"Because You Got to Have Heat":

The Networked Assemblage of Energy Poverty in Eastern North Carolina

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Abstract

Current discussions of energy policy seldom acknowledge the problem of energy poverty, a situation in which a household cannot afford to adequately heat or cool the home. In this article, we examine the concept of energy poverty and describe some of its contours in a rural part of North Carolina. Energy poverty, we suggest, is best viewed as a geographical assemblage of networked materialities and socio-economic relations. To illustrate this approach , we focus on the geographical patterns of three key determinants of energy poverty in Eastern North Carolina: the socio-economic characteristics of rural households, the networked infrastructures of energy provision, and the material conditions of the home. Throughout, we highlight the lived effects of energy poverty, drawing on transcripts from interviews conducted with recipients of weatherization assistance in the region. The challenges of the energy poor, we suggest, deserve greater attention in public policy, and as part of a broader understanding of welfare and care.

Keywords: energy poverty, networks, infrastructure, weatherization, North Carolina

Introduction

Contemporary discussions about energy policy in the United States have tended to focus on the need to transition from our current fossil fuel regime to one in which renewable energy sources play a much larger role. Amid the debates about energy security, climate change and a new green economy, however, it is easy to overlook the fact that millions of Americans currently lack access to reliable, affordable energy regardless of source. In this contribution, we highlight some of the dimensions of this uneven landscape of energy consumption, by examining the concept of energy poverty and tracing some of its contours in a rural part of North Carolina.

We use the term energy poverty to describe a situation in which a household cannot afford to maintain the home's indoor temperature at a level that allows for a comfortable or healthy lifestyle, a condition also known as fuel poverty. Our aim in what follows is twofold: first, we wish to put forward a view of energy poverty as a particular kind of techno-social assemblage, comprised of an array of networked actors and materialities. A focus on the networked nature of energy poverty, we suggest, can help to highlight its historical foundations and multidimensional character. Our second aim is to offer a glimpse of the lived realities of energy poverty. To do so, we draw upon results from a research project centered around in-depth interviews with households receiving weatherization assistance in Eastern North Carolina. By giving voice to those coping with energy poverty, we hope to shed some light on a phenomenon that is seldom given a prominent role in contemporary policy debates, and also to suggest some of the ways that the challenge of energy poverty might be viewed in the context of an expanded conceptualization of welfare and care.

Energy as an Assemblage

On the surface, energy poverty is a straightforward relationship between household income and the cost of energy. In Boardman's (1991) often-used formulation, a household spending more than 10 percent of household income on energy bills should be defined as energy poor. It should be clear, however, that this financial equation is not simply a matter of incomes and energy prices, but is mediated by a variety of factors and relationships, including the provision of energy to the home, the home's energy efficiency, and the unique requirements for an individual to be comfortable in their home. Boardman (1991) and Healy (2002) have examined some of these aspects of energy poverty in the European context, with a particular focus on the links between energy poverty and household risk factors. Both authors have produced empirically rich studies detailing the prevalence of energy poverty using large scale census and survey data. Building from the work of Healy and Boardman, Buzar (2007a; 2007b) examines energy poverty at a finer scale in the former socialist countries of Central and Eastern Europe. Buzar (2007a) advocates a 'relational approach' to the study of energy poverty, one that combines an understanding of postsocialist energy policy and housing infrastructures with an appreciation for the lived experiences of the energy poor.

While we are broadly supportive of this kind of approach, we wish to suggest that new avenues of inquiry can be opened up through an engagement with recent geographical discussions of relational thinking (Jones 2009) and 'assemblage geographies' (Robbins and Marks 2010), which have called attention to the ways in which networks and relations are assembled and stabilized to produce what we take to be 'the social'. More specifically, we would say that energy poverty is best viewed as a geographical assemblage of networked relations of various kinds, including flows of energy, infrastructures of production and

distribution, the properties of the built environment, and the social and economic networks that sustain communities.

In developing this perspective, we draw loosely upon work in a number of theoretical traditions, including Actor Network Theory (Murdoch 1997; Farías and Bender 2010), Deleuzian philosophy (Marston, Jones, and Woodward 2005), and Science and Technology Studies (Graham 2001; Hommels 2005). While not wishing to gloss over their distinctions, we find in this work a common theoretical orientation, which provides a useful frame for viewing the problem of energy poverty in new ways. For one thing, and in contrast to much work in Marxist political economy, such work refuses to take social structures and relations at face value, instead asking how 'the social' has come to be assembled in particular, historically-contingent ways (Kirsch and Mitchell 2004; Holifield, 2009). A focus on networked assemblages also calls attention to their heterogeneous character, as well as the cultural attitudes that shape their use. Seen this way, the lived reality of energy poverty can be approached as a condition that arises from the ways in which nature, technology, cultural norms, and the individual biographies of households have been drawn together into particular networked configurations.

In what follows, then, we take a closer look at the nature of energy poverty in Eastern North Carolina. Our aim is not to assess the scope of the problem, but rather to suggest some of the theoretical resources and ethnographic insights that might be brought to bear in developing a richer understanding of energy poverty in the U.S. context. In so doing, we focus attention on the geographies of three key dimensions of the energy poverty assemblage: the socioeconomic characteristics of rural North Carolina, the varied landscape of energy provision in the region, and the material character of housing. While geographical variations in any one of these factors

may influence energy use and access, it is their combination into particular techno-social assemblages, we suggest, that results in energy poverty.

Networked Infrastructures

The networked infrastructures of energy and other substances have been the focus of considerable recent discussion. This research has highlighted a number of ways in which networked infrastructures and their associated technological systems work to shape landscapes and spaces. First, infrastructures are important sites for mediating the relationships between, and thus producing particular understandings of, 'nature' (on the one hand) and social or domestic space (on the other). This has been described as a metabolism, through which the flows of 'natural' substances such as water, energy or waste, are isolated and channeled toward, or away from, the socially-produced spaces of the city and home (Gandy 2004; Swyngedouw 2006).

