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Sustainable Construction Practices of Intentional Communities: a Pilot Investigation in Loudoun County, Virginia and Frederick County, Maryland

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Sustainable Construction Practices of Intentional Communities:

A Pilot Investigation in Loudoun County, Virginia

and Frederick County, Maryland

By

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This project investigated the sustainability of homes within three intentional communities. Semi-structured interview and photographic walkthroughs examined the variability of architectural and technological approaches toward sustainability. These include: passive solar design, green roofs, radiant flooring, composting toilets, ground assist heat pumps, solar water heaters, multi-family units and modular construction. It was hypothesized that variation in sustainable construction is related to socioeconomic status and that economics would be a constraint. This project investigated whether communities were transmitting their practices to wider society, if individuals were copying vernacular architecture and if architectural practices followed individual beliefs regarding sustainability. It was found that the Internet is the main method of conveying these practices; that variability was tied less to individual beliefs than to the communities' institutional documents; and that copying vernacular architecture was for aesthetics not sustainability. Intentional communities are good models for sustainable development, but knowledge transmission is limited.

Key Words: Virginia, Maryland, Intentional Communities, Co-housing, Ecovillage, Sustainability, Green Building, Vernacular Architecture, Architecture, Built Form, Strawbale, Green Technologies, Solar Water Heater, Composting Toilet, Photovoltaic, PVs, Geothermal, Ground Assist Heat Pump, Radiant Flooring, Multi-Family Units, Duplex, Modular Construction, Formal Consensus, Dynamic Self-Governance, Sociocracy

DEDICATION

This work is dedicated to my mother and father who were educators, inspiring me to learn throughout my life, and to my wife Julie who has given me much needed support throughout this process.

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CHAPTER I

PROJECT SUMMARY

The world population now exceeds seven billion people and many use far more resources than their peers. Scholars express concern over the current global practices of resource exploitation (Elgin and Mitchell 1977; Brundtland 1987; McDonough and Braungart 2002; Brown 2008). According to Brundtland (1987) the global North takes far more than its fair share of resources. Hawken (2007) states that the twentieth century has seen the greatest rate of environmental destruction in recorded history. Authors such as Brundtland (1987), Brown (2008) and Hawken (2007) caution that we can no longer continue down this road without facing consequences such as shrinking farm lands, failing fisheries, water table depletion, desertification, oil scarcity, increasing poverty, mass refugee influx into megacities, and general conflict over resources.

Many of these resources are consumed in the construction and maintenance of modern homes (Thormark 2005; Shukla, et al. 2009). Some people are attempting to change this by using alternative means to design and build homes. Intentional communities such as ecovillages or cohousing communities have been viewed as test labs for alternative forms of community building and interaction, economic activity and construction practices (Veto and Lockyer 2008). This makes intentional communities an ideal place to research new and innovative ways of building homes that are more environmentally friendly and sustainable than most other homes found in mainstream developed societies.

“Intentional community” is an “inclusive term for ecovillages, cohousing communities, residential land trusts, communes, student co-ops, urban housing cooperatives, intentional living, alternative communities, cooperative living and other projects where people strive together with a common vision” (Fellowship Intentional Communities 2010). Ecovillages can exist in either rural or urban settings; they consist of people “who strive to integrate a supportive social environment with a low-impact way of life” (Global Ecovillage Network 2010a). Cohousing communities are “old-fashioned neighborhoods,” where people know and interact with their neighbors; these communities combine private homes with common facilities and use consensus to make decisions (Cohousing Associations of the United States 2010). Some of these communities are inspired by a shared concern with current practices of resource exploitation and their potential consequences.

This proposed research focuses on how intentional community members use technologies and the built form (their dwellings) to contribute to a lessened impact on the environment. The specific aims are: 1) to measure the variability of architectural practices and technologies and their relationship to beliefs and knowledge regarding sustainability, conservation, and reduced environmental impact among residents of intentional communities; 2) to investigate whether these architectural practices and technical knowledge are transferred to wider society and, if so, how; 3) examine how an intentional community’s foundational documents impact the variability of architectural practices and technologies found in individual community homes; and 4) to see if people are copying traditional vernacular architecture of the region.

Results from this study will contribute to the understanding of why certain practices are being used and what methods communities use to share their knowledge. I hypothesized that there would be significant variation in construction practices among members of intentional communities related to both socioeconomic status and beliefs about sustainability, conservation, and lower environmental impact. I also hypothesized that participants would report that economics are an important constraint in their attempts to enact sustainable and environmentally-friendly architectural and technological practices.

Intellectual Merit

This research examines the technologies and construction practices geared toward creating a sustainable future within the setting of intentional communities. Focus on sustainable construction practices and technology is an underrepresented area in current literature on intentional communities. Ultimately, this research will contribute to an understanding of the way that particular segments (i.e. intentional communities) of the North American population organize around beliefs in sustainability to respond to global environmental degradation by means of technology and architectural solutions.

Broader Impact

Innovative building and architectural methods for contributing to a sustainable future are explored in this project along with problems that hinder individuals from implementing practices. The practical application of this research is to use the knowledge gained to guide future intentional communities and individual homeowners in the implementation of viable technological and architectural solutions to lessen environmental impact in Western society.

Methods

Research was conducted during the summer of 2010 in three intentional communities. Two are located in Loudoun, Virginia: the Ecovillage of Loudoun County (ELC) and Catoctin Creek Village (CC). One was located in Fredrick, Maryland: Liberty Village (LV).

This research project used both qualitative and quantitative methods. Qualitative data give a better understanding of community life. Because this is a pilot study of a specific population, I used purposive sampling technique. Subjects were chosen based on residence in the community and only if they have either homeowner or renter status. I employed participant observation and semi-structured interviewing of community members. Semi-structured interviewing further aids in understanding what people do, why they do it, and what they see as problems to implementing specific technologies and construction practices.

In addition, this research project incorporates photographic surveying techniques along with an architectural/building checklist modified from the ecological sustainability checklist used by the Global Ecovillage Network (GEN) to record sustainably oriented features of community homes and deals in part with buildings (Global Ecovillage Network 2010b). This checklist is used as an indicator of the sustainability of specific ecological components of a community. Photos document ecological and sustainable technologies and building features.

CHAPTER II

LITERATURE REVIEW

Sustainable Development

A vast amount of literature has been generated on the topic of sustainable development over the years. One of the most frequently cited definitions of sustainable development comes from the World Commission on Environment and Development (also known as the Brundtland report): “humanity has the ability to make development sustainable - to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development 1987: 24). The report claims that sustainable development “is a new concept for economic growth” (Brundtland 1987: 4). However, it is the capitalist system that initially created the sustainability crisis (Brown 2008; Elgin and Mitchell 1977, Lockyer 2007, McDonough and Braungart 2002). The emphasis on economic growth has been one of the more contested and criticized points of the Brundtland report, and some argue that it does not go far enough, as this selected portion of the Earth Charter shows:

> Fundamental changes are needed in our values, institutions and ways of living… Our environmental, economic, political, social and spiritual challenges are interconnected… we must decide to live with a sense of universal responsibility, identifying ourselves

> with the whole Earth community as well as our local communities (Lockyer 2007: 5).

Since the publication of the Brundtland report, two notable international documents have been produced that attempt to address its shortcomings, Agenda 21 and the Earth Charter.

Agenda 21 comes from the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (United Nations Department of Economic and Social Affairs 2010). According to Lockyer (2007:4), Agenda 21 "makes a more realistic attempt to confront the complexity of the sustainability challenge by indicating that all humans are stakeholders in the attempt to create a more sustainable world." Agenda 21 makes this attempt by more seriously stating the social side of sustainability and calling for a grassroots approach, coming from local communities, as a means for achieving sustainability. Agyeman (2005) echoes this critique by suggesting that sustainability will not be met by top-down institutional action and that local communities must be involved if the movement is to succeed. Fricker (2006) in turn echoes Agyeman's sentiment, stating that the challenge of sustainable change is one of change in attitude and behavior, where social discourse must be "explored collaboratively within the groups or community concerned" (p. 193). Intentional communities are engaging in this type of discourse (Lockyer 2007).

"The Earth Charter," according to Lockyer (2007), "breaks from both the Brundtland report and Agenda 21 by more extensively articulating the idea that achieving sustainability will require major socio-cultural change" (5). The Earth Charter went through three drafts from 1997 until 2000 and was formally launched by Queen Beatrix of the Netherlands on June 29, 2000 (Earth Charter Initiative 2010). This charter

> is a declaration of fundamental ethical principles for building a just, sustainable and peaceful global society… It seeks to inspire in all people a new sense of global interdependence and shared responsibility for the well-being of the whole human family, the greater community of life, and future generations… [It] is centrally concerned with the transition to sustainable ways of living and sustainable human development… [And] recognizes that the goals of ecological protection, the eradication of poverty, equitable economic development, respect for human rights, democracy, and peace are interdependent and indivisible (Earth Charter Initiative 2010).

Lockyer (2007) notes that the tone of the Earth Charter's conclusions are of a utopian nature, calling as they do for a reworking of institutions and of cultural values. Fernando (2003) proclaims that, "without such a counterhegemonic utopian vision, it is impossible to create the necessary conditions for sustainable development," but also concedes that capitalism has no politically powerful alternative (27). This irony lies at the heart of the sustainability discourse. As Lockyer (2007) notes, there is a fundamental tension between reality and ideology, which is now at the forefront of the sustainability debate. This same tension also exists at the very heart of the concept of utopia, which suggests that sustainability is actually a utopian challenge. Intentional communities are sometimes critiqued as utopian experiments interested in promoting social justice and social equity within their communities, making them ideal subjects for research in sustainability.

Anthropology and Sustainability

Since the release of the Brundtland report, anthropologists have examined the topics of environmental degradation and sustainability. Stone (2003) points out that, even with the upsurge of interest by researchers in sustainable and unsustainable practices during the 1980s and 1990s, a coherent definition of sustainability or sustainable development never materialized, nor did agreement of measurement or the appropriate size for the scale of study. Scale is an important factor because all people operate within the context of regional, national and global processes (economic, political etc.) beyond their control. An example of how larger processes affect groups is provided by McCabe (2003), in his study on the diversification of livelihoods among the Maasai of Northern Tanzania.

McCabe (2003) points out that early development efforts aimed at these pastoral peoples all included a forced reduction in the cattle they owned. This was due to the notion that the majority or pastoral peoples overstocked their rangeland (McCabe 2003). As a response to continual changes in conservation policies for the region from the late 1920s through the 1990s, the Maasai peoples have had to adopt new methods to support their livelihoods. Some of these diversified activities included agricultural cultivation, working for wage labor, or migration. While it is not expected that individuals in intentional communities will have to modify their economic activities due to external pressures the way the Maasai did, it is expected that the architecture represented in these communities will be heavily impacted by external policies.

Intentional Communities

Much of the research on intentional communities has revolved around the aspects of social change embedded in them, most prominently the concept of utopianism

(Gardner 2006; Hicks 1969, 2001; Hine 1966; Holloway 1966; Kesten 199; Kindade 1994; Lockyer 2007; Meltzer 2001). The ideal of utopian communities has been viewed by some as an unattainable goal (Hicks 1969; Gardner 2006), and by others as a process rather than destination (Lockyer 2007). While there is much literature on intentional communities, no work is specifically dedicated to the aspect of sustainability of the structures (built forms) they construct.

Anthropology and the built form

The study of built forms in anthropology can be traced back to the evolutionary and functional theories of Morgan and Durkheim (Lawrence and Low 1990). Built forms, as defined by Lawrence and Low, are "building types (such as dwellings, temples, or meeting houses) created by humans to shelter, define, and protect activity" (1990: 454). They also include spaces which are "defined and bounded, but not necessarily enclosed," as well as landmarks or sites "which do not necessarily shelter or enclose activity," and may refer to "specific elements of buildings (such as doors, windows, roofs, walls, floors, and chimneys) or to spatial subdivisions of buildings" (Lawrence and Low 1990: 454).

Early theorists attempted to explain built forms based on their adaptive success and the role they play in maintaining societies. Morgan's 1881 book *Houses and House-Life of the American Aborigines* asks what "domestic architecture show[s] anthropologists… about social organization, and how…social organization combine[s] with a system of production technology and an ecological adjustment to influence domestic and public architecture" (Bohannan 1965: *x*). Morgan, along with showing the kinship forms of the Iroquois, also described their buildings and how these buildings related to the group's social organization. Morgan noted that house form was designed for occupation by several families, allowing for the shared production and consumption of food; what Morgan referred to as primitive communism (Bohannan 1965).While the lifeways of contemporary groups are very different from the peoples Morgan describes, some functional parallels can be found in the shared common kitchens and communal buildings of some intentional communities. According to Bohannan (1965: viii), Morgan held a mature theory of social groups' needs and "an idea of culture (though he did not use the words) as the device by which such needs are met." Julian Steward expanded on the idea of culture as a localized adaptive strategy to meet the needs of peoples in specific environments, which became a characterizing feature of the field of cultural ecology that emerged from Steward's work (see Steward 1955).

Cultural Ecology and Ecological Anthropology

Julian Steward is credited with the theory of cultural ecology, which seeks to understand the processes that societies use to adapt to their environments. Cultural ecology examines the way that the physical world influenced changes in culture. Steward (1955: 5) explains that cultural ecology seeks "to explain the origin of particular cultural features and patterns which characterize different areas rather than to derive general principles applicable to any culture-environmental situation." Cultural ecology attempts to determine if the adjustments of societies to their particular environments require specific approaches or if there is freedom for a variety of cultural approaches while paying closest attention to the approaches that are involved in the exploitation of the environment in prescribed cultural manners (Steward 1955).

Like cultural ecology, ecological anthropology focused on the ecological population and viewed culture as the primary means of environmental adaptation. It arose in Columbia University in the 1960s (Kottak 2006). According to Brosius (1999: 278), ecological anthropology is characterized by a "persistent interest in localized adaptations to specific ecosystems," with cultural factors being viewed primarily in consideration of their adaptive significance. The ecological anthropology that emerged in the 1960s was known for its focus on negative feedback, systems theory and functionalist perspective, but there were factors that forced the discipline to rethink some of the old assumptions of ecological anthropology (Kottak 2006).

The "new ecological anthropology" (or environmental anthropology) that Kottak (2006) discusses attempts to understand and develop solutions to problems such as environmental racism, environmental degradation, environmental hazards, and the roles played by non-governmental organizations (NGOs) and the media while taking political awareness and policy concerns into consideration. Environmental anthropology draws its insights from a variety of sources such as "poststructuralist social and cultural theory, political economy, and recent explorations or transnationalism and globalization" (Brosius 1999: 278). Consequently, new subfields such as political ecology (discussed below) and applied ecological anthropology have emerged (Kottak 2006). The new ecological anthropology uses a linkage methodology, looking at varying levels of the world stage and the linkages between them. One of the ways anthropologists pursue linkages research is to study sites which are chosen based on certain similarities or differences which "extend… to the levels at which policies are worked out," with the aim being to "link changes at local levels to those in regional, national, and world systems" (Kottak 2006: 48-49). This research will examine foundational policies at the community level to see if they impact the variability of architectural practices and technologies found in individual communities.

Political Ecology

The roots of political ecology run deep, being traced back to the writings of great thinkers like Hobbes, Adam Smith, Malthus, Ricardo, and Marx (Greenburg and Park 1994). “Political ecology is an interdisciplinary, non-dualistic strategy that remains under development, and perhaps deliberately so, seeking to describe the dynamic ways in which, on the one hand, political and economic power can shape ecological futures and, on the other, how ecologies can shape political and economic possibilities” (Center for Energy and Environmental Policy 2010). Brosius (1999) states that political ecology attempts to understand the ways the environment serves as a locus for enacting and perpetuating patterns of inequality. While others attempt “to explain the evolution of specific cultural practices and institutions in terms of adaptations to ecological systems and to explain how internal dynamics within systems can actually lead to change and development through time” (Greenberg and Park 1994: 4).

Vernacular Architecture & Anthropology

Rapoport (1969) and Turan Mete (1996) point out that much architectural theory and history has focused on the study of monuments such as temples, palaces, and other grand structures rather than examining the mundane structures of common people. After World War II, there was a surge in interest in primitive architecture due to disappointment in unsustainable modern architectural solutions (Lawrence and Low 1990). An example of the unsustainable nature of homes can be seen in the amount of energy that goes into their production and maintenance. Lockyer (2008) notes that the average person living in the US used 57.5 Barrels of Oil Equivalent (BOE) each year and that, out of this, seven BOE went to home use, heating and cooling, lighting and appliances. This seven BOE is approximately what a person in the developing world would use in a year (Lockyer 2008). Harris (1999) reports that about 50% of all primary energy used in the U.K. goes toward servicing buildings and that an additional 8% is used in the manufacture and transportation of building materials. With these high levels of energy use, it is clear that housing must become more sustainable.

Part of the previously mentioned interest in primitive or traditional architecture is spurred on by some authors' claims that these types of structures are inherently sustainable (Oliver 2007; Rudofsky 1964). These structures may be viewed as simple compared to contemporary structures, which require more energy and technology to support. Primitive or traditional architecture may also require less embodied energy to construct. Embodied energy is the amount of energy that goes into making, transporting and disposing of a product (Verbeeck and Hens 2010).

Verbeeck and Hens (2007, 2010) claim that to increase the energy performance of a structure, extra materials and components are added, such as added insulation, resulting in higher embodied energy. Harris (1999) notes that when improvements are made in one aspect of a building's energy performance, degradation may occur in other aspects. For instance, extra insulation in an outer wall may lower the heating requirements of a building, but the embodied energy it may require and the additional carbon dioxide it may emit can outweigh the lifetime energy savings it provides (Harris 1999).

While the terminology is still somewhat incongruent, terms such as "primitive," "vernacular" (preindustrial and modern), "popular," "folk," "domestic" and "traditional" all refer to buildings constructed by non-pedigree (meaning non-professional) architects (Rudofsky 1964; Rapoport 1969; Upton 1983; Oliver 1997). "Often 'vernacular architecture' has been a catch-all term for the study of kinds of buildings neglected by traditional architectural history" (Upton 1983: 263). This means anything that is clearly not the product of a high style, an “upper-class, avant-garde, aesthetic movement” can potentially be studied under the rubric of “vernacular architecture” (Upton 1983: 263). Upton also makes an important distinction for the term “vernacular,” noting that vernacular architecture is not a category that buildings either do or do not fall into, but “an approach to architectural studies that complements more traditional architectural historical inquiries” (1983: 263). Under this classification, a wide variety of contemporary structures can be studied as vernacular architecture.

