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Mapping Energy Poverty in Huntington, West Virginia

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MAPPING ENERGY POVERTY IN HUNTINGTON, WEST VIRGINIA

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by
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ABSTRACT

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by Elizabeth Anne Callicoat

Energy poverty is a growing phenomenon culminating from the combination of low to mid household income, deteriorating housing structures and rising household energy costs. Energy prices are increasing for all households, but the burden is proportionally larger for those with low to mid income. These groups must sacrifice to afford energy and are often unable or do not have the autonomy to make structural improvements, especially if they rent their home. Data on residential dwellings from the Cabell County Tax Assessor's Office were used within a geographic information system to map where energy poverty likely exists within the city limits of Huntington, WV. It was found that one-fifth of Huntington households are at a high risk of energy poverty, primarily located across the northern section of the city and in the center, surrounding Marshall University, Downtown and Cabell Huntington Hospital.

INTRODUCTION

Activity at the household level is an important mediating factor in our consumption of energy. U.S. homes consume about 21% of the energy used in the United States (Margonelli, 2009). This energy comes primarily from the combustion of fossil fuels, which, as a by-product, releases carbon dioxide – a potent greenhouse gas that works to warm our atmosphere. The U.S. share of world energy consumption is 24% (Soytas et al., 2007). In the U.S., energy is made affordable by government subsidies (Adeyeye et al., 2009), which has led to a lack of attention to saving energy and the use of household energy as an invisible resource (Brandon and Lewis, 1999). As each new wave of personal and/or household technology becomes available and affordable, more households obtain it, increasing energy consumption overall (Inhaber and Saunders, 1994; Oxley, 2010). Now that energy prices are rising annually, an important conflict is developing between energy affordability and the convenience and comfort that we have grown accustomed to and expect, made possible by cheap energy (Crum, 2005; Coburn, 2006; Power, 2008).

The aim of this thesis is to explore energy poverty in the residential setting and to map its potential spread in the city of Huntington, WV. Energy poverty[1] is a repeating situation of low to mid income households spending a large portion of their income, as compared to other income groups, to pay for household energy costs. This situation is primarily caused by living in older, deteriorated homes with inefficient heating and

[1] The term "energy poverty" is chosen for this work to represent the combination of other terms used by different agencies and regions to identify the same situation as they see it within their study area. These terms include fuel poverty, energy poverty, home energy unaffordability, and energy burden. Conceptually, it is important to note that these terms represent a relatively new phenomenon that is quickly growing due to our changing world.

cooling systems combined with a lack of resources and knowledge to support improvements and change. As energy prices rise, low to mid income households must sacrifice to afford energy, whereas most other income levels can sustain the price increase by either allotting more discretionary income or turning off extra appliances (Anker-Nilssen, 2003). Energy poverty is linked to a loss in quality of life. It contributes to poor overall health and exacerbates poverty. According to the analysis of Cabell County Tax Assessor data presented within this thesis, one-fifth of households within the city limits of Huntington, WV are at high risk of energy poverty.

BACKGROUND

Energy poverty is potentially rampant in Huntington, WV due to its old housing stock (average year of construction is 1933) and low income. As energy prices rise, more households need help cutting their utility bills (Crum, 2005; Coburn, 2006; Power, 2008). According to the 2006-2008 American Community Survey (U.S. Census Bureau, 2010), median household income was $28,246 in Huntington, WV, which was lower than the state average ($37,528) and national average ($52,029). Twenty seven percent of Huntington's population is in poverty – 21% of all families and 37% of families with a female householder and no husband present. Of the occupied housing units (21,000), 56% are owner occupied and 44% are rented. Thirty percent of owners with mortgages, 10% of owners without mortgages, and 59% of renters in Huntington spend 30% or more of household income on housing (U.S. Census Bureau, 2010).

In West Virginia, home energy unaffordability was measured in 2008 by Fisher et al. (2009) and released on the WV Governor's Office of Economic Opportunity's website as a report titled, “On the Brink: 2008 The Home Energy Affordability Gap.” According to this report, home energy is a crippling financial burden for low to mid income WV households (see Table 1.) WV households with incomes below 50% of the Federal Poverty Level pay 63.1% of their annual income for their home energy bills. Households with income at 75% to 100% of the poverty level pay up to 18% of their income for home energy. According to Fisher et al. (2009), 273,102 households in WV may be suffering from home energy un-affordability. According to Coburn (2006), WV’s poorest families are poorer than families in any other state. Low income families have the highest energy burden and the least amount of flexibility in being able to afford increasing costs.

Table 1. WV Home Energy Un-Affordability

Income Compared to Poverty Level	No. of Households	Home Energy Burden (portion of income)
Below 50%	56,287	63.1%
50-74%	36,313	25.2%
75-99%	39,138	18.0%
100-124%	41,377	14.1%
125-149%	42,690	11.5%
150-185%	57,297	9.4%
Total Households	273,102	

(Adapted from Fisher et al., 2009)

As of 2004, natural gas, oil and propane prices had increased more dramatically for WV households than electricity (Crum, 2005). The following graph in Figure 1, provided by Dr. Meg Power (2008) as part of her work “The Burden of FY 2008 Residential Energy Bills on Low Income Consumers” with the Washington, DC organization Economic Opportunity Studies, illustrates the comparison of the median income of the lowest-income households (one-fifth of U.S. households) to rising energy costs. The income of the group stayed flat while energy costs rose, creating a growing gap between purchasing power and the price of all essential fuels (Power, 2008). The data for this graph come from the U.S. Department of Energy Residential Energy Consumption Surveys analyzed within an unpublished database provided by the Oak Ridge National Laboratory that incorporates current price and weather projections from the Energy Information Administration (Power, 2008).

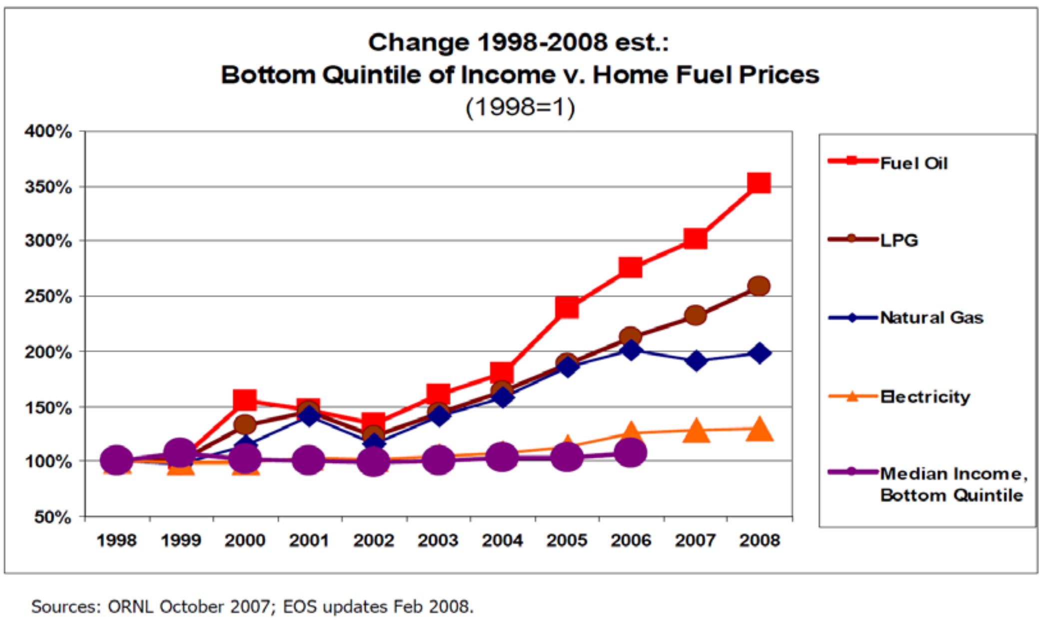

Figure 1. Bottom Quintile of Income versus Home Fuel Prices (Power, 2008)

Since this graph was completed (February 2008), the cost of electricity has risen in the state of WV. On March 13, 2009, it was reported in *The State Journal* that American Electric Power was requesting a 43% rate increase – 18.5% increase beginning July 1, 2009, 14.5% in 2010 and 13.2% increase in 2011 (Darst, 2009). According to Ed Oxley (2010), an Energy Analyst at the WV Public Service Commission, the price of 1000 Kwh has already risen from $55.26 in January 2006 to $86.39 as of July 2010 – an increase of 56%. The WV Public Service Commission will decide on American Electric

Power's current request for a rate increase of 17% by March 2011. Currently, citizens are opposing these rate hikes and have submitted a petition with 5,580 signatures to the WV Senate Majority Leader H. Truman Chafin (Coil, 2010).

As an energy analyst for the state of WV, Oxley (2010) provided an overall summary of energy use in the past and what to expect in the future. In the past, WV households benefited from relatively low, stable energy prices. Ninety percent of the electricity used in WV comes from coal, and the idea was that energy use was good for business because coal is WV's primary industry. Over time WV households have acquired more appliances and have increased their energy use overall. Now, the federal government is pushing for energy conservation. Utility companies are responding by increasing rates and encouraging households to conserve, an initiative known as Demand Side Management. Oxley (2010) said that WV households can expect their utility companies to begin offering programs to help conserve energy, such as coupons to offset the price of energy efficient light bulbs.