A second insight of recent work on networked infrastructures is that their deployment is both 'obdurate' over time (Hommels 2005) and uneven across space, which can often lead to significant forms of spatial inequality. Graham and Marvin (2001), for example, have identified what they call a 'splintering urbanism', in which infrastructures are able to bypass certain groups and regions, resulting in an increasing gap between "premium networked spaces" and those suffering a "poverty of connections" (Graham and Marvin 2001, 249; 288). The more general point, as Monstadt (2009, 1934) puts it, is that "the quality of networked infrastructures and the degree of social and geographical access to them has a huge impact on distributional justice and social well-being." Thirdly, regulatory regimes and public policy can shape network availability in significant ways. Recent trends toward liberalization and deregulation, for example, have

increased the sociospatial inequality in the cost of, and access to, many forms of networked infrastructure (Graham 2001).

For the most part, examinations of networked technologies and infrastructures have focused on their constitutive role in shaping specifically urbanized landscapes (e.g., Graham 2000; Hommels 2005; Farías and Bender 2010). Here we wish to suggest that rural spaces are in part constituted through and defined by networked materialities of various kinds. Although such networks may be less evident than those within the entangled spaces of large cities, rural settings are no less comprised of what Woods calls "hybrid assemblages of human and non-human entities, knitted-together intersections of networks and flows" (Woods 2007, 499). Among these networks are the rural infrastructures that gather together and distribute energy and other material substances. These infrastructures, like their urban counterparts, are characterized by fragmented regulatory regimes and significant spatial inequalities in access and cost. For these reasons, we believe, the geographies of rural energy poverty are worthy of examination.

Energy Poverty in Eastern North Carolina

Our particular investigation is focused on three counties in Eastern North Carolina (Figure 1). The area is typical of lagging rural regions throughout the U.S. South (Table 1), and is characterized by relatively high rates of poverty and unemployment, a declining economic base, low levels of educational attainment, and endemic health problems (North Carolina Rural Economic Development Center, n.d.). It is this kind of socioeconomic landscape that presents a high risk for energy poverty (Colton and Leviton 1991; U.S. Department of Health and Human Services 2005).

In the US, two federal programs have been established to assist those in energy poverty. The first is the Low Income Home Energy Assistance Program (LIHEAP) which provides income subsidies to low income households, most often in the winter when heating bills are the highest. The second is the Weatherization Assistance Program (WAP) which updates and renovates houses occupied by low income residents in an attempt to increase their energy efficiency. Weatherization improvements typically include adding or improving insulation and repairing non-functioning HVAC equipment. These improvements usually result in lower bills and safer indoor conditions for recipients. Since its inception, more than 6.2 million homes in the United States have been weatherized by the WAP (National Association For Community Service Providers 2009).

In North Carolina, the WAP is administered by the state's Department of Commerce, which distributes funding to community action agencies across the state. One such agency is WAGES, Inc. (Wayne Action Group for Economic Solvency), which administers the WAP in Greene, Lenoir, and Wayne counties. Our research was undertaken in partnership with WAGES, who have provided access to their recipient database and also facilitated our interviews with weatherization recipients. Potential interview participants were identified using a typical case sampling technique (Bradshaw and Stratford 2005). An initial group of 30 potential participants was selected from the WAGES database that loosely approximated a cross section of ages, locations, housing, and fuel types in the study area. Once identified, potential participants were contacted by WAGES to gauge their willingness to participate in the interviews, which were then scheduled and conducted by the authors in the recipient's homes. From the initial group, 17 weatherization recipients agreed to participate in interviews conducted during the summer months of 2009. When used in conjunction with data collected from the WAGES database and

U.S. Census, the interviews allow for a richer understanding of how individual people experience fuel poverty, with an emphasis on the meanings people attach to their lives (Valentine 2005).

To be eligible for weatherization, households must apply to the program and meet income criteria (less than 150 percent of poverty level). WAGES then prioritizes applicants based on need, with priority going to households with elderly or young children present and those in which the inhabitants face an imminent health risk. Not surprisingly, then, the WAGES recipient database reflects the particularly challenging socioeconomic circumstances faced by many of the energy poor in Eastern North Carolina. Many recipients are elderly and/or disabled, and rely upon Social Security or disability payments as their sole income; 74 percent of recipients are African Americans, and 79 percent are female; 84 percent of recipients are the sole source of income in their families, and 41 percent did not complete high school or obtain a GED. Across the three counties, WAP recipients have a mean annual household income of $13,602 and average annual energy costs of $1,949 (an energy burden of 14 percent).

Of course, the lived reality of the energy poor is more personal than such figures can convey. Each household has come to WAGES from a unique set of circumstances, a biography that forms a part of the assemblage of energy poverty. Our ethnographic interviews shed significant light on the nature of these biographies, and on the challenges facing the energy poor. One of our key findings was that a thread of precariousness was woven through the lives of our interview subjects (Table 2). Many suffered from poor health or had sustained an injury that made them unable to work. Recipients commonly found themselves with insufficient income in retirement, and felt on the verge of financial ruin. A number were coping with the recent loss of a loved one. For some participants, personal circumstances meant that energy bills that were once affordable were now simply too high. In other cases, little had change in the household

itself, yet the networks to which the home is connected or the materiality of the home itself had changed. It is difficult, then, to point to a single factor underlying the descent into energy poverty. As an assemblage, it is rather the outcome of the ways in which physical health, financial exigencies, social networks, the materiality of the home, and the infrastructure of energy provision interact to produce an uneven geographical landscape of energy cost and availability.

The Variable Landscape of Energy Provision

The landscape of Eastern North Carolina is crisscrossed by a dense web of networked energy infrastructures. The ability of any particular household to effectively access these networks, however, is conditioned by a number of factors that vary geographically. Although such constraints are experienced by all energy users, they pose particular challenges for low-income residents. The primary heating sources used in the study area are electricity, liquid propane gas (LPG) and natural gas (Table 3). Each of these forms of energy has distinctive properties, and varies in its ability to be efficiently converted from raw fuel to heat. Natural gas and LPG are much more efficient than electricity as a source of heat and, all things being equal, would be a more cost effective method of space heating. All things are not equal, however, as the networks of energy provision can vary significantly by both cost and availability.