Bernard Rudofsky (1964) examines non-pedigree architecture of peoples around the world and claims that “vernacular architecture does not go through fashion cycles” because it is “unimprovable” as it serves its purpose so well. Paul Oliver (1997) argues the importance of studying vernacular forms because of the insight they give into environmental adaptation, and that ensuring a sustainable future will require using these forms. Amos Rapoport (1969) claims that built forms are principally influenced by sociocultural factors, and are modified in response to the climate in which they are constructed, as well as the material limitations faced by the group. Studies of primitive, traditional or vernacular architecture do not address the abilities of people to construct their homes out of materials that may not be found locally (within a few miles of the building site), nor can they examine the impacts of modern technologies, such as forced air heating and cooling systems, that tend to uncouple buildings from the climatic conditions in which they are constructed. However, some intentional communities have been known to follow a few traditional or vernacular, as well as experimental approaches, in the construction of their homes.

Intentional Communities and Architecture

Intentional communities act as live-in laboratories for experimenting "in cultural, social, political, economic and technological change toward sustainability" (Lockyer 2008: 20). This includes experimenting with alternative forms of construction. The use of "local, non-toxic, recycled materials" and "non-traditional, highly insulative building technologies" such as straw-bale can be found in today's ecovillages and cohousing communities (Lockyer 2008: 20). This practice includes building with earth, and is in many ways a link back to traditional building structures. Building with earth has a very long history dating back at least 9000 years, and earth composes the bulk of building material used throughout human history. Even today, as much as 1/3 of the human population still resides in earthen structures (Minke 2006).

Lockyer (2007) notes that Earthaven ecovillage's A&A House (a large home where guests and visitors are lodged) features insulation made of recycled newspaper cellulose. Blouin (2007) briefly mentions that Twin Oaks uses "super-insulation" but never discusses what it has made from. The EcoVillage of Loudoun County use Structural Insulated Panels (SIPs) made of "oriented strand board that sandwiches expanded polystyrene insulation" that have a lifetime warranty, release no Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs), or Hydrofluorocarbons (HFCs), and are not supposed to twist or warp (Boastfield, 2010). Whether this insulation contributes to sustainability or has an embodied energy that outweighs its lifetime usage is yet to be determined. Alternative construction materials also can be used to reduce a building's embodied energy without extra components. Using alternative building materials such as adobe, lime, cow dung, cob, etc. has been shown to reduce a building's embodied energy (Shukla et al. 2009).

Intentional communities also may follow other vernacular traditions in their pursuit of creating a sustainable future, such as harvesting community owned timber for building, thereby keeping both money and resources in the community (Lockyer 2007; Veto and Lockyer 2008). They also may use primitive construction techniques, such as human power instead of machine power, to lessen their environmental impacts. One such method includes building orientation designed to use the sun's rays in winter for solar gains, with some type of thermal mass (used tires, concrete, adobe or cob, etc.) to absorb the solar energy and redistribute the energy at night. This method of heating can be traced back to Roman and Greek times, though the degree and success to which it was used remains questionable (Butti and Perlin 1980; Ring 1996). The use of earth as a building material has a very long history, as mentioned earlier. Building out of cob (a mixture of soil or clay, sand, and straw) is seen in many intentional communities, such as Dancing Rabbit Ecovillage and Earthaven Ecovillage (dancingrabbit.org 2012; earthaven.org 2012). As with timber structures, earth and straw structures often are built by community members from resources found within or near the community.

The practices and technologies communities or individuals may use can take a variety of appearances, from very high-tech to very low-tech, and can span in price from very expensive to free. For example, installing photovoltaic panels may be expensive, and it could take up to 12 years to pay back the embodied energy that goes into them (Wilson and Young 1996), or one could build with cob or adobe, where there is virtually no embodied energy costs (Shukla et al. 2009). This research will identify what specific practices are being implemented in these communities and why. Another objective of this thesis is to see if communities are sharing their practices with wider society and, if so, how they are doing it.

Diffusion and Culture Change

Rip and Kemp (1998) point out that technology is not only a functional artifact but is symbolic and ideological as well. One example given by Rip and Kemp (1998) is that of the automobile in Norway. The car not only functions as a method of travel but also serves as a symbol of modernity and "grew into a critique of everyday life" (ideology) (Rip and Kemp 1998). One can contend that architectural practices and technologies used by intentional communities are representative of their ideological reaction to mainstream culture. Items like solar water heaters, for example, fulfill a functional purpose but also lend a physical symbol to an ideology of lessening one's impact on the environment. The diffusion of these practices, technologies and beliefs into wider society may provide a conduit for sustainability. If the communities proposed for this study are indeed experimenting with technologies and architecture, it is important to see if they are attempting to spread knowledge of their successes or failures, as they embody the quintessential dilemma of capitalistic reality versus utopian ideology found at the heart of the sustainability debate as described by Lockyer (2007). The reality that our current patterns of production and consumption are unsustainable create inequalities in social relations and requires a utopian vision to question these patterns and define and enact alternatives to them (Lockyer 2007). Lockyer (2007: 8), drawing from the works of Fernando (2003) and Bebbington (1997), suggests that intentional communities act as "islands of sustainability" where alternative "intellectual and material practices are being experimented with" and may play a significant role in contributing to sustainable practices.

According to Mead (1955: 259), "in most areas people can not be motivated to adopt new ways on the basis of logical evidence of better results or of charts or scientific arguments." While in this instance Mead is referring to behavior, the same may be said of changes in technologies. Echoing Mead's sentiment, but in regard to technology, Podolny and Stuart (1995: 1225) note that it is "frequently observed that the 'best' technologies (e.g., on the basis of price-to-performance ratios) are not necessarily the most successful ones…" This is due to technologies being embedded within cultures and the matrix of interdependent technological regimes as described by Rip and Kemp (1998). These observations reiterate the need for a utopian vision in the quest for sustainability. Mead's observation appears problematic in relation to the Earth Charter's call for a change "in our values, institutions and way of living," because this change necessitates an accompanying change in behavior. Intentional communities may provide examples of alternative values, social institutions and ways of living, which could prove more compelling than simply trying to convince people to adopt new behaviors.

The question posed here is whether or not these communities are modeling their homes for wider society. As was previously discussed, some intentional communities experiment with alternative forms of building materials, construction practices, and technologies. The potential importance of these material practices to reduce energy requirements of homes as well as the embodied energy of homes can hardly be understated, and for need for this type of grassroots community-based ecological movement already has been stated by international directives toward sustainability and researchers studying sustainability. If the communities proposed for this study are experimenting with alternative building practices and technologies, it is important to see what approaches they are taking, the variation of their approaches, and how they may be promoting their building techniques as models for wider society to follow.

CHAPTER III

INTENTIONAL COMMUNITIES AND DECISION-MAKING

This chapter is devoted to giving a general overview of intentional communities. While there are many different types of intentional communities, this paper focuses specifically on ecovillages and cohousing communities, as these are the types represented in this study. This chapter will also discuss Formal Consensus and Dynamic Self-Governance (or sociocracy), two types of decision-making processes that are associated with the intentional communities in this study.

Intentional communities

Intentional communities are groups of individuals who have voluntarily and intentionally chosen to live within close geographic proximity to one another in order to attain some type of common goal or purpose that arises as a response to some critique of dominant culture (Lockyer 2007). Often, they are attempting to improve perceived social problems with deliberately formulated alternative social, political, spiritual or economic systems in mind (Lockyer 2007). There is a great amount of personal interaction within the group, along with some degree of economic sharing, altruism, or the suppression of individual choices for the greater good of the community (Lockyer 2007). A group of this sort is invariably characterized by the sense of disconnection from the dominant surrounding culture (Lockyer 2007).

For many Americans, the image of an intentional community may be either that of the hippie communes or of religious compounds, and in both cases they would be correct.

However, these notions lie at the extreme ends of the spectrum of intentional communities and certainly do not give a complete picture of what intentional communities are. According to Fellowship for Intentional Community's website (2010), an intentional community is an "inclusive term for ecovillages, cohousing communities, residential land trusts, communes, student co-ops, urban housing cooperatives, intentional living, alternative communities, cooperative living and other projects where people strive together with a common vision." Some of these communities are inspired by a shared concern with current practices of resource exploitation and their potential consequences. As well, intentional communities can act as laboratories experimenting with alternative forms of social interaction, economics and technological changes toward sustainability (Lockyer 2008).

Intentional communities have a long history. Lockyer (2007) notes that the phenomenon of intentional communities can be traced back more than two-thousand years, typically as groups seeking freedom in spiritual practice. Religious-based intentional communities flourished during the 12th, 13th, 16th, and 17th centuries in Europe, and in America between the 17th and 19th centuries (Lockyer 2007). Lockyer (2007) notes that, in the 1960s and 1970s, there were several thousand intentional communities in the United States. The "hippie communes" of the 60s and 70s, according to Lockyer (2007), are most often recognized as a manifestation of modern intentional community building in the United States, and possibly represent the largest period of intentional community development in any period of history. Currently, there are numerous intentional communities, which are increasingly interconnected through communication networks, organizations, conferences and publications (Lockyer 2007). Fellowship for Intentional Communities, Gaia Trust, Global Ecovillage Network and

Cohousing Association of the United States represent are examples. These networks help groups to form new intentional communities and allow existing groups to share ideas. Over the last few decades there has been a surge in intentional community formation in the form of ecovillages and cohousing communities (Lockyer 2007).

As mentioned above, intentional communities may take numerous forms. This research examines three intentional communities; all three are cohousing communities but one also identifies itself as an ecovillage. The next two sections will briefly give a general description of ecovillages and cohousing communities.

Cohousing

Cohousing communities are "old-fashioned neighborhoods," where people know and interact with their neighbors; these communities combine private homes with commons facilities and use consensus to make decisions (Cohousing Associations of the United States 2010). Cohousing typically refers to a community that is setup as a small neighborhood, in which each household is fully featured (meaning that each home has all the amenities typically found in homes), and the community also shares a common house or other common facilities as well as common spaces (Cohousing Association of the United States 2010; Fellowship for Intentional Community 2010). Shared space or commonly owned property is referred to as a common area. Residents also actively participate in the design as well as the operation of their community (Cohousing Association of the United States 2010). The physical design of these communities encourages social contact but also respects private space (Cohousing Association of the United States 2010). These communities typically attempt to make the community pedestrian-oriented (Fellowship for Intentional Community 2010). This means that vehicle traffic is often designated to the outskirts of the community while the center of community is dominated by pedestrian-only sidewalks that facilitate the social interaction of residents. Often, construction happens all at once, although some communities use retrofitted buildings (Fellowship for Intentional Community 2010). Cohousing community members also typically share some meals together and pool their resources, but residents generally do not share their incomes (Fellowship for Intentional Community 2010).

Ecovillages

Ecovillages can exist in either rural or urban settings, they consist of people "who strive to integrate a supportive social environment with a low-impact way of life" (Global Ecovillage Network 2010b). Typically, an ecovillage is built around some combination of social, ecological and spiritual dimensions, though one dimension may be more dominant or excluded altogether (Joseph and Bates 2003). While there seem to be some similarities in ecovillages, there are no specific criteria for determining what is or is not an ecovillage. Indeed, there can be overlap where an ecovillage is also a cohousing community. The term ecovillage has been around for about three and a half decades. In 1975, *Mother Earth News* began construction of an education center, which included experimental buildings, energy systems and organic gardens close to its business in Hendersonville, North Carolina. It started calling the center an "eco-village" in 1979 (Bates 2003). At around the same time, in Germany, a group of anti-nuclear activists tried building a small, ecologically centered village in the town of Gorleben to protest the disposal of nuclear waste; they called the village *ökodorf*, which literally means ecovillage (Bates 2003). Meanwhile, in Denmark, there were a number of cohousing communities (and other types of cooperative housing) that began looking at the ecological potential of these communities, and in 1993 the Danish ecovillage network, the *Landsforeningen for Økosamfund*, emerged as a model for the movement that was to come (Bates 2003).

The next part of this chapter deals with two decision-making processes found to be used by the communities of this study. The first is Formal Consensus that is used by Liberty Village and by Catoctin Creek Village, and the second is Dynamic Self-Governance, which is used at EcoVillage of Loudoun County.

Conflict and Consensus

> If war is the violent resolution of conflict, then peace is not the absence of conflict, but rather, the ability to resolve conflict without violence (Butler 1987).

When people decide to live together in an intentional community, they must have a method for decision-making. These people must at times make decisions that impact the community as a whole. Two of the communities use Formal Consensus as described below. The EcoVillage of Loudoun County's decision-making process will be discussed in the section regarding that community. The rules and regulations for Catoctin Creek Village specify Formal Consensus as the main decision-making method. One resident from Liberty Village mentioned that C.T. Butler (see next section) actually came to their community to give a weekend workshop for training the community to work in this process. Formal Consensus strives for fairness and equal participation, making it an ideal choice for any groups seeking social justice, which as noted earlier, intentional communities often seek to promote. This could be a reason why Fellowship for

Intentional Communities links to the handbook for Formal Consensus decision-making on their website (Fellowship for Intentional Communities 2010). This process can be used to address decision-making regarding resource management issues at the community level and can conceivably be used at higher levels of political interaction.

There are several methods of decision-making for groups, including autocracy, oligarchy, representative democracy or majority rule, to give a few examples. The particular type of decision-making relevant for the communities in this study is called Formal Consensus. Autocracies and oligarchies do not allow participation of people who are directly affected by decisions, but representative democracy, majority rule, and consensus include everyone to a different extent (Butler 1987). Formal Consensus strives to be a fair process that includes all members of a group. A commitment to cooperation is required. However, this does not mean that people must be in complete agreement on a topic. Formal Consensus actually encourages and works best in an atmosphere where non-violent conflict exists, so long as it can be resolved cooperatively (Butler 1987). This is because decision-making is not only about coming to an agreement but about addressing conflict regarding issues related to that agreement.

The point of Formal Consensus is to come up with a proposal that is best for the group as a whole. Proposals are considered one at a time, and everyone works to modify the proposal until it is the best decision for the group (Butler 1987). When a proposal is being considered, people are responsible for voicing any concerns they have with the original proposal. All concerns must be resolved before a decision can be adopted, unless the person or persons with concerns opt to *stand aside* and allow the adoption of the proposal, while still noting that a concern exists (Butler 1987). If an individual or individuals still entertains legitimate concerns, the proposal is *blocked,* meaning that it is unable to be adopted at that particular meeting. An organization must define its commonly held principles if it wishes to develop a more formalized type of consensus process (Butler 1987). The foundation for decision-making, and for legitimizing concerns, comes from commonly held decisions and principles that initially created the group (Butler 1987). This means that when an obstinate concern is keeping a proposal from being enacted, that concern can be scrutinized to see if it is in line with the original guiding principles of the group. If the concern is principled (meaning it is in accord with the original guiding principles of the group), it is considered legitimate and the proposal is blocked, but if the concern is deemed unprincipled, the group can decide to drop it from the discussion.

As was previously mentioned, two of the communities in this study use Formal Consensus to make decisions that affect the group. The attempt to use a fair process of consensus to address important issues facing the community can be viewed as a utopian undertaking where individuals experiment in social justice. This experimentation can be seen as an example of the counterhegemonic utopian vision that Fernando (2003), states is a valuable contribution to rethinking sustainable development.

Dynamic Self-Governance

Dynamic Self-Governance (also known as sociocracy) is a method of decision-making that operates by consent rather than by consensus. In consensus-based decision-making, participants vote "for" a decision, whereas in consent-based decision-making, people vote "against" or "not against" the decision at hand, preserving their ability to make related independent decisions (Sociocracy Center 2012). A decision only can be made if there is no objection to making that decision (Twin Oaks 2012). In consensus, a decision can be vetoed and blocked without an argument, but in consent, when a decision is challenged, the objector must provide a reasoned argument as to why they are against the decision. A decision is accepted only when no one present has an argued objection against the decision (Sociocracy Center 2012). Sociocratic systems strive for equality because everyone in the decision-making process has equal power, the power to veto a decision (Twin Oaks 2012).

In a sociocratic system, members are organized into a series of semiautonomous circles, arranged into a hierarchical structure (Sociocracy Center 2012). The hierarchies do not represent a power structure, though. Circles have their own aims, mission statement and vision, but these must fit with the aims, mission and vision of the organization as a whole, as well as with all of the other circles in the organization (Twin Oaks 2012). Each circle is connected with the circle above it by a double link, two people who are members of both circles (Sociocracy Center 2012). Members can nominate themselves or other members for roles and responsibilities during discussions and make arguments for their choice. After the discussion, members can change their nominations if they like and elect someone else for a particular role or responsibility.

Much like Formal Consensus, the sociocratic system is meant to decentralize power and empower the people directly affected by the decisions of an organization or community.

The next chapter deals with technologies, architectural designs and practices which were found in this study. These approaches to sustainability could have major impact on energy and resource consumption both nationally and globally if adopted by enough people.

CHAPTER IV

RELEVANT TECHNOLOGIES, ARCHITECTURE, AND PRACTICES

This chapter discusses technologies, architectural designs and practices which contribute to achieving a sustainable future by reducing the energy use of homes and lessening our impact on the environment and our consumption of natural resources. Some of these technologies provide alternative energy; others allow residents to reduce their heating and cooling needs by providing free heat for water and homes or allowing resident to be comfortable at warmer temperatures than they normally would be. Other architectural practices and technologies help to mitigate stormwater runoff and conserve water. These technologies and sustainable practices can have major impacts on the energy use and impact a home has on the environment.

Green Roof

A green or living roof is a roof that is covered with living plants (see Figure 1); that is to say vegetation of some type. This could be anything from fruits and vegetables, to grasses or succulents, to shrubs and vines. The only thing that determines what is grown is the owner's interest, the depth of the growing medium, and the amount of weight the building's skeleton will support. A living roof has several advantages. It is resistant to freeze-thaw cycles and to UV damage (Snell and Callahan 2009). This attribute helps to extend the life of the roof. The roof of a building is where the most heat is gained in summer and lost in winter. Another advantage of a green roof is that it acts as a large thermal mass (more on this later) buffering the structure from temperature swings.

