Smart Connections:  Green Affordable Housing and City Planning

By

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A Masters Project submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements of the degree of Master of Regional Planning in the Department of City and Regional Planning.

Chapel Hill
2004

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(Advisor)
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I. Introduction

Architect Sam Davis speaks of architecture as a field residing in the public realm to be harnessed for the betterment of the built environment. He points to the history of affordable housing in the United States with its many design flaws and failures, and calls for a drastic re-thinking of the importance of good design in affordable housing as a basic human right.

Architecture is public domain. Even the private house makes use of our diminishing natural resources and is affected by many individuals, laws, and institutions. As material resources dwindle further and more people become involved in various aspects of building, the problems grow in complexity and in their interdependence. Nowhere in the field of building and architecture is this more true than in housing. For those interested in architecture and its relationship to society, the place for fruitful investigation is housing

(Davis, vii).

Among the movements to mitigate sprawl, provide viable low-income housing, attend to declining inner city cores, and develop and grow in more environmentally sensitive ways, there are many places of disconnect, that, if bridged, could yield a more sustainable model of development - economically, environmentally, and socially. If approached separately, only short-term solutions are likely to develop. For instance, growth boundaries and downtown revitalization – while very important alternatives to sprawl style development – often do not account for and thus negatively impact the affordable housing stock. Affordable housing has been through many incarnations of poorly planned or just outright bad designs that have taken a toll not only on the health and well-being of the residents, but on the urban fabric and social equity of entire
regions. In addition to being uncomfortable, unattractive dwellings unfit for human habitation, too often they have been developed without adequately accounting for the myriad of uses and services that must co-exist to yield viable living environments.

Finding the glue that could potentially bring together these movements to function synergistically could render them all stronger and more effective. Following Davis, housing, as “the place for fruitful investigation,” can be the seed for a type of development that could overcome the lack of sufficient communication between these movements. Specifically, green affordable housing speaks to a number of those movements all at once. It demands quality housing for low-income households and sensitivity to the environment, which in turn breeds healthy city planning trends including building and land recycling, transit oriented development, walkability, connectivity, and community development.

Following the premise that green affordable housing is an impetus for a broader model of change, I will focus on the how’s and why’s of green building for the bulk of the paper in order to demystify this buzz word and situate green building within reach of the affordable housing industry and other movements toward more livable cities. Once a clear framework for green affordable housing has been established, the remainder of the paper will be dedicated to an on-the-ground look at holistic city planning founded on sustainability and affordability in a project called the Cleveland Eco-Village.
II. Toward a Definition of Green Building

Green building is part of our architectural heritage. Ancient cities, such as Athens, Miletus, and Olynthus, employed what we today call passive solar design, though at the time it was considered common sense and necessary to withstand harsh weather.

As the center of family life, the proper arrangement of rooms in relation to the site received attention from builders and philosophers alike. The climate urged emphasis upon orientation of the dwelling. The maximum amount of sunshine that could be invited into the dwelling was desirable in the winter months, and if the rooms were shielded from the cold north winds, heat could be conserved. Conversely, the heat in summer was relieved when the direct rays of sun were excluded…The principle rooms were faced to the south, opening upon the private courtyard. A colonnade projected from the rooms to shelter them from the high summer sun. The north wall of the house was punctured with only a few small windows.

(Gallion & Esiner, 19).

Today, “Green buildings incorporate the best ancient building approaches in logical combination with the best technological advances to address environmental issues such as resource use, ecosystem protection, and indoor environmental quality” (Seattle Business and Industry Resource Venture, 2003). It addresses a broad range of other issues including community and site design, transportation and connectivity, materials selection, construction management, and building maintenance. There are many shades of green and a number of things that can be done with little or no cost increase that make a significant difference in the operation and maintenance cost and health of the buildings, not to mention the decrease in environmental disruption. Seattle’s Business and Industry Resource Venture describes building methods on a scale from “Conventional Building” to “Sustainable Building,” with varying degrees of “green” in between.
There are a number of ways and combinations of ways to achieve varying levels of sustainability. Two primary rating systems in place to evaluate green buildings include the U.S. Green Building Council’s LEED rating system and the EPA’s Energy Star Rating System.

**LEED**

The Leadership in Energy and Environmental Design, or LEED, Green Building Rating System is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. It uses industry standards (ASHRAE, EPA guidelines) to quantify environmental performance. Members of the U.S. Green Building Council developed the LEED rating system and continue to contribute to it as standards evolve.

LEED provides a complete framework for assessing building performance and meeting sustainability goals. Based on well-founded scientific standards, LEED emphasizes state of the art strategies for sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. LEED promotes expertise in green building through a comprehensive system offering project certification, professional accreditation, training and practical resources

(USGBC, 2003).
LEED standards are currently available for

- New construction and major renovation projects (LEED-NC)
- Existing building operations (LEED-EB, Pilot Version)
- Commercial interiors projects (LEED-CI, Pilot Version)
- Core and shell projects (LEED-CS, Pilot Version)

(USGBC, 2003)

LEED is currently assembling the personnel and standards to complete the most recent addition to the rating system: LEED-H, or LEED for homes. It is based on the standards for commercial building and is expected to bring more environmentally responsible, healthy, and efficient homes into the market. According to LEED, this expansion of its rating system will contribute to over 20 other green home rating systems that have emerged since 1990. “To ensure a cohesive and influential rating system, USGBC and LEED-H will be aiding the natural evolution toward homogeneity of green guidelines already occurring in the marketplace” (USGBC, 2004).