Figure 2 shows the percentage of residences using natural gas, electricity, and LPG, respectively, as their primary heating fuel. The patterns are largely a result of the ways in which infrastructure networks have been laid down over time. Natural gas requires significant distributional infrastructure, and as a result, it tends to cluster in dense urban areas where utilities can expect to profit. Electricity, which is available virtually anywhere in the study area, and

LPG, which is distributed by vehicles and thus less bounded geographically, are more prevalent in rural areas where natural gas is unavailable. In addition, most mobile homes leave the factory with electric heat sources, which predetermines the energy network to which they are connected.

The nature of these networked energy infrastructures also plays a significant role in the cost of energy for consumers. In North Carolina, natural gas distribution, and in some areas electricity, are regulated by the North Carolina Utilities Commission (NCUC), meaning that price increases must be approved by the commission, thus decreasing volatility. LPG is not regulated by the state and compared to natural gas its price is more closely tied to the vagaries of the market for international crude oil (U.S. Energy Information Administration 2010). This means that LPG prices, in particular, can go from being relatively affordable one month to being a significant burden the next. In addition, the price for LPG, and to a lesser extent natural gas, fluctuates based on demand, and so tends to peak during particularly cold stretches. Natural gas and LPG prices during winter months between the years 2004 and 2009 are shown in Figure 3. While natural gas prices exhibit some fluctuation from year to year, LPG prices are increasing long term increases and experienced a significant price spike in the winter of 2008.

The most complicated energy landscape is presented by electricity (Figure 4), the networks for which have their roots in the North Carolina Electric Membership Corporation Act of 1935, legislation that emerged from the New Deal's emphasis on bringing electricity to rural areas. The Act encouraged the formation of non-profit membership corporations to expand the availability of electricity at the lowest possible cost. At the same time, investor-owned utilities were focusing their efforts on cities and towns, where population densities held the promise of high returns on infrastructure investment. Smaller municipalities, which seldom received the attention of investor-owned utilities, were often left without electricity and many pursued

electrification on their own. The three types of electricity providers in the study area are subject to different regulation regimes. Investor-owned utilities are regulated by the NCUC, and rate increases are subject to Commission approval. Not-for-profit rural cooperative rates are not regulated and provide at-cost service to customers. Municipalities are also exempt from NCUC regulation, and revenues are used not only to cover the cost of electricity service but also to support non-energy related municipal programs. As a result, municipal providers charge the highest rates of any electricity supplier in the study area. Table 4 shows electricity rates for the various providers in one county within the study area. The largest discrepancy in rates occurs between a rural co-op at the low end, Tri County Electric, and a municipal provider at the high end, the City of Kinston. Assuming the average electricity usage of 888 Kwh per month (U.S. Energy Information Administration 2004), a household in Kinston can expect to spend an additional 60 percent on each electricity bill, or $53 per month.

Irrespective of provider, many interview participants reported that they had a difficult time with high energy bills. Roger McDonald had electricity bills as high as $400 per month, nearly 50 percent of his monthly income. During that time, he, "about lost the house two or three times because the bills got so high." Carl Williams described his electricity bill as:

> The killer. I mean, you are talking about $3[00], $345, $350. That's basically what I was paying for this house. And to me it is ridiculous to pay that much, but you have to.

The Porous Materiality of the Home

The experience of energy poverty emerges not only from the geographically uneven character of energy networks, but also the ways in which those networks intersect with the materiality of the home. For the energy poor, a decline in the home's thermal efficiency brings

on new challenges in the form of higher energy bills and indoor conditions that can at times become dangerous to the occupant.

The connection of the home to networked infrastructure beginning in the early 20th century remade the house into a new space, a symbol of progressive society. Life was made easier by a range of electric appliances, and the home more comfortable through the climate control enabled by air conditioners and furnaces. The home thus became the site of a socio-natural metabolism, in which flows of water, fuels, electricity and other substances were regulated in and through the home (Kaika 2004). The efficiency of the modern home, however, is belied by the leaky materiality of the typical house. As Graham and Thrift (2007) remind us, the U.S. housing stock is in a perpetual state of break-down and decay, such that commonplace activities of repair and maintenance (such as, for example, weatherization) can be viewed as constitutive of modern life. For the energy poor, in particular, the structural features of the home, and the proficiency with which it regulates its metabolism with nature and energy, play a large role in the quality of their daily living environment (Healy 2004; Santamouris et al. 2007).

The aging of the materials and systems comprising any particular house will obviously affect its energy efficiency, and houses in the study area are older than the state average (Table 5). The older homes tend to be located in the urban neighborhoods of Kinston, Goldsboro, and Mt. Olive (Figure 5). For those living in such homes, the lack of insulation, as well as the leaks and drafts that inevitably appear in the house, will eventually begin to show up in the form of high heating and cooling bills. Karen Thompson, for example, describes the variable conditions inside her home, noting that:

> The living room and the kitchen, was the coldest thing in the house. 'Cause we got … them old windows, and air comes up there through them, and you can hear the glass sometimes rattling in the wind.

In addition to the gradual decay of housing materials, older homes are susceptible to a failure of their heating or cooling system. According to WAGES, 76 percent of weatherization recipients had heating systems that were not functioning correctly at the time of inspection. As a result, we were told, many households are forced to seek other sources of heat for their homes, most often in the form of dangerous and inefficient electric, kerosene, or propane space heaters.