This means that the daytime heat often never even reaches the insulated layer of the roof, much less the inside of the structure. According to Melby and Cathcart (2002), by comparing the summer temperature of a sunny sidewalk to that of a grassy area you will find a temperature difference of between sixteen to twenty-two degrees Fahrenheit. This is because the grass shades the soil, while reflecting heat. Evapotranspiration, evaporation along with the release (or transpiration) of water from the plants, helps to cool the area as well. In cities, these living roofs can have a great impact, where conventional rooftops can be as much as 90 degrees hotter than the air temperature (EPA 2012a).

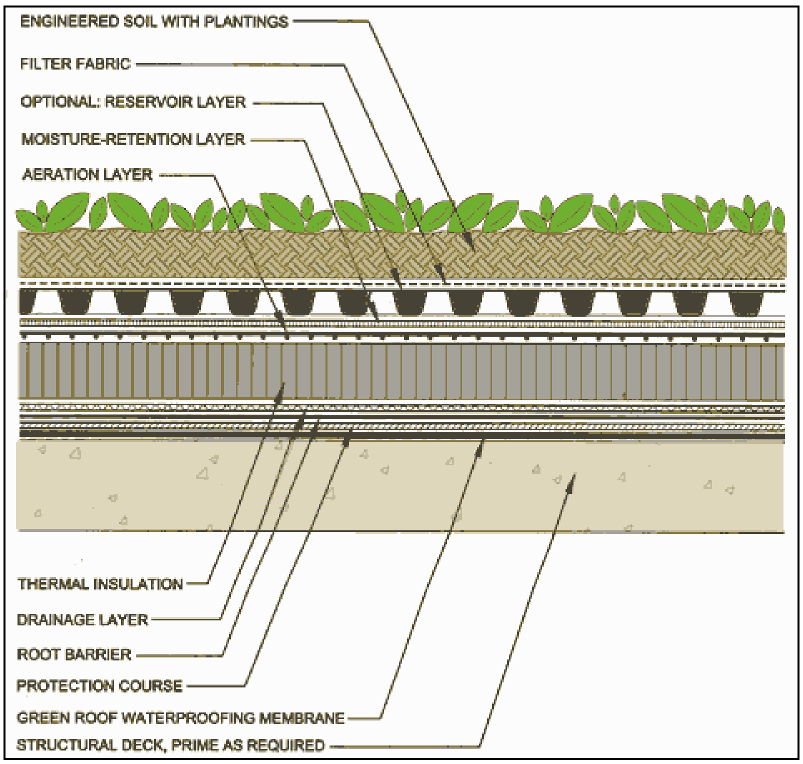

Figure 1 Diagram of a green roof. *Source:* Eco Brooklyn Inc. (2012).

Living roofs are being used in cities more and more as a means of reducing the urban heat island effect. The urban heat island effect is caused primarily by the replacement of porous natural landscapes with non-porous surfaces. These non-porous surfaces tend to absorb most of the solar radiation and then release it, causing the heat island effect as well as preventing the absorption of water after rainfall. This effect can increase the temperature of a city with a million plus people by between 1.8-5.4 degrees Fahrenheit during the day and as much as 22 degrees in the evenings (EPA 2012a). The rise in temperature can increase peak energy demands and air conditioning costs in the summer months, boost greenhouse gas emissions and air pollution, and increase heat-related illness and mortality (EPA 2012a). Incorporating green roofs in cities can reduce these negative consequences of the urban heat island effect. Aside from the previously mentioned benefits of green roofs, they also help to manage stormwater runoff.

The impervious surfaces of city spaces prevent rainfall from being absorbed and instead channel it into the sewer infrastructure. This over stresses sewer systems in cities across the nation (Greenroofs 2012). Living roofs help to restore the natural hydrologic cycle (evapotranspiration, water retention and minimized runoff) by increasing on-site water retention and lowering the flow of stormwater to sewer systems.

Gray Water and Composting Toilets

Composting (or dry) toilets are toilets that require no water to operate. Composting toilets come in many different types, from what is essentially nothing more than a bucket with sawdust in it to far more complex systems. Dry toilets, according to Scott and Chilton (2006), represent an important technology when it comes to the design and construction of the sustainable built environment because the continued large-scale exportation of sewage is no longer practical within the framework of sustainability. Contemporary sewage is unsustainable because it requires massive amounts of potable water, a huge capital investment, and causes water pollution in rivers and along coastlines, as well as wasting nutrients that could be used as fertilizer (Scott and Chilton 2006).

The current practice of sending massive amounts of human waste into the sewer system or septic tanks requires the use of water. This water is the same as the water we drink. It has been pumped from aquifers and has been filtered and treated to make it potable for us to drink. According to the Environmental Protection Agency's website, the average home uses approximately 26.7% of this water just to flush toilets (EPA Water Sense 2012b). This accounts for the largest water use in a home, followed at 21.7% for washing clothes (EPA Water Sense 2012b). By contrast, only 15.7% of a home's water use occurs at the faucet and 16.8% in the shower (EPA Water Sense 2012b). It should be clear that using a composting toilet would save a great deal of potable drinking water. But there is another way to conserve water, a method to give water from the faucet, clothes washer and shower a second chance.

Gray water (or greywater) is wastewater without inordinately large concentration of bacteria or organic matter (Melby and Cathcart 2002). Typically, this water comes from showers, sinks, and clothes washers. A gray water system can be used in place of treated drinking water for applications such as flushing toilets or landscape irrigation. Using this approach reduces the amount of water a household uses because it reuses water that otherwise would go straight into the sewer or septic tank. This can be especially valuable in areas experiencing water shortages.

Photovoltaic (PV) Panels

Of the many renewable energy resources available today, solar energy is the most promising and encouraging because it is noiseless, does not suffer from mechanical losses, and takes less maintenance than other sources of renewable energy (Obaid 2010). Photovoltaic Panels (PVPs) are an established technology that directly converts sunlight into electricity that, at the time of this writing, has high initial costs. PV energy can be viewed as sustainable for a couple of reasons. The energy they produce has no associated waste (Melby and Cathcart 2002). PV produces no CO^2 or other pollution associated with burning fossil fuels. They use solar radiation that is practically inexhaustible, and they have little embodied energy as well as a long life expectancy (Melby and Cathcart 2002). Solar panels also have no mechanical losses, produce no sound, and require little maintenance (Obaid 2010). This is because there are no moving parts to break down, make noise or lose energy. PV can be considered a universal energy source because nearly everyone has access to sunlight (Obaid 2010). Photovoltaic panels can be used as the sole source of electricity for people wanting to live "off the grid" (these are battery storage systems), or they can be tied into the grid, or they can be a hybrid system (a system that combines two or more sources of power, such as a gas-powered generator) (Melby and Cathcart 2002). Only the grid tie-in system is applicable to this study.

As the name implies, a grid tie-in (or grid linked) system maintains a connection with the power utility grid and has no storage capacity of its own (Melby and Cathcart 2002). A grid tie-in system has the advantage of not requiring expensive batteries to provide power during nighttime when no power is being produced by the panels. This type of system also allows the power company to purchase and redistribute green energy. The use of PVs (regardless of the type) will reduce one's personal use of fossil-fueled electricity with the added benefit of reducing or eliminating one's electric bill (Melby and Cathcart 2002).

Solar Hot Water

Solar water heaters (SWH) have a long history and once were commonplace in several states across the U.S. (Butti and Perlin 1980). In fact, the first commercial solar water heaters were produced in Baltimore, Maryland in 1891 (Butti and Perlin 1980). At that time, using solar was cheaper than using natural gas, electricity was even more expensive, and fueling wood stoves (the traditional method) was a major chore (Butti and Perlin 1980). Over the past one hundred and twenty years, access to cheap fossil fuels has made solar water heaters far less commonplace. However, using solar radiation to heat water can save anywhere from 30-100 percent of fossil fuel energy normally used to heat water (Melby and Cathcart 2002). According to Cassard, Denholm and Ong (2011), a typical residential consumer will save 50-85 percent on water heating demands, some 1600-2600 kilowatt hours annually, by using SWH. As with PVs, solar water heaters use the inexhaustible power source of the sun. Using this free energy to heat water can lead to significant energy savings, as water heating can take approximately twenty percent of the energy used at a residence (Melby and Cathcart 2002). This savings could range from around $100 to $300 or more per year on an electric bill (Cassard, Denholm and Ong 2011). Water is the largest energy expense in a home next to space heating and cooling respectively (EPA 2012c). Electrically heated water uses in excess of 120 billion kilowatt hours in the U.S. annually (Cassard, Denholm and Ong 2011).

A solar water heater allows for the heating of water by sunlight (see Figure 2). Solar water heaters either directly heat the domestic water or heat an antifreeze solution that is run through a heat exchanger. Once the water is heated, it is typically stored in the conventional water heater for distribution. Storing the water in a conventional tank has the advantage of heating water at night when the sun is not shining, or on overcast days if the water does not get as hot as one prefers. It also has the advantage of using the hot water tank's insulation to keep the water heated. The hot water is treated the same as domestic hot water for baths, etc., but because it heats for free, it can be used another way and save people even more money.

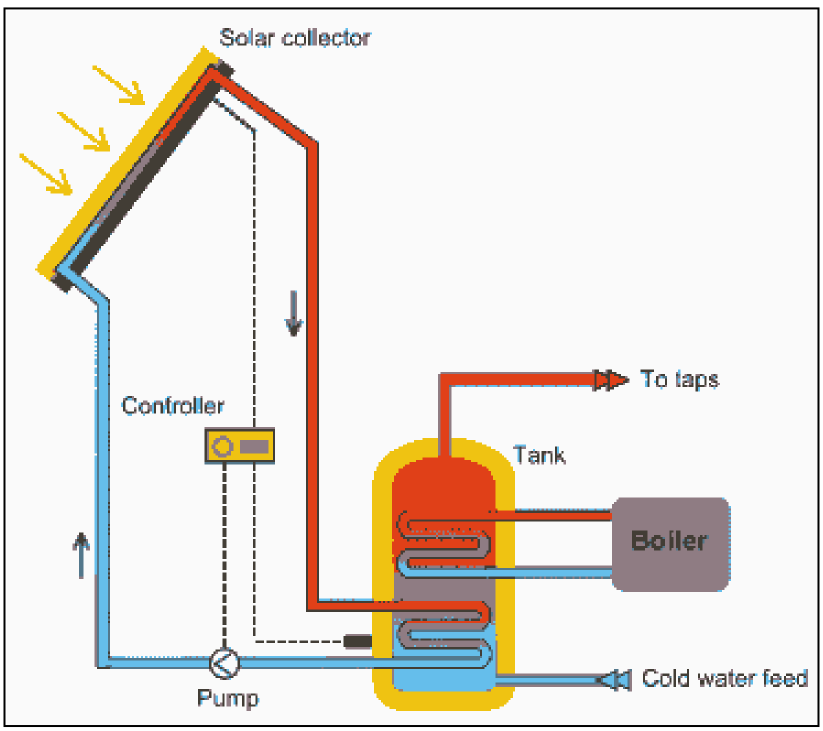

Figure 2 Diagram of solar water heating system. *Source:* Solar Energy Facts (2012).

Radiant Flooring

Solar-heated water can be used to heat interior spaces through radiant heated flooring for greater savings on heating costs (Melby and Cathcart 2002). Remember, space heating is the most energy-expensive activity for a home. Because it is solar powered, solar-heated radiant flooring further reduces the home's use of fossil fuels for heating (Melby and Cathcart 2002). There are three types of radiant flooring, electric, air heated and hydronic (U.S. Department of Energy 2012a). It is worth taking a moment to discuss all three.

Air-heated radiant floors use air as the heating medium. Warm air does not hold a great deal of heat, is not a cost-effective system for residential applications, and is rarely used[1] (U.S. Department of Energy 2012a).

Electric radiant flooring uses electric cables (or conductive plastic) built into the subfloor below a covering such as tile to directly heat the floor (U.S. Department of Energy 2012a). These systems are typically not cost-effective because of the relatively high cost of electricity, however, if there is a significant thermal mass (discussed later) to hold the heat, it can potentially become cost-effective (U.S. Department of Energy 2012a).

The third type, the hydronic system, is the most popular and cost effective (U.S. Department of Energy 2012a). A hydronic system, as Melby and Cathcart (2002) describe it, is "a system of heating or cooling that involves the transfer of heat by circulating a fluid in a closed system of pipes" (Melby and Cathcart 2002: 213). The hydronic is placed under or in the floor where heated water is pumped through tubes to warm the floor to a desired temperature. The expression "radiant heating" is a bit of a misnomer in that all of these systems actually employees all three types of heat transfer (convective, conductive and radiant heat transfer).

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[1] This method of heating is often linked with a wood burning heater called a rocket mass stove and ducted into benches or walls (thermal masses) to heat homes or outdoor seating in some intentional communities. See Dancing Rabbit Ecovillage 2012b.

From the point that water (or air) is heated and moved through the pipes, the heat transfer is conductive (as with electricity), meaning this is direct contact between objects, namely the tubes or cables and the floor. The floor then heats the interior space by convection or the movement of molecules in the air. It heats by radiation as particles of greater heat diffuse into cooler objects. An example of this is feeling the heat from a hot stove. It again heats by conduction, where objects in the room such as table legs and human feet are warmed by direct contact with the floor. Radiant heat transfer accounts for the largest portion of heat transfer in one of these systems, and that is the reason for the name.

Thermal Mass and Passive Solar Orientation

Much of being sustainable is attempting to live in harmony with the landscape. Orienting a dwelling to take advantage of the winter sun for heating is one method of achieving this goal while reducing energy consumption. This basic strategy can be traced back thousands of years and through various cultures (Butti and Perlin 1980). It also has major architectural design implications because, unlike active heating systems, a passive system is intimately built into the architecture of the structure (Moore 1993). Passive systems do not use fans or pumps to run; they use natural means of heat transfer (radiation, convection and conduction) along with architectural design to warm buildings (EPA 2012d). Active systems are mechanical systems that can be placed anywhere, and the heated (or cooled) air is simply piped to the place one wants. This isn't the case with solar heating.

One must be conscious of the cycles of the sun, both daily and yearly. In basic terms, one simply orients their home to capture as much of the winter sun as possible.

This typically involves orienting the long side of the structure to the south, including large, south-facing windows, for people living in the northern hemisphere or vice versa for people living in the southern hemisphere (See Figure 3). These windows let sunlight into the structure, which in turn warms the interior space. For a passive solar heating system to function effectively, there must be sufficient insulation to prevent heat loss and there needs to be a thermal mass available to absorb, store, and redistribute the heat collected during the day back into the space at night (Moore 1993; Melby and Cathcart 2002; Snell and Callahan 2009).

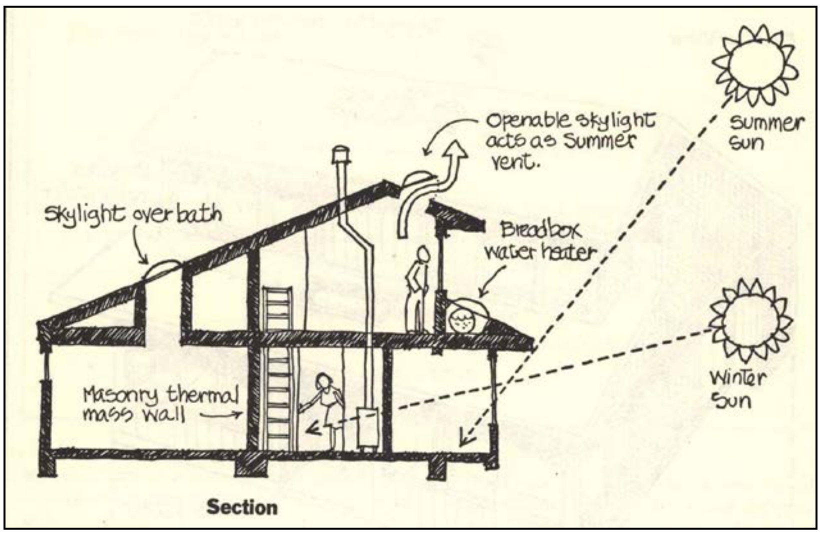

Figure 3 Passive Design Diagram. *Source:* East St. Louis Action Research Project (2012).

A thermal mass refers to a material with good thermal storage capacity, something like concrete, brick, water or adobe[2], rather than materials like carpeting or wood flooring. A thermal mass also helps to keep the temperature stable throughout the day by absorbing excess heat, and the more mass that is present the smaller the

[2] For a more extensive list of the thermal storage capacity of common building materials, see Moore (1993)

temperature fluctuation (Moore 1993). A thermal mass allows the nighttime temperature to drop slowly thereby reducing the need for supplemental heat. Without adequate thermal mass, a dwelling may overheat during the day, requiring cooling, and then require heating at night due to rapid heat loss (Melby and Cathcart 2002). Passive solar orientation combined with thermal mass can save between twenty and one hundred percent of fossil fuels for space heating (Melby and Cathcart 2002).

Central Heat and Air and Geothermal Systems

In terms of energy usage, heating and air conditioning (also known as AC or air source heat pump) account for around fifty-five percent (over half) of a home's energy consumption (Melby and Cathcart 2002). Air conditioners use approximately five percent of the electricity produced in the U.S., accounting for over $11 billion of cost to homeowners (EPA 2012e). This usage results in around 100 million tons of CO^2 being released into the atmosphere each year; this is around two tons per home with an air conditioner (EPA 2012e).

An air conditioner works by evaporation. It is a closed loop system, meaning that it is a continuous coil where heat is collected on one end of the loop and moved to the other to be released. Air conditioners are typically air compression systems that exchange inside heat with the outside atmosphere. Virginia often has warm summers; the average maximum temperatures from 1895-1998 have been (in Fahrenheit) for May 75.8, for June 82.9, for July 86.1, and 84.6 for August (University of Virginia 2012). Maryland's temperature is similar (Maryland State Archives 2012). These are, of course, averages, and while I was there the temperature reached the mid-90s by the end of the first week of July. These temperatures could make living without air conditioners difficult for many people. According to the U.S. Department of Energy, two-thirds of all U.S. homes have air conditioners (U.S. Department of Energy 2012b). Air conditioners use a good deal of energy, but there is a more efficient form of central heat and air.

