Energy Performance and Community Resilience: A Review of Housing Policy and Programs

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ABSTRACT:
Americans spend more than $160 billion on heating, lighting and cooling their homes annually and these costs are increasing. Energy costs place a disproportionate burden on low- and moderate-income families. In the U.S. there is an enormous gap (nearly $50 billion) between the cost of home energy for electricity, heating, and air conditioning and the amount that residents can reasonably afford to pay. This discrepancy leads cost-burdened families to make difficult, sometimes dangerous, choices on where to spend. Moreover, low- and moderate-income residents are more impacted by disaster events. Therefore it is important to recognize how expenses related to energy use in residential buildings can be reduced through effective policy and the role that integrated planning and design plays in realizing more resilient housing and communities.

The objective of this research is to understand how energy is considered in American housing policy in order to determine how successful programs and strategies contribute to improved energy performance in the development of affordable housing. Housing policy was analyzed and successful strategies and case study projects were identified to establish best practices. Outcomes show that energy considerations in housing policy largely follow other patterns of more energy-conscious environmental design. More interesting is that the community-based approach infused in U.S. housing policy by the influence of Catherine Bauer remains central to more energy-conscious housing. Conclusions indicate that todays housing design and development strategies must address the important contemporary issue of resiliency by providing viable community-oriented solutions for integrating energy efficiency and renewable energy into housing society's most vulnerable citizens.

KEYWORDS: Housing, Energy, Energy-efficiency, Resilient Communities

INTRODUCTION

There is a direct link between the production of energy for use in buildings, climate change, and the resiliency of residential environments that must be addressed through responsible policy, planning and design.

Over the past five decades, climate change has had a profound impact on weather patterns. Rising air temperatures allow the atmosphere to absorb more moisture and hold it for longer periods of time, which has resulted in a growing amount of severe weather events. In the Northeastern US this means a rising trend in heavy precipitation, hurricanes and storms of increasing intensity and duration, and a heightened risk of high magnitude flooding. As the percentage of Americans living in the 100-year floodplain continues to grow, riverfront communities become more and more vulnerable due to rising flood insurance costs and damaged or overworked infrastructure. Energy costs are also rising, placing a disproportionate burden on low- and moderate-income families. "Americans spend $161 billion on heating, lighting and cooling their homes. According to the Energy Information Administration, over the past 5 years the cost of home heating has more than doubled in some parts of the country." (HUD 2006, 2). This burden is exacerbated by an older housing stock, the majority of which are located in the coldest and warmest climate zones in the US (HUD 1999), making them even more susceptible to climate change related disaster events. In the U.S. there is an enormous gap (48.8 billion dollars) between the cost of home energy for electricity, heating and air conditioning and the amount that residents can reasonably afford to pay (Fisher 2012). This discrepancy leads low and medium-income residents to make difficult, sometimes dangerous, choices in where to spend and in worse case scenarios inability to pay for home energy leads to homelessness (Davis 2012).

Fortunately, recent research and experience has shown that expenses related to energy use in housing can be greatly reduced through effective architectural planning, design, and detailing for little if any increase in the cost of construction over conventional building. However, the question remains as to how these successes have or can inform policy to assure enhanced performance of communities and residential environments. This paper explores this question by analyzing US housing policy from the development of the National Housing Act of 1934 through implementation of current HUD directives and programs to determine how energy performance is considered in the development of affordable housing. Case study projects and successful strategies were identified to establish best practices in attaining more resilient and affordable communities.

1.0 ENERGY CONSIDERATIONS IN US HOUSING POLICY

Figure 1: "Houser" Catherine Bauer advocated for a contextual and community-centered approach to housing celebrating European housing examples that included public amenities, individual gardens and distributed energy. "Heliotropic" housing was oriented for light, ventilation and views. Image: Paris Plessis-Robinson Garden City (Source: *Modern Housing*. Boston, New York, Houghton Mifflin Co., 1934)