**Energy Star**

Energy Star is a voluntary labeling program jointly managed by the U.S. Department of Energy and the U.S. Environmental Protection Agency. The Energy Star rating system promotes energy-efficient products, homes, and buildings, reducing energy use while helping businesses and consumers save money and protect the environment. Energy Star qualified homes are “at least 30% more energy efficient than homes built to the 1993 national Model Energy Code or 15% more efficient than state energy code, whichever is more rigorous.” These savings are based on heating, cooling, and hot water energy use. An Energy Star rated home may include:

- Building envelope upgrades
• High performance windows
• Controlled are infiltration
• Upgraded heating and air conditioning systems
• Tight duct systems
• Upgraded water-heating equipment

(EPA, 2004)

A home can be verified Energy Star compliant by an independent third party such as an accredited home energy rater or Build Option Package (BOP) verifier. The HERS, or Home Energy Ratings Systems, is one way of scoring the energy efficiency of a house on a scale of 0 to 100, with the reference house assigned a score of 80. An Energy Star house must have a HERS score of at least 86. Any single family or multifamily home that is three stories or less can qualify for the Energy Star certification. Not only does the Energy Star rating provide guidelines for builders and designers, it also yields more sturdy, comfortable, and cheaper to maintain housing that will hold its value. The Energy Star rating or other ratings systems such as HERS or LEED can also be used to qualify homes for an Energy Efficient Mortgage (EPA, 2004).

**Funding**

As an incentive to mainstream energy efficiency, The National Home Builders Association and Fannie Mae have formed the Environmental Initiative Partnership to provide housing finance products that acknowledge the relationship between green building and affordable housing. The Energy Efficiency Mortgage (EEM) was launched to harness the savings in operation and maintenance costs of green homes to increase the buying power of low-income households for such homes. Through the EEM initiative, a certified energy rater verifies a home's monthly energy savings, and those savings are
added to the borrower's income in the qualification calculation, allowing the borrower to qualify for a larger mortgage. EEMs offer lower interest rates and borrowers may contribute as little as $500 down, depending upon their income. The EEM is available for both home purchasing and home refinancing, so green renovations or weatherization initiatives can also qualify a household for this innovative mortgage (Fannie Mae, 2004).

Fannie Mae also offers the Energy Improvement Mortgage (EIM) for making renovations to meet efficiency ends. Up to 15% of the property’s value can be financed into the mortgage for more cost effective energy improvements. The U.S. Department of Housing and Urban Development also offers the FHA Energy Efficient Mortgage, which allows borrowers to finance energy improvements of $4,000 or 5% of the value of the home. No re-qualifying or appraisal is needed in order to finance these improvements (U.S. Department of Energy, 2000).

Location Efficient Mortgages, offered in Chicago, Seattle, San Francisco, and Los Angeles is another way to increase a household’s buying power by adding back to the loan amount the savings in transportation costs that comes from living in an urban community close to job opportunities. Location Efficient Mortgages are available to households living in urban areas that are walkable and served by public transportation (Smart Communities Network, 2004).

Other methods for funding green affordable housing include historic preservation tax credits (for green rehab), low-income housing tax credits, green building tax credits (available in many states), loans, grants, and donations. Spratley and Hubbard, in Green Energy Ohio’s “Tools for your Green Toolbox,” point to the importance of third parties in achieving sustainable design and renewable projects. Third parties, who may be able
to offer funding or technical expertise, include utilities, non-profits, and federal, state, or local government agencies (Spratley and Hubbard, 3).

Global Green USA’s Blueprint for Greening Affordable Housing discusses the alliance that can be forged with utility companies on the basis of “demand-side management,” whereby utility companies pay customers to invest in energy efficiency measures in their buildings because it ultimately translates into less cost for the utility to upgrade its own facilities to keep up with demand. The Blueprint also points out that green affordable housing projects can leverage funds from different interest groups on a variety of platforms – from foundations supporting environmental initiatives to organizations advancing community development practices. As new technologies are being developed and honed, opportunities to partner with the U.S. Department of Energy research laboratories may also be an option for pioneering green housing projects. Creating partnerships between non-profit developers with experience in a given community with for-profit developers or private consultants with technical expertise can yield a sustainable result based on knowledge of and connection to the social capital and existing assets of a community. (Karlenzig, 24).

### Techniques and Materials to Green Buildings

In order to better understand how energy can be conserved, indoor air quality improved, and money saved through simple building practices, it is important to know the techniques and materials that are involved in the “greening” of structures.

Real savings can be found in carefully planned design, but the education of such design must still be mainstreamed among the building community: “Compact eco-
homes, for instance, are more sustainable in every way: They're a bargain to build, maintain and operate. Yet blueprints for such homes are as scarce as old-growth cedar” (Horrigan, 1997). Global Green USA, a leader in the green affordable housing movement has developed easy to meet goals that can help standardize the practice. Global Green divides no or low cost building strategies into four main categories: energy, water, materials, and indoor air quality. Within each of those categories there are simple choices in building that can be made to yield more durable, healthy, environmentally sensitive buildings that are cheaper to operate. Below are simple guidelines, based partially on Global Green’s Top 20 No or Low-Cost Green Building Strategies, to green affordable housing.