A geothermal system (or ground-assist heat pump) takes the place of the outdoor heat exchanger in the HVAC system, and instead of exchanging heat with the air, it exchanges heat with the earth. See Figure 4 for an illustration of geothermal heat exchange. The reason this is important is because it is not as easy to exchange heat into a gas as it is into a more dense substance. At around five feet in depth, the temperature of the earth stabilizes to around 55 degrees year-round (this varies depending on where you are) and, because of the constant temperature of the earth, geothermal systems are far more efficient than an air-exchange system (Melby and Cathcart 2002). Geothermal systems are powered by an electric pump that cycles water or antifreeze through long tubes, which run over a hundred feet in the earth. The piping can be laid horizontally or vertically or can be placed in a pond or lake. The installation process for a geothermal heat pump requires digging into the earth and laying tubes, which causes the price for one of these systems to be several times more than an air-source of equivalent capacity (U.S. Department of Energy 2012c). Geothermal systems cost several times more than a conventional air conditioning system and the prices can vary greatly. I conducted a search online for a two ton geothermal unit and found prices ranging from a little over $3,000 to over $6,000 dollars and this is without the cost of instillation. The price of installation, particularly the ground loop portion, is extremely variable depending on the region, the soil composition and the availability of contractors and the only way to know how much it will cost it to have a professional come examine the area and give an estimate. The price is often justified by the savings these heat pumps can provide, up to 60% over conventional heating and cooling (Melby and Cathcart 2002). The additional costs of installing a geothermal system can be returned over a five to ten year period (U.S. Department of Energy 2012c). Their long life expectancy of fifty years for the ground loop and twenty-five years for the inside component make geothermal systems more appealing (U.S. Department of Energy 2012c).

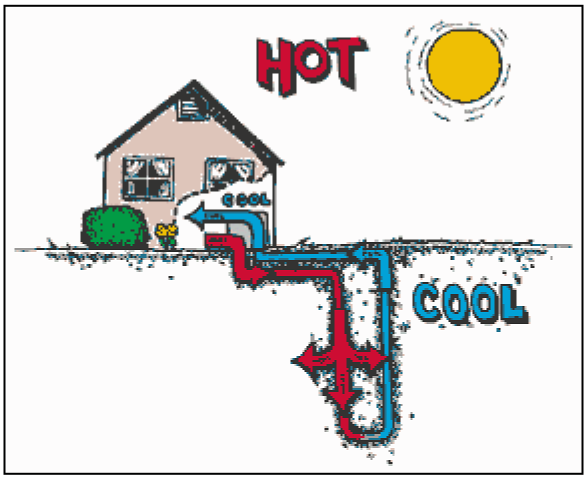

Figure 4 Illustration of a geothermal system. *Source*: Waterways Plumbing and Heating (2012).

Low Flush Toilets

Low flush toilets help to ease the consumption of water resources. Toilets installed before 1980 had an average rate of 5 gallons per flush (gpf); this rate dropped to approximately 3.5-gpf from 1980-1994 (Martin and Heaney 2011). The Energy Policy Act of 1992 (actually went into effect in 1994) established a 1.6-gpf volume on all gravity tank type toilets (EPA Water Sense 2012f).

Passive Air Flow

Another of the most common features found in my study is the use of passive air flow (or ventilation), which is a passive cooling technique that has been used since ancient times (Moore 1993). Ventilation is a passive method, meaning that no pumps or fans are used to move air for cooling. Moving air can be accomplished in a number of ways (see Moore 1993). Here, I focus on wind-driven ventilation, essentially opening windows to catch a breeze (cross-ventilation). Cross-ventilation works by opening two or more windows, allowing air to enter and exit a room or home, and works best when windows are opposite one another, allowing air to pass directly through the cooling area.

Ventilation can be used two ways: warm air can be exhausted from a building and replaced by cooler outside air, or air can be moved directly over an occupant to cool by evaporation and convection (Moore 1993). That is to say that one can use ventilation for home cooling or for person cooling. The temperature at which people are comfortable, their comfort zone, increases with the addition of moving air (Sonne et. al. 1996). In other words, someone can tolerate warmer temperatures if there is a breeze present. This is because the warm air adjacent to a person's skin is displaced by moving air faster than it would be in still air (Moore 1993). This basic of rule of heat transfer allows people to feel cooler at temperatures that normally would be warmer than are comfortable to them. Along with the convective cooling, ventilation will cool by evaporation. The evaporation of sweat increases with air movement because the more saturated air near the person's skin is displaced by drier ambient air (Moore 1993). Using natural, wind–driven ventilation reduces cooling cost of a home during favorable times of the year. One does not need to use the AC if they are comfortable with the windows open.

Ceiling fans

Ceiling fans are mechanical means of cooling people by moving air. As previously mentioned while discussing ventilation, people's comfort zones are extended in warm environments by the use of moving air. Convective cooling does not work well on objects that do not produce their own heat; therefore, fans do little in the way of home cooling. Ceiling fans can be used in conjunction with natural ventilation or with mechanical cooling to enhance their effectiveness. When used with natural ventilation, the cooling season may be extended into warmer weather, when people may otherwise close the windows and use air conditioning. When fans are used with mechanical cooling, people can set the thermostat to a higher temperature than they may find comfortable without the added circulation of air. The use of these fans in these ways can reduce energy costs to residents.

There is a caveat about the use of fans with air conditioning, however. If the temperature is set two degrees Fahrenheit higher, a fan can save about fourteen percent on annual cooling (this takes into account the fan's energy use and its released heat (Sonne et. al. 1996). However, if the thermostat is not adjusted for use with the fan, the energy use may actually increase by up to fifteen percent (Sonne et. al. 1996). I did not inquire as to whether or not residents used their fans in conjunction with their central air or not, or if they raised the temperature of the thermostat when using fans. Therefore, the true savings or lack-thereof is unknown.

Reused, recycled or salvaged

One of the most recognized slogans from resource conservation campaigns is "reduce, reuse, and recycle." That is, to reduce the amount and toxicity of waste you throw away, reuse containers and other items, and recycle items you can while buying products made with or containing recycled content (EPA 2012g). These habits can apply to homes as well. Materials can be salvaged not only from on-site waste and be reused but materials can come from the demolition of other structures. Thrifty individuals can occasionally salvage furniture, shelving, lumber, carpet or any number of other things from the demolition of another building. Individuals can also opt to purchase materials composed of recycled materials.

This chapter discussed a variety of technologies architectural designs and practices. These approaches to sustainability can greatly contribute to a more sustainable future. They can take pollution out of the atmosphere, conserve considerable amounts of water, and mitigate stormwater runoff, prevent tons of waste out of landfills, and save a great deal of energy for heating and cooling homes. Taken together these technologies can not only save resident hundreds of dollars each year and they can greatly reduce a home’s impact on the environment.

The next chapter discusses the research setting for this project. This includes communities and the states and counties in which they are located, as well as zoning regulations which impact development within the states.

CHAPTER V

RESEARCH SETTING

It is important to first understand a little about where these communities are located and how county-level politics has shaped their development before describing the individual communities. Catoctin Creek Village (CC) and EcoVillage of Loudoun County (ELC) are both located in Loudoun County, Virginia. Loudoun County has a concentration of wealth. It has been rated by the U.S. Census Bureau' *Income, Earnings, and Poverty Data From the 2005, 2006, 2007 American Community Surveys* as having the highest median household income per year of any County in the U.S. in 2005 (at $98,483) and 2007 (at $107,207), and it came in second in 2006 (at $99,371) (Webster and Bishaw 2006, 2007; Bishaw and Semega 2008). The U.S. Census Bureau's State & County "QuickFacts" online shows Loudoun County having a median household income of $111,582 in 2008 (U.S. Census Bureau 2010). For comparison, Frederick, Maryland (where Liberty Village (LV) is located) had a median household income of $78, 437 in 2008 (U.S. Census Bureau 2010). It is important to note the general trend of difference in incomes between these two counties.

Developers and individuals interested in developing a subdivision must comply with county zoning regulations, regardless of location in the country. These regulations are beyond the control of the individuals. Any visions or goals that people have for developing an intentional community must work within the state and county guidelines if they wish to proceed with construction. This is true for all communities, including the ones in this study.

Virginia

The State of Virginia's statutory law is the Code of Virginia. These statutes define the policies of the counties, towns and cities and outline the intent of the state. It is title 15.2 (chapter 22) of the Code of Virginia that deals with zoning, planning, and the subdivision of land in the state's political boundaries (American Planning Association 2009). The declaration of legislative intent 15.2-2200) gives explicit guidance to local governments, as shown below:

> This chapter is intended to encourage localities to improve the public health, safety, convenience and welfare of its citizens and to plan for the future development of communities to the end that transportation systems be carefully planned; that new community centers be developed with adequate highway, utility, health, educational, and recreational facilities; that the need for mineral resources and the needs of agriculture, industry and business be recognized in future growth; that residential areas be provided with healthy surroundings for family life; that agricultural and forestal land be preserved; and that the growth of the community be consonant with the efficient and economical use of public funds."
>
> Title 15.2-2200 Code of Virginia 2012

The local government is also mandated by state law to adopt a comprehensive plan, and the plan needs to include a wise use of land and resources, anticipated future needs, beneficial development patterns, the most cost-effective use of tax money, and a good environment for people to live in (American Planning Association 2009). In the Code of Virginia there are four primary tools that local level government can use to implement their comprehensive plan: The Official Map; Subdivision and Site Plan Regulations; Capital Improvement Programs; and Zoning Tools (American Planning Association 2009). The most relevant of these in the case of this research project are the zoning tools. There are several variants of zoning in Virginia, including Agricultural or Large Lot Zoning, Cluster Zoning, Historic District Zoning and Traditional Neighborhood Development, to name some of the prominent variations (American Planning Association 2009). Zoning is intended to prevent disruptive land use patterns and will be discussed in the description of Loudoun County below.

Loudoun County is on the periphery of Washington D.C. and acts as an exurb. Exurban counties extend sixty or seventy miles from the circumferential highways of all metropolitan areas; these counties include those that have been added to larger metropolitan vicinities since the 1960s, as well as adjacent nonmetropolitan or nonadjacent nonmetropolitan counties (Davis, Nelson, et al. 1994). Essentially, this definition accounts for all counties surrounding or near a metropolitan area. Loudoun County's population nearly tripled in the fifteen years between 1990 and 2005, from 86,000 to 248,000 (Orski and Shaw 2005). In 1999, officials were elected on a "smart growth" slate due to this expansion (Orski and Shaw 2005). A respondent from CC referred to this election of the board of supervisors as a "slow growth or no growth" ticket. The county of Loudoun essentially placed a moratorium on the development of new community subdivisions. In 2003, the board of supervisors changed the zoning rules to require ten or twenty acres per home, and up to 50 acres in some instances (Orski and

Shaw 2005). These county-level political decisions directly affected the way ELC and CC could develop, as will be seen later.

There was some backlash to these building restrictions. According to Orski and Shaw (2005), there were critics who chided these as exclusionary policies cloaked as environmental preservation acts, which actually sheltered well-to-do landowners from the encroachment of suburbanization. The new zoning regulations would not stop sprawl, as other critics noted, but would instead cause it to spread over an even larger area, albeit with less density (Orski and Shaw 2005). There also were a number of court cases against the county by land-owners who felt that a suburban type of development was more appropriate (Sympoetica 2010). In response to these court cases, Loudoun County developed the "Rural Hamlet Act." A rural hamlet is an alternative to large-lot zoning developments. Loudoun County developed the concept of "rural hamlet" to preserve farmland and maintain the rural character of agricultural areas (Sympoetica 2010). The Rural Hamlet Act is ultimately an extension of the Agricultural and Forestal District Act created in 1977 (Isle of Wight County 2011). Under the Rural Hamlet Act, a new development is required to preserve 85% of the open space. The homes must be single-family homes, and each lot has to be 10,000 square feet.

Maryland

Maryland has a long history of looking to find methods of managing land use. Maryland has the oldest planning commission in the country, the Maryland State Planning Commission, founded in 1933 (Maryland Smart Growth Indicators 2012). Later, the Planning Commission was elevated to the Maryland Department of Planning, and since the 1970s has been enacting legislation aimed at protecting rural areas and deterring “sprawl development” (Maryland Smart Growth Indicators 2012). Sprawl development refers to urban sprawl that destroys green spaces. The state created environmental programs to protect “tidal and non-tidal wetlands, to preserve farmland, to purchase open space for parks, to regulate storm water runoff from development projects and require trees to be preserved or planted to replace those cut to make way for development,” while revitalizing older urbanized areas (Maryland Smart Growth Indicators 2012). The logic behind these programs (discussed later) is that wildlife habitats, agricultural lands, scenic spaces and clean water are at risk from sprawl development and rural subdivisions, with around 25,000 acres lost per year (Maryland Department of Natural Resources 2012).

In the 1990s, Maryland began instituting Smart Growth Programs. Smart Growth Programs have four clear-cut goals: 1) to support communities that already exist, where infrastructure already exists; 2) to save valuable natural resources before they are lost; 3) to save taxpayers the cost of building infrastructure for developments that have spread far away from traditional population centers; and 4) to provide a high quality of life for Marylanders regardless of whether they live in a city, small town, suburb or rural community (Maryland Department of Planning 2012c).

In 1992, Maryland passed the Economic Growth, Resource Protection, and Planning Act (Maryland Department of Planning 2012a). This Act originally had seven visions (an eighth was added in 2000) that articulate the growth policy for the State that local jurisdictions are required to incorporate into their development plans (Maryland Department of Planning 2012a). These visions are:

1. Development shall be concentrated in suitable areas; 2. Sensitive areas shall be protected; 3. In rural areas, growth

> shall be directed to existing population centers and resource areas shall be protected; 4. Stewardship of the Chesapeake Bay and the land shall be a universal ethic; 5. Conservation of resources, including a reduction in resource consumption, shall be practiced; 6. To encourage the achievement of paragraphs (1) through (5) of this subsection, economic growth shall be encouraged and regulatory mechanisms shall be streamlined; 7. Adequate public facilities and infrastructure are available or planned in areas where growth is to occur; and 8. Funding mechanisms shall be addressed to achieve this policy (Vermont Journal of Environmental Law 2012).

The Planning Act was created to direct development at both the State and local levels, and funding decisions for public construction must hold to these visions (Maryland Department of Planning 2012b). Part of complying with this Act is identifying sensitive areas and having plans that contain goals, objectives and standards that are designed to reduce damage to these areas. These areas include streams and their buffers, the habitats of endangered and threatened species, and consideration of floodplains and steep slopes (Maryland Department of Planning 2012b). This legislation has acted as a foundation for other policies to follow.

Since 1992, Maryland has adopted a number of other Smart Growth policies (Maryland Department of Planning 2012c). These include the Rural Legacy Program (1997) The Smart Growth and Neighborhood Conservation Acts (1997), the Priority Funding Areas Act (1997), and, more recently, the Smart Green and Growing (2009), and

Sustainable Communities legislation (2010) (Maryland Department of Planning 2012d, 2012e).

The Rural Legacy Program was enacted to help preserve rural agricultural lands by protecting private land with conservation easements that keep the land from being developed in the future (Maryland Department of Planning 2012e). The program aims to make sure that farms stay viable and to make sure Maryland families will continue to have jobs in the agricultural economy (Maryland Department of Planning 2012e). The Priority Funding Areas Act of 1997, Smart Green and Growing legislation of 2009, and Sustainable Communities Act of 2010 follow the Planning Act of 1992 in placing emphasis for development on existing communities (Maryland Department of Planning 2012f). The Priorities Funding Areas Act would have been in place as Liberty Village began construction. The more recent Smart Growth programs may potentially impact LV in unknown ways as it continues to grow in the future.

Communities

Some of the information about these communities comes from data gathered during fieldwork. The description for each community is laid out in a similar fashion. First, is the community's mission statement, followed by a brief note on the way the group is organized, and their decision-making process. Next will be a description of the house type, the amount of property owned, how much of it is developed, and the number of homes currently in the community and the number expected.

Table 1 Community Overview

	CC	ELC	LV
Organized	Co-housing	Co-housing	Co-housing
Decision-making	Formal Consensus	Sociocracy	Formal Consensus
Home types	Single Family	Single Family	Duplex
Total size of property (acres)	164	180	23
Developed property (acres)	49	13.5	8
Number of homes	9	14	18
Homes when complete	18	25	38

Catoctin Creek Village

Catoctin Creek Village's mission statement reads:

> It is our mission to build a cooperative community where residents pool resources in order to have greater access to natural beauty, recreational facilities, shared meals, educational resources, entertainment, childcare, security, a sense of belonging, and fellowship. We want to create a physical and social environment that fosters spontaneous, neighborly interaction while safeguarding the independence and privacy of each individual and family. Membership is open to all who want to live collaboratively and contribute to our diversity. No one doctrine, philosophy, or lifestyle is promoted. (Catoctin Creek Village 2008: 1)

Catoctin Creek Village is organized as a co-housing community. The community uses the Formal Consensus decision-making process.

CC is an intentional community, still in the construction phase. Figure 5 shows a few of the homes in CC. The community began to form in 1998 as the original group of members came together. This group of investor families bought the land for the community in 1999, but it was not until 2005 that the group gained subdivision approval from the county board of supervisors and sold the first lots. There are currently nine homes in the community, counting the common house, with plans to expand up to eighteen homes. These are single family homes (this is a requirement of the Rural Hamlet Act); however, some homes contain renters along with the resident family, which may also be a multigenerational family. There is at least one home in the community that contains a multigenerational family along with a renter.

Figure 5 View of three CC homes.

The community is planned in a way to “conserve open spaces, protect natural bodies of water, and to preserve views of rolling hills, mountains, and open sky” (Catoctin Creek Village 2010). One way this community conserves open spaces is by developing only 15% of the total community property. This is not only an environmental move, but a political one. By planning Catoctin Creek Village to develop only 15% of its total property, the community qualified for one of the requirements of the Rural Hamlet Act. Had CC not developed their property in this manner, they would not have been permitted to build. The community consists of 164 acres of land, 115 of which are to be left undeveloped, and is comprised of both private and communal property. The undeveloped property is owned by the community as a whole, while the homes and lots are privately owned.

The oldest home is used as the common house (see Figure 6). This house was built around 200 years ago, long before the community was ever conceived. It and the barn are the only two structures that existed before the community. They are used for community functions such as cookshare meals, barn dances, parties, movie nights, community meetings, and as a gathering point on work days. The common house is also home to four renters, each with their own quarters. All residents of Catoctin Creek Village share part ownership of the common house, barn and community equipment. On the following page, Figure 7 shows the site plan for the community, and Figure 8 shows a satellite view of Catoctin Creek Village. They may opt to donate time and energy to maintain the community grounds or the common area, (during work share days) in exchange for a reduction in their home-owner fee.