For many of the energy poor in Eastern North Carolina, it is not so much the age of the house that determines the energy relationship, but rather the properties of the house. This is particularly true of mobile homes, which have become an important housing option for low income households in the state (Rust 2007). As Figure 4 makes clear, many weatherization recipients located outside of the urban areas are living in mobile homes. Mobile homes comprise 11 percent of the residences across the entire study area, and up to 75 percent of the residences in some census blocks. While buying a new mobile home is more affordable than a site built home, the construction quality tends to add hidden costs when it comes to energy efficiency. Many tend to have significant air leakage through walls, little or no insulation in walls, ceilings, and floors, uninsulated heating ducts, and uninsulated doors (U.S. Department of Energy 2010). Although new building and energy efficiency standards were put in place in 1992, code enforcement is irregular, and even many newer mobile homes have poor energy efficiency (Hart, Rhodes & Morgan 2002).

Many interview participants highlighted the challenges of living in a mobile home. Ronald Bush's experience is not atypical. "As mobile homes go it is a very pretty mobile home," he noted, but it is:

> One of the most poorly built structures I have ever seen. When the wind is not even gusting, it's like someone is banging gongs up there…Water comes in from the vents in the bathroom, and water pours, I have to put buckets on the oven, to

> accommodate all the water that comes in…I don't know if there is an ounce of insulation in this thing.

The poor energy efficiency of Ronald's house led to unaffordable bills, which reached as high as $400 during the warmer summer months.

The Lived Experience of Energy Poverty

We have tried to suggest some of the ways that energy poverty emerges as a kind of assemblage, in which networked infrastructures, the materiality of the house, and the biographies of individual households combine to produce a physical and/or financial inability to properly heat or cool the home. For residents who are already facing various social and economic challenges, this is experienced as a 'domestic network crisis', to borrow a term from Maria Kaika (2004, 277). This is particularly true for those who lack extensive social or familial networks of support, which might mitigate the impacts of energy poverty.

Interview participants described a variety of coping mechanisms they employed to deal with the discomfort that comes from living in energy poverty (Table 6). These ranged from relatively small changes in their day to day behavior to large changes that fundamentally alter their interactions with their home, their social networks, and their community. Some householders were aware of the role their homes played in the high bills and made crude alterations to the home itself. Others limited their movement throughout the house in an attempt to keep their bills down. Marilyn Wallace essentially limited the size of her home to two rooms. As she describes it:

> I had a kerosene heater, and an electric heater. The kerosene heater I would take to the bathroom to warm up to bathe, and the electric heater I kept in the bedroom, and I kept the door closed, to keep the room warm…I don't go about the house much during the day.

At the extreme, some interview participants were forced by the low temperatures to stay in bed, fully dressed and wrapped up under blankets, until it was warm enough inside to get out. Karen Thompson, when asked how she had coped with the low winter temperatures when her furnace failed, replied:

> We just dealt with it. We put on more clothes, get in the bed with some covers.

Such reactions are not only personally trying; they may also disrupt the social networks of friends and relatives that can provide assistance to those coping with energy poverty. In the case of Theodore Cole, one particularly hot Father's Day his grandchildren:

> Were complaining that it wasn't comfortable in here because it was so hot. I had a fan … and the ceiling fans all going, and you couldn't even tell they was on.

For Marilyn Wallace, cold winter nights often meant sleeping at her daughter's house because despite using space heaters and blankets, she "couldn't even keep the bedroom warm."

In spite of the great lengths the interview participants went to save money, the relational nature of energy poverty means that even individual conservation and coping behavior is not always enough in the face of networked relationships over which the energy poor may have little control: the obduracy of the technosocial infrastructure through which fuel is made available; the recalcitrant materialities of old, leaky houses or mobile homes; low incomes exacerbated by the shrinking welfare state, economic restructuring, and poor health or disability; high energy prices resulting from past legacies and regulatory structures within the energy system, as well as distant geopolitical events (see table 6). Within such assemblages, even the most mindful user of energy may be faced with unaffordable energy bills, a reality that forces many Eastern North Carolina residents to make unenviable choices about which bill to pay and what they can do without. As Sally Moore puts it:

> When you get that gas bill, and you pay your electric bill…now I do have Medicaid…it helps me out with my medicine. I don't know what in the world I would do. I would have to choose between…I don't know what I would do. Because you got to have heat, you got to have food, and you got to have medicine.

Conclusion

Our aim in this article has been to examine, both conceptually and empirically, some of the characteristics and relationships defining energy poverty in Eastern North Carolina. Our investigation, we believe, has theoretical, policy and ethical implications. Theoretically, we have explored some of the avenues opened up by characterizing energy poverty as a geographical assemblage of networked materialities. We believe that such an approach can make us more attentive to the ways in which lives, networked infrastructures and the porous materiality of the built environment interact in a kind of energy metabolism. More broadly, this kind of open and relational account has affinities with recent geographical debates in a wide range of fields, including science and technology studies (Hommels 2005; Lovell 2005; Coutard and Guy 2007), urban political ecology (Heynen, Kaika, and Swyngedouw 2006) and studies of rural networks (Murdoch 2006; Woods, 2007).

From a policy perspective, our work calls attention to the lived experience of energy poverty, an experience that often results in painful choices and fundamental changes in the daily lives of already-disadvantaged rural residents. Pending energy legislation represents an opportunity to address some of the relational factors that help to create energy poverty, but only if those suffering or at risk become a part of the conversation. Energy efficiency standards for low income housing and mobile homes should be improved and rigorously enforced, and funds that might be raised by carbon taxes or cap-and-trade programs should be used to assist chronically underfunded programs like the LIHEAP and the WAP, as some pending legislation

proposes. Such programs will be at the forefront of assisting the energy poor to cope with an evolving energy system. Indeed, weatherization in particular has been shown to have a positive impact on energy poor households and communities (Schweitzer & Tonn 2003; Shortt & Rugkasa 2007), and has made a significant difference in the lives of WAP recipients in Eastern North Carolina. Says Roger McDonald:

> Since they come in and did all the weatherstripping and stuff, that brought the bills down like it should. If they hadn't have done that, man, we would have still been in a mess.

Carl Williams, now finally relieved of his 'killer' electricity bill, concurs:

> I got nothing but high praises for what they did … they helped me to help my family and help keep up my home, so this is a blessing for me.