**Energy**

Buildings should be oriented to maximize daylighting and passive heating and cooling. Natural daylighting is usually available from the east, south, and west facades. Daylighting reduces the need for artificial light, and thus electric bills, and provides pleasant, light-filled living space for residents. Recent studies on daylighting in schools found that exposure to natural light increases productivity. The Pacific Gas and Electric daylighting study found that classrooms with the most amount of daylight yielded a 20%-26% faster learning rate (The Pacific Gas and Electric Company, 13). It should noted, however, that using east or west facing windows for daylighting can work against passive cooling strategies, as eaves cannot keep out hot summer sun as it rises and sets. Trellises outside of windows with spring and summer foliage or deciduous trees can be used to address excessive glazing on east and west facing sides.
Larger windows on the south side can harness the low winter sun to passively warm the building and cut down on heating costs. Depending on geographical location and slope of the land, two-foot eaves on the south-facing windows will block the direct rays of the higher summer sun, which will help mitigate unwanted heating during hot months. The use of eaves has been widespread throughout the history of building. The vernacular African thatched cottage made use of deep eaves, and this practice was later adapted into Bungalow style architecture.

Selecting a light-colored “cool roof” will reflect heat away from the building. Dark roofing materials absorb heat, making the house warmer in the summer, and also contribute to the heat island effect. Light colored roofs help decrease air-conditioning bills and are thought to last longer because they do not thermally expand and contract as much as darker colors (Global Green, 2003).

“Well, all it tight and ventilate it right.” Local green builder, Mark Marcoplos expounds upon the importance of a tight building envelope and proper ventilation in order to maximize energy efficiency and comfort. Marcoplos explained, “If all the gaps – around windows, doors, joints etc – in a conventional house were put together, they would form one huge hole in the wall.” He went onto to explain a simple measure that can be taken to decrease the size of that hole: if every builder will walk around during the framing of a house and caulk all of the open spaces that should not exist, the unwanted exchange of hot and cold air through the building envelop will decrease and dramatically reduce energy consumption (Marcoplos, 2004).

Ventilation is the next step to healthy and comfortable living. Whole house fans placed in the upper portion of a house can circulate hot air up through carefully placed
open windows or vents. The direction of the whole house fan can also be reversed in winter to push rising hot air down into the living space. Properly venting heat and moisture producing uses, such as bathrooms and stoves is key to passive cooling and moisture control. Marcoplos carefully designed his residence to cool – in the South – without air-conditioning, by designing with natural ventilation in mind. During warmer months, the whole house fan runs at night to draw cooler air through, then windows are kept closed during the day to retain the cooler air temperature. A “belvedere” at the top of the house, where the whole house fan is located, has a hatch that is left open from April to October to passively vent out rising warmer air. Slight variations in ceiling heights on the first storey move the rising hot air toward the house’s stairwell and up toward the belvedere to exit. Marcoplos also chose energy efficient appliances that, in addition to lowering bills, generate less heat inside the house (Marcoplos, 28).

Selecting Energy Star rated appliances not only minimizes the heat produced inside the house, they also use 10-15% less energy and water than standard models. “Refrigerators and freezers are among the largest users of electricity in most homes. They can account for up to 25% of household energy use” (Global Green, 2003). The upfront cost of household items that save money will more than pay off in the long run. For instance, compact fluorescent bulbs, while more expensive upfront, last up to 10 times longer and use 66% less energy than incandescent bulbs. “Replacing a 100-watt incandescent with a 32-watt CFL can save you at least $30 in energy costs over the life of the bulb” (Energy Star, 2004). An incandescent bulb costs about $.75, lasts for about 750 hours, and uses 75 watts, whereas a compact fluorescent bulb costs about $15-$20, lasts about 10,000 hours, and uses 18 watts.
If electricity costs 8 cents per kilowatt-hour in each case, the total cost to buy and operate the ordinary bulbs for 10,000 hours will be $70, whereas the cost to buy and operate a single efficient bulb over the same period will be only $35 -- a savings of $35, or 50 percent. That single efficient bulb would also save more than half a ton of carbon dioxide from electricity produced from coal!

(Union of Concerned Scientists, 2003).

The other important strategy outlined by Marcoplos to increase energy efficiency is proper insulation. “The best bang-for-the-buck for wall and ceiling insulation is cellulose. It’s made from recycled newspapers, costs about $100 more per 1,000 square feet than fiberglass, and uses only 10% of the energy to manufacture that fiberglass does” (Marcoplos, 25). The consistency of “damp spray cellulose,” as it is called, allows it to penetrate every nook and cranny when sprayed into framing and provides the same high R-value as fiberglass. Furthermore, the boric acid with which it is treated as a flame retardant is non-toxic.

Combined hydronic heating, another measure to heat efficiently, uses the hot water already produced and stored in the hot water heater to operate radiators typically installed in baseboards (Global Green, 2003).

The use of thermal mass, such as concrete or tile flooring, can capture winter sun coming through the windows and act as a heat sink, soaking up the rays throughout the day and slowly giving off heat during the night to warm the house.

Water

Low-water landscape designs (such as xeriscaping) minimize maintenance and reduce water use by emphasizing native and drought resistant plants and eliminating turf areas. Rooftop gardening can be used not only as a community development tool, but
also to insulate the building below and mitigate stormwater runoff. Using permeable paving materials – in particular, the cheapest, gravel – also allows stormwater to percolate into the soil and minimizes pollution of nearby bodies of water. Last, installing water efficient toilets and other fixtures can significantly reduce water consumption, and thus water bills. “Low-flow toilets can save up to 22,000 gallons of water per year for a family of four. Flow reducers can cut water usage of faucets and showers by as much as 40% with little noticeable effect” (Global Green, 2003). Recycled water, or grey water, can be used for non-drinking uses, such as flushing toilets. In Hong Kong, for instance, every toilet uses grey water as a common sense way to conserve water usage.