Figure 6 Common house at CC.

The other houses of the community vary in size, shape, and method of construction. Some of the homes were constructed from prefabricated modules. One resident noted that his lot went from a cleared space to a shell of a house in just a few days. Other homes were built on site in a more traditional manner, not using prefabricated sections. The community does not place regulations on the manner of construction or features of the homes.

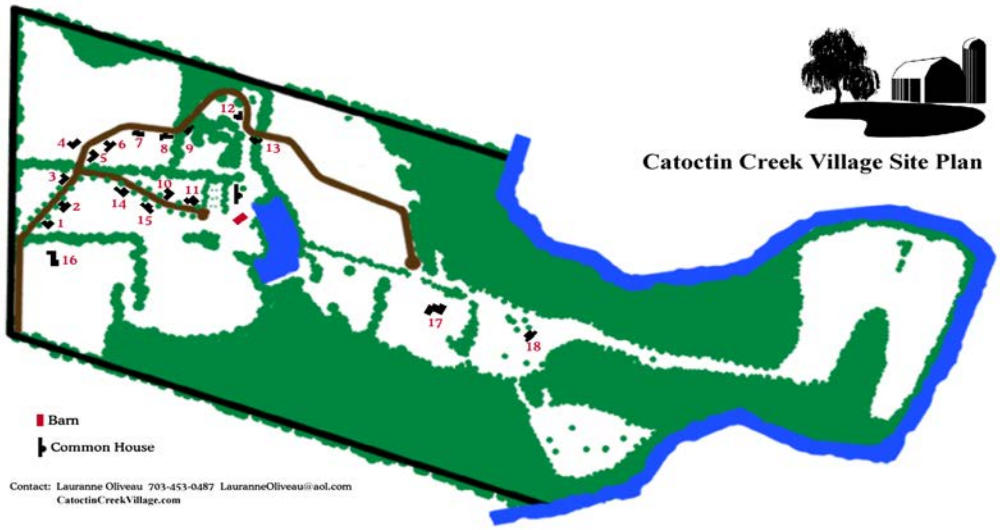

Figure 7 CC Site Plan. *Source*: Catoctin Creek Village (2012).

Figure 8 Satellite view of Catoctin Creek Village. *Source*: Google Earth (2012a).

EcoVillage of Loudoun County

EcoVillage of Loudoun County's (ELC) mission statement reads:

> EcoVillage of Loudoun County combines the co-housing ideal of people living together in community with the ecovillage ideal of people living in harmony with Earth and its inhabitants. We aim to

> restore nature and expand human potential by creating a lifestyle that nurtures the human spirit and offers hope for future generations. (EcoVillage of Loudoun County 2010a)

ELC is organized as a cohousing community. ELC is different from the other two communities in that it does not use Formal Consensus as its decision-making process. This community uses a Dynamic Self-Governance system, also known as a sociocracy.

The original size of the property was 180 acres, which has been divided in two, a northern and southern section, each of 90 acres (EcoVillage of Loudoun County 2010a). Setting aside conservancy lots is one way the ELC strives to reach its stated goal of restoring nature. The northern section is composed of three conservancy lots (lots not to be developed), one of which is in a permanent conservation easement, and 25 rural hamlet lots (EcoVillage of Loudoun County 2010a). The southern 90 acres (plus the 10 acre lot in the northern section) have been placed under a permanent conservation easement under the care of the Northern Virginia Conservation Trust and are no longer a part of ELC (EcoVillage of Loudoun County 2010a). Ecovillage of Loudoun County is still growing (Figure 9 shows a few spread out homes in the community). There are fourteen homes in the community, with plans to expand up to twenty-five when complete, not counting the proposed common house.

There were three investor families in the mid-nineties that bought the property. The location for the community was partly chosen for its zoning (it was already zoned for development) and also for its proximity to public transportation. They are around ten minutes' drive from the commuter train station in Point of Rocks, Maryland that connects with the Metro in Washington D.C. The selection of this property was carried out by three original families as well as other residents who joined later. One resident noted, “We were actually out on the property for days at a time, in tents or under canopies and exploring where to put the houses within the constraints of the Loudoun County requirements as well as the topography.”

Figure 9 Native plants with homes in background at ELC.

ELC is built on a farm zoned for residential construction, and the homes use “the latest innovations” to achieve a “healthy and green” design (EcoVillage of Loudoun County 2010b). Figures 12-15 show the community’s site plan and the satellite views of the neighborhood and total community property. These technological innovations include passive solar orientation, super insulation in the walls and roof, and ventilation systems to reduce heating and cooling needs, and geothermal systems, which will be discussed in depth later (EcoVillage of Loudoun County 2010b).

Preservation and restoration of biodiversity, as well as improving the quality and quantity of natural resources, with each successive generation acting to benefit future generations, are noted ecological goals (EcoVillage of Loudoun County 1999). The EcoVillage lists its social goals as protecting individual rights while fostering a spirit of community, and facilitating activities to benefit individuals, enhance the community, and promote positive relations with larger society (EcoVillage of Loudoun County 1999).

The community has several committees, one of which is the Architectural and Environmental Design Review Committee (A&EDRC). This committee is given the responsibility to approve all architectural and environmental alteration plans to the common area (space shared by residents), as well as improvements to the lots homes are built on. The community association has the right to remove any additions, structures, landscaping or other modifications to lots, at the owner's expense, which do not comply with the Architectural and Environmental Design Guidelines or the Governing Documents. The A&EDRC's aim is to establish standards that will protect and enhance environmental quality and aesthetic beauty as well as to promote the highest energy independence possible for the community (EcoVillage of Loudoun County 2006). The A&EDRC also may approve and impose more stringent standards for development and construction than are in the community's Architectural and Environmental Design Guidelines (A& EDG) (EcoVillage of Loudoun County 2006). This committee may also retain an architect, as needed, who has expertise in passive solar design and energy efficiency, along with a landscape architect or ecologist (EcoVillage of Loudoun County 2006). It is preferred that the designer of a home has participated in an education program for sustainable building (EcoVillage of Loudoun County 2006). This access to professionals with experience in passive solar design and sustainable building techniques helps to ensure that all homes built in the community will be constructed within the guidelines set forth by the community, with the goal of reducing environmental impact. One home in this community, while still conforming to the Architectural and Environmental Design Guidelines, is built differently than any of the other homes in this study. The respondent came in with his own design, his own designer (rather than an architect), and concept. But, he notes “there was no real conflict because our thinking was in line with their thinking.”

The Strawbale Home of EcoVillage of Loudoun County is the most unconventional home in this study (see Figures 10). This house is made from a combination of straw bales and timber frame construction (see Figure 11). Humans have used straw and hay in their buildings for thousands of years, though baled hay and straw didn’t appear until the late 1800s when baling machines were invented (Snell and Callahan 2009). According the resident, the timber used was harvested from about fifty miles away; the straw was from less than twenty miles, and the earthen plaster that covers the straw bale was from on-site. This home also has a composting toilet and a gray water system, and the owners have future plans to finish installing a green roof. These and other features will be discussed later.

Figure 10 Strawbale home in ELC.

Figure 11 Wall section showing earthen plaster wall meeting timber frame supports with a "truth window" showing off the straw bale used in the wall.

Figure 12 Northern 90 acre parcel for subdivision. *Source:* EcoVillage of Loudoun County(2012).

Figure 13 Total property site plan. *Source:* EcoVillage of Loudoun County (2012).

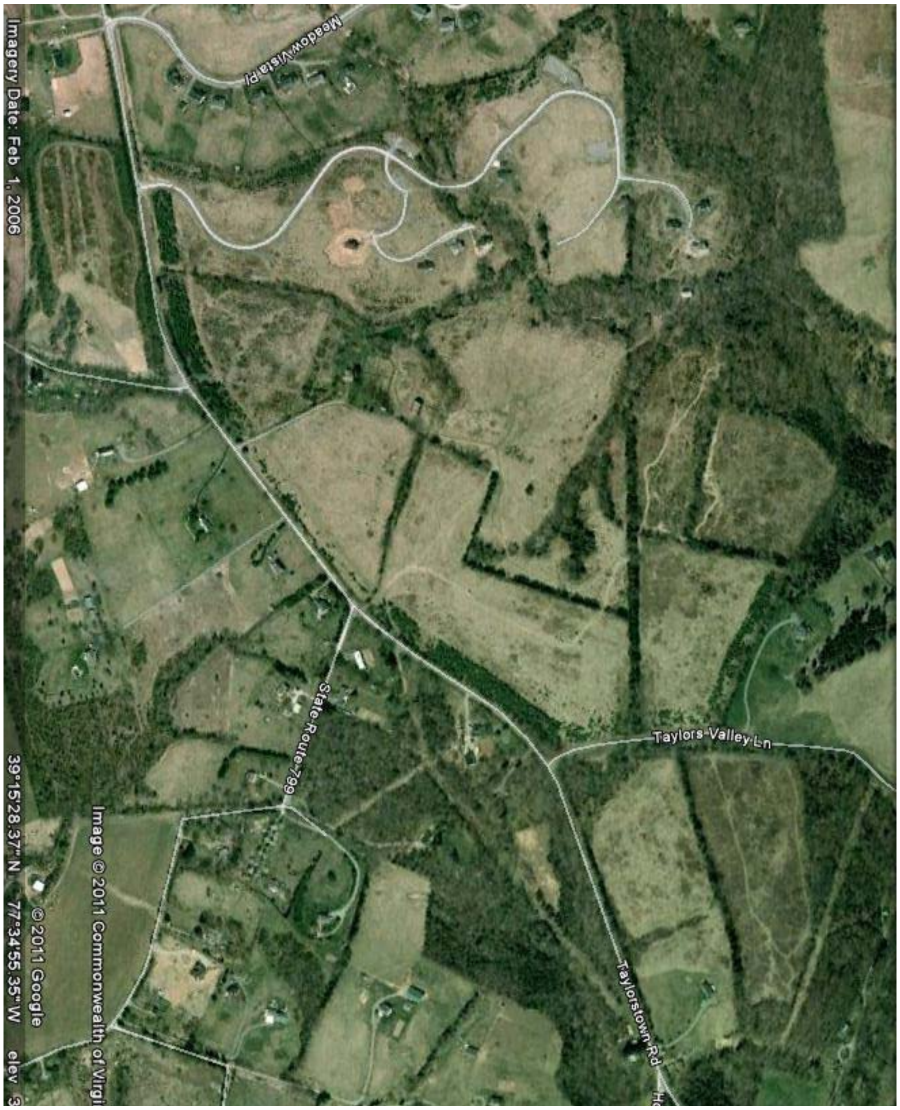

Figure 14 Satellite view of total EcoVillage property. *Source*: Google Earth (2012b).

Figure 15 Satellite view of EcoVillage of Loudoun County community. *Source:* Google Earth (2012c).

Liberty Village

> Liberty Village is a cohousing community in a beautiful country setting, where neighbors are friends. We balance privacy with neighborliness to support and extend each family. We play and work together with respect, honor, trust, and caring, using our differences to find new solutions and new ways to grow together (Liberty Village 2010a)

Liberty Village (LV) is a cohousing community located in Frederick, Maryland. This community uses Formal Consensus as its decision-making process. Liberty Village is still in the building phase, with eighteen homes and plans to expand up to thirty-eight by completion. At the time of this writing, the community lacks a common house but has intention of constructing one. Currently, the community uses a home that is unoccupied for their common house. This is where community meetings and potlucks are held.

The community owns twenty-three acres, eight of which are developed and fifteen which are left undeveloped. This community has a designated parking area and pedestrian-only sidewalks. The sidewalks are wide enough for vehicle traffic and can be opened when needed, (see Figure 16) but are usually left closed so that children can play freely. The design of the sidewalks also impacts the architecture of homes. The homes are built to face the sidewalks, so orientating the houses for direct solar gain was not possible. This is an instance where social concerns outweighed environmental concerns. Another aspect of architecture geared toward social concerns rather than environmental concerns is the first floor layout. All homes are similar in design. Homes all have a foyer (or air lock) facing the sidewalks. This leads to the kitchen, a recognized social area, and then on into the living room that is at the rear of the home. This is a design for social interaction and privacy, not sustainability. However, these socially-oriented decisions do not completely overshadow design aspects that reduce the community's impact on the environment.

Figure 16 A place for interacting at LV.

The homes are all built as duplexes[3], and each resident owns half of the building and one foot (beyond the building's footprint) of surrounding yard. This system of

[3] There are two homes in the community that are not duplexes. One of the first homes built was built for a resident who wanted a single family home with a small yard. Because the homes were supposed to be built

building is one way of reducing the community's ecological footprint. The shared walls of duplexes reduce heating and cooling requirements and therefore reduce environmental impact by not consuming as much fossil fuel as single family homes (EPA 2011).

LV got its start in 1994-1995 when the original investor families bought the land. These families had been together since 1985, when they read an article on cohousing. They had a speaker on the subject come out to give a talk and had thirty people come. From this first meeting, the core group formed. This group then attempted to buy a property unsuccessfully. In the mid-1990s the remaining families obtained the current location, and began building around 1999/2000. A resident remarked, "We were so naïve, we thought we would have it [LV] built in two years; that was a big joke. We started building in 1999 or 2000. When we built the first house there was no infrastructure, there was nothing and they couldn't live in it until we finished the infrastructure, so people had to dip down into their kid's college savings and everything, and we sold the old barn to raise money to finish the infrastructure for all 38 homes (public sewage, water, electric) and then we started building houses". Figure 17, below shows a satellite view of Liberty Village neighborhood.

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in pairs the group had to include another single family home to keep with the zoning plan they applied for.

Figure 17 Satellite view of Liberty Village. *Source:* Google Earth (2012d).

This chapter discussed the communities, the states and counties they are in. It also discussed the intentions on the states when it comes to planning and development as well as zoning ordinances which affect the communities. The next chapter discusses the methods used in this study.

CHAPTER VI

METHODS

Research was conducted from May to July 2010 in Loudoun County, Virginia and Frederick County, Maryland. The principal investigator conducted all research, including participant observation and semi-structured interviewing in these communities.

Sampling

Convenience and snowball sampling techniques were used to recruit subjects from the three communities. Because these methods of sampling were used, most participants were recruited from community activities or were referred by previously recruited participants. Data collection was conducted using two methods: a) participant observation and b) a semi-structured interview combined with a photographic walk-through survey of participants' homes. Participant observation is both a scientific and humanistic method that produces experiential knowledge (Bernard 2006). The interview schedule employed a questionnaire based on the ecological portion of the Global Ecovillage Network's Community Sustainability Assessment Toolkit (Global Ecovillage Network 2010b). The toolkit was adapted by importing questions about technological and design features.

I accompanied residents while documenting these features and asking questions about their significance. During this process, I inventoried features and technologies aimed at reducing environmental impacts, such as solar orientation for passive heat gain, window orientation for passive cooling, alternative energy production and storage, and use of locally available and reused or recycled materials.

The following sections will provide details of how I gained access to the communities.

Gaining access

I contacted community representatives to gain access to community functions. I made contact with representatives of Catoctin Creek Village and EcoVillage of Loudoun County via e-mail beginning in early March of 2010. After arrival in Virginia I made contact with Catoctin Creek Village, and a preliminary visit was scheduled. It was near the end of July 2010 when I first made contact with Liberty Village. I will briefly describe the events I attended at each community before discussing how interviews and walkthroughs were conducted.

Participant observation

Participant observation consisted of attending community events such as community meetings, workdays and barn dances at Catoctin Creek Village, and working with individuals constructing a home at EcoVillage of Loudoun County.

Liberty Village

Participant observation at Liberty Village consisted of a potluck and open house, a community meeting, and a fourth of July celebration for a total number of three visits. The community occasionally hosts an open-house for people who are interested in potentially living in the community or who are just curious. It is a chance to come and meet residents, to see the community, and to ask questions. These open-houses are frequently accompanied with potlucks. Attending these events allowed me to see how the community presents itself to outsiders interested in the neighborhood.

I attended one of the community meetings at Liberty Village. Community meetings operate as a means of facilitating changes within the community through the Formal Consensus process. These meetings allow residents to voice concerns or grievances, to make suggestions, and to come to consensus on issues. It is important to attend this type of event because these meetings represent the decision-making process of the community and provide insight into group dynamics and governance of the community.

Catoctin Creek Village

At Catoctin Creek Village (CC) I attended a workday and a barn dance. A work day is when residents come together to perform maintenance tasks around the common areas of the community. This maintenance consists of projects that residents report need doing, such as trimming bushes, cutting grass, or working on the community equipment. Participating in a community workday allowed me to gain insight into dynamics between residents as well as allowing me to gain access to residents for this project. I worked with four residents moving rocks, cutting grass, brush and some limbs. After the work was concluded, three of the residents (a married couple who built a house and a renter of the common house) and I ate lunch in the common house and chatted about my research interests and what the residents liked about living in the community.

The Taylorstown Community Association Barn Dance was held at CC on June 22nd, 2010. Taylorstown is a small town located close to CC. I helped clean and setup for the event. This event was aimed at bringing together people from the local area. The dance was a good opportunity to socialize with residents and recruit participants. There was a good turnout, including one resident from EcoVillage of Loudoun County who showed up along with various Taylorstown residents.

EcoVillage of Loudoun County

Participant observation at ELC consisted of one eight-hour day working with a man and his father-in-law while they were in the final stages of building a home. This day of work consisted of a variety of tasks: setting nails (making them set lower than the top of the boards) in the deck; staining boards with an all natural, non-toxic, oil wood finish; and helping move the washer and dryer into place. Engaging in this activity allowed me to engage with a future community resident and the individual most responsible for the design of the house and gave me access to other residents. Most importantly, it allowed me to interact with individuals who are in the process of constructing a home; they are still making some choices about features to include, and the reasons for their previous choices are still fresh in their minds. It also allowed me to interact with people not living in the community, but who were associated with it (i.e., the father-in-law).