Efforts to remedy home energy poverty are dependent on federal energy assistance funds and WV's limited and under-utilized 20% utility discount program. Other smaller programs exist such as utility sponsored projects, local Salvation Army efforts, church and ministerial associations, and the United Way. The Southwest Community Action Council and other community action agencies around the state work to coordinate all these assistance sources into one efficient delivery system (Coburn, 2006). These agencies also advocate for low income households during hearings at the WV Public Service Commission when deliberating requested energy rate increases

(Crum, 2005; Coburn, 2006). As a statewide group, these community action agencies are known collectively as the West Virginia Community Action Partnership (Coburn, 2006).

The U.S. Federal government allots funding to offset home energy bills for low income households (LIHEAP – Low Income Household Energy Assistance Program) and provide weatherization services to improve the structure efficiency of low income households (Soratana and Marriott, 2010). Fisher et al. (2009) note in their report that WV's LIHEAP allocation has lost ground relative to WV's Home Energy Affordability Gap. From 2002 to 2008, the total Home Energy Affordability Gap increased by 26.8 million compared with only a 2.5 million increase in LIHEAP funding, increasing the overall gap between need and funding by 134.1%.

The Southwest Community Action Council is the agency responsible for implementing the federally funded weatherization program in Huntington, WV. SWCAC serves a four county area – Cabell, Wayne, Lincoln, and Mason, and has been providing this service for over 25 years (Coburn, 2006). Due to the Department of Energy guidelines for implementing the Weatherization Assistance Program, SWCAC mostly services low income homeowners and few renters. At one time,[2] SWCAC could go into a rental unit and make improvements without requesting payment from the landlord for improving the property. Then the Department of Energy decided that the landlord should be paying for at least a portion of the improvements – about 15% (Sherrill, 2010). If the landlord is in poverty then the work can be performed free of charge. Unfortunately, few landlords are interested in participating in the program (Parsons, 2010; Sherrill, 2010).

[2] (about 30 years ago according to SWCAC's weatherization program manager Connie Sherrill, phone interview on October 14, 2010, Huntington, WV)

Yet renters are most likely to suffer energy poverty due to a lack of control to change the structure of their housing.

On March 12, 2009 as part of a stimulus package, the Obama Administration announced that West Virginia would receive more than $70.3 million dollars to provide energy efficiency upgrades of up to $6,500 per home, available to families making up to 200% of the federal poverty level – about $44,000 a year for a family of four (U.S. Department of Energy, 2009). As of October 15, 2010, this stimulus money has supported SWCAC to greatly increase its capacity. SWCAC has increased its employees from 6 to 40 and will service 349 homes during the 2010/2011 fiscal year as compared to 152 in the 2009/2010 fiscal year. Unfortunately, the stimulus will end this December and SWCAC will either have to let employees go or find a new source of funding (Sherrill, 2010). Information provided by this thesis can be pertinent to SWCAC's planning efforts to retain and build its capacity via seeking new funding. Ideally, SWCAC will be able to retain funding that supports more assistance provided to renters.

LITERATURE REVIEW

A. EXPLORING ENERGY AND POVERTY

The factors that combine and cause energy poverty include low to mid income, increasing energy costs and an inefficient housing structure (poorly insulated, deterioration due to age, and inefficient heating/cooling systems) (Morrison and Shortt, 2008; Baker and Starling, 2003). Developed countries and some developing countries are investing research and development into improving the energy efficiency of their housing stock and are facing similar dilemmas, such as a lack of action on the part of almost all households combined with an aging housing stock that continues to waste energy year after year. A critical and growing component of this issue is the affordability of energy and how the poor are more greatly affected by increasing prices. In Western Europe, this is referred to as "fuel poverty" (Baker and Starling, 2003; Morrison and Shortt, 2008). In the United States, we refer to "home energy un-affordability" (Fisher et al., 2009) and "energy burden" (Power, 2008), and in developing countries, such as Africa, researchers refer to "energy poverty" (Haines et al., 2007). These concepts explain the worldwide situation between the poor and access to energy for improving quality of life. In the western world, most households have access to energy, but the poor have difficulty affording it, especially as the cost of energy rises due to dwindling energy supplies (fossil fuels) (Kaufman, 1997; Baker and Starling, 2003; Anker-Nilssen, 2003; Gilbertson et al., 2006; Lutzenhiser and Biggart, 2007; Morrison and Shortt, 2008; Fisher et al., 2009). A household is considered to be in fuel (energy) poverty if it must spend 10% or more of household income for energy (fuel) in order to maintain adequate indoor air temperatures (Morrison and Shortt, 2008; Fisher et al., 2009).

American poor households have access to more material objects and larger spaces to live within than the impoverished populations in other countries. So, at least materially and in terms of quantity of space, the American poor are really not that poor, at least not all of them (Rector and Johnson, 2004). But they have their own set of situational factors with one of the most important for the situation of energy poverty being the landlord/tenant relationship and the tenant's level of control to direct improvements to his/her home. The poor are more likely to rent their home. According to Kauffman (1997), the large gap between the cost of decent housing and household income, particularly renter household income, is the root cause of the housing affordability problem that is spreading across the nation.

People with very low incomes cannot pay rents high enough to enable private market landlords to cover their costs, which leads to some landlords offering housing that is seriously substandard (Kauffman, 1997). Not only do these households not have the ability to make improvements, but also the landlords usually shift the energy costs to them (Lutzenhiser and Biggart, 2007). The tenant's inability to affect change within his/her home while a landlord tries to capitalize on a rental unit that is past its useful life leads to deteriorated living standards, which affect physical and mental health. This deterioration leads to poor air quality, bugs and rodents, draftiness, inefficiency leading to large utility bills and sometimes the loss of energy services and ultimately eviction (Rector and Johnson, 2004). A case study located in the Appendix illustrates the reality of energy poverty on the ground (Callicoat, 2009). Also, the loss of control, in and of itself, is detrimental to health; the connection between feelings of control and health are well documented (Gilbertson et al., 2006). All of these factors work against the sustainability of the household.

There is a wide range of living conditions among the poor (Rector and Johnson, 2004). Some of the categories that can be identified include:

1. The impoverished who own their own home (46% according to Rector and Johnson, 2004).
2. Persons who aspire to a simple lifestyle that requires fewer resources and thus less income (Leonard-Burton, 1981).

3. The impoverished who sometimes do without basic necessities, such as food, space, emotional support, control of their destinies (Kaufman, 1997). This is the "at-risk" population and includes one-third of the poor (approximately 11,550,000[3]) according to Rector and Johnson (2004).

These categories have different, yet sometimes overlapping, circumstances. The impoverished who own their own home can implement change, although it can be hampered by strict building codes that do not allow for alternative materials and have the requirement of going through a permitting process. They may not have resources such as a knowledgeable network or money for materials (Soratana and Marriott, 2010). There are also people who choose to live a simple lifestyle by consuming less and working less so as to have more time to do what they want (Leonard-Burton, 1981). Although the government may categorize them as impoverished, they may not consider themselves impoverished. The at-risk category (#3) might be considered those who are most impoverished. The lack of basic necessities cripples their ability as human beings (Heyman et al., 2005). They are unable to improve their lot in life and easily fall into the energy poverty category.

Table 2, which was abstracted from Rector and Johnson's (2004) research, compares the percentage of households with certain upkeep problems, comparing all households to poor households. The poor households score higher on each category. The comparison of all to poor is misleading and could underestimate the difference because the poor is part of all households. Rector and Johnson (2004) do not account for this

[3] Rector and Johnson's analysis of the 2010 U.S. Census was that 35,000,000 Americans were categorized as impoverished – one-third of this total is 11,550,000.

effect. Nonetheless, the point is supported, albeit weakly, that poor households have more physical upkeep problems within their homes than all households put together.

Table 2. Physical Upkeep Problems in Houses or Apartments (Rector and Johnson, 2004)

Percentage with Problems	All Households	Poor Households
Leaking Roof or Ceiling	6.9%	10.5%
Broken Window Glass or Windows that Cannot Shut	4.1%	7.9%
Electrical Wires Running on Outside of Wall in Finished Areas of Home	0.8%	1.9%
Toilet, Hot Water Heater, or Other Plumbing That Does Not Work	2.6%	4.5%
Holes in Walls or Ceiling or Cracks Wider than the Edge of a Dime	4.0%	7.1%
Holes in Floor Big Enough for Someone to Catch their Foot On	0.9%	2.1%

It is important to note that genuine research on poverty may be inherently flawed due to the mismatch between the backgrounds of those doing research and those who live in poverty. Growing up in poverty has life-long impacts. Impoverishment greatly impacts the health of those impoverished, which influences the ability to make good decisions and to work (Kaufman, 1997; Brinegar and Leonard, 2008). Child development studies suggest that living in poor housing early in life has long-term impacts that are not reversed by living in improved housing during adulthood. The damage to physical and mental health caused by poor housing conditions creates a mutually reinforcing situation (Heyman et al., 2005). Life paths are born out of circumstance (Brinegar and Leonard, 2008; Bailey, 2009). Those who produce research via their paid work are probably not from an impoverished background. This observation does not mean that these researchers do not provide relevant information for analysis, but their conclusions, which reflect their unique perspective, may not be genuine in terms of representing the impoverished situation.