**Materials**

Material choice greatly affects the impact a building has on the environment and its inhabitants. Recycled material can reduce pollution generated from newly manufactured goods, divert waste from landfills, and can provide economical alternatives to non-renewables. The cellulose insulation discussed above, is one example of a cost-wise, highly effective use of recycled newspaper. Recycled-content drywall and carpet are also viable alternatives to their conventional counterparts. They are made from recycled paper, plastic and glass bottles, wool, or cotton. They do not difference in appearance or performance and are priced comparably to conventional products. “Approximately 40 two-liter soda bottles are recycled per square yard of carpeting” (Global Green, 2003). Carpeting can be acquired in squares, which allow for creative designs and patterns, and also for cheaper and less wasteful replacement, as only the squares in well-worn paths need to be replaced.
Some materials can be substituted for others that requiring polluting or energy consumptive practices to produce. For instance, Global Green recommends using 30%-50% flyash – a byproduct of coal burning power plants - in concrete as an inexpensive substitute for 15%-40% of the Portland cement typically used in concrete. Flyash increases the strength and durability of concrete and also reduces the amount of cement needed, which requires mining to produce (Global Green, 2003).

Manufactured goods can be used to minimize the use of lumber from old growth wood. Engineered lumber uses wood fiber more efficiently than conventional lumber, resulting in stronger, higher quality buildings.

Solid sawn lumber in sizes of 2X10 or greater typically comes from old growth forests. Engineered lumber products, however, come from small-diameter and fast growing plantation trees. 2X10 and larger dimensional lumber is typically used for floor and ceiling joists and some seismic applications. Large size lumber can be replaced with engineered lumber (microlam, paralam, gluelam) in most applications unless required by seismic codes. Solid sawn 4X6s are often used for headers when smaller dimension lumber would suffice, such as double 2X6s, unless solid 4X6s are required by seismic codes. Wood I-Joists are an alternative to 2X6s or 2X8s used for floor and roof joists (Global Green, 2003).

**Indoor Air Quality**

Products used in houses often contain chemicals which “off-gas” over time and subject inhabitants to unhealthy levels of toxins. Organic chemicals are found in many household products such as paint, adhesives, and cleaning supplies. Using low- or no-VOC (Volatile Organic Compounds) paints, which are exactly like conventional paints, can “eliminate the eye, nose, and throat irritation, loss of coordination, and potential damage to the liver and central nervous system caused by VOCs. Outside, VOCs can
bond with other pollutants and create ground-level ozone” (Global Green, 2003).

Formaldehyde is another common chemical found in conventional house building products, such as particleboard, which can off-gas for up to 10-15 years. The EPA ranks formaldehyde as a probable carcinogen. Sealing products which contain formaldehyde with a flat, latex-based primer can prevent the off-gassing of formaldehyde (Global Green, 2003).

Other ways to achieve sustainability

The old adage “reduce, reuse, recycle” is very much akin to the practice of green building. “136 million tons of construction and demolition waste (approximately 2.8 lbs per person per day), most of which is recyclable”, go to the landfill every year (Wells, 1). Waste can be addressed in the form of re-use of demolition re-use, recycling, and reducing the amount of materials used in the first place. Recycling can come in many forms, including material re-use and recycling, land recycling, building recycling, such as green rehabs or weatherization. The following table illustrates the typical Construction Waste Estimated for a 2,000-Square-Foot home.

<table>
<thead>
<tr>
<th>Material</th>
<th>Weight (in pounds)</th>
<th>Volume (in cubic yards)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Sawn Wood</td>
<td>1,600</td>
<td>6</td>
</tr>
<tr>
<td>Engineered Wood</td>
<td>1,400</td>
<td>5</td>
</tr>
<tr>
<td>Drywall</td>
<td>2,000</td>
<td>6</td>
</tr>
<tr>
<td>Cardboard (OCC)</td>
<td>600</td>
<td>20</td>
</tr>
<tr>
<td>Metals</td>
<td>150</td>
<td>1</td>
</tr>
<tr>
<td>Vinyl (PVC)**</td>
<td>150</td>
<td>1</td>
</tr>
</tbody>
</table>
Standard construction practice places studs at 16 inches on center. By increasing the wood size from 2 x 4’s to 2 x 6’s, the spacing can be increased to 24 inches. Doing so not only decreases labor but also cuts down on lumber (by as much as 19%) usage and cost. The wider space left between the framing studs allows for more thorough and effective insulation, and thus a tighter envelope (EPA 2000).

Global Green asserts that housing “should be affordable, not cheap” (Wells, 3). The materials and techniques outlined above are more likely to give way to durable housing that has a sense of dignity. Some of the strategies are at no additional cost, while others are marginally more expensive. Global Green compares environmentally unsustainable material use in cheaper, construction and assesses minimal gain, if any, of making such choices. The following tables illustrate the cost difference between materials of more and less environmental sensitivity and long-term durability:

<table>
<thead>
<tr>
<th>Masonry***</th>
<th>1,000</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous Materials</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>1,050</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8000</strong></td>
<td><strong>50</strong></td>
</tr>
</tbody>
</table>
Choosing linoleum over vinyl conserves resources because it is more durable, thus sending less material to the landfill. Linoleum also does not pose the pollution at manufacture that vinyl does, nor does it off-gas once in the home (Well, 31).
The selected wall assembly adds about 8/10 of 1% to the project cost, and reduces wood use, reducing the impact from forestry and timber production, creates more space in the framing for more insulation, and creates better indoor air quality (Well, 32).