Such outcomes are worth applauding, but we would point out that the WAP and similar programs focus on only one strand within the constellation of relationships comprising energy poverty. While re-engineering the physical structure of the home can modify the built environment's metabolism with nature, it fails to address the many other networks and relationships through which energy poverty may emerge. It is here, then, where larger questions of ethics and responsibility come to the fore. At issue is the extent to which we may be said to bear a collective responsibility toward the various forms of connection—not just technological, but social and economic—that may either mitigate or exacerbate the challenges faced by the energy poor. There are good reasons, we believe, to fold energy well-being into an expanded sense of welfare and a wider net of care. We agree with Susan Smith when she asserts that "the aim … is to emphasize the values of interdependence over individualism and to … build an ethic of care fully into models of social policy and into the practice of welfare" (Smith 2005, 11). Our hope is that energy poverty, and its networked relations and materialities, might be included in any assessment of our progress toward such a goal.

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Table 1. Socio-economic data for counties in study area

	Total Population	White Pop (%)	Black Pop (%)	Median Age of Population (Years)	Pop 25 years + Less than 12th grade education (%)	Median Household Income ($)	Median Income, Black ($)	Median Income, Age 65 and Older ($)
Greene County								
2008 ACS	20,542	49.1	39.2	35.8	29.3	38,654	28,586	22,039
WAGES	55	21.8	76.4	61.9	40.0	15,442	13,152	13,152
Lenoir County								
2008 ACS	56,840	54.5	40.1	40.8	25.7	31,475	22,875	20,901
WAGES	106	26.4	73.6	60	41.0	13,271	12,588	10,965
Wayne County								
2008 ACS	113,223	60.8	32.1	37	19.3	40,464	27,554	27,024
WAGES	193	27.5	71.0	59.4	41.7	13,260	10,596	10,128
North Carolina								
2008 ACS	9,036,449	70.3	21.2	36.8	17.1	46,107	31,580	30,175

Source: 2006-2008 American Community Survey 3-Year Estimates and WAGES, Inc weatherization recipient database

Table 2: Factors Contributing to Energy Poverty

Individual biographies

Health problems

- *"There were days when I was sick, there were days when she was sicker than I was … See I was out of work, back surgery … that put me behind on a lot of bills."*
- *"I was doing pretty good, but I had a leg amputated … and I would work right now if I could get around good."*

Precarious economic circumstances

- *"I about lost the house two or three times because the bills got so high."*
- *"Right after my dad died all my mom had was $638 (a month). And it has just been very difficult."*

Isolation

- *"I am here by myself, and don't nobody take care of me but me."*
- *"You see when you get sick … you don't have nobody to come help you out."*

Energy situation

High electricity rates

- *"When everything, the light bill … went up, everybody's bill went up, whether you burn a lot of not … One man I know at school said he got one for $500, no way he can pay that."*

Spikes in LPG prices

- *"I'm scared to turn on the gas. Sometimes I have to, but last year, you know how high gas was."*

Housing situation

Older energy inefficient homes

- *"Where the cold air was coming in, around the cabinets, and around the attic, that would be cold back there."*

Older inefficient/poorly functioning appliances

- *"It was a July 1967 refrigerator so … [WAGES] saw fit to replace it."*
- *"That unit out there … was an old unit … It running a whole lot of time that the Freon was out … and it sat there and ran and ran and ran and it brought the light bill up."*

Energy inefficient mobile homes

- *"We had a garden tub … and the weatherization guys came out here and they pulled that off and there was a big hole in the floor, and all the cold air in the bathroom, and it was always so cold … and that's what it was."*

Inability to perform upkeep and maintenance of housing

- *"When I was walking, I would put plastic up to the windows, then that would help keep the house warmer … In this chair I can't do stuff like that."*

- *"When I first moved here … I had the money to really take care of my home … When I got injured on my job and went on disability … it was overwhelming."*

Table 3. Heating fuel use in the study area

	Study area		North Carolina
Fuel Type	Census (%)	WAGES (%)	Census (%)
Electricity	53	61.6	48.8
LPG	24.6	22.3	12.6
Natural Gas	14.5	9.9	24.2
Fuel Oil	6.6	1.4	11.8
Space Heater	N/A	2.8	N/A
Other	1.1	N/A	2.1

Source: US Census (2000) Population and Housing Summary File 3 and WAGES weatherization recipient database
Notes: Space heater use is not collected by Census; WAGES does not collect data on other fuel types

Table 4. Electricity rates and estimated monthly charges for utilities serving Greene, Lenoir, and Wayne counties in November 2009

Supplier	Utility type	Rate per Kwh ($)	Base charge ($)	Avg monthly charge [a] ($)
City of Kinston	Municipal Power	0.1435	13.40	140.83
City of Wilson[b]	Municipal Power	0.1438	8.99	136.68
Town of Pikeville	Municipal Power	0.1359	8.95	129.63
Town of Walstonburg	Municipal Power	0-50 Kwh 0.0758; 51-250 Kwh 0.1573; 251+ Kwh 0.1257	13.00	128.45
Town of Hookerton	Municipal Power	0-500 Kwh 0.138; next 1000 Kwh .1238	8.55	125.58
Town of Fremont	Municipal Power	0.1265	10.01	122.34
Pitt & Greene Electric	Rural Electric Co-op	0.1122	20.00	119.63
Town of LaGrange	Municipal Power	0-800 Kwh 0.135; 800+ Kwh 0.1193	0.00	118.50
Town of Stantonsburg	Municipal Power	0.1103	8.99	106.94
Progress Energy	Investor Owned Utility	0.10634	6.75	101.18
Tri County Electric	Rural Electric Co-op	0.0888	8.98	87.83

Notes: Because Kwh rates vary for some utilities between winter and summer, we use summer rates and standard residential base charges.
Source: Rate data collected by authors during November 2009 from published rates available by phone or internet.
[a]Average monthly charge is calculated using average monthly residential electricity consumption data from *Residential Energy Consumption Survey 2001* (US Energy Information Administration 2004)
[b]City of Wilson electric utility serves a small portion of Wayne County despite being headquartered in Wilson County