For example, the “Understanding Poverty in America” paper published by The Heritage Foundation and produced by the Domestic Policy Studies Department (Rector and Johnson, 2004) provides relevant knowledge in regard to situational factors contributing to poverty but oversimplifies the inherent characteristics of the impoverished situation. The authors state simply that nearly three-fourths of currently impoverished children would be lifted out of poverty if mothers would marry the fathers. The author of this thesis has lived in impoverished neighborhoods and knows the situation is not this simple. The mothers and children may be worse off if in partnership with the father. The father may not be healthy, or the relationship between the mother and father may not be healthy. It may be that the mental health aspect of poverty is poorly understood by those who are not in poverty. It can be a completely different life-world.

Another mismatch is the categorical systems that the U.S. Census develops to summarize and disseminate resources to the low income population. For example, according to Rector and Johnson (2004), most of the 35 million poor households (as categorized by the U.S. Census) live in single family homes (54%), 36.4% live in apartments, and 9.6% live in mobile homes. Earlier they explain in their report that the average poor person within these 35 million households is really not poor and has a much higher standard of living than what the public envisions for the poor. So, these numbers do not really represent the poor, as envisioned by the public. In effect, the U.S. Census categorization of income levels softens the numbers by including non-poor households. This is an example of ecological fallacy in that the level of analysis misconstrues the reality on the ground (Coulton et al., 2001; Morrison and Shortt, 2008). This point is important to consider if society is going to offer effective opportunities for the poor to improve their living situations. We must understand the actual social characteristics of the household (Lutzenhiser, 1992; Santamouris et al., 2006; Gram-Hanssen, 2009).

In the United States, the poor are more likely to be located in urban centers (Brinegar and Leonard, 2008). Once pockets of poverty are created, they themselves become creators of impoverishment due to the surroundings and practices created (Brinegar and Leonard, 2008; Bailey, 2009; Gram-Hanssen, 2009). Neighborhoods can become sources of chronic stress (Steptoe and Feldman, 2001), and households can become land-locked in bad situations by virtue of exacerbating economic conditions such as energy poverty (Heyman et al., 2005).

Poor households often must bear more of the overall environmental degradation created by our industrial society because they cannot afford to place themselves in environmentally safer spaces (Heyman et al., 2005). An example of an environmentally induced impact triggered by the work of our society is the Urban Heat Island (UHI) effect, which is a concentration of waste heat located in urban areas caused by the running of many machines combined with the surface characteristics of the built environment. Many of the materials used to build a U.S. city (concrete, brick, and asphalt) absorb the sun's energy, heat up and then slowly release heat back into the air causing the urban space to be warmer than its surrounding hinterland. The poor are often located in central urban areas where UHI can be strongest (Santamouris et al., 2006) because of geographic positioning, i.e. being surrounded on all sides by the UHI effect. Accessing energy is important for creating a controlled home environment that provides a safe space for getting away from the urban decay and extreme temperatures that are common in many urban regions of the planet. Left unprotected, the poor endure a greater proportion of health problems (Heyman et al., 2005; Gilbertson et al., 2006; Haines et al., 2007).

B. HOUSEHOLD ENERGY USE

Household energy consumption varies because of the physical size of the residence, climatic zone, design characteristics of the building, income level of the household and available energy infrastructure (Santamouris et al., 2006). Another factor according to Lutzenhiser (1992) and Gram-Hanssen (2010) is that a household's technology choices and use are entwined within their daily practices, which are greatly impacted by that household's interaction and social comparison to the outside world. Material objects, which often require energy, are important for social status (Lutzenhiser, 1992).

In the U.S., the wealthiest households and the poorest households use the most energy per square foot of living space but for different reasons (Pitcher, 2009). Although household energy stagnates at a certain level even for the wealthiest, primarily energy use increases as income increases (Santamouris et al., 2006). Energy saves time and provides comfort, which are indispensible life commodities (Anker-Nilssen, 2003). For poor households, living in inefficient dwellings and not having the tools, support or ownership to make improvements usually increases the level of energy use. Also, poor households are likely using older technology, which is usually less efficient due to age. For example, in a phone interview on October 14, 2010 with Connie Sherrill, SWCAC's weatherization program manager, Ms. Sherrill stated that old refrigeration is a major source of energy waste for low income households.

Caring for our physical well being is made easier through the use of energy, which provides warm water, lights, entertainment, kitchens to cook in, etc. (Anker-Nilssen, 2003). For low income households, heating, refrigeration and lighting are essential energy uses (Coburn, 2008). From 1987 to 2001, energy use in the average American home rose 9%, with lighting and appliances having the most growth (McClain, 2004 - see Table 3, *A Gadget for Every Room*). Appliances can be bought cheaply at yard sales, Goodwill, and retail stores such as Family Dollar or Dollar General. According to Rector and Johnson (2004), "The typical American defined as poor by the Government has a car, air conditioning, a refrigerator, a stove, a clothes washer and dryer, and a microwave. He has two color televisions, cable or satellite TV reception, a VCR and DVD player, and a stereo" (p. 1). The quality of these objects is not accounted for, but it can be assumed that they are likely older and less efficient like the systems and envelopes of the housing structures for low income families, thus exacerbating energy poverty overall. Consumers and product designers often don't consider the efficiency of these items (Lutzenhiser, 1992; Allcott and Mullainathan, 2010), but onsite energy consumption is dependent on household appliance energy efficiency (Soratana and Marriott, 2010). Table 3 shows the greatest growth between 1987 and 2001 was for cordless phones (81%), answering machines (68%), printers (57%), modems (56%), and computers (48%).

Table 3. A Gadget for Every Room (McClain, 2004)

A. Percentage of homes with each item	1987	2001	growth
Microwave ovens	66.0%	96.0%	30.0%
Clothes washers	70.0%	94.0%	24.0%
VCRs	52.0%	94.0%	42.0%
Blenders	64.0%	82.0%	18.0%
Cordless phones	0.0%	81.0%	81.0%
Electric coffee makers	67.0%	81.0%	14.0%
Clothes dryers	60.0%	78.0%	18.0%
Answering machines	10.0%	78.0%	68.0%
Computers	15.0%	63.0%	48.0%
Dishwashers	48.0%	59.0%	11.0%
Curling irons	44.0%	49.0%	5.0%
Printers	0.0%	57.0%	57.0%
Modems	0.0%	56.0%	56.0%
Freezers (standalone)	41.0%	47.0%	6.0%
Waffle irons/grills	26.0%	46.0%	20.0%
Electric tooth brushes	0.0%	20.0%	20.0%
Espresso machines	0.0%	12.0%	12.0%
Total percentage points	563.0%	1093.0%	530.0%
B. Home energy use (millions of BTUs)			
Home heating	54.6%	51.5%	-3.1%
Cooling	5.0%	8.7%	3.7%
Water heating	18.1%	17.9%	-0.2%
Lighting and appliances	23.2%	31.8%	8.6%
Total	100.9%	109.9%	9.0%

C. HOUSEHOLD ENERGY CONSERVATION

Energy poverty is an important social justice issue that illustrates the connection between sustainability and equality, and one which, if remedied, can greatly decrease energy waste and provide for a higher quality of life for economically challenged households who are unable to make changes of their own. In reality, we exist within layers of life-worlds (Bailey, 2009) that access, use and relate to energy in various ways (Lutzenhiser, 1992). Rising energy costs affect households in different ways, mediated by each household's circumstances, especially income (Crum, 2005; Coburn, 2006), thus creating niches within the home energy use dilemma that can be further explored.

Household conservation studies were first produced in response to the Arab oil embargo sanctioned in 1973 against the United States, Japan and Western Europe (Canton, 2004). Throughout the 1970s, researchers in the United States and Western Europe (United Kingdom, Sweden and Netherlands) worked to understand and encourage energy conservation behavior at the household level. By the 1980s energy policy and research in the U.S. had come to be focused upon technology, and by the early 1990s research turned toward sociology and psychology (Lutzenhiser, 1992). Today, the U.S. and other countries around the world are focused on reducing household energy consumption in order to mitigate climate change (Allcott and Mullainathan, 2010; Flannery, 2010). The U.S. considers energy efficiency to be its first line of defense (U.S. Department of Energy, 2009).

Most studies have found that environmental awareness alone does not necessarily cause people to save energy. Furthermore, there seems to be a disconnect between awareness and the application to one's own home. Many researchers attribute this disconnect to the invisibility of energy. "To most consumers in developed countries, the fuel used within homes has become, to a large extent, an invisible resource" (Brandon and Lewis, 1999, p. 75). The only visible record of consumption is the utility bill, which usually comes monthly and by which time the link between activities and consumption is lost. Studies show that people fail to adopt existing technologies that would save them around 23% from baseline (Allcott and Mullainathan, 2010). This lack of action may be due to the stability of our values, attitudes and social habits, according to Brandon and

Lewis (1999). This conclusion is supported by Lutzenhiser's (1992) cultural model, which focuses on the relationships between humans and their materials and then uses groupings to identify general trends. "Houses, automobiles and appliances, for example, are central and meaningful in the lives of families, social networks, neighborhoods and communities. Energy consumers receive information, approval, criticism, legitimacy, and status-confirmation through participation in these networks, and their hardware is routinely subject to social critique and regulation" (Lutzenhiser, 1992, p. 55).

Many economists believe raising the cost of energy will curb use and slow global climate change (Allcott and Mullainathan, 2010), and on a very practical level this is true. But to truly be a sustainable solution, we must acknowledge the complexities coming from different perspectives of this issue (Gram-Hanssen, 2009). Cost is a proportionally larger burden for low income groups than those on up the socioeconomic spectrum (Crum, 2005; Coburn, 2006; Power, 2008; Pitcher, 2009). Households with more income can simply pay more, but low income households have to sacrifice, especially if their house is inefficient (Crum, 2005; Coburn, 2006; Power, 2008; Morrison and Shortt, 2008).