<table>
<thead>
<tr>
<th>Standard</th>
<th>$/SF</th>
<th>Selected</th>
<th>$/SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 4 DF @ 16&quot; OC</td>
<td>$2.35</td>
<td>Certified 2 x 6 @ 24&quot; OC</td>
<td>$2.00</td>
</tr>
<tr>
<td>1/2&quot; Gypsum Board</td>
<td>$2.30</td>
<td>5/8&quot; Gypsum Board</td>
<td>$2.50</td>
</tr>
<tr>
<td>Standard Caulking</td>
<td>$0.10</td>
<td>Low VOC Caulking</td>
<td>$0.16</td>
</tr>
<tr>
<td>Standard Paint</td>
<td>$1.10</td>
<td>Low VOC Paint</td>
<td>$1.50</td>
</tr>
<tr>
<td>MDF Baseboard</td>
<td>$0.40</td>
<td>Low VOC MDF Baseboard</td>
<td>$6.76</td>
</tr>
<tr>
<td>$/SF of Wall</td>
<td>$6.25</td>
<td></td>
<td>$6.76</td>
</tr>
<tr>
<td>Total SF Wall</td>
<td>$6,500</td>
<td></td>
<td>6,500</td>
</tr>
<tr>
<td>Total Project Cost</td>
<td>$40,625</td>
<td></td>
<td>$43,940</td>
</tr>
</tbody>
</table>
III. The Argument for Green Building

The release and use of toxic substances, resource exploitation, and physical alterations of the environment have has substantial unintended consequences of human health and the environment. Some of these concerns are high rates of learning deficiencies, asthma, cancer, birth defects and species extinctions; along with global climate change, stratospheric ozone depletion; and worldwide contamination with toxic substances and nuclear materials (Global Development Research Center, 1998).

It is expected that the world will double the size of the built environment over the next 20-40 years, which will make the creation and maintenance of the built environment one of the most resource and energy consumptive industries in the world. “Pollution is about inefficiency and waste; it’s about bad design…” (Brown, 2001) bad design in housing and planning that is wreaking havoc on the environment, the stock of affordable housing, and communities. When we consider the amount of energy that is needlessly wasted, not without a laundry list of permanent environmental degradation, and the number of people who suffer as a result of the high bills that accompany that waste, it would be daft not to forward a movement that addresses so many of these issues at once.

Heating and cooling represent the largest consumers of energy in residential buildings, 29% and 37% respectively. Changes as simple as the way we design houses can dramatically impact the amount of energy needed to heat and cool them, which can in turn significantly reduce the amount of non-renewable energy used to operate houses (U.S. Dept. of Energy, 2001).
Consider the following impacts of buildings on the environment in the United States each year. Buildings in the US account for roughly

- 40% of energy use (mostly from operation; also from manufacturing and transporting material)
- 30% of CO2 emissions (from energy use)
- 16% of water use (building operation plus power plant coolant)
- 40% of the raw materials entering the global economy
- 25% of the world’s virgin wood use
- 20-30% of landfill waste

(Wells, 1).

In the year 2000, 55% of the energy generated in the American South came from coal (Ravetto, 2003). A typical 500-megawatt coal plant produces more than 125,000 tons of environmentally damaging ash and 193,000 tons of sludge from smokestack scrubbers each year, 75% of which is disposed of in unlined onsite landfills. These coal plants impact about 114 billion gallons of water each year, enough water to support a city of approximately 250,000 people. Over the last 150 years, burning fossil fuels – coal, natural gas, and oil – has resulted in more than a 25% increase in the amount of carbon monoxide in our atmosphere (Green-e Renewable Electricity Certification Program, 2003). In 1998, electricity production alone in the U.S. accounted for 2.6 billion tons of carbon dioxide, 13.6 billion tons of sulfur dioxide, 6.4 million tons of nitrous oxides and 86,700 lbs. of mercury (EPA, 2001). Scientists have estimated that the number of deaths in the United States associated with pollution range from 50,000 to 100,000 per year. Each year there are 265 hospital admissions for asthma and 240 non-asthma respiratory admissions, 3,500 respiratory emergency doctor visits, and 180,000 asthma attacks (Green-e Renewable Electricity Certification Program, 2003).
Current house building practices are putting residents’ health at risk. Americans spend over 80% of their time indoors. According to the EPA, indoor air quality can be two to five times worse than outdoor air quality. The EPA estimates that over $60 billion each year in medical costs can be attributed to poor indoor air quality (Wells, 4). With increased rates of asthma connected to unhealthy buildings, it is important to start considering the way our houses are affecting our health and what changes can be made to create more harmony between resident and dwelling.

The impact of changing building patterns to yield more energy efficient homes would be felt in other areas of crisis. According to Housing and Urban Development, utility bills impose a disproportionate burden on the poor and can result in homelessness. Single, elderly poor, and disabled persons living on Social Security Income (SSI) spend an average of 19% of that SSI on utility costs, while in Delaware, Illinois, and Vermont it was nearly 25%. AFDC (Aid to Families with Dependent Children) families spend on average 26% percent of their income on energy bills, while median income families spend an average of 4% of their income on the same costs. With increasing energy prices, more households face utility shut-off, which leads to condemnation and ultimately homelessness. A study conducted by the Energy Cents Coalition found that in St. Paul, Minnesota in 1997, 26% of evictions due to condemnation were a result of electric and gas termination and another 40% were a result of water cutoffs (HUD, 2001).