1.1. Housers, Community Development, and Housing Policy 1934-1950s

Historically natural ventilation and light was integral to housing design, a recognized necessity for health and hygiene. A contextual approach to housing is evident in the design of social housing of the 1920s showcased in the groundbreaking *Modern Housing* (Bauer 1934). "The more recent inspiration for public housing emerged from the modern idea of planning, in the broadest sense, drawn heavily from European experiments in Garden City and municipally owned housing developments" (von Hoffman 2012, 6). Garden City planning and related housing appealed to Bauer in their functional planning, orientation, and utilization of open space, for overcoming the "fundamental deficiencies in light, sun, [and] ventilation…" but also for contributing to community enhancement (Bauer 1934, 149) (Fig. 1). Given the role that Catherine Bauer played in informing U.S. housing policy in the mid-1930s throughout the 1950s (Oberlander 1999), it seems evident that energy/environmental awareness related to social responsibility was implicit in U.S. housing Policy in its inception. Indeed, beginning with the United States Housing Act of 1937 energy costs associated with housing was included in the definition of 'affordability', defining maximum housing expenses inclusive of "heat, light, water, and cooking fuel" (United States Housing Act of 1937,1).[1] However, these "carrying costs" associated with the long-term affordability of housing is not the primary focus of US housing policy. Against the desires of Catherine Bauer and other "Housers," housing policy was linked to slum-clearance projects. "Ultimately, housing policy is subject to politics" (van Hoffman 2012,12). Following the great depression housing policy focused on job creation. The first major revisions to the U.S. housing policy came following World War II in response to the need for more housing and addressing urban areas blighted as a result of suburbanization (HUD Historical Background, National Housing Act of 1949). Although some new housing construction programs continued through the mid-1970s, 1950s marked the beginning of a gradual shift away from new construction. The Housing Act of 1954 amended the 1949 Act to provide funding for the rehabilitation and conservation of deteriorating areas (in addition to limited new construction and demolition). During the 1940s and especially in the early 1950s, code enforcement and rehabilitation became the preferred method of slum control. "The idea of code enforcement was by no means a new idea to housing reformers. It dated from the early twentieth century… although public housers endorsed the

standards of inner-city homes that lacked plumbing and other modern necessities, they generally dismissed the idea that code enforcement even in combination with rehabilitation could solve the problems of blight and slums (von Hoffman 2008, 14). However, the influence of Catherine Bauer may be embedded in policy's attempt at community "renewal"[2]; A summary of provisions of the National Housing Act of 1954, calls for rehabilitation or redevelopment programs "…for the establishment and preservation of a well-planned community with well-organized residential neighborhoods and decent homes and suitable living environments for adequate family life" (National Housing Act of 1954, 22).

1.2. Energy in Housing Policy, Programs and Competitions from 1960 through 2000

"Legislation in the 1960s expressed the social concerns of providing decent and sanitary housing and ensuring that such housing is made available to all," related to the Civil Rights Act of 1964 (HUD Historical Background, 1960s). For better or worse, the focus of US housing policy remained (remains) significantly on support for home ownership. The two decades from 1970-1990 saw the emergence of several new housing programs. A new community development Block Grant (CDBG) program, providing "flexible funding for community needs" was introduced in the 1974 Act and "remains one of the longest continuously running programs at HUD" (CDBG 2014). Policy during the decade also favoured "demand side" incentives (Mallach 2009, 18). Rental voucher programs were introduced beginning as early as the 1940s, but were widely condemned by public housers (von Hoffman 2008, 10). They found traction in the Community Development Act of 1974 with the introduction of the Section 8 Leased Housing Assistance Program.[3]

Not surprisingly US Housing Policy in the 1970s responded to national (and international) attention to energy. Language about the environment, natural resources and solar energy appears in the 1974 Act. A section entitled *Energy Conservation* was added to the 1937 Act during the 1970s and both passive and active solar energy was also directly addressed in US housing policy during that decade. "An authoritative non-profit, nongovernmental "National Institute of Building Science" [was authorized] to develop, promulgate and evaluate criteria for housing and building regulations" (CRS 1974, 69). Now celebrating its 40th year, this Institute continues to develop and disseminate building science information "for the purpose of improving the performance of our nation's buildings while reducing waste and conserving energy and resources" (http://www.nibs.org). During the late 1980s and early 1990s legislation- including the Energy Performance Contracting introduced in 1987, the 1991 DOE Building Energy Codes Program (BECP), and Energy Policy Act of 1992/1992 Model Energy Code- resulted in the incremental improvement of the energy performance of affordable housing.

The Quality Housing and Work Responsibility Act of 1998 (QHWRA), signed into law in 1998 and constituting a substantial overhaul of the United States Housing Act of 1937, was created for the purpose of revitalizing severely distressed public housing projects (Greenbaum 1998, 310). QHWRA concentrated on "de-concentrating poverty and promoting mixed-income communities in public housing" (Gray 1999). In this act all provisions for energy conservation and solar energy were struck from housing policy (QHWRA 1999). The term "energy" was changed to "utility" in accordance with Section 564(1)(b) of the QHWRA amended section 6(j)(1)(d)), but *utility* consumption was one indicator that the HUD Secretary was authorized to use for evaluating the performance of public housing agencies and resident management corporations (QHWRA 1999, 39). Moreover, through the Urban Revitalization Demonstration (URD) program/HOPE VI, "concepts of 'new urbanism'…- closely aligned with the energy-savings concepts embedded in Smart Growth – "have been embraced by HUD as the appropriate approach to revitalization of public housing" (Greenbaum 1998, 332).