According to Inhaber and Saunders (1994), if properly understood, conservation increases general economic welfare by empowering more people to access energy via the energy savings. Ironically though, improvements in the energy efficiency of appliances leads to increased energy use over time due to the dispersal of the technology at each wave of new technology introduced (Inhaber and Saunders, 1994; Haines et al., 2007). In a 2007 study of 94 low income United Kingdom households, Gilbertson et al. (2007) found that energy bills were not reduced after home energy efficiency improvements;

rather, the households bought the same amount of energy but got more benefit from it via improved technical energy efficiency. The study found, "Most householders reported improved and more controllable warmth and hot water. Many also reported perceptions of improved physical health and comfort, especially of mental health and emotional well-being and, in several cases, the easing of symptoms of chronic illness" (p. 946). According to Anker-Nilssen (2003), without an increase in the price of energy, use will not decline. Households will find another use for the energy saved.

An important part of the solution is energy efficiency, but not just in the sense of better technology; we all need to also look at how we use it as human beings (Allcott and Mullainathan, 2010). Although challenging, individual households can do many free things to lessen their energy demand, such as turning down the water heater, choosing not to bake a cake on a hot summer day, strategic use and cleaning of appliances, shortening the time spent in the shower, etc. - it is just a matter of determination and information (Heede, 2002; Allcott and Mullainathan, 2010).

D. FUEL POVERTY INDICATOR MODELS

The United Kingdom Fuel Poverty Indicator Model (Baker and Starling, 2003) and the Scotland Refined Fuel Poverty Indicator Model (Morrison and Shortt, 2008) provided direction for mapping energy poverty in Huntington, WV. The following discussion summarizes the important points of these two models.

Centre for Sustainable Energy – The United Kingdom Fuel Poverty Model Indicator

The optimal way to measure fuel (energy) poverty is to directly survey households but this is not usually feasible (Baker and Starling, 2003). With a lack of local housing surveys to work with, Baker and Starling (2003) created a composite indicator of fuel poverty by using census indicators of low income, poor housing and/or fuel poverty itself. They used housing surveys conducted at a regional level to weight their data. Baker and Starling (2003) found considerable evidence that certain groups are highly likely to live in poor housing, such as single parents, single pensioners, and pensioner households. Overall, this research group identified two categories of fuel poverty:

1. People with relative low income, such as lone parents and unemployed people, are likely to suffer high rates of fuel poverty. However, the exception is energy efficient social housing where a household may have low income but does not live in fuel poverty.

2. People with low/moderate income living in energy inefficient housing. This group may have income above the relative poverty or income assistance threshold, but the energy inefficiency of their housing (coupled in some cases with under-occupancy) may push this group into energy poverty. Single pensioners living in poorly insulated older dwellings make up the bulk of this group.

Because this model was created at the census level using social indicators, ecological fallacy can undermine the results by masking housing characteristics that can only be seen at a finer resolution. In the next example, researchers Morrison and Shortt (2008) successfully refine the Scottish Fuel Poverty Indicator Model and reveal that around 3,150 households contained within wards previously designated as at least risk for fuel poverty are actually at high risk of fuel poverty based on income level and housing quality.

Scotland Refined Fuel Poverty Indicator Model

Morrison and Shortt (2008) created the Scotland Refined Fuel Poverty Indicator Model, which is a GIS-based, multiple risk index, specifically for Sterling Council, Scotland. Sterling Council has a population of around 86,212 and comprises 35,508 households that display a marked polarity in areas of both extreme affluence and deprivation; a setting similar to Huntington, WV. The methodology employed combines mapping of social factors at the census scale with characteristics at the individual home scale. Table 4 lists the variables employed.

Table 4. Variables Used for the Scotland Refined Fuel Poverty Indicator Model (Morrison and Shortt, 2008)

Census Variables	Dwelling Characteristics
low income proxy (state benefits, unemployed, lowest grade workers)	tenure (renter or owner occupied)
single pensioner households	type of water heating
all pensioner households	property type
lone parent households	year of construction
households without central heating	rural or urban location
under-occupied housing	
average number of rooms per household	

Morrison and Shortt (2008) combined the social and physical data to create a fuel poverty risk score for census output areas and individual dwellings. Ten of the 139 output areas that had been included in the earlier version of the Scottish Fuel Poverty Indicator Model as part of wards classified as low-risk for energy poverty were found to be at high-risk of fuel poverty according to Morrison and Shortt's (2008) refined model. Overall, there were considerable differences in the outcome of the two models with the newer, refined version using local housing stock data and producing much more detail on the pattern of fuel poverty in Sterling Council, Scotland.

OBJECTIVE

The goal of this work is to map energy poverty within the city limits of Huntington, WV by using a geographic information system to analyze a mix of Cabell County Tax Assessor data. Ideally, this map will outline the shape of energy poverty as a phenomenon in Huntington based on housing characteristics that have been linked to energy poverty in other geographic areas.

METHODOLOGY

A. DATA

In order to gauge energy poverty, information (ideally at the household level) is needed to determine the ability of the inhabitants to make improvements (autonomy and affluence or income level), the quality of housing, and energy costs. In Huntington, WV, the Cabell County Tax Assessor's Office has a geographic information system database containing details on each dwelling, including age, tenure, heat source, square foot living area, building appraisal, and geo-referenced location. Mr. Ottie Adkins of the Cabell County Tax Assessor's Office provided a GIS shapefile of georeferenced dwelling data (year 2004) for all of Huntington to populate the Huntington, WV Energy Poverty Map. Mr. John Perry of the Cabell County Re-appraisal Office provided follow-up advice on using the data. Three variables from this dataset were combined to identify dwellings conducive to energy poverty – tenure, age of house, and value per square foot. Value per square foot was determined by dividing the building appraisal by square feet of living area.

Energy costs are rising for all households in Huntington, WV. Although it can be determined using Tax Assessor data which fuel (gas, electric, wood, coal, solar) is being used by each household, it is difficult to determine which fuel is currently most expensive. As noted earlier, natural gas and propane were much higher in cost than electricity as of 2008, but according to the WV Public Service Commission this has changed. Natural gas has dropped in price and electricity has increased 56% over the last four years. For the state of WV, prices for natural gas and electricity have an inverse relationship -- as one goes up, the other goes down based on market changes (Oxley, 2010). Additionally, most households in Huntington (13,721 of 15,008) use gas as their heat source, whereas only 1,206 households use electricity. Overall, there is not enough difference to use for comparison in terms of which households are paying higher energy rates to heat their homes.

B. DATA ANALYSIS

ESRI ArcGIS was used to map energy poverty in Huntington, WV by employing a suitability modeling technique to rank residential dwellings relative to each other based on tenure, age and value per square foot. Each of these three variables had a total ranking of five distributed among a range of possible conditions, with four and five indicating the highest levels of energy poverty. This ranking of variables was accomplished by adding fields to the original shapefile provided by the Assessor's Office and then either creating specific formulas or selecting groups of data and assigning a rank. The energy poverty ranking for each variable was determined as follows:

- For tenure, rental units received a 5 and owner-occupied units received a 3.
- For age, the energy poverty range of 0 to 5 was distributed on a continuous scale with the oldest houses receiving the highest energy poverty ranking. Five was divided by the range of years (5/193 = .0259) and the following linear function was applied:

  *(2009 - year constructed) * .0259*

- For value per square foot, the lowest values received the highest energy poverty ranking. Value per square foot was calculated by dividing appraisal value by square feet of living area, i.e. appraisal value / square feet of living area. The resulting range of values was divided into two groups. Square foot values above $76 were considered to represent higher quality dwellings not conducive to energy poverty and were assigned a zero. (The average price per square foot of a new house built in 2009 in the southern region of the United States is $76.77.) The energy poverty range of 1 to 5 was distributed on a continuous scale across the second group, which had a range of values from $0 to 76. The multiplying factor was .0658 (5/76). The linear function for this variable was:

  *5 – (value per square foot * .0658)*

The three variables were then combined and divided by three to determine an average energy poverty ranking between 0 and 5 for each residential dwelling.

RESULTS AND DISCUSSION

Tenure is an important variable in determining locations of energy poverty because of the disparity between owner-occupied and renter-occupied households in terms of ability to make improvements. In general, more poor households rent their homes, which are usually less efficient than owner-occupied units. As noted by Baker and Starling (2003), the exception can be government housing, where low income families may live in highly efficient dwellings, or private investors who are building federally subsidized, low income apartment complexes that are energy efficient. Besides a few houses being built by Habitat for Humanity each year, these investments in low income, energy-efficient designed housing units do not yet exist in Huntington, WV. Simultaneously, low income homeowners can also suffer from energy poverty due to their lack of resources even though they have the autonomy to make changes. Fortunately though, low income homeowners have access to the federally funded weatherization program although they may have to wait on a waiting list. Figure 2 shows the pattern of tenure in Huntington, WV.