*The Cold Facts*, a report on the effect of home energy costs on low-income Americans, found that the average annual percentage of low-income households’ budgets spent on energy can reach as high 70% during the winter months. During the winter of 2000-2001, “natural gas prices rose an average of 42% over the previous winter’s prices.
Heating oil prices were 36% higher than 1999-2000 and over 50% higher than the winter before that” (National Fuel Funds Network, et al., 2001-2002). The resulting number of low-income families on the brink of power cutoffs is staggering: The National Energy Assistance Directors’ Association (NEADA) recently found that “at least 4.3 million low-income households – in just 19 surveyed states plus the District of Columbia – are at risk of having their power cut off because they can’t afford to pay” (NEADA, 2001).

Individual utility companies have reported amounts in past due utility bills as high as $15 million, among 63,000 households in Iowa, and $32.9 million, among 76,000 households in Louisiana (National Fuel Funds Network, et al., 2001-2002).

One primary shifts need to take place in order to allow green building to become standardized in the affordable housing industry. First, the attitude about what “cost” means needs to be reconsidered. In order to cut costs and make the initial attaining of housing more affordable, residents pay down the road with less durable housing with higher operating costs. Real sustainability means durability and ease of maintenance. If materials and construction costs are cut, the result is lower quality housing that is expensive for residents to maintain and will eventually end up in the waste stream headed for the landfill. What good is a low monthly rent or mortgage payment if utility bills are more than making up for the difference in the upfront cost of higher quality construction?

The neighborhoods in which these houses exist are more likely to decline as the housing stock becomes less and less livable. Those who can get out will, and those who cannot afford to relocate will suffer from lack of services and viable housing. Ultimately, the cost to remedy such a situation is far higher, requiring years of revitalization and channeling of money to bring back economic development. Green affordable housing, on
the other hand, not only requires that housing be durable, comfortable, dignified places for people to live, it also, by definition, must be located within a context of sustainable development – development that takes into account all aspects of growing and prospering.

Global Green points out a reality of affordable housing that justifies long payback periods for more expensive upfront “greening.” Because affordable housing developments are typically owned and operated by the same organization for many years (“most are deed restricted for 55 years”), the organizations will still be around to realize the paybacks down the line (Wells, 3).

The average household spends 18% of its disposable income on energy costs (Ravetto, 2003), so for households on limited budgets, even a small reduction in monthly costs is significant. Green building and the energy savings that accompanies it has, for years, primarily been a luxury for those who could afford it. However, increasingly, architects and developers are tapping into the common sense side of green building through easy design strategies that can save significant amounts of money for low-income residents. According to “The Costs and Financial Benefits of Green Buildings,” a report to California’s Sustainable Building Task Force, “minimal increases in upfront costs of 0-2% to support green design will result in life cycle savings of 20% of total construction costs – more than ten times the investment” (Kats, ii). Furthermore, “the benefits of building green include cost savings from reduced energy, water, and waste; lower operations and maintenance costs; and enhanced occupant productivity and health” (Kats, ix).
As more green affordable housing projects are realized, the practice of green building and green materials will become more standardized, and thus more affordable. Eventually, even with big business oil companies dictating the market, it cannot but shift into the direction of more sustainable building as costs fall, nonrenewable materials diminish, and global warming becomes more of a threat. The Cleveland Eco-Village is taking steps toward educating and standardizing the practice of green building, all the while addressing pressing urban issues in a declining West Cleveland neighborhood previously dependent on manufacturing.

IV. The Cleveland Eco-Village

An ecovillage is a human-scale full-featured settlement in which human activities are harmlessly integrated into natural world in a way that is supportive of healthy human development and can be successfully continued into the indefinite future

(Gilman, 1991).

The Cleveland Eco-Village is an inner-city infill and redevelopment project in West Cleveland’s Detroit Shoreway neighborhood initiated by a partnership between EcoCity Cleveland, a non-profit think-tank and ecological design institution and Detroit Shoreway, a community Development Corporation. In the mid 1990’s Cleveland was undergoing significant redevelopment, but little of that development was taking the environment into account.

As Cleveland’s redevelopment phase was beginning, local neighborhood groups whose focus was improving the housing stock was under tremendous pressure to produce
as many housing units as possible. While some attempted to insulate better, most were conventionally built. By late 1995, Cleveland-area environmental and citizen groups began questioning the true sustainability of this style of development, realizing that these short-term solutions were not addressing more pressing environmental concerns facing Ohio. The Regional Environmental Priorities Project (REPP), an initiative of the Case Western Reserve University, had ranked suburban sprawl and out-migration from the urban core as the most serious environmental problem facing Northeast Ohio. This issue placed the Detroit Shoreway neighborhood in prime candidacy for a neighborhood revitalization effort that could both save the neighborhood and address the greater regional issues outlined by REPP (Gillespie, 2003).

Ecocity Cleveland began researching the feasibility of an Eco-Village in Cleveland as a tool to reduce sprawl and attract people back into the city by creating a healthy, attractive, urban neighborhood. Dr. Wendy Kellogg, as associate professor at Cleveland State University was hired using funds from the George Gund Foundation to conduct the study, looking at Eco-Villages around the world (Gillespie, 2003). She found that virtually all of them were located in rural areas, and the goal “was to create a sustainable urban development. Although the rural models were useful, Cleveland Eco-Village organizers are truly breaking new ground” (unknown author, 2000). While the rural Eco-villages contain many healthy sustainable elements, they could not also address the growing social and environmental concerns of sprawl, spatial mismatch, and urban decay facing Cleveland neighborhoods.

To determine the best site for the Eco-village Ecocity Cleveland, along with Wendy Kellogg met with staff of non-profit housing organizations, staff of the city’s
departments of Planning and Community Development, neighborhood development
funding organizations, architects, and transit specialists. There were many potential
neighborhoods to focus on, as Cleveland has a history of strong Community
Development Corporations, and neighborhoods in West Cleveland each boast a series of
Block Clubs which meet on a monthly basis to discuss concerns and plan community
events. Kellogg developed a survey that was sent out to all of the neighborhood-based
development groups in the city, inviting groups to nominate sites for the Eco-Village.

