural traditions can affect housing and health.
- Create a strong collaboration between housing, health and environmental professionals to achieve holistic, green and healthy renovations.
- Research the pros and cons of green materials and their availability in your area before adding them to your plans.

Viking Terrace shows that even an apartment complex in a deplorable condition can be rehabilitated to provide a healthier environment for residents.

—Jorge Lopez, Sr. Project Manager, SWMHP

The National Center for Healthy Housing (NCHH) is a 501(c)(3) nonprofit dedicated to creating healthy and safe homes for children through practical and proven steps.