Interviews and walkthroughs

Participant observation at community events, meetings, workdays, and gatherings enabled me to recruit subjects for semi-structured interviews and photographic walk-through surveys. Participants were chosen for the semi-structured interview and photographic walk-through survey based on residence in the community, as either a home-owner or a renter. Once a participant agreed to be interviewed, the semi-structured interview and photographic walk-through survey was conducted at that time, except where a rescheduling was necessary. I conducted four walk through and surveys at Catoctin Creek Village (44% of households; N=9), four at EcoVillage of Loudoun County (29% of households; N=14) and six at Liberty Village (33% of households; N=18).

The semi-structured interviews[4] were aimed at collecting information: 1) to measure the variability of architectural practices and technologies and its relationship to beliefs and knowledge regarding sustainability, conservation, and reduced environmental impact among residents of intentional communities; 2) to investigate whether these architectural practices and technical knowledge are transferred to wider society and if so how; 3) to examine how an intentional community's foundational documents impact the variability of architectural practices and technologies found in individual community homes; 4) and to see if people are copying traditional vernacular architecture of the region.

The survey included questions that probe subjects on their beliefs about sustainability and the degree of importance they place on these beliefs. These beliefs were then compared to the number of sustainable features at their home. The questions regarding beliefs were based on a five point Likert scale, (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree. The semi-structured interviews collected demographic information on household members in each community including: age, income, occupation, education level, number of residents in the household including number of children, and how long the respondent has lived in the community. This provided quantitative data on household makeup, economic standing, weekly

[4] See APPENDIX A

occupational requirements, and whether or not the community is supportive of the household (financially, emotionally, or by providing labor). These demographic questions provide insight into potential problems that prevent households from enacting practices they view as important or uncover factors that enable these practices.

Open-ended questions were used to collect qualitative data on a variety of topics, such as: the perceived importance of sustainability (drawing more detail than the ordinal data permits), why the subject joined the intentional community, what they hope to get from the experience, and questions about the practices of residents.

Limitations

The limitations of this research are small sample size and restricted access to community functions and limited geographic space. Originally, I planned to attend at least one community meeting and workday in each community. However, many functions such as community meetings and workdays only take place once a month or less frequently. With only two months of research time available, it was impossible to meet the schedules for each community. Time limitations also affected the overall number of interviews. While this project sampled 34% of homes in all three communities (CC 44%, LV 33%, and ELC 29%), more interviews could have been conducted had more time been available. With more time, in a population of only forty homes it is not inconceivable to achieve a sample nearing one-hundred percent.

Working in a rather limited geographic range also has implications for this project. CC and ELV are only about five minutes drive from one another and LV is only around an hour and a half drive. Because of their geographic proximity, these communities experience similar weather conditions and cultural landscapes, so it would be expected that the homes within these groups would be fairly homogeneous.

CHAPTER VII

ANALYSIS

In this chapter, I will discuss the findings of this research project. I will begin with a brief demographic analysis of the residents I interviewed to give as accurate a view of these communities as possible. Next, I discuss some of the least and most common features found in the communities and why these features were chosen. Finally, there will be a brief discussion about the belief scores of individuals.

Demographic analysis

A brief examination of my sample reveals that the average age of respondents (across communities) is 62 years old (see Table 2). This is the average age of participants not the households.

While the respondents' average age approaches retirement age, only two of the respondents (one from CC and one from ELC) identified as retired. The people I interviewed had a wide variety of occupations: a writer, a social work supervisor, a hospice supervisor, a visiting nurse, a nurse podiatrist, a research scientist, a teacher, an adult education and preschool teacher, a general contractor, a home remodeler, a consultant, and a self-employed antiques merchant. All of the residents in this study have some college experience and 64% of the respondents have a Master's degree or higher level of education. These are highly educated individuals with knowledge on many topics including environmental issues.

These variations in occupation lead to wide range in income scores. The average household income for CC is $132,500 (n=4), which is $20,000 more than the county's 2008 median household income of $111,582. However, it should be noted that ELC's median household income of $52,667 (n=3) is less than half of the county's median income for the same year (see Table 2). Liberty Village's average household income of $89,200 (n=5) was $10,763 higher than Frederick, Maryland's median household income of $78, 437 for 2008.

The average cost of homes (see Table 3) for the sample of homes in this study is $700,000 at CC (n=3), $383,333 at ELC (n=3), and $235,500 at LV (n=6). CC's homes are approximately $385,000 above 2011's median sales price for this Loudoun county zip code ($314,977),while the ELC's homes are just over $68,000 above this average (Trulia 2011). LV's homes are approximately $235,500, this is some $102,000 less than the corresponding median price of homes in Frederick county ($337,500) in 2011 (Trulia, 2011). The average price of homes at LV is much cheaper than those in either of the other communities and considerably cheaper than the average of Frederick County. This price difference between LV and the other communities also reflects the size differences in homes. The average size of homes sampled at CC is 4,567sq/feet while ELC homes averaged 2,108sq/feet, both of which are larger (with CC being considerably larger) than the homes at LV that averaged 1,898sq/feet. The homes in Liberty Village are smaller and less expensive than the homes of either community in Loudoun County.

From these analyses we can see that the average resident of this is study is approaching retirement age, has considerable disposable income, and owns a large and expensive home.

Table 2 Age and Household Income

Community	n	Average Age of Respondent	n	Average Household Income
CC	4	59	4	$132,500.00
LV	6	64	5	$89,200.00
ELC	4	63	3	$52,667.00

Table 3 Home Price and Square Footage

Community	n	Average home Price	n	Average Square Footage
CC	3	$700,000.00	3	4567
LV	6	$235,500.00	5	1898
ELC	3	$383,333.00	3	2108

Variation of Technologies, Architecture and Practices

The first aim of this project is to measure the variability of architectural practices and technologies and its relationship to beliefs and knowledge regarding sustainability, conservation, and reduced environmental impact among residents of intentional communities.

There are many ways to live a more sustainable life. One prominent way to contribute to a more sustainable world is be energy efficient. Energy efficiency in buildings reduces the use of non-renewable fuels along with the pollution associated with burning them. There are a number of ways to reduce the energy produced by fossil fuels required in a home. Along with cutting fossil fuel use, homes can be more sustainable by reducing or reusing water.

The next portion of this analysis deals with variations on these practices. I will begin with the least commonly found features from this study (see Table 4). These features can have a major impact on energy use and water consumption for a home. These features also are not commonly found in the typical North American household. The inclusion of these technologies in mainstream homes would have a significant impact on resource consumption, both in is this country and globally.

Least common features

Table 4 Least Common Features

Features	% CC (n=4)	% LV (n=6)	% ELC (n=4)	% Total (n=14)
Green Roof	0	0	25	7
Gray Water System	0	0	25	7
Composting Toilets	0	0	25	7
Photovoltaic Panels	0	0	25	7
Solar Hot Water	0	0	50	14
Thermal Mass	0	0	50	15

Green Roof

Only one home in this study has a green roof and, as previously mentioned, this feature was not completely installed at the time of the interview (see Figure 18). The only portion of the roof that was already intact was the waterproof membrane that the other components of the roof rest on. This is a partial green roof, meaning that not all of the home's roofing is living. In this case, there is a conventional-looking (though made of recycled material) roof over the second-floor portion of the home and a second roof that only covers part of the first floor living area. The green portion of this home's roof is over the west side of the first floor and over the door exiting the basement, also on the west side.

Figure 18 Waterproof membrane for green roof.

Only ELC had a home with a living roof. This type of roof will contribute both ecological benefits and energy efficiency to the home and are in line with the goals and visions of the community. The other homes in ELC have eco-shake roofs made of recycled vinyl and cellulose. Because of their rural settings and abundance of permeable surfaces, ELC and CC would gain more energy efficiency benefits from green roofs than ecological benefits. Liberty Village is less rural in nature and has more impervious surfaces in the way of parking lots and paved walkways. While LV doesn't deal with storm water runoff via architectural practices, it does use landscaping practices to achieve the same end by incorporating several rain gardens (or bioretention areas) as a means of mitigating stormwater runoff.

Green roofs have an ecological benefit of reclaiming or replicating a portion of the environment that was lost when the building was constructed. This gives living roofs their greatest impact in highly urbanized areas, where green space is at a premium. These living roofs can reduce the cooling costs and their associated pollution while helping to mitigate stormwater runoff.

Gray Water and Composting Toilets

Only one home in the study had a gray water system or a composting toilet; this was the strawbale home in ELC. This home combined the gray water and the composting toilet in one system. This system was referred to as a "nutra-cycle system" by the homeowner. The gray water and composted urine from the toilet was fed into an area populated by native plants at the time of my visit; later, it was to be planted with garden vegetables. Some of the other homeowners in this study expressed the desire to incorporate composting toilets but claimed they were restricted by county regulations. The strawbale home received experimental status from the Loudoun County Health

Department that allows for a 2,400 square foot area for this purpose. This home is the only home in this study that has this type of status.

Of the three communities, only ELC (see Figure 19) had a home containing a gray water system or a composting toilet. These features are not required by the community and, according to some residents, have been prohibited in the past by county health regulations. For the most part, these communities approach toilet water conservation through low flush appliances rather than through alternative technology.

Figure 19 Composting portion of composting toilet in basement of strawbale home.

Photovoltaic (PV) Panels

In the entire study sample, only EcoVillage of Loudoun County contained a home that had photovoltaic panels. This home belongs to one of the community's original families. These PVPs are tied into the utility grid rather than being tied to batteries for energy storage. The owner of the strawbale home in ELC said that he plans to add PVPs to the house sometime after it is completed.

Solar Hot Water and Radiant Flooring

Two homes in this study have solar water heaters and both of these homes tie their SWH into a hydronic radiant flooring system as well as into the domestic hot water. Both of these homes are in ELC. Figure 20 shows the solar water heater at the strawbale house while Figure 21 shows the plumbing tubes for the radiant flooring. Two other homes did have a form of radiant flooring. One home in CC had a heated floor in the bathroom, however, it was an electric system and it is unknown if this system reduces the home's energy consumption. A LV resident also had radiant-heated flooring in the basement, but this again was not tied into a solar hot water system so the previously mentioned energy savings do not apply.

Figure 20 Solar water heater at strawbale house in ELC.

Figure 21 Plumbing for radiant flooring.

Of the three communities, only one contained homes with solar water heaters. As with the PVs, the inclusion or exclusion of this technology was a personal decision, because there are no regulations regarding these systems at the state, county or community levels. A few residents noted that the high upfront costs impacted their decision not to get one. The fact that this feature was found at the ELC is consistent with the community's goal of having a lower environmental impact.

As previously mentioned, the U.S. uses over 120 billion kilowatt hours each year to heat water. SWH can save over half of the energy required to heat water, as well as making a major reduction in the fossil fuel need to produce that energy.

Thermal Mass and Passive Solar Orientation

In this study, two homes in ELC included high thermal mass in their homes to hold daytime solar energy, let in by strategically placed windows, for nighttime heating. Both of these homes used concrete for their thermal mass and large, south-facing windows to warm it (see Figure 22). These homes also use radiant flooring to augment the heat provided by the passive solar orientation of these homes. While two of the respondents at ELC did not report using thermal mass, all homes at ELC are oriented for passive heating. One resident in ELC noted some degree of difficulty gaining permission from the county to orient their homes for passive heating. The county's planning agency expected the homes to be oriented facing the driveways and required some convincing before signing off on the community's design.

Figure 22 Concrete thermal mass floor containing hydronic radiant heating at strawbale house in ECL.

None of the homes at LV were designed for passive heating and therefore none of them used thermal mass for this purpose. As previously noted, the homes of LV were oriented for social interaction, not for passive solar orientation.

Half of the homes sampled at CC two were oriented for passive heating. Both of these homes benefit from gaining solar exposure to heat their homes, but neither of them utilizes thermal mass to garner the full benefits available through passive solar heating. The resident I interviewed living at the common house in Catoctin Creek Village did not know if the home utilized thermal mass to heat the home at night. This home was built around 1750 and it most certainly contains a great deal of thermal mass. The home was originally built, at least in part, with thick stone walls, and some still exist. There is a central inside wall approximately three feet thick that houses an old fireplace. This wall would act in the same way to regulate temperature fluctuations as noted above. However, it is not likely to have been used to aid in passive solar heating.

All of the homes in EcoVillage of Loudoun County are oriented for passive solar gain, as is required by the Architectural and Environmental Design Guidelines (A&EDG) of the community. The A&EDG will be discussed in more depth later. While the A&EDG specifies the building orientation, the window orientation and the use of overhangs and pitch of roofs, it does not require thermal mass be used for heating purposes. The other two communities do not have a similar architectural guideline and, as previously stated, Liberty Village's main focus was on social interaction rather than passive solar design. Catoctin Creek Village had two homes with solar orientation and both of these were constructed by the same developer, a community resident. But the inclusion of this design was due to individual choice rather than a community covenant or bylaw.

Passive solar design employs the unlimited energy from the sun to warm homes in the winter. The use of an inexhaustible resource reduces the amount of non-renewable resources that a home will require throughout its life. Cutting back heating cost not only saves the homeowner money but lowers the amount of pollution he or she is directly responsible for.

The previous section dealt with the least commonly found features, which include: a green roof, composting toilet and gray water system, photovoltaic panels, solar water heater and passive solar orientation with thermal mass. The next section deals with technologies and practices that were commonly found in this study.

Most common features

The following covers the most commonly found features of this study. This section examines technologies that reduce energy and resource consumption by being efficient. As previously mentioned, being energy efficient was a predominant strategy for respondents in this study.

Table 5 Most Common Features

Feature	% CC (n=4)	% LV (n=6)	% ELC (n=4)	% Total (n=14)
Geothermal System	75	100	75	86
Low Flush Toilets	100[5]	100	75	92
Passive Air Flow[6]	75	67	100	79
Ceiling Fans	50	67	100	71

Central Heat and Air and Geothermal Systems

Only one home in this study did not have central heat and air. This home is the strawbale house in ELC, which intentionally excluded this technology in an attempt to reduce the home's impact on the environment. This home attempts to be as passive as

[5] One response is not counted.
[6] Planning a home for passive air flow can be an architectural feature but for the purpose of this research it is being treated as a behavior.

possible in heating and cooling, so leaving out this feature was an intentional decision. Rather than incorporating central heat and air, the strawbale home uses a combination of radiant heated floors that are supplied with solar heated water and thermal mass and passive solar orientation to heat, and a whole-house fan (or an attic fan see Figure 23) for summer cooling. An attic fan or whole-house fan is powerful exhaust fan placed in a central location that draws outside air into the home through open windows while blowing warm inside air into the attic. This is an active method of cooling, but it is less energy intensive than central heating/cooling systems.

Figure 23 Whole house fan at strawbale home in ELC.

Of the remaining thirteen homes, all but one had a ground-assist heat pump working in conjunction with their central heat and air. Figure 24 shows a typical geothermal system. This home was the common house at Catoctin Creek Village.

According to one of the founding members of the CC community, they considered adding a geothermal system to the common house, but it didn't seem worth the expense.

The overall sample showed the vast majority of homeowners having a geothermal system tied into their central heat and air; only two homes in the study did not. Residents realized the cost benefits of having a ground-assist heat pump as well as the implications for sustainability this technology has due to its energy efficiency.

Figure 24 Geothermal system at CC home.

Low Flush Toilets

Another common feature found in my study was the low flush toilet. Low flush toilets help to ease the consumption of water resources. All of the communities were constructed after the Energy Policy Act of 1992 had gone into effect. Two homes are not counted[7] as having these types of toilets. A resident in the common house of CC did not know the status of all the toilets in the house (each renter has a private restroom). Because the resident did not know the status of all toilets in the home the response was thrown out. I will briefly note that the two toilets in the common house that I did see were both low flush, but there were two other toilets in the house, to which I did not have access. This house does have at least some low flush toilets even if not all of them are. The strawbale home in ELC does not have a flush toilet at all; instead, it has a composting toilet, as was described above.

One ELC resident mentioned that he didn't know what the rating was for his toilet, but that it was supposed to be the most efficient toilet available (when the home was built). EcoVillage of Loudoun County's A&EDG require that all homes be built with toilets that meet or exceed the Energy Policy Act of 1992 (EcoVillage of Loudoun County 2010b). All other homes (aside from the common house at CC) are newly built and therefore have 1.6-gpf toilets or better.

Nearly all of the homes in this study have efficient toilets that can help to conserve water. As new homes are built and as older toilets are replaced, more efficient toilets will be installed as a matter of course.

[7] Since half of the toilets in the common house did have low flush toilets, it would probably be fair to say that all homes with flush toilets had low flush toilets.

Passive Air Flow

Originally, I wanted to know if people built their homes with passive ventilation in mind. Many of the respondents did not know if this was the case, so I asked about their behavior instead. I asked if respondents opened windows to cool off when weather permitted rather than using their central heat and air. Three out of four residents at CC report using passive air flow to cool their homes. A resident at CC recalled that their house was built so that the windows would "grab" the prevailing winds. These were large casement windows (approx. three and a half to four feet tall by two feet wide) that opened out as one pane of glass to scoop passing air into the home (see Figure 25). Casement windows have 90% effective open area as opposed to the more traditional and common double-hung (both top and bottom pane open) windows (see Figure 26) that only provide 45% open area (Moore 1993). Four of six respondents at LV report using passive air flow for cooling their homes. All or the respondents from ELC reported using passive air flow to cool their homes because the homes of ELC are required by the A&EDRC to be built with passive airflow in mind.

Figure 25 Casement window at CC.

Figure 26 Double hung window at ELC.

Seventy-nine percent of respondents in the study reported the use of passive air flow in their homes. Sixty-seven percent of residents at Liberty Village, seventy-five percent at Catoctin Creek Village, and one-hundred percent at EcoVillage of Loudoun County report using natural ventilation when possible.

As was previously noted, the demand air conditioners place on energy consumption is substantial. The use of natural, wind-driven ventilation can save money and reduce energy for cooling during favorable times of year. Another way of potentially saving money and energy on cooling costs is by person cooling rather than house cooling. This can be done cheaply by using fans.

Ceiling fans

It is at least worth noting that half of CC respondents, sixty-seven percent of LV, and all respondents from ELC had ceiling fans. Ceiling fans at ELC must be Energy-Star compliant. Energy Star is a program of the U.S. Environmental Protection Agency and the U.S. Department of Energy that promotes energy-efficient products and practices. The Energy-Star requirement at ELC also includes the whole house fan that is the mechanical portion of the strawbale home's cooling strategy, which was discussed earlier.