With a long list of possible sites and neighborhood partners, Ecocity Cleveland
used the following criteria to narrow down the choices:

- Proximity to transit (presence of Regional Transit Authority Rapid station
  or bus lines or potential for bike/pedestrian facilities)
- Presence of vacant land for development
- Diversity of population (percent minority, income levels, education levels)
- Neighborhood economic status (moderate income, need for employment,
  small business/commercial areas)
- Existing community resources (presence of active organizations and
  churches, health services, recreational programs, funding for programs
  like the Federal Empowerment Zone)
- Physical characteristics (condition of housing stock, affordability of
  housing, presence of brownfields needing environmental remediation)
- Environmental activities (for example, participation in lead-abatement
  programs, urban gardening, green space planning)
- Community development organization (technical capacity, including
  quality of past projects and the ability to be a partner in an Eco-Village
  project)
- Interest in an Eco-Village among the community development
  organization, other neighborhood institutions, and residents
EcoCity Cleveland selected the area of the Detroit Shoreway neighborhood near W. 65th and Lorain Avenue because of its “potential for transit-oriented development, a vibrant mix of residential and commercial uses, and a combination of new development and rehab of existing building” (Gillespie, 2003). Furthermore, Detroit Shoreway Community Development Organization had a reputation for being one of the most capable non-profit groups in the city. Before any steps could be taken, however, Ecocity Cleveland needed to gain broad-based acceptance throughout the community for the Eco-Village. The first few months were spent with staff of Detroit Shoreway, who were already very familiar with its focus neighborhood, introducing the project to block clubs, Ward 17 Councilman Timothy Melena, local church leaders, and other neighborhood organizations. Ecocity Cleveland and Detroit Shoreway received a positive response, so they decided to sign a formal partnership agreement and begin looking for funding.

Ecocity Cleveland obtained a grant from the Katherine and Lee Chilcote Foundation for development of an Eco-Village plan, and Detroit Shoreway received a grant from the city’s Cityworks program. The partners hired City Architecture, local planning and architecture firm who specializes in environmentally sensitive design.

The design of the Eco-Village formed around a quarter mile radius of a Rapid Transit stop, which, at the time was deteriorating and known as a dangerous area within the neighborhood. Early in the development of the Eco-Village, the city announced the imminent closing of the neighborhood’s transit stop – but the threat had a silver lining. There was such an outcry among residents and neighborhood organizations that, not only was the station kept open, a new station was proposed that would include green features, space to exhibit art, and a commercial use such as a coffee shop (Bier, 2004).
Clearly, the residents were becoming enthusiastic about the new development. In December of 1997, the Eco-Village coordinators invited residents and design professionals to a charrette to brainstorm ideas. These meetings, whether formal charettes or more informal discussions at block clubs have continued throughout the development of the Eco-Village, giving it a strong community development component that has helped propel it on toward positive and inclusive change.

The project has attracted assistance from the local USGBC affiliate, the Cleveland GBC, and the U.S. EPA. Construction has been supported by the City of Cleveland and other sources. The Eco-Village features twenty of Cleveland’s first green townhomes (designed in partnership with Building Science), a four
million dollar rapid transit station with green features, a straw bale garden shed on the community garden site, two independently built green homes, a designated footpath that weaves throughout, Cleveland’s first school to incorporate solar panels, and large scale green space improvements. The Eco-Village stands “as an opportunity to realize the promise of urban life in the most ecological way possible” (Gillespie, 2003).

Oregon Housing & Community Services' "Green Building Source Guide" points out that in a development that aims to implement green principles, "a team member should be available to add a sustainable perspective to relevant discussions and decisions" (Barnett, 2). Jim LaRue, local residential green building consultant with the Green Building Coalition has served that role for the Eco-Village since they first began developing housing, both new and rehab. He has conducted research for the Eco-Village, located contractors and suppliers that shared their vision, and has evaluated products and services of others who have come forward claiming to be green (LaRue, 2004).

LaRue served as consultant on one particularly interesting project in the Eco-Village: The Ecovation, or green rehab of a drafty, dark, cramped 1916 bungalow. The Cleveland Housing Network, a low-moderate income housing advocacy organization, purchased the house with the goal of renovating it within the context laid out by the Eco-
village: “in an environmentally responsible way.” The renovation focused first on making the house more energy efficient with the use of cellulose insulation, upgraded windows, and low-VOC foam to fill in air leaks. Duct work in the exterior walls was moved to the interior walls of the house to cut down on heating and cooling loss. The square footage, insulation levels, and windows were all calculated carefully to determine the appropriate size energy efficient HVAC system, a measure that is often over looked in conventional building. The HVAC unit, which is 4 times more efficient than the standard 20-year-old ones, is a sealed combustion design that brings in fresh air from outside, an important feature in a tightly sealed house. A tubular skylight, which does not produce heat, was placed above the stairwell, and the wall was opened up halfway to create a lightwell to take advantage of daylighting. The work on the interior made use of recycled wood from inside the house, as well other new recycled products. An office or spare bedroom was carpeted with carpet squares from a one of two companies in the country that take back their own product and re-use all of it. The tile in the bathroom is composed of more than 50% recycled material, and the new drywall installed is composed of paper that is 98% recycled and gypsum that is 100% recaptured. The kitchen cabinetry is composed of wheat straw and sunflower seed husks, a strong alternative to particleboard, which contains formaldehyde. They are covered with a maple veneer derived from hardwood certified by the Forestry Stewardship Council. The water efficient toilet, which was donated, only uses 1.4 gallons per flush and a kitchen sink is made from dust left over from the production of other granite products. The rear detached garage, which was unfixable, was rebuilt with a south-facing oriented roof for future possibility of photovoltaic panels (Taxel, 2004).
The price tag on this 1,172 square foot house is $135,000, not as affordable as future projects plan to be, though the purpose of this house is to provide more than affordable housing. The buyer of the Ecovation will have access to assistance through the Cleveland Housing Network’s Homeward program in then form of tax abatement, and a reduced interest rate. Not only does the Ecovation house represent the Eco-Village’s attempt to diversify the area economically (the townhouses are an even better example of that, priced at around $200,000), it is also the first model green rehab on which continuous education of residents and outsiders will be based (Taxel, 2004).