Throughout the last century American's struggled to afford even "a median-priced home in the area where they lived" (Guttman 1993, 131). When HUD budgets were gutted in the 1980s and early '90s, not-for-profit development corporations stepped in to fill a detrimental gap in providing low-income solutions. A new era of "housers and other architects" came onto the scene (Gutman 1993), speculating on low-income housing solutions, mostly for urban infill conditions, through architectural competitions. Some competition briefs defined standards for design and project performance, including energy (*Progressive Architecture* 1992). Federal programs, including CDBG and Low Income Housing Tax Credit (LIHTC) and HOME programs introduced in 1986 and 1990 respectively, remain the primary funding source for providing affordable housing. These programs present interesting opportunities for influencing design related to building energy performance. Allocation plans for LIHTCs, administered at the state level, may include both Federal mandates for performance and state-determined criteria. For example, Pennsylvania's LIHTC allocation plan requires Energy Star performance standards and provides incentives for Enterprise Green Communities and higher (Passive House) performance.

1.3. Recovery, Reinvestment and Housing Resiliency

Pursuit to HUD's long-term mission *To increase homeownership, support community development and increase access to affordable housing free from discrimination* HUD strategic plans since 2006 have linked sustainability to community primarily through Section 8, LIHTC, HOME and Community Development Block Grant programs (HUD Strategic Plan 2006-2011 and 2010-2015). In fact, in the 2010-2015 HUD Strategic

Framework, HUDs mission was revised to *Create strong, sustainable, inclusive communities and quality, affordable homes for all.* The Energy Policy Act of 2005, building off the Energy Action Plan adopted in 2002 to promote energy efficiency in all HUD programs, contained several provisions that resulted in the improved energy performance in public housing, raising energy standards from the 1992 Model Energy Code to meet or exceed 2003 International Energy Conservation Code (HUD 2006). In FY 2007, Section 152 of the Energy Policy Act of 2005 required (when cost-effective) the purchase of energy-efficient appliances and Energy-Star products (HUD 2006, 21). Most influential in recent years has been the American Recovery and Reinvestment Act of 2009 and related programs. Under the U.S. Department of Energy's (DOE) Weatherization Assistance Program (WAP) local weatherization agencies provide energy conservation services to low-income housing including air sealing, storm windows, replacement windows, attic insulation, water efficient showerheads and faucet aerators, and tune-up of heating equipment. In addition to the Weatherization Assistance Program, the DOE Better Buildings Initiative, instated through investments associated with the Recovery and Reinvestment Act, was introduced in 2011 to reduce energy consumption in commercial and industrial buildings; in 2013, as part of the 2013 climate Action Plan, the DOE and HUD partnered to expand the Better Buildings Challenge to the multifamily residential sector. In addition to strategies to reduce energy demand in affordable housing, President Obama's Climate Action plan includes a goal to produce 100 MW of renewable energy capacity on-site at federally supported housing by 2020 (Solar Progress Report 2014). CDBG Disaster Recovery (CDBG-DR) funds allocated from the Disaster Relief Appropriations Act of 2013 are resulting in precedent-setting designs for responsible, community-oriented, energy-conscious affordable housing development.

2.0 AFFORDABLE HOUSING AND RESILIENCE COMPETITIONS

Between 2011 and 2013 forty-eight states, along with Washington D.C., had disasters declared due to extreme weather events, which according to the National Climate Assessment are going to be occurring more and more frequently due to climate change. HUDs most recent NOFA (notification of funding availability) for the National Disaster Resilience Competition invites eligible communities to compete for nearly $1 billion CDBG-DR funding. In the wake of past natural disasters, this competition is focused on solving the unmet needs of past disasters as well as enhancing communities' ability to mitigate and adapt to future chronic or acute stressors to address the environmental and economic resilience of communities. In partnership with the Rockefeller Foundation, The National Disaster Resilience Competition builds off previous CDBG-DR efforts including the "Rebuild By Design" competition of 2013.