Table 5. Housing data

	Median House Age	Median Mobile Home Age	Houses that are mobile homes
	(years)	(years)	(%)
Greene County			
2000 Census	22	N/A	36.9
WAGES	39	19	44.4
Lenoir County			
2000 Census	28	N/A	23.9
WAGES	55	18	32.1
Wayne County			
2000 Census	25	N/A	25.4
WAGES	49	21	38.9
North Carolina			
2000 Census	22	N/A	16.4

Source: US Census (2000) Population and Housing Summary File 3 and WAGES, Inc weatherization recipient database
Note: Age of mobile home not available from US Census

Table 6. Common coping strategies of interview participants

Utility bill non-payment
Use of oven or stove to warm kitchen and house
Closing off portions of the home to limit space heating/cooling
Use of electric, kerosene, and propane space heaters
Buying less food
Staying in bed during cold winter days

Selected quotes:

- *"Yeah, sometimes I used to have to use my oven to keep the house warm."*
- *"You know, sometimes you might have to let a bill go … put a bill off until you can get that paid and then you deal with that."*
- *"I even put padding in the windows, I blocked out all the sun light in these two pain windows, and the lights bills continued to be enormous."*
- *"I just put these comforters up, one there, one back there where the washing machine is, and we pretty much lived in one room."*
- *The heat wouldn't work no more. So I ended up getting a kerosene heater."*
- *"It was too much … groceries are so expensive. I have health problems … I am just trying to tell you, when I go buy something, I got where I did without."*
- *"At Christmas, I don't buy no Christmas presents, I can't afford it. Even if they were ten dollars a piece … It is hard on a senior citizen, you know, it's really hard on us."*
- *"We tried to burn not much of the heat, but with the kids, you know?"*

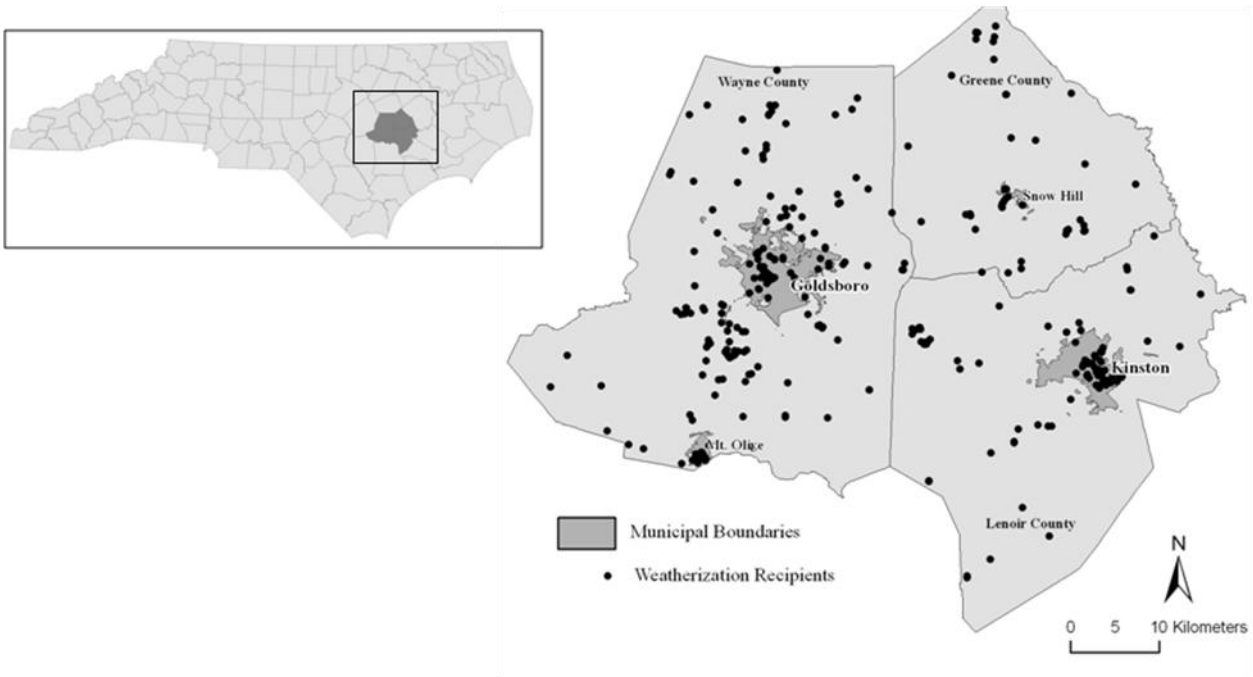
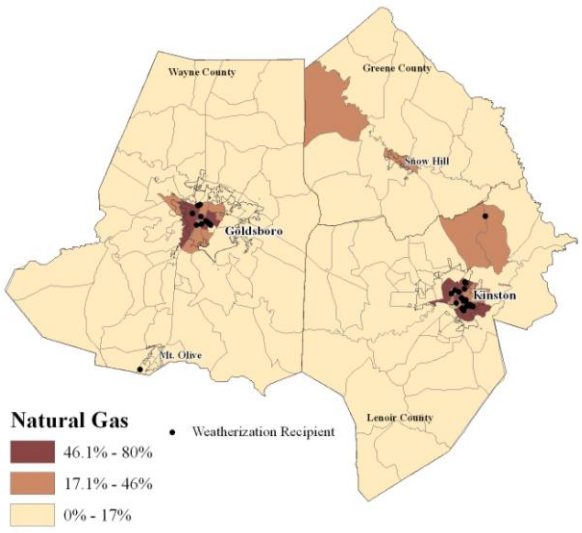


Figure 1. Study area showing municipal boundaries and location of all WAGES weatherization recipients