Eco-Village coordinators will go door to door in the area to share information about the new green additions to the neighborhood in hopes of helping them understand how they could apply green building principles to their own homes. LaRue believes that “once [the residents] learn about the energy savings and health benefits they will be more interested. We will be focusing on those families who are just above the income level that would make them eligible for various programs.” There is talk of collective purchasing of building materials and services to make it less costly. “Our goal is to help folks prioritize work so they are getting the most for the money they spend” (LaRue, 2004).

As far as other ways residents are getting involved, resident Kevin Borowiak finds the community garden and block club meetings to be the most effective ways for residents. He also notes the word-of-mouth information spreading about the green building taking place...
in the area. From the signage on the buildings, the press, and the discussion at meetings, Borowiak believes that approximately 85% to 100% of the residents of the area are aware of the Eco-village. Still, he continues, regarding the older residents who are former factory workers, “it becomes critical to engage them and build bridges that keep them involved and committed to the neighborhood.” Borowiak also pointed out the importance of standardizing green practices – and the Eco-village’s role in that – in order to drive down the price of expensive materials to make green rehab more affordable to residents. (Borowiak, 2004).

Mandy Metcalf, Eco-Village coordinator hopes that a study being conducted by Building Science Corp, looking at cost-effective ways to retrofit houses for energy conservation, will help existing residents do some upgrades.

Nathan Yost at Building Science wants to figure out how to structure improvements so that it is financially feasible for private contractors to do these energy retrofits and profit from the future cost savings, while not charging high prices for the improvements upfront. This would help the residents who don't qualify for weatherization programs yet can't afford high cost renovations (Metcalf, 2004).

There is a real commitment by the local green building community in Cleveland to find green building techniques that are both affordable and environmentally appropriate. For example, “the only reason that there are photovoltaic panels on the townhome garages is that they were paid for by a grant - otherwise they would be considered too expensive” (Metcalf).

In the future, the Eco-Village will likely be supported by local and national foundations, federal agencies, building materials manufacturers, financing through utilities and location-efficient mortgages, and investments by private developers. Metcalf speaks of plans for greater density around the Rapid Station, incorporating more cutting
edge green building to continue to serve as an example and a vehicle to educate local contractors on green building, possible some cohousing. Metcalf says, there are increasingly “more people in the neighborhood who not only know about the Eco-Village but who are really excited about environmental issues - meaning both new people who have moved in and existing residents who have been inspired (Metcalf, 2004). The expectation is that these residents will be so well organized that they will be initiating Eco-Village related projects on their own. The Eco-village also plans to focus more of its energy and resources on furthering a commercial component: “Environmentally-related businesses on W.65th and Lorain, and new development along these streets that creates a sense of place and completes the village…innovative stormwater treatments throughout the EcoVillage…safe and pleasant places to walk and bike…weatherization and energy retrofits done to the majority of houses” (Metcalf, 2004).

The Eco-village is not without its own concerns, though. LaRue explains that “one of the biggest headaches for existing residents is that building new housing and renovating old raises property values, which raises taxes. If you ware paying more taxes you have less money to spend on maintaining and improving your home (LaRue, 2004). However, the Eco-village, as a sustainable redevelopment tool, does have an environmental edge which can be used to create and maintain affordability through the greening of housing, perhaps making up for the market shift that is bound to occur. The words of Greg Watson, executive director of the Dudley Street Neighborhood Initiative in Roxbury, Massachusetts ring true for a project like the Cleveland Eco-Village:

If you cut your home heating bill 30 to 40 percent, that’s money in your pocket, and that’s a form of economic development. That’s a very powerful concept. That’s one that you have some control over…Economic development certainly
means jobs and job creation, but if you can also find ways to cut your costs of living, especially around energy and food, in many respects that’s almost like getting a raise (Pitcoff, 1999).

The tool that is the catalyst of the Eco-Village – green affordable housing – is also the mechanism by which it will sustain itself.

V. Conclusion

One key element of building greening affordable housing is carefully orchestrating all elements in the process from beginning to end. Because the design of a house can largely affect its “greenness,” decisions to incorporate sustainability must happen at the outset and take all aspects of the building into account. The “systems thinking” model by which green affordable housing must be built is a sort of microcosm for the larger planning field. When all aspects of the house developing process happen in concert, the maximum benefit of those working elements can be realized. Likewise, in planning, any one aspect of the city cannot be altered or ignored without the effects rippling throughout the region. The benefit of that web of interconnections is that making thoughtful changes that consider the myriad of connections can effect real change. The Eco-Village concept presents a model through which multiple elements of urban growth and change are accounted for – all parties are present to speak and be heard, thus everyone, each function of the whole, can function that much better.
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