I did not inquire as to whether or not residents used their fans in conjunction with their central air or not, or if they raised the temperature of the thermostat when using their fans. Therefore, the true savings or lack-thereof is unknown. While the actual benefit of respondents having ceiling fans is unknown, it is entirely possible that this technology helps them to increase energy efficiency. This is particularly true if they use their fans with natural ventilation rather than running their geothermal systems.

Reused, recycled or salvaged

I asked residents what materials used in the home were reused, recycled or salvaged. Three of the CC residents noted their homes contained recycled or reused or salvaged materials. Two residents have Trex decking. Trex is made from recycled plastics (such as grocery bags) and reclaimed wood (such as sawdust and pallets) and claims to keep thousands of tons of plastic and wood from landfills each year (Trex 2012). Another CC resident noted that they had salvaged kitchen cabinets and bathtub in their home. None of the LV residents claimed to have any recycled, reused or salvaged materials in their homes. All of the residents at ELC report recycled materials used in their homes. The ELC A&EDG requires that construction activities generate as little waste as possible and that as much as possible of this waste material is reused, salvaged, or recycled (EcoVillage of Loudoun County 2010b).

Figure 27 Trex decking from home at CC.

Summary of architectural practices

Most architectural practices within all three communities were fairly homogenous even though each community approaches building in a slightly different way. A common theme for each community was building energy-efficient homes to reduce environmental impact. This does not necessarily mean including building with alternative technologies or architectural features. Building sustainable or 'green' homes is not always at the forefront of community development and planning. With the task of picking a location for a community and dealing with county planning commissions, simply forming a community may overshadow environmental ideals. For Ecovillage of Loudoun County this was not the case, but for both Catoctin Creek Village and Liberty Village the act of “creating community” was the primary concern. Even if these communities did not make sustainable architecture a priority, it does not mean that their buildings don’t make some interesting contributions to sustainability.

Catoctin Creek Village has several homes that are built from prefabricated modular sections, but these homes aren’t to be confused with mobile homes. Prefabricated modular construction does reduce environmental impact in some ways. First, by doing the lion’s share of construction in a controlled factory setting not only is greater quality assured, but onsite waste is reduced. The second way modular homes can reduce environmental impact is by being more energy-efficient than traditional on-site construction. The reason these homes tend to be more efficient is because they often use 2x6 framing for the walls (rather than 2x4) and this allows more insulation to be added.

The homes in Liberty Village all have air locks (foyers) to keep the air exchange to a minimum when entering or exiting the public facing side of the house. All homes are built to be energy efficient and have high-efficiency windows. The most notable feature for these homes was the multifamily aspect of their design. As previously noted, homes sharing walls result in great energy saving, about half of that of single-family detached homes (EPA 2011). All of the houses at LV have porches. The use of outdoor space can save electricity for lighting, heating, or cooling that may otherwise be used by residents if they are indoors. Porches also have a highly social function that particularly resonates with the goals and values of this community.

EcoVillage also emphasizes energy efficiency in their homes. All homes have air locks to minimize heat exchange between inside and outside. All homes are designed so that they gain maximum solar exposure, thereby reducing winter heating costs. As previously mentioned, ELC was the location of the home with the most deviation from the rest of the study in terms of alternative architectural practices and technologies.

The community with the greatest number of technologies and sustainable architectural features in this study belongs to EcoVillage of Loudoun County, owing mostly to the home of strawbale construction, which has been granted experimental status by the Loudoun County zoning board.

Beliefs

This section looks at the way respondents agreed or disagree with statements designed to examine the way they viewed current mainstream values, to see if: a) price was a determining factor in the variation of observed technologies; b) zoning restrictions prevented people from having certain technologies; and c) occurrences of traditional architecture were due to people attempting to reduce their environmental impact. Taken together, these statements will help explain the variation in technologies and features previously discussed. The information presented comes from the interview questionnaire. Four surveys were conducted at CC, six at LV, and four were conducted at ELC.

These statements were ranked:

1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), 5 (strongly agree)

The numbers in Table 6 are the average response for each community and the total average for the study.

Table 6 Belief Scores

Statement	CC	LV	ELC	Total
Creating a sustainable future will require a shift in values.	4	5	5	4.6
Eco-friendly technologies are cost-prohibitive.	3	2	1.8	2.2
Building codes (zoning restrictions) prevent me from doing things I see as beneficial for the environment.	3.5	4	4.5	4.1
Copying traditional architecture will reduce environmental impact.	2.3	2	4.3	2.9

The majority of residents from each community felt that creating a sustainable future would require a shift in values. This question was designed to gauge respondents' ideas about current mainstream values. Overall, the sample felt strongly that there needed to be a change in the present direction, that society was headed in the wrong direction, and it would require us to rethink our attitudes toward what we view as important. The average CC response agreed, averaging four for the statement and both ELC and LV strongly agreed, with an average of five.

One ELC resident told me,

> "As Americans, as humans we need to reorient our way of thinking if we're going to survive; our outlook on so many things including energy is just wrong. It's not sustainable; an example is a cloth dryer, why are we using clothes dryers? It's absolutely crazy. They may have some necessity in an emergency but the sun comes up every day."

Another resident from ELC responded by saying, "I think we've got to dramatically change our given activity, our approaches to nature and to one another in order to survive as a species" and later noted that we don't tend to realize the impact of our current economic system, "a system that doesn't include nature, but instead sees nature as an externality." This type of answer tended to occur regularly and often was verbalized as our economic system viewing nature as a commodity and as people being too consumer-oriented. A resident from LV said, "People now are too consumer oriented but it's a sticky situation, if they stop buying the economy collapses. Of course, if they keep buying then earth collapses." The answers to this question show that the residents in these intentional communities are aware of the sustainability issues and display a general disagreement with the way that mainstream society approaches these issues.

I hypothesized that participants would report that economics are an important constraint in their attempts to enact sustainable and environmentally-friendly architectural and technological practices. I asked if residents believed that eco-friendly technologies were cost-prohibitive. Residents typically disagreed with the idea that eco-friendly technologies were cost-prohibitive. CC averaged a neutral response of three, while LV averaged two (disagree), and ELC averaged slightly more disagreement with a score of one-point-eight. As previously noted, many of the residents in this study have incomes greater than that of the county in which they reside, so for a number of respondents an expensive technology is not necessarily out of reach. One resident said, "They are [expensive] but that doesn't mean they are prohibitive. You just have to be a little more selective." Another resident echoed the sentiment saying, "Upfront, a geothermal system costs about twice as much as HVAC system, so you have to have the money to pony up for the geothermal system to save money in the long run." Being selective was a theme in people's answer to this question.

It is interesting to consider that most residents did not have photovoltaic panels or solar water heaters but nearly all have geothermal systems. Is it because they are balancing the cost of these expensive technologies? One respondent referred to PVs as "way too expensive for most people" and another said PV was "very expensive." The question of eco-friendly technologies being cost-prohibitive is complicated, as evidenced by the theme of being selective in regard to these technologies as well as by the lack of these systems in the overall sample.

As discussed in the section on anthropology and sustainability, people have to operate within systems and processes beyond their control. To see if the architecture represented in these communities was heavily impacted by external policies, I asked residents if they felt zoning restrictions prevented them from doing things they see as beneficial for the environment, and if they experienced problems trying to incorporate sustainable technologies.

CC scored an average of 3.5, or just above neutral, on the statement that building codes prevented them from doing things they felt were beneficial for the environment. LV agreed with an average of 4, while ELC also agreed with a score of 4.5 on this statement. Residents typically felt that building codes did prevent them from doing things they see as beneficial for the environment. For example, one resident of CC told me that building multi-family housing units was not possible. She said, "We cannot do here what they are doing at Liberty Village, which makes it [building multi-family units] higher density and more affordable." She went on to say, "Your energy efficiency is better when you have shared walls, then you can have your dwelling units closer together allowing more access to shared resources." As mentioned earlier, Loudoun County's Rural Hamlet Act would not allow the construction of duplexes or the tight clustering together of homes. According to this resident, another restriction of this ordinance was that they could not use wind generators for anything other than farm use. A resident in EcoVillage noted difficulties getting permission from the Loudoun planning agency to have their houses oriented due south rather than to face the street. Liberty Village residents discussed construction being held up because of a county waste treatment facility. One LV resident noted that he felt that they managed to develop “a very environmentally sensitive community in spite of County requirements for excessive land clearing that forces excessive storm water runoff.”

I asked people if they believed that copying traditional architecture would reduce environmental impact. For the most part, few people thought that copying traditional architecture reduced environmental impact. Residents at CC averaged 2.3 on this statement, LV scored an average of 2 disagreeing, and ELC by contrast averaged 4.3 agreeing with the statement. While most of the subjects in each community reported being at least somewhat familiar with the traditional architecture of the area, very few reported attempting to copy this architecture. Only one resident in ELC reported copying traditional architecture, one resident at LV, and two at CC; however, it should be noted that one of these homes was the common house, which is a traditional home at its core. Some residents noted that traditional homes were heated with fireplaces (no residents in this study had a wood-fired heater), were smoky and drafty, and were difficult to heat and cool. Those who did report copying traditional architecture reported doing so for almost entirely aesthetic reasons. A resident at CC said “We liked the look of stone and insisted on it for the facing of the basement… we would have copied the veranda look, a porch without the railing, but zoning restrictions wouldn’t allow it.” Stone has been a frequently used building material in this region historically. When asked if he copied traditional architecture, one LV resident said "We copied the outside design some; we wanted the community to look like it belonged."

An example of this phenomenon can be seen in LV where the gable ends of the homes had louvers attached; these faux louvers were not designed to take hot attic air outside homes. These louvers are for the purpose of blending homes into the existing cultural identity of homes in the area. The actual work of moving hot air from attics was accomplished with a strip running along the peak of the roof called a ridge vent. The ridge vent allows hot air to escape along the length of the attic rather than from the ends. So, while there were some elements of design that resembled traditional practices, these elements were used to tie the homes to the cultural landscape, not to reduce environmental impact.

While many of the materials used to construct the homes are not traditional, some of the designs are. "The prevailing wind is from the West and Northwest and the breeze, as it moves through the house, helps to cool it in the spring and fall", noted an ELC resident. This resident also noted that his home has the same type of gable on it as a much older structure that exists in the common area. However, much of this is also for appearance rather than function. While talking about the virtues of casement windows versus the traditional double hung windows of the area he said, "We went around and around with the architect on that [whether to use casement windows or double hung windows] and the architect eventually won out because he really stressed using double hung windows to capture the vernacular of the area." This is interesting because, as previously noted, casement windows have a higher air flow rate than the traditional double hung windows. In this case copying traditional styles showed a reduction in air flow available for cooling the home. Overall, the general trend toward vernacular design tended to be due to a desire for the home to blend into the existing landscape. However, the community also maintains a goal of using locally available materials in the construction of homes and reusing and salvaging materials from the demolition of other building. These goals are vernacular practices, once born from necessity, now being implemented in the name of sustainability.

ELC showed the least agreement with the idea that technologies were cost-prohibitive and the most agreement on the other three belief questions. Although this group's scores on the belief statements were close to those of the other communities (except for the somewhat higher score on copying traditional architecture) there does appear to be a trend. It is still unclear if these belief scores are the contributing factor for the variation seen in these communities.

Cultural Transmission

The second aim of this project was to investigate if these architectural practices and technical knowledge of these communities are transferred to wider society and, if so, how.

Cultural transmission is the way in which information is passed between individuals by means of social learning mechanisms such as teaching, language or imitation (Mesoudi and Whiten 2008). These mechanisms may easily include open houses, workshops, Internet websites, Internet web logs (blogs), Internet video logs (vlogs), or consultation.

During the participant observation portion of this research I did not witness any promotion of architectural practices. While at the barn dance at CC and the Fourth of July celebration at LV, the communities were engaged in community building, having fun, and showing off their hospitality to outsiders rather than the promotion of sustainability-oriented components of their neighborhoods. However, there is another way in which communities can promote themselves and that is through the Internet.

Within the context of the intentional community movement, the Internet has played an important role since the early 1990s, when e-mails and electronic file exchanges were still in the domain of universities and research centers (Bates 2003). By 1994, the Internet had become more accessible to individuals outside the academic setting and the Global Ecovillage Network (GEN) "went online" as the Ecovillage Information Service launched from Gaia Trust website http://www.gaia.org (Bates 2003). Now websites such as The Fellowship for Intentional Community (http://directory.ic.org/), The Global Ecovillage Network (http://gen.ecovillage.org/), The Cohousing Association of the United States (http://www.cohousing.org/), and The Mid-Atlantic Cohousing (http://www.midatlanticcohousing.org/) exist, to name just a few. Sites like these allow intentional communities, other interested communities, or just individuals to share information, stories, and the locations of communities as well as when they may be conducting tours or different workshops and demonstrations. In short, these websites allow for education and the diffusion of ideas and knowledge. Many intentional communities have their own websites as well, often detailing where they are located, how to contact them, tour dates, workshops, their goals or mission statements, information about residents, and a host of other information.

Agenda 21 calls for a grassroots, community-based movement to spur change, which may be provided by intentional communities (Lockyer 2007). The Internet may provide an ideal tool for this type of bottom-up change to occur. Henderson (1974: 34) suggests, "the rise of new participatory citizen movements for consumer and environmental protection, peace and social justice are grounded in an almost intuitive understanding of the persuasive power of information." Collecting and disseminating information is very important to citizen groups that seek to challenge the status quo (Kutner 2000). Kutner (2000: 2) points out that, "With Internet-based technologies, citizen groups are able to get their messages out more quickly to larger numbers of individuals who are more geographically dispersed than was previously possible. Because of a lack of resources and the marginalized nature and small size of such groups, these groups are particularly well suited to productive use of the Internet." Kutner (2000), notes that web pages allow activist groups a means to disseminate information to a large and geographically dispersed audience as well as giving these groups the ability to transfer files very rapidly.

The three communities in this research project all have websites to convey such information. The main objective for each of these communities' website is to promote their community and find new members, as each is still growing. The website for Catoctin Creek Village (http://www.catoctincreekvillage.com/index.htm) does not place any emphasis on green or sustainable practices. Its main focus is on promoting the "community" aspect of the neighborhood and providing contact information for individuals interested in taking tours. This is a way for the community to reach out to prospective new members and people interested to learn about cohousing. Liberty Village's website (http://www.libertyvillage.com/index.html) contains links to "openings" in the community, as well as ways for people to "contact" and "look around" the community, but it also has a page dedicated to "green stuff." This page discusses a variety of community topics such as geothermal systems, single stream recycling, their rain gardens, their Baywise certification and riparian buffer as well as their chicken coop

(Liberty Village 2010b). While it does in fact discuss ecologically friendly components of the community, it does not discuss architectural practices much aside from geothermal heat pumps. The site does also briefly mention that the homes are "semi-detached, side-by-side, to provide higher energy efficiency" but doesn't discuss why this provides higher efficiency or include this information in the "green stuff" page where it could potentially be better suited at promoting this architectural feature (Liberty Village 2012).

LV is also taking advantage of social networking by putting up a Facebook page. This page (http://www.facebook.com/pages/Liberty-Village-Cohousing/165511043501352) with photos of community parties, meals and holiday celebrations along with the occasional news feed about community happenings.

EcoVillage of Loudoun County's website (http://www.ecovillages.com/index.php) is divided into four parts: a section for prospective families, one for builders, one for real estate agents and one for visitors. Each of these sections is composed of roughly the same components (welcome, location, mission, site plan, etc.), with each of these components written a little differently for each audience. One heading discusses human impact on the environment, organic management and reforestation under the title "Natural Habitat" in the visitor's section. Another heading is titled "Home Construction and Design." This heading discusses some of the home designs available in the community and how the owner will work with an approved architect to bring the design up to specs to meet the community's Architectural and Environmental Guidelines. This heading also discusses home size, features and the thoughts behind the material selection criterion for homes, such as Structural Insulated

Panels (SIPs are mentioned on p. 18), and Hardiplank[8] siding and the EcoShake roofing shingles[9]. Some of these features include geothermal systems, solar thermal panels (for radiant and domestic water heating), the R-value required for exterior walls, doors and windows. It also discusses lighting and the passive solar nature of homes, the wiring and plumbing. It discusses the need for an architect with LEED Accreditation or similar equivalent and financing loans that can be obtained if the home meets certain energy requirements. LEED stands for Leadership in Energy and Environmental Design and is a rating system that provides third party standards for green building construction. LEED was created by the U.S. Green Building Council (USGBC) to give a host of standards for environmentally sustainable construction and is the most widely accepted accreditation program in green building (Green Work Experience 2012).

An ELC resident noted that their website was the main means of communicating themselves to others, but, as previously noted, the Internet also can be used to organize groups. One way these communities use this to their advantage is to participate in the annual Mid-Atlantic Cohousing tour that brings people who are interested in cohousing out to communities to see them, to meet residents and ask questions. Along with the cohousing tour, ELC has also been a part of a solar tour for a number of years. As mentioned before, tours can be arranged individually at each community through their website, but using the Internet to network allows the communities greater visibility by mainstream society than one website alone would bring. These communities also can be found at the Fellowship for Intentional Community, the Cohousing Association of the

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[8] Hardiplank siding is a type of fiber-cement home siding. It is fire resistant, looks similar to wood siding, and is typically viewed as a green or sustainable material.

[9] EcoShake roofing shingles are shingles made from vinyl and cellulose fiber that have been recycled and have an appearance looking like wood.

United States, and the Mid-Atlantic Cohousing websites, and ELC can also be found at the Global Ecovillage Network listed earlier in this section.

These networks not only give communities the ability to communicate with each other, but with the rest of society that doesn't necessarily share the same social values and ecological goals as the communities have. These networks allow nearly anyone from anywhere to learn about intentional communities, and to locate and schedule visits with these groups around the world.

The Internet gives the power of communication to Lockyer's (2007) "islands of sustainability" as well as a forum for these networks of islands to communicate with the mainland of mainstream societies around the globe. The Internet gives these enclaves of sustainability a platform to facilitate a grassroots sustainability movement and a stage to showcase their alternative building practices, materials and social practices. While the Internet has great potential for connecting people of all walks of life and from all around the world, one question that remains is exactly how effective these websites are at garnering attention from mainstream society and getting the practices of intentional communities noticed.

Foundational Documents

The third aim of this project was to examine how an intentional community's foundational documents impact the variability of architectural practices and technologies found in individual community homes.