2.1. Rebuild By Design

Rebuild by Design was a competition created by HUD, the Presidential Hurricane Sandy Rebuilding Task Force, and the Rockefeller Foundation in order to assess the preparedness of disaster affected regions, and design innovative solutions to the vulnerabilities communities face as an effect of global climate change. The competition focused on areas devastated by Hurricane Sandy with proposals for coastal communities, particularly in Northern New Jersey and New York City.

Figure 2: Submissions to the 2013 "Rebuild by Design" competition explored critical infrastructure solutions including food security and community-scale distributed energy. Above: overview site plan of Hunts Point Proposal, Source: (courtesy of Rebuild by Design/PennDesign/Olin)

A main goal of this competition was hazard mitigation, including critical infrastructure and resource protection. Rebuild by Design identified five main components necessary for the resilience of all systems:

- diversity of resources in order to allow for a wide range of responses;
- redundancy, or having back-up systems;
- connectivity to provide rapid detection of changes;
- modularity to allow individual units to retain self-sufficiency if disconnected, and;
- adaptability, the capability to modify responses to stressors.

HUD allocated 930 million dollars to this project, which was divided between the winning proposals in order for the teams to begin implementation.

One of the winning proposals by PennDesign and OLIN focused on Hunts Point, an extremely poor South Bronx neighborhood that is a food supply hub serving over 20 million people (fig. 2). An important focus of this project is energy resilience, in order to assure continued power to the food distribution center as well as provide affordable energy to the workers, tenants and homeowners that live in the area. Power loss in Hunts Point results in millions of dollars in spoiled food, critically affecting the economy in an already low-income area. A long-term energy resilience goal is to create a micro-grid in order to allow the peninsula to operate independently should the main power grid fail. Along with this, tri-generation energy is proposed, a system that captures and utilizes the waste heat from fossil fuel electricity generation. Using tri-generation would decrease the cost of energy so substantially that the electricity subsidy currently available for residents of Hunts Point could be completely eliminated, while still allowing for a reduction in overall energy costs (fig. 3).

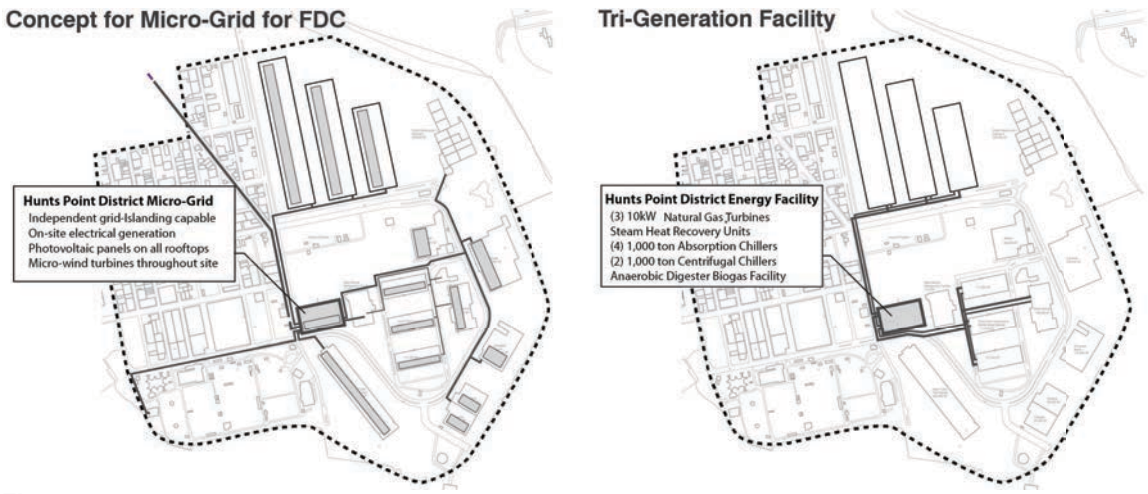

Figure 3: The "Rebuild by Design" proposal for Hunts Point included a community scale micro-grid and tri-generation energy facility. Source: (courtesy of Rebuild by Design/PennDesign/Olin)

2.2. Scaled solutions to housing development and community resilience

A resilient community is tough and has effective defenses along with the ability to fight against hazards and disasters, but these admirable attributes are not the only qualities resilience is centered on. A resilient community is conscientiously focused on the ability to bounce back with minimal effort and waste, while consistently investigating, testing, and implementing smarter ways to adapt. The Rockefeller Center defines resilience as the "capacity of individuals, communities, institutions, businesses, and systems… to survive, adapt and grow, no matter what chronic stresses and acute shocks they experience" (100 Resilient Cities). To achieve this, a multi-scaled approach to housing and community development is necessary.