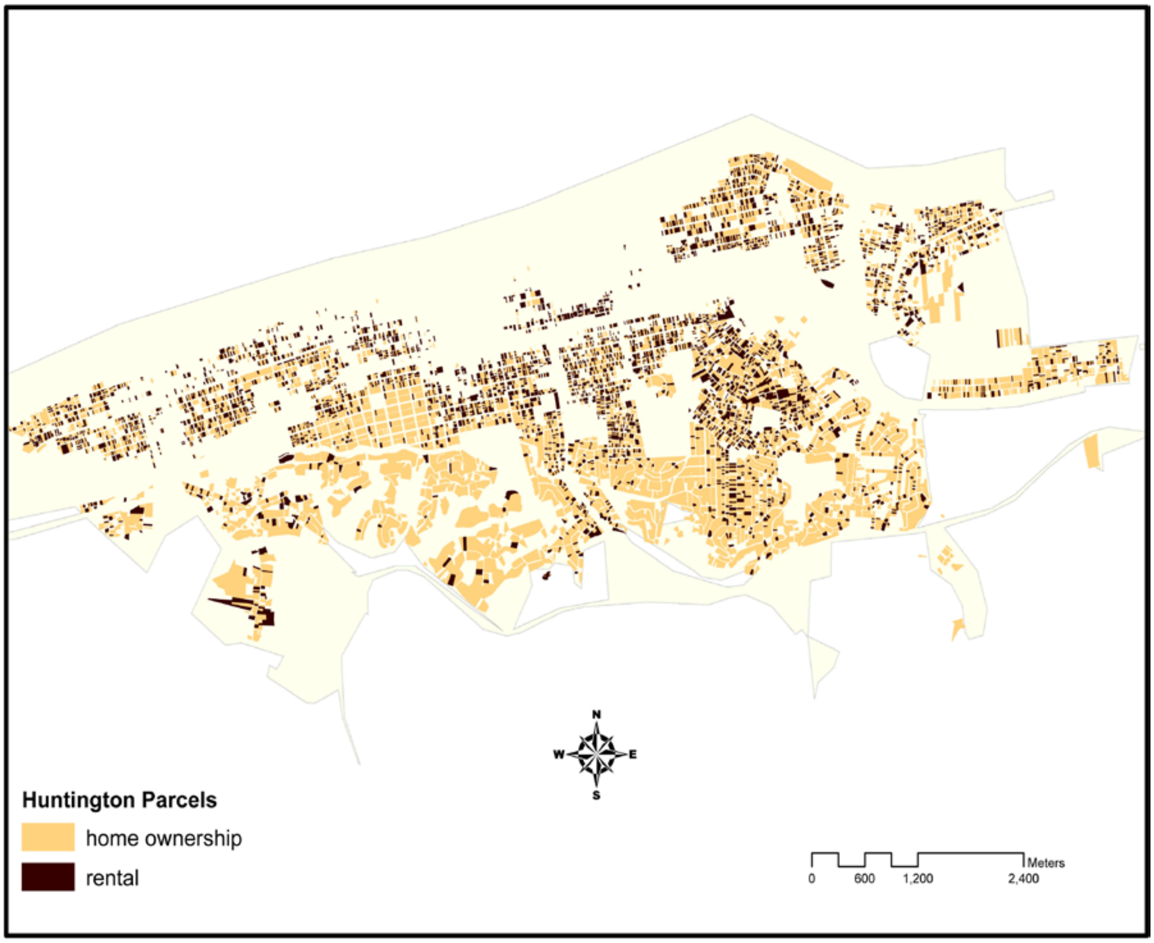

Figure 2. Tenure in Huntington

It is generally accepted that the age of a house is an important determinant of efficiency and that older structures are less efficient (Krigger and Dorsi 2008). The age of houses in Huntington ranges from 1816 to 2008 with an average construction date of 1933. Figure 3 shows the pattern of housing stock ages across Huntington, WV.

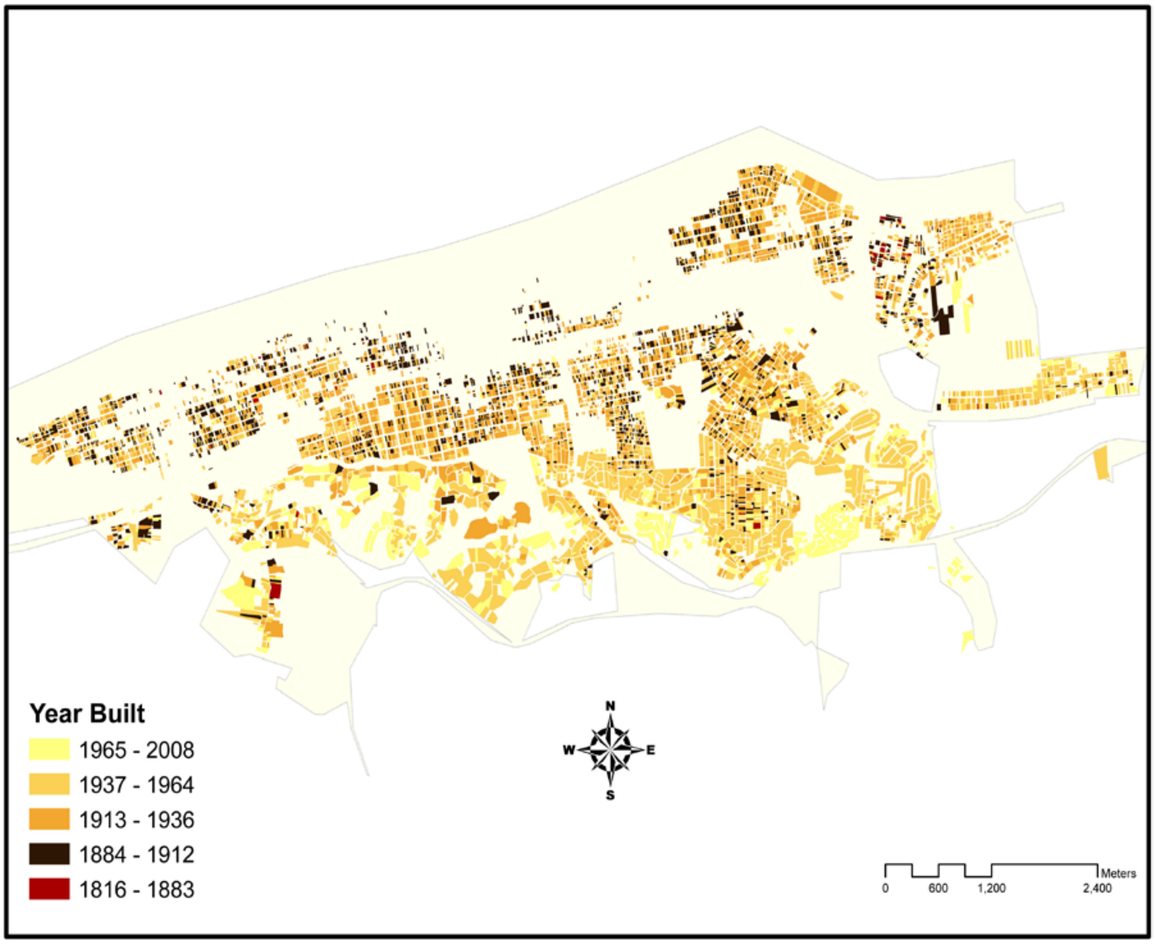

Figure 3. Age of Housing Stock in Huntington, WV

The third variable, value per square foot of living space, provides an estimate of the quality of the housing, which also indirectly estimates the affluence of the household. Data on income level are not available at the parcel level of data analysis. It is assumed that households will choose better quality housing if given a choice, made possible by having higher income. The range of value per square foot was $0 to 1100. The mean value per square foot was $29 with a standard deviation of $21.7. Eleven hundred was the highest outlier. The next highest value was $653. Forty-eight structures had an appraisal value of $0; it is assumed that these are the structures currently designated for demolition. Almost half (7,136 of 15,008) of Huntington's housing stock has a square foot value of $25 or less. Figure 4 illustrates the pattern of value per square foot of housing stock in Huntington, WV.