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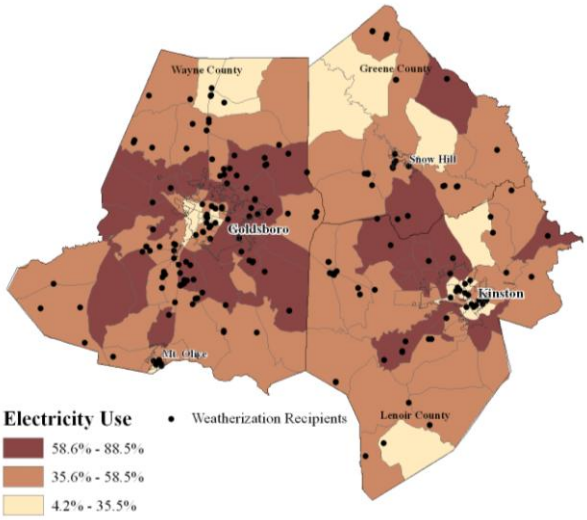

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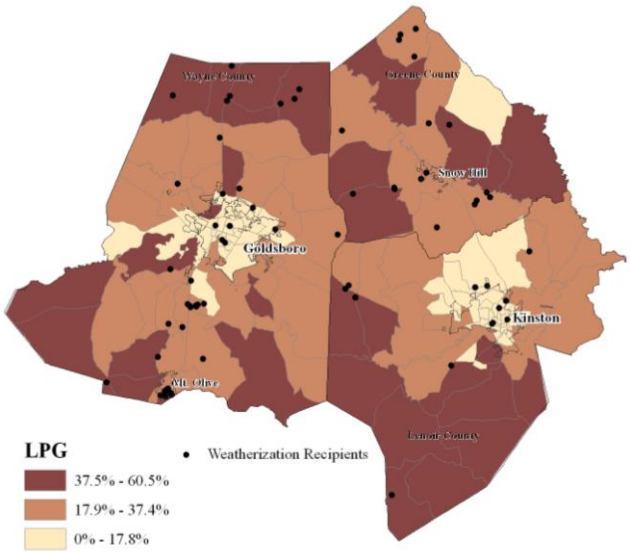
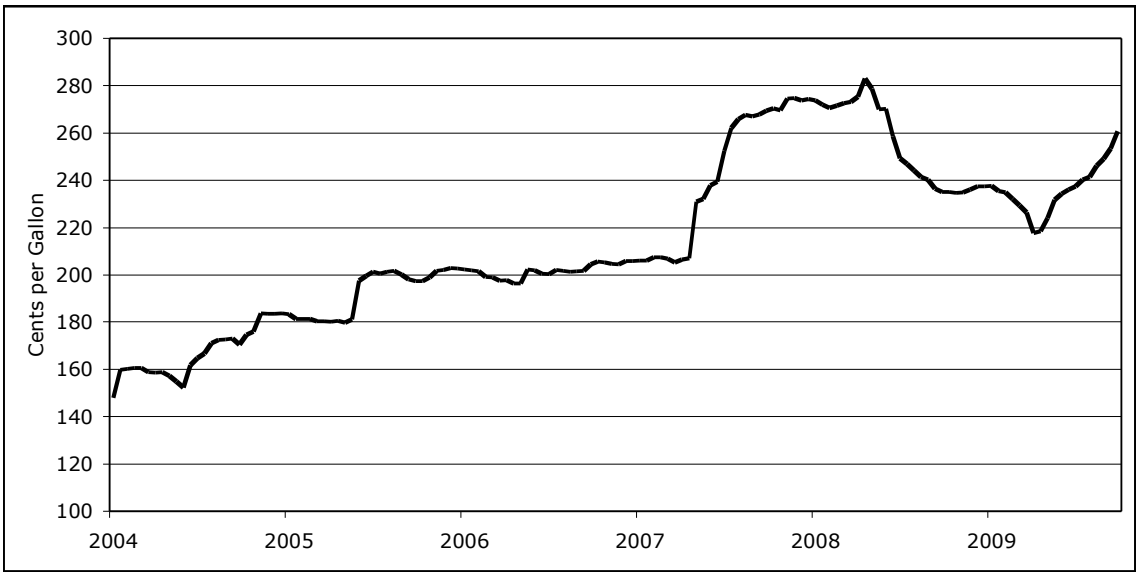


c.

Figure 2. Spatial intensity of heating fuel types in study area, by (a) natural gas, (b) electricity, and (c) LPG. Weatherization recipients using the respective fuel are identified. *Sources:* WAGES database and US Census (2000) Population and Housing Summary File 3.



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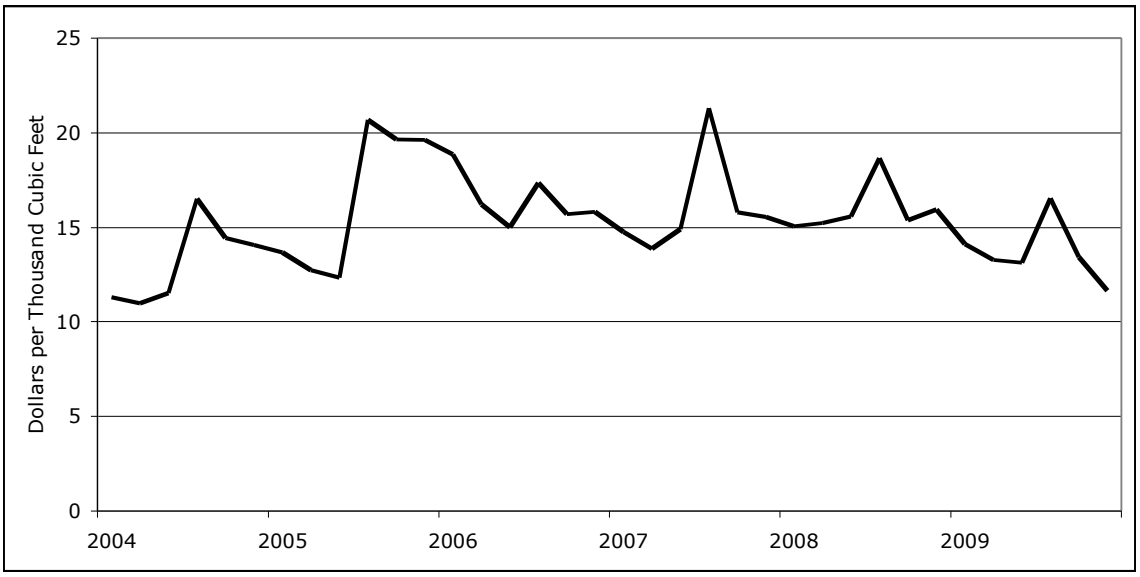


b.