Three inter-related scales are evident in the policy and programs studied above and must be considered and integrated through holistic design. These are:

- Community-based solutions for resilient, energy-conscious community design thinking:

As increasing numbers of Americans move back into cities, urban densification through infill construction, brownfield site reuse and building renovation or repurposing is necessary. This "Smart Growth" development must happen in a way that enhances ecological and energy infrastructure and reinforces community interaction. By considering the interconnection between buildings, co-generation and "tri-generation" becomes feasible, providing potential for reliable energy and "sheltering in place". Finally, the "energy-water-food nexus" should be considered (Brownson 2014). Allotment gardens were featured prominently in the projects featured in *Modern Housing* (Bauer 1934) and urban food production, community gardens and aquaponic architecture are currently popular. The "Hunt's Point Lifelines" project illustrates the important connection between "livelihood and supply chain protection" (fig. 4).

Figure 4: The Hunt's Point "Rebuild by Design" scheme by PennDesign/Olin proposes a new 6-day farmers market to create jobs, increase food security, and improve over-all community well-being. Source: (courtesy of Rebuild by Design/PennDesign/Olin)

- Building-scale solutions that consider form and construction methods and materials:

Housing design and renovation must go beyond the insulation and envelope improvements considered in weatherization programs to address building location and orientation. Materials must be highly energy efficient, durable and replaceable or "permeable" (fig. 5; Henrique 2014).

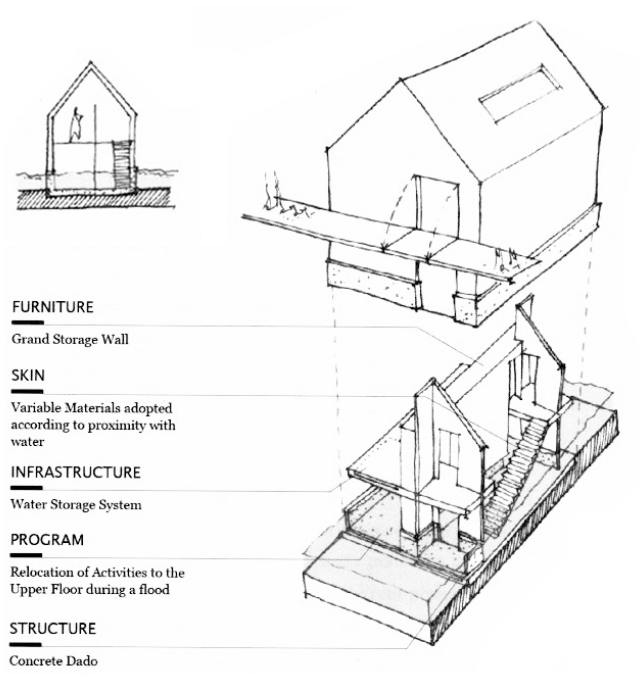

Figure 5: Karen Henrique illustrates permeable, flood-resilient design techniques. Source: (M.Arch thesis, Penn State, 2014)

- "Smart" controllable and integrated building systems:

Foremost, active building systems (and community infrastructure) must be out of harms way in the face of disaster, and easily accessible and replaceable. "Smart" systems are coming to the fore in energy and building research; Ideally these systems should be controllable, interconnected and integrated (fig. 6). Unlike at the building scale where optimizing materials and methods is preferable, redundancy in building systems is beneficial.

Figure 3: The Rebuild by Design "New Meadowlands: Productive City + Regional Park" proposal envisions integrative ecological, energy, data and waste management infrastructure at multiple scales. Source: (courtesy of Rebuild by Design / MIT CAU/ZUS/ Urbanisten)

CONCLUSION

Much of the existing affordable housing is in disaster-prone areas, and future housing development is likely to occur in increasing density along coastal areas and in floodplains.[4] Therefore holistic planning at multiple scales is necessary to responsibly retrofit or develop affordable housing in the US. The innovative "Rebuild by Design" projects provide some guidance. However, the competition teams faced multiple obstacles stemming from existing policy and regulatory framework, revealing that many governmental policies are not set up to fully allow resilience in our built environment. As the implementation stage continues, unless policy changes can be realized, many teams will be forced to adjust their responses and communities will suffer in the face of climate-related disaster.

Housing Policy and programs are beginning to address energy-responsible, more sustainable and resilient housing and communities through measures at the community, building envelope (insulation and weatherization) and systems scale (more efficient appliances and equipment). However, for the most part, they have limited impact. Recent presidential and legislative action has directed HUD to implement energy-efficient and green building practices and provides for