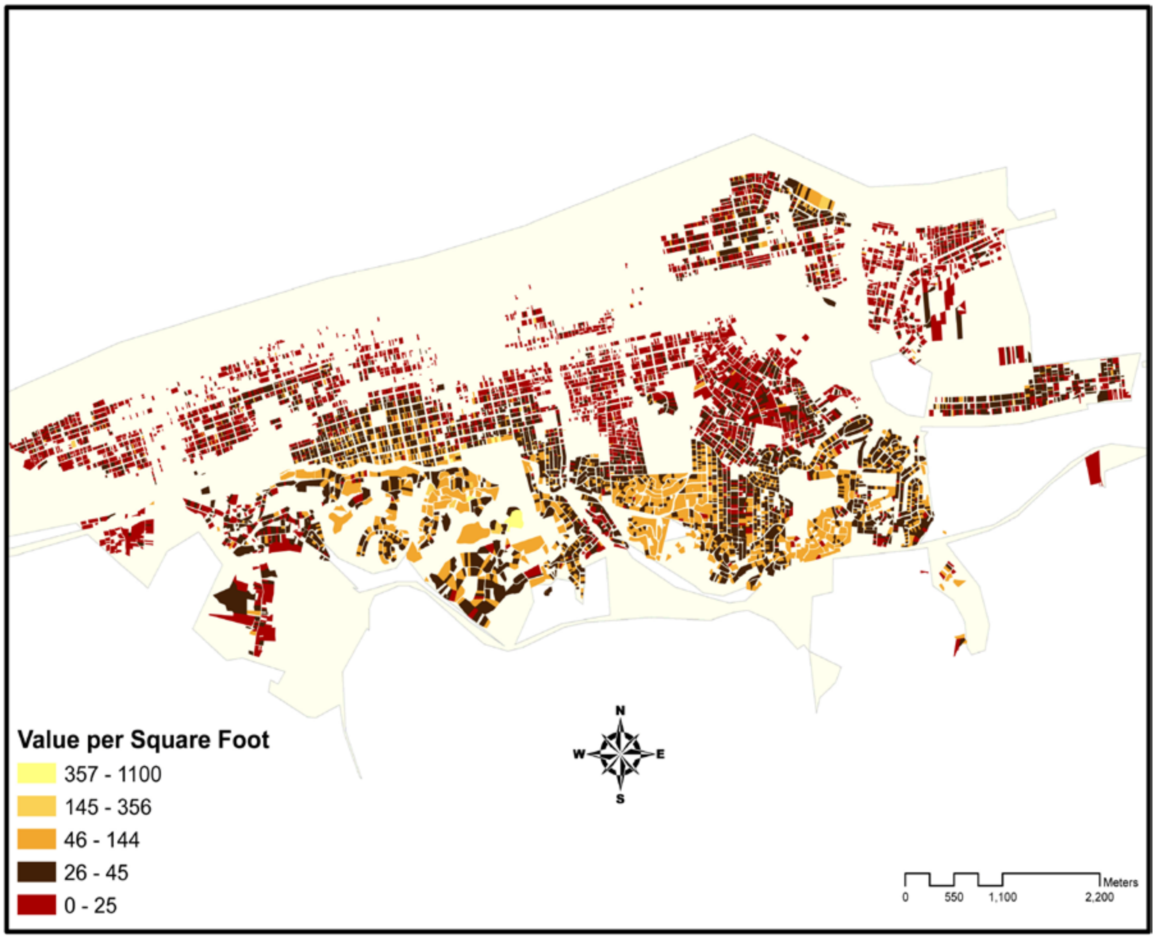

Figure 4. Value per Square Foot of Housing Stock in Huntington, WV

Rental units, older dwellings and low value per square foot of living area in Huntington, WV show similar patterns with a concentration at the north stretching east and west and dipping south in the middle. This similarity in patterns supports the conclusion found in other studies that rental units are more likely to be located in older, deteriorated housing structures. Figure 5 is the final map, which combines these three variables. Figure 6 summarizes the final map (figure 5) into U.S. Census Block Groups. Roughly one-fifth (3,015 of 15,008 total) of Huntington's dwellings are at high risk of energy poverty (a score of 4 or 5 on the energy poverty ranking indicated by dark red and dark brown in Figure 5.) Of these 3,015 high risk dwellings, 3,013 are rental units. The year of construction for these dwellings ranges from 1816 to 1974, and value per square foot ranges from $0 to $37.

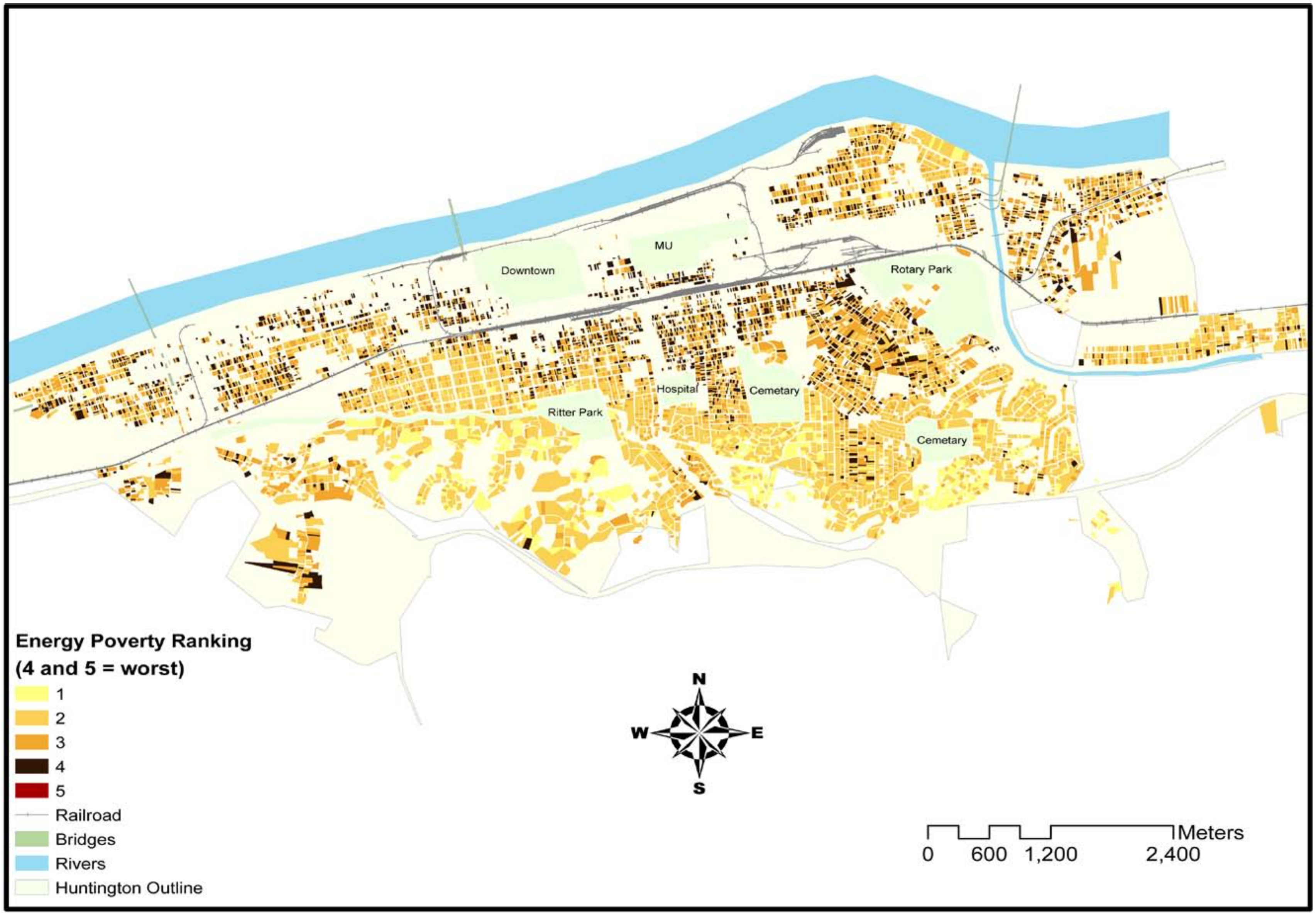

Figure 5. Energy Poverty in Huntington, WV

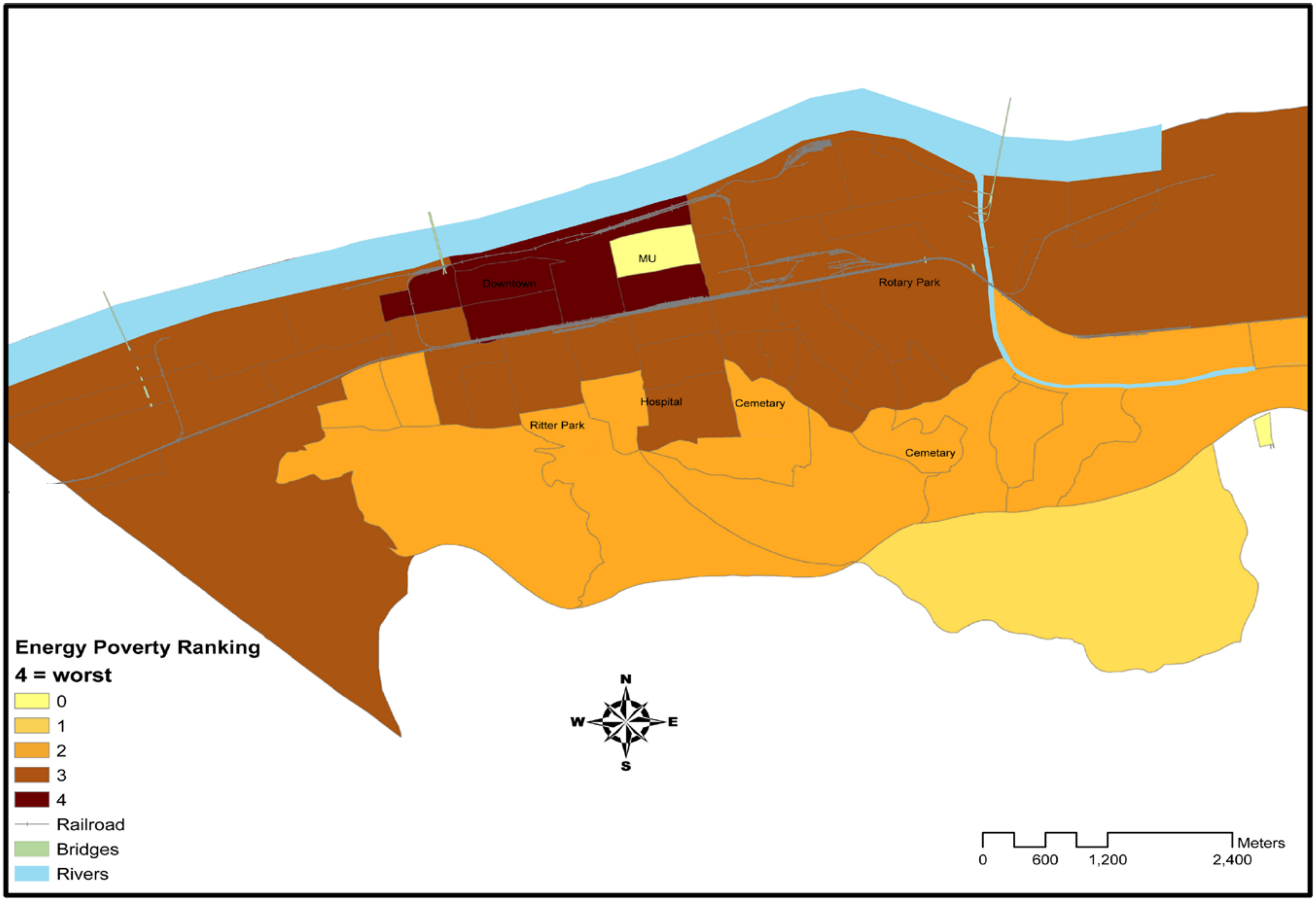

Figure 6. Energy Poverty in Huntington, WV Summarized by Census Block Group

It is important to note that this map of energy poverty in Huntington, WV ranks households by comparing all households to each other based on a set of criteria conducive to energy poverty. It is generally accepted that deteriorated housing wastes energy and that those living within these structures are there because of a lack of resources/incomes to live elsewhere. The importance of creating this map is not in proving that energy poverty exists but in identifying and analyzing available data to locate where it exists so that it can be targeted for improvement.