Figure 3. North Carolina estimated aggregate residential heating fuel prices for (a) LPG and (b) Natural gas. Data collected for peak heating months (October – March), 2004 – 2009. *Source:* US Energy Information Administration (2010) Independent Statistics and Analysis

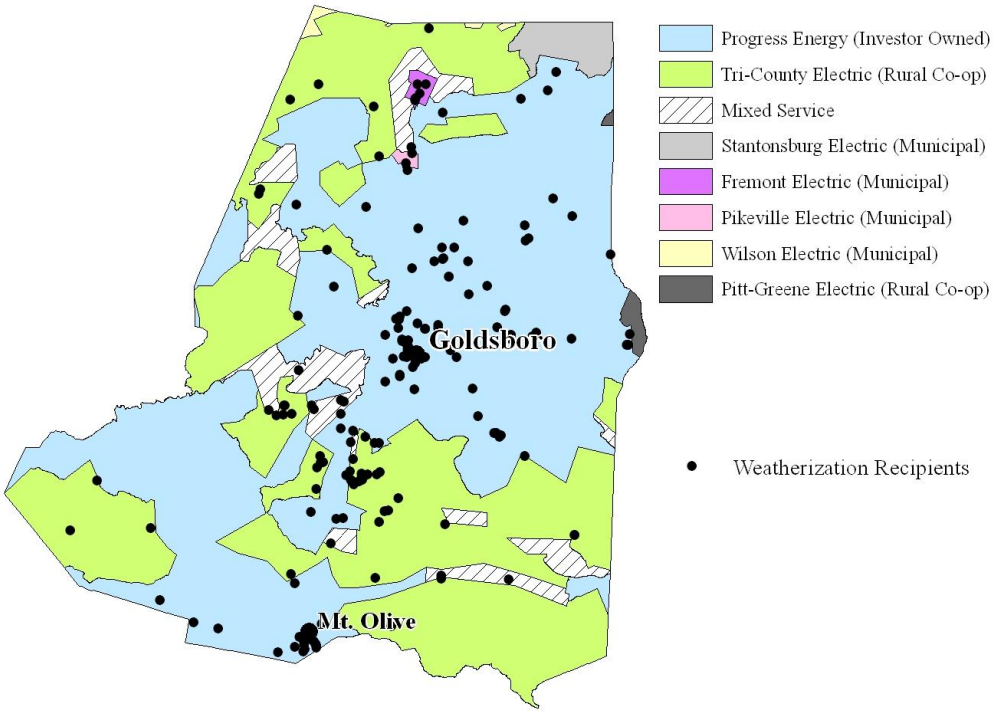
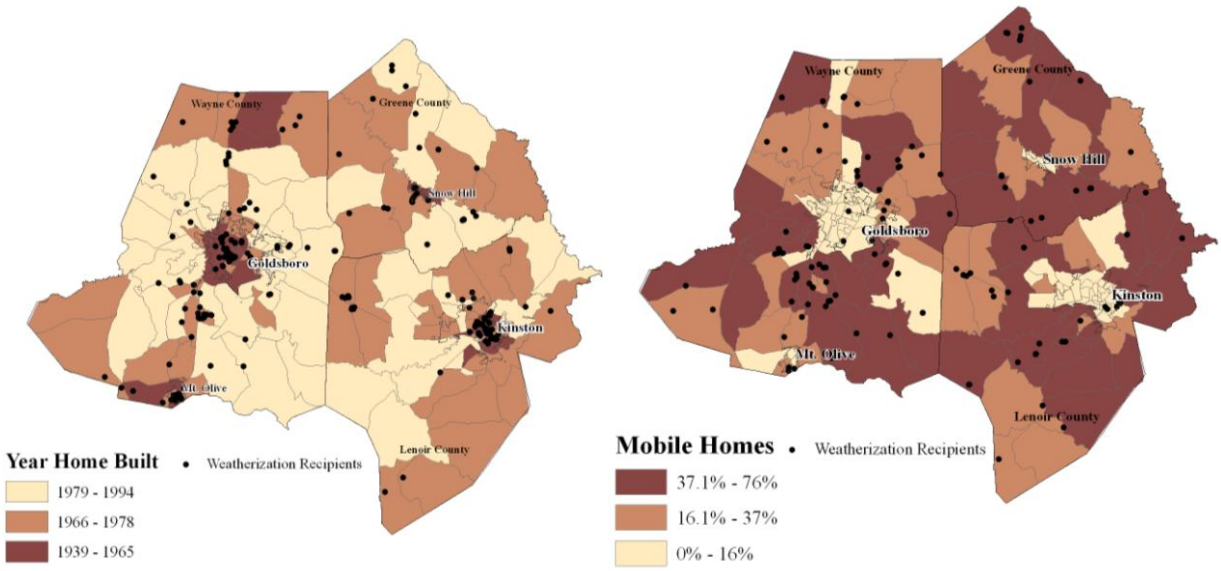


Figure 4. Location of weatherization recipients and electricity provider service areas in Wayne County. *Source:* WAGES database and Wayne County GIS Department.
Note: Provider service area data was not available in Lenoir and Greene Counties.



a. b.

Figure 5. Median year of home construction and spatial intensity of mobile homes, by Census block. Weatherization recipients living in houses are shown in (a), while recipients living in mobile homes are shown in (b). *Sources:* WAGES database and US Census (2000) Population and Housing Summary File 3.