Catoctin Creek Village's foundational documents place no regulations on the energy efficiency of new homes, construction process or design specifications. The community rules and regulations document has a section for site plan goals and priorities.

This section notes that the community intends structures be designed and oriented to be in harmony with the landscape and to make the best use of natural light (Catoctin Creek Village 2008). This is the only mention of architecture other than to say it should be comforting, inviting and conform to common aesthetic guidelines (Catoctin Creek Village 2008). However, no mechanism in the rules and regulations appear to evaluate or enforce these goals.

Liberty Village has four design plans available for new homes. All of these floor plans are set to be part of a multifamily structure. As mentioned earlier, the layout of the community and its concentration on design for social interaction, namely facing houses toward the sidewalks, made including some architectural features such as solar orientation impossible. This is a case where the original decision-making on what the goals and values of the community should be had an impact on the architecture and the variation of features found in the community.

EcoVillage of Loudoun County's Architectural and Environmental Design Guidelines provides a strong covenant for producing environmentally friendly architecture. This community's original guiding values on how to approach sustainability were focused more on architectural approaches than those of the other two groups. On page forty the A&EDG states, "Building designs shall be climate responsive, relying primarily on passive solar heating, natural cooling and ventilation, natural lighting, conservation techniques, and other renewable energy sources" (EcoVillage of Loudoun County 2010). The document goes on to specify home orientation and the use of overhangs, and recommends amounts of recycled materials to be included in homes. EcoVillage of Loudoun County requires certain elements be included in the construction of new homes that the other two communities do not require.

As previously mentioned ELC requires that architects and builders have LEED accreditation or a similar equivalent (EcoVillage of Loudoun County 2010b). This community also requires that certain materials or equivalent alternative materials be used in the construction of one's home. For instance, ELC requires exterior walls to have an R-value of 24 and typically prefers that structural insulated panels (SIPs) be used. This requirement was amended for strawbale construction; the insulative value of straw is seen as an acceptable alternative for the SIPs. The other two cohousing communities in this study place greater emphasis on the element of "community" than they do on environmentally sustainable housing.

Vernacular Architecture

The fourth aim of this project was to see if people are copying traditional vernacular architecture of the region in an attempt to reduce environmental impact.

The short answer to this question is no. Of the fourteen residents surveyed, only four mentioned attempting to copy vernacular architecture in their own homes, and all who did also noted doing so for aesthetic reasons. The common house at CC *is* a traditional home that has been remodeled over the years. The strawbale house in ELC may have followed traditional architectural practices more than any other home in this study. The strawbale design is not a traditional type of design for the area; however, the practice of using locally available materials is universally true in vernacular structures. ELC notes using locally available materials as a goal in the A&EDG. In most cases, any resemblance to vernacular architecture was an attempt to make a new house fit into the existing architectural landscape rather than as a means of reducing environmental impact.

As previously discussed residents reported liking the look of traditional materials or wanted the design to look like it belonged.

CHAPTER VIII

DISCUSSION AND CONCLUSION

This chapter will discuss the contributions this work makes to the literature on intentional communities and political ecology, the limitations of this project, the findings of this work in relation to the original hypotheses presented. I discuss the transfer of knowledge regarding sustainable architecture and the limitations of these communities' approach and the importance of the adoption of these approaches.

This work contributes to the literature on intentional communities, particularly regarding their attempts at constructing sustainable buildings, which is an underrepresented area of study on intentional communities. Intentional communities have been viewed as utopian experiments and testing grounds for alternative forms of social and environmental practices. This pilot study confirms this is the case, as all three communities experiment with alternative forms of group decision-making and approaches toward sustainability.

It is important to remember that intentional communities fall into multiple categories. They identify themselves differently based on their main concerns or values, but these lines can be blurry. While all three groups are organized as cohousing communities, the EcoVillage of Loudoun County also identifies itself as an ecovillage, and places heavy emphasis on environmental concerns. Liberty Village and Catoctin Creek Village identify themselves as cohousing communities only. Residents at both LV and CC confirmed that the major concern in their community was "community" (alternative social practices) with environmental concerns being secondary or tertiary. The different way that intentional communities identify themselves may play a significant role in the way a group addresses an issue such as sustainability. In this study, the community identifying as an ecovillage used more alternative building materials, architectural solutions, and technologies than their counterparts. However, with such a small sample it cannot be verified that ecovillages are always going to have more sustainably-oriented architectural designs or technologies than other types of intentional communities, and because this study also found that cohousing communities experiment with sustainable architectural practices.

CC had homes that were built in modular fashion, which reduces embodied energy and increases energy efficiency and residents also used salvaged and recycled materials in the construction of their homes. ELC maintains a goal of reusing, salvaging and using recycled materials in the construction of their homes. LV built mostly multi-family units that are very energy efficient and cluster their homes in a way to conserve open space. All of the communities built energy efficient homes that reduce the homes' energy requirements and upstream power generation costs. All of these communities have something to contribute to the dialogue on how to create a more sustainable world through means of the built form.

These communities also exemplify the Earth Charter's call for a reworking of institutions and cultural values. Both CC and LV carry out their decision-making by Formal Consensus, and ELC uses a sociocratic system, both of which strive to give everyone affected by a decision a chance to participate in the decision-making process. This form of activity can be viewed as an example of the counterhegemonic utopian vision that Fernando (2003) claims will be needed to create the conditions necessary for sustainable development. These communities all participate in alternative forms of social interaction and in social justice, which will be needed in reaching a more equitable, and sustainable future.

This project contributes to the field of political ecology by examining the relationship between behaviors and the larger political systems in which these groups have to operate. All of these communities have to work within the context of political systems beyond their control. Part of the broader impact of this work is to determine problems that hinder individuals from implementing sustainable practices. It was shown that county level zoning regulations restricted CC from building multi-family units and tightly clustering homes as LV did. Health and zoning regulations could act as a barrier to people wishing to have composting toilets as special permission from the county may be required. Even setting the homes at a particular orientation (for direct solar gain) was an issue for ELC, which had to be resolved with the zoning board before this architecturally-sustainable practice could be implemented. Certain architectural practices or technologies may be restricted by local or county level ordinances.

I will briefly return to the original research hypotheses presented for this study and interpret the results of this research in light of these hypotheses.

I had hypothesized that variation in construction practices would be related to socioeconomic status and beliefs regarding sustainability, conservation and lower environmental impact. This does not appear to be the case. Overall, individuals shared similar ideas about the need to be more sustainable and more environmentally-friendly. As well residents' socioeconomic status did not appear to influence the amount or variation of their construction practices. Instead in this particular study, there was a relationship between the requirements of architectural and environmental covenants held by the community and the variability of architectural and technological features. All respondents were well educated and shared similar notions regarding environmental issues, but it was the community that placed requirements on the built environment (EcoVillage of Loudoun County) that had the greatest architectural variability, use of alternative materials, and sustainable practices.

The covenants held by ELC account for architectural practices such as passive solar orientation and air flow and foyers which reduce a home's impact. As well they placed requirements on the efficiency of technologies homeowners have, such as fans, on the accreditation of contractors and builders, and on construction practices such as reducing and reusing material waste from the construction process. If similar covenants were adopted by real estate developers or by local or county-level zoning ordinances it would be beneficial in reaching a sustainable future.

However, these covenants alone do not account for all of the variability seen in ELC. The green roof, composting toilet, gray water system, solar water heaters, radiant flooring and photovoltaic panel were not required by ELCs A&EDG even though other practices and technologies were required by the community. Unfortunately, the small sample size in this study makes determining the cause for these additional architectural designs and technologies impossible. It may be that people who are willing to live in a community that demands high environmental standards for building practices would also be willing to go beyond those requirements.

Second, I hypothesized that participants would report costs as an important constraint in their attempts to enact sustainable and environmentally-friendly architectural and technological practices. I asked if people agreed that eco-friendly technologies were cost-prohibitive, and respondents generally did not agree. Most acknowledged that the technologies were costly, but suggested that people should be selective about what they get. It is possible that respondents misunderstood the wording of this statement. Several respondents talked about specific technologies, such as photovoltaic, as being quite expensive, and there was a corresponding lack of these. However, one cannot ignore the fact that technologies which cost thousands of dollars each will be outside the reach of some people.

Someone building a new home can approach sustainability with architectural design, such as orientation for direct solar gain and passive ventilation, without much, if any additional building cost. However, the design of the community or county level policies may be a barrier to enacting these practices. Individuals can also salvage materials from the demolition of other structures and find ways to reuse construction wastes. These are vernacular practices which can save money and keep waste out of landfills. Alternatively, individuals may purchase materials composed of recycled materials as a means of reducing landfill waste. Health and zoning regulations may also prevent people from adopting some technologies, such as composting toilets. However, technologies such as geothermal systems and photovoltaic panels may not be restricted by local or county level ordinances, but could be financially outside the reach of many people. The incorporation of these practices and technologies by individuals interested in contributing to a sustainable future is not unheard of; however, community, local, or county-level requirements on these behaviors would have greater impact in the adoption of these practices and technologies among individuals less interested or informed about environmental sustainability.

While intentional communities model alternative social, material, technological and architectural practices toward sustainability a question still remains; and that is how transferable are these practices are to wider society? As previously noted, the main method these communities use to promote themselves or their building practices is the Internet. It is unknown if these communities are finding audiences among individuals who are not interested in intentional communities. Any messages intentional communities wish to transmit to wider society regarding their experimentation with sustainable architecture, alternative building materials or technologies and practices are competing with hundreds of millions of other websites dedicated to "green building". With so much competition on the Internet it is unknown if intentional communities will be able to successfully model sustainable architectural practices or continue to be relegated to islands of sustainability.

The current construction practices, energy use, and resource consumption of society are unsustainable and need to be changed. The adoption of sustainable building practices exhibited by intentional communities can save U.S. homeowners billions of dollars yearly, greatly decrease the consumption of non-renewable fossil fuels, take millions of tons of pollution out of the air, prevent loads of waste from going into landfills, manage stormwater runoff, reduce the embodied energy of building materials, and conserve water resources. The need to emulate these practices grows more imperative each day. However, this study found that the implementation of these sustainable practices and technologies are variable even within intentional communities with only one community and one home in particular (the strawbale house) having the majority of these features. So, even within the context of this research the adoption of sustainable practices and technologies is limited. This fact is disparaging and truly brings the willingness of wider society to emulate successful architectural designs and practices into question, particularly if not prompted to do so by community, local or county level ordinances.

CHAPTER IX

FUTURE RESEARCH

This project focused mostly on architecture and its associated political environments. However, one cannot completely ignore other practices when discussing sustainability. Landscape is an extension of architecture and impacts a home's energy efficiency. Beyond this effect, controlling the landscape is exactly what we discuss when talking about natural resource conservation. For this reason, it would be very interesting to examine the way that intentional communities manage their common areas.

This research would be on Community Based Natural Resource Management (CBNRM) on intentional communities. These communities all practice a form of CBNRM. They all operate with a designated area for community homes and area intended not to be developed. These shared areas are managed by the community, and examining their practices warrants more attention. Along these lines, it would also be of interest to examine the particular methods of self-governance used by intentional communities that contribute directly to the decisions being made regarding resource management.

Another way of reducing environmental impact is to live in a transit-oriented development, as do CC and ELC residents. This is housing that is located near public transit, schools, employment centers or other amenities that allow resident to reduce driving distance and costs. Reducing these costs reduces dependency on natural resources and has a significant impact on the amount of energy one uses, regardless of the type of home one lives in. With transportation costs greatly influencing our energy consumption, it would wise to include them in any future studies on the environmental impact that intentional communities have. One can examine their proximity to public transportation and carpooling practices, including how many vehicles are in the community[10].

In this research project the community identifying itself as an ecovillage showed more variation in sustainable architectural practices and technologies than the communities identifying themselves as cohousing communities. It would therefore be interesting to see if this remains the case in a larger sample of intentional communities. Because having a low-impact way of life is part of the ecovillage creed it would be expected that they would have more environmentally sustainable architecture than other types of intentional communities.

Future research could examine the variation in architectural practices and technologies between ecovillages and see if there are corresponding foundational documents requiring residents to build with alternative materials and technologies. This research could be conducted in any number of states across the country, as there are around 120 ecovillages in the USA (Global Ecovillage Network 2012). As previously mentioned, Loudoun, VA is one of the wealthiest counties in the U.S., and it would be interesting to see what approaches to building communities take in less well-to-do counties. Regardless of location or community type, future research should strive to approach 100% sampling of the communities studied. This will give a much better indication of what is going on in the community.

[10] Some intentional communities share just a few vehicles among all of the residents. See Dancing Rabbit 2012a

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APPENDIX A

SURVEY

Case ID#: ________________

Date: ________________

Location: ______________________________

Signed informed consent form? Y N

1. Male or Female
2. What is your age? _____
3. What is your current marital status?
   Single___, Married___, Divorced___, Widowed___, Partner Not Married___
4. Age of partner? _____
5. Do you have any children? Y N How many? _____, how old? _____
6. How many people live in this home? _____
7. What is your highest level of education?
   ____
   a. Your spouse's education? -
      ____
   b. What did you study?
      ____
8. What is your household income per year? ________
9. What is your occupation? _______________________________
   a. How many hours do you work each week, approximately?
      ____

10. How long have you lived here? _____

11. Have you lived in an intentional community before? Y N How many? _____
Where?

____
____
____

12. Does the community give you emotional support? Y N

a. Do they lend you financial support? Y N
b. Do they help you with physical labor? Y N

____
____
____
____

Beliefs

How do you identify with the following statements?

13. Creating a sustainable future will require a shift in values.

Strongly disagree Disagree Neutral Agree Strongly agree

____
____
____
____
____
____
____
____

14. Current technologies ***alone*** are capable of creating a sustainable world.

Strongly disagree Disagree Neutral Agree Strongly agree

____
____
____
____
____
____
____
____

15. Eco-friendly technologies are cost-prohibitive.

Strongly disagree Disagree Neutral Agree Strongly agree

16. It is possible to build comparable versions of eco-technologies cheaper than buying them (solar furnaces, solar hot water etc.).

Strongly disagree Disagree Neutral Agree Strongly agree

17. Building codes (zoning restrictions) prevent me from doing things I see as beneficial for the environment. (i.e., Natural building materials, wind turbines or not including features)

Strongly disagree Disagree Neutral Agree Strongly agree

18. The values of this community are the same as that of mainstream communities.

Strongly disagree Disagree Neutral Agree Strongly agree

19. The way we build our homes reduces impact on the environment.
Strongly disagree Disagree Neutral Agree Strongly agree
How?____

20. Living simply will reduce environmental impact.
Strongly disagree Disagree Neutral Agree Strongly agree

21. Community based economics are important for contributing to sustainability.
Strongly disagree Disagree Neutral Agree Strongly agree

22. Copying traditional architecture will reduce environmental impact.
Strongly disagree Disagree Neutral Agree Strongly agree

23. Using simple technologies is a good way to reduce environmental impact.

Strongly disagree Disagree Neutral Agree Strongly agree

24. Using complex technologies is a good way to reduce environmental impact.
Strongly disagree Disagree Neutral Agree Strongly agree

Conservation/ production:

25. Do you recycle? Y N Reuse materials? Y N

Details:

26. Do you have a seasonal garden? Y N Do you sell surplus? Y N Do you trade?

Y N

Why?____

____

____

____

____

27. Do you save seeds? Y N

Why?____

_____

____

____

____

____

____

28. Do you compost? Y N

29. Do you have a gray water system? Y N

Vernacular Aspects

30. Are you familiar with the traditional architecture of this area? Y N

a. Did you attempt to copy any of this architecture in your own home? If so, why?

____

____

____

Ethnographic Interview Questions:

31. Why did you decide to join this intentional community?

32. Tell me what ways you see yourself as lessening your impact on the environment.

33. What are your goals and motivations for living in an intentional community?

About your Home:

34. What local materials have you used in this home?

a. Trees

b. Stones

c. Earth

d. Straw or other plant fibers

e. Other

Details

35. Why did you choose to use these materials?

36. How is this home different than modern American homes? How is it the same?

37. Does this home lessen your impact on the environment?

38. What does "being sustainable" mean to you?

39. What do you consider to be obstacles in achieving a sustainable future?

Walk-through survey
About This Building:

40. Did you build this house (meaning you had decision-making power during construction)? Y N If yes a. If no b.

a. Did you design it? Y N

b. Have you made improvements? Y N

41. What is the square footage of this home? ______________

42. How much did it cost to **buy/build** this home? _____________________

43. How many rooms are there in this home? ______________

44. Do you use outdoor space frequently? Y N

Landscaping, Shading and Windows:

45. Did you plant trees? Y N

b. For what reasons?

____

____

____

____

____

____

____

____

____

46. Are your windows shaded by outside shutters, overhangs or vertical blinds? Y N

47. Was this home designed for natural light? Details:

____

____

____

____

Construction:

48. Is this house oriented for passive heating? Y N

49. Does this house use thermal mass to store solar energy for nighttime heating? Y N

50. Does this house utilize passive airflow for cooling? Y N

51. What type of insulation is used in this home?

____

52. Do you know the R value for the ceiling and walls in this home? Y N

c. What is it? __________

d. Is the R value (the amount of insulation) in this home higher than the recommended amount? Y N DK

53. What materials used in this home are reused, recycled or salvaged?

____

____

____

____

____

____

____

54. Do you use any local materials? Y N What are they?

____

____

____

____

____

____

Technologies:

55. Central Heat and Air Y N

56. A. Do you use: PV panels? Y N

57. B. Wind turbine? Y N

58. C. Micro-hydro turbine? Y N

59. If yes on any question 28-30. How do you store the energy? Code energy type A B C

____

____

____

____

____

60. Geothermal? Y N

61. Radiant flooring? Y N

62. A furnace? Y N What type?

____

63. Efficient Biomass heater? Y N

64. A solar hot water heater? Y N

65. Composting or dry toilets? Y N

66. Low flush toilets? Y N

67. Toilet Dams? Y N

68. Rain Catchment? Y N

69. Do your appliances use electricity, natural gas, propane, other? Y N

____

____

____

70. Do you have a cold box, a cellar? Y N

71. Cistern? Y N

72. Ceiling fans? Y N In what rooms?

73. Do you have other technologies that I have overlooked? Y N what are they?

74. Why did you incorporate these technologies?

75. Have you experienced any problems trying to incorporate sustainable technologies or construction practices?