The concentration of housing structures that are at a high risk of energy poverty in Huntington, WV as shown in Figure 5 resembles a T formation. North of the rail-line that crosses through the middle of the city east to west, households at high risk of energy poverty are spread all throughout the landscape, stretching to the east and west city limits and surrounding Marshall University and the downtown area. South of the rail-line, households at high risk of energy poverty are more densely and centrally located, stretching south to Cabell Huntington Hospital, west to Ritter Park and east to Rotary Park. Also, a concentration of energy poverty exists in the southwest tip of the city, which is the community of Harveytown.

This map is simple, yet helpful and is a good starting point for understanding where energy poverty likely exists within the city limits of Huntington, WV. More GIS analysis work could be performed to consider the impact of various other data and the ranking of the variables used could be refined. For example, refining the energy poverty rankings could identify a smaller group of high risk structures, which as a group are older and more deteriorated than the 3,015 structures identified as high risk within this study. The Southwest Community Action Council can use this map to identify need when asking for funding, as well as target their strategic efforts as needed. This map can also be used to single out the landlords who are renting dilapidated housing and who could be approached with some type of improvement program appropriately designed for their implementation. The tax assessor data provided for this map include the owner's name for each parcel/structure. As energy costs rise, their rental units will be less attractive as is and may become un-rentable, providing an incentive for them to consider an investment in upgrades.

Currently, the City of Huntington is in the process of tearing down several dilapidated housing structures. A study could be made of how the structures that are being torn down compare to surrounding structures that are not being torn down, based on energy poverty rankings formulated for each property within this current study. Recommendations could be provided to City Government regarding which additional structures should be targeted for demolition and which structures should be targeted for rehabilitation. Furthermore, an on-the-ground analysis of a particular section of the city could be undertaken to authenticate and improve the energy poverty map created by this current work.

CONCLUSION

In the United States we have come to know a high level of convenience and comfort made possible by home energy use. But this convenience and comfort come at a great price; we are using up our resources and changing our climate via the release of carbon into our atmosphere. To slow our rate of impact upon the planet, policy-makers are calling for increased energy prices and are approving annual rate hike requests being proposed by utility companies. Unfortunately, low to mid income households often are in situations of low resources and support to change their household and are most affected by increased energy prices, which constitute a social challenge that exacerbates poverty. As energy prices increase, energy poverty can impact population groups higher up the socioeconomic ladder.

Energy poverty is an example of how sustainability must be more than protecting our environment and conserving our resources. Sustainability must include the voices and needs of all people in order to be something that doesn't lead to strife. Strife ultimately leads to more environmental destruction. The ideas that we have regarding the impoverished and the application of mainstream tools and models to their situations should be questioned. We should consider providing support for vernacular development – i.e. providing resources and information for renters and property owners to fix deteriorating housing stock in a format that supports their unique situations.

The Rural Studio (affiliated with Auburn University) located in Hale County, Alabama is an example of a business model that services low income households with appropriate technology, knowledge, and price structure. Since 1993, the Rural Studio has been designing affordable housing structures using alternative materials and ideas based on the needs, as expressed, of their clients. This architectural school focuses on understanding the family for whom they are working so as to support their lifestyle and circumstances (Schultz, 2002). This service is an example of what our low to mid income population needs but cannot access.

For the Marshall University community, energy poverty might constitute a black hole for school loan money, creating additional debt, which is a form of impoverishment.

For a university, this is an opportunity to take a greater role in the sustainability of higher education in its community. Marshall should consider surveying its student population to assess the relationship between rising energy prices and deteriorating rental units and the impact on student short-term and long-term success. Assessing energy poverty is an important sustainability opportunity, financially and environmentally, for the Marshall community.

Energy poverty is a growing, potent issue environmentally and socially. For Huntington, energy poverty exacerbates the decline of an already impoverished community. Energy is a basic need in order to exist in today's world, especially when land-locked within an urban area that does not provide resources for non-monetary sustainability such as living off the land – growing food, hunting and gathering, etc. Energy efficiency is key in helping households make the most of the amount of energy they can afford, which is why it is important that weatherization programs include renters, regardless of whether landlords are willing to contribute to cost. The federal weatherization program's decision to help only renters whose landlords are willing to contribute is unrealistic. Landlords are in business to profit and will not invest unless they can see a clear profit-making opportunity. Policy-makers are disconnected from the reality of the impoverished condition. A strict cohesion to an ideal situation in which the landlord contributes to the weatherization of his/her rental unit is leaving those who suffer energy poverty the most to continue suffering.

Energy poverty represents a concentration of energy waste. Although it has been shown that when households in the energy poverty situation are provided assistance in improving the efficiency of their homes they do not decrease their energy use but rather use it in more ways to improve their lives, providing this assistance is still a step in the right direction. These improvements mean we are making the most of the energy we use, which is an important value for a sustainable society. And improvements in quality of life support our ability to think beyond our own immediate situations and begin to consider how our actions and decisions affect the world. Energy poverty identifies the current relationship between low to mid income households and rising energy costs, a topic that will grow in importance and that will require further exploration.

APPENDIX

Home heating case study (2008 - 2010)

Provided by Elizabeth Callicoat, Huntington, WV Resident

In November 2008, my family and I moved within the city of Huntington to a rental unit located at 308 Division Street (figure 7). This unit is a 2 bedroom cottage-type house, heated and cooled by a gas-forced air unit. Soon after moving in, I received a gas bill of $380 for a 20 day period during the month of November 2008. The gas had been set at 68 degrees Fahrenheit during this period. I phoned my landlord, who tried to dismiss the bill as reasonable, but I had lived in two other locations of a similar size (approximately 1,000 square feet) with gas heat and had accomplished heating my home for much less. I knew something was wrong. I couldn't afford to move again so I resorted to survivalist tactics. I closed off the front of the house (2 rooms) and retreated to the back. The dining room became a bedroom. I also used two energy efficient electric heaters to offset the gas bill.

Figure 7. 308 Division Street

With our activity being focused in the dining room I was able to pay more attention to the air intake for the heating system, which is a rectangular (1' by 2') vent in the floor. My bed sat beside it and I soon realized that a continuous flow of cold air was coming in through this vent. By coincidence of sitting quietly and reading, I also heard noises around this vent coming from underneath the house. I realized that some type of animal was working to break into the ventilation system, which I suspected was an opossum. I phoned my landlord, and, after some convincing, he set up a trap. In a day or so, the opossum was taken away, but the air-leak persisted. The landlord claimed he repaired the ventilation, but it wasn't fixed. I only used the gas forced system during the coldest times in order to not overuse the electric heaters and run a risk of fire. We made it through the winter but were only able to use half of the house. We had to sacrifice quality of life to keep our heating bill affordable, which was approximately $160 per month ($110 gas, $50 in additional electric.)

In the late summer of 2009, I telephoned my landlord to ask that he work more on the ventilation system before winter came. He didn't want to do the work and claimed that he had had someone go under the house and it was just fine. I finally asked a friend to help me out, someone who had some experience going under houses. I bought tape appropriate for adhering to metal and tubing, and my friend went under the house and repaired many holes. The opossum had worked in various places to break into the ventilation tubing in order to stay warm. I also found a section that was completely disconnected from one of the vents on the inside of the house. Basically, during the winter of 2008/2009, the system was heating underneath the house, not only the interior -- and was very wasteful. After several phone calls, the landlord did a few more upgrades including a new thermostat and registers (floor vents), but these were primarily band-aids for the real problem had been the ventilation system. He never knew that I had someone go under the house to repair the ventilation because he had told me that no one was allowed to go under the house. But I had to take matters into my own hands to survive and then let him believe he had somehow solved the problem -- a degradation of quality of life from stress.

During the fall of 2009, my family and I worked to weatherize our home. The landlord wouldn't allow caulking to be done, and he wouldn't agree to come in and do the caulking, so we had to develop an alternative material to seal the various cracks. A cold spell came early during the month of November, which provided a temperature gradient between outdoor and indoor temperatures. By feeling along the indoor services of the exterior walls of the house we identified the places of air exchange. We then used four products to seal off the air flow – plastic, toilet tissue, cloth, and duct tape. We covered the least efficient windows with plastic. For some windows we did plastic on the inside and out. We also used plastic over top of one wall area between a west-facing window and floor, which was passing a lot of cold air.

We used toilet tissue rolled into ropes to fill crevices in the walls, where the floor and walls meet, and in the ceiling. A flat head screw driver was used to neatly push the paper into place, which looked like caulking once in place (see figures 8 and 9). Also, the closets had several holes in the walls and ceiling, which we filled with paper/cloth and sealed with duct tape (see figures 10, 11 and 12). We hung blankets over two west-facing windows and a door going to a room that had previously been a porch in order to negate some of the coldest spots of the house. An important note is that the front of the house, which faces west, is the hardest to keep warm, which appears to be due to it being the windward side. The overall goal for the 2009/2010 winter season was to be able to comfortably use the entire house.

Although I was worried about receiving a large gas bill, I took a chance and tried heating the whole house at 68 degrees using the gas-forced air accompanied by my two energy-efficient electric heaters. I was pleasantly surprised to find that our work had paid off. The 2009/2010 winter season was one of the coldest we had had for some time, and my gas bills consistently stayed at around $108/month, less than 1/3 of the first bill I had received for the initial 20 day period of our moving into 308 Division Street. This personal case study qualitatively reveals the challenges of renting quality homes in Huntington, West Virginia and the struggle of the landlord/tenant relationship in regard to making improvements.

Figure 8. Crack between floor and wall

Figure 9. Crack filled with toilet tissue

Figure 10. Hole in closet wall

Figure 11. Hole in closet carefully stuffed with cloth

Figure 12. Hole in closet sealed with duct tape

REFERENCES

Adeyey, A, Barrett, J., Diamond, J. Goldman, L., Pendergrass, J., Schramm, D. (2009). Estimating U.S. Government Subsidies to Energy Sources: 2002-2008, *Environmental Law Institute*, September 2009.

Allcott, H. and Mullainathan, S. (2010). Behavior and Energy Policy, *Science*, 327, 1204-1205.

Anker-Nilssen, P. (2003). Household energy use and the environment – a conflicting issue. *Applied Energy*, 76, 189-196.

Bailey, A. (2009). Population Geography: Lifecourse matters. *Progress in Human Geography* 33(3), 407-418.

Baker, B. and Starling, G. (2003). Predicting energy poverty at the local level. *Centre for Sustainable Energy* (http://www.bris.ac.uk/poverty/fuel%20poverty/Predicting%20Fuel%20Poverty%20at%0Local%20Level%20Report.pdf)

Brandon, G. and Lewis, A. (1999). Reducing Household Energy Consumption: A Qualitative And Quantitative Field Study." *Journal of Environmental Psychology* 19 (1999): 75-85.

Brinegar, S. and Leonard, J. (2008). Poverty and Affluence: A Comparative Analysis of Economic Segregation in Metropolitan Cincinnati, Cleveland, and Columbus, Ohio, 1970-2000. *Urban Geography*, 29(6), 581-606.

Canton, V. (2004) Perils of the Petroleum Industry. *The International Relations Journal*. Fall: 29-35.

Coburn, D. (2006). "Testimony of West Virginia Community Action Partnership" (Direct Testimony of Dwight Coburn, Executive Director of the Southwest Community Action Council located in Huntington, WV to the WV Public Service Commission, Charleston, WV)

Coil, K. (2010). "Chafin, 'thousands' of citizens opposing AEP base rate hike." *Bluefield Daily Telegraph*, November 16, 2010.

Coulton, C. J., Korbin, J., Chan, T., and Su, M. (2001). Mapping Residents' Perceptions of Neighborhood Boundaries: A Methodological Note. *American Journal of Community Psychology*. 29(2), 371 – 383.

Crum, T. (2005). "Testimony of West Virginia Community Action Partnership, March 3, 2005" Case No. 04-1595-G-2T – Application to increase rates and charges. (Presented in front of the WV Public Service Commission. Tim Crum is the Executive Director of the West Virginia Community Action Partnership, Inc., Charleston, WV)

Darst, P. (2009). AEP Asks State for 43 Percent Rate Increase. *The State Journal*. March 13, 2009.

Fisher, P., Sheehan, M., Colton, R. (2009). On the Brink: 2008 (The Home Energy Affordability Gap), West Virginia. Public Finance and General Economics, Belmont, Massachusetts. (http://www.wvf.state.wv.us/oeo/WAP%20Files/On%20The%20Brink%202008.pdf)

Flannery, T. (2005). *We are the Weather Makers*. Candlewick Press, York, PA.

Gilbertson, J., Stevens, M., Stiell, B., Thorogood, N. (2006). Home is where the hearth is: Grant recipients' views of England's Home Energy Efficiency Scheme (Warm Front). *Social Science and Medicine* 63, 946-956.

Gram-Hanssen, K. (2010). Standby Consumption in Households Analyzed with a Practice Theory Approach. *Journal of Industrial Ecology*, 14(1), 150-165.

Haines, A., Smith, K., Anderson, D., Epstein, P., McMichael, A., Roberts, I., Wilkinson, P., Woodcock, J., Woods. J. (2007). Policies for accelerating access to clean energy, improving health, advancing development, and mitigating climate change. *Lancet* 2007; 370: 1264-81.

Heede, R. (2002). Household Solutions. *Cool Citizens, Everyday Solutions to Climate Change*. Rocky Mountain Institute. www.rmi.org

Heyman, B., Harrington, B.E., Merleau-Ponty, N., Stockton, H., Ritchie, N., Allan, T.F. (2005). Keeping Warm and Staying Well. Does Home Energy Efficiency Mediate the Relationship between Socio-economic Status and the Risk of Poorer Health? *Housing Studies*, 20(4), 649-664.

Inhaber, H. and Saunders, H (1994). Road to Nowhere – Energy conservation often backfires and leads to increased consumption. *The Sciences*. November/December 1994, 20-25.

Kaufman, T. (1997). Out of Reach: the Unaffordability of Rental Housing. *Journal of Housing and Community Development*. Nov/Dec97, 54(6), 25-31

Krigger, J. and Dorsi, C. (2008). *The Homeowner's Handbook of Energy Efficiency*, Saturn Resource Management, Inc., Helena, Montana.

Leonard-Barton, D. (1981). Voluntary Simplicity Lifestyles and Energy Conservation. *Journal of Consumer Research*, Volume 8, December 1981.

Lutzenhiser, L. (1992). A Cultural Model of Household Energy Consumption. *Energy* 17.1 (1992), 47-60.

Lutzenhiser, L. and Biggart, N. (2007). Economic Sociology and the Social Problem of Energy Inefficiency. *American Behavioral Scientist* 50.8, 1070-1087.

Margonelli, L. (2009). Energy Security for American Families. *Issues in Science and Technology*, Winter 2009, 81- 88.

McClain, D. (2004). Ideas and Trends; The House Electric: Cozy but Voracious. *The New York Times*, September 26, 2004.

Morrison, C. and Shortt, N. (2008). Energy poverty in Scotland: Refining spatial resolution in the Scottish Energy poverty Indicator using a GIS-based multiple risk index. *Health & Place* 14, 702-717.

Oxley, E. (2010). Phone interview with Energy Analyst Ed Oxley regarding household energy use past and present, and recent energy rate increases. *WV Public Service Commission*. 304.340.0360.

Parsons, A. (2010). Weatherization Work in Huntington, WV, *Southwest Community Action Council*, Huntington, WV. Phone Interview on February 12, 2010, 304.781.0651.

Pitcher, H. (2009). Measuring income and projecting energy use: An editorial comment. *Climatic Change*, 97, 49-58.

Power, M. (2008). "The Burden of FY 2008 Residential Energy Bills on Low Income Consumers," *Economic Opportunity Studies*, Washington, DC.

Rector, R. and Johnson, K. (2004). Understanding Poverty in America. *Backgrounder,* Published by the Heritage Foundation, Produced by the Domestic Policy Studies Department, No. 1713, January 5, 2004.

Santamouris, M., Kapsis, K., Korres, D., Livada, I., Pavlou, C. Assimakopoulos, M.N. (2006). On the relation between the energy and social characteristics of the residential sector. *Energy and Buildings*, 39, 893-905.

Schulz, C. (2002). *Rural Studio: A Documentary*. Blueprint Productions.

Sherrill, C. (2010). Weatherization Work in Huntington, WV, *Southwest Community Action Council*, Huntington, WV. Phone Interview on October 14, 2010, 304.781.0651.

Soytas, U., Sari, R., Ewing, B. (2007). Energy consumption, income, and carbon emissions in the United States. *Ecological Economics* 62, 482-489.

Soratana, K., and Marriott, J. (2010). Increasing innovation in home energy efficiency: Monte Carlo simulation of potential improvements. *Energy and Buildings*, 42, 828-833.

Steptoe, A. and Feldman, P. (2001). Neighborhood Problems as Sources of Chronic Stress: Development of a Measure of Neighborhood Problems, and Associations with Socioeconomic Status and Health. *Ann Behav Med*, 23(3), 177-185.

U.S. Census Bureau (2010). 2006-2008 American Community Survey 3-Year Estimates for Huntington, WV. *Factfinder*. http://factfinder.census.gov.

U.S. Department of Energy (2009). Obama-Biden Administration Announces More Than $70.3 Million in Weatherization Funding and Energy Efficiency Grants for West Virginia, March 17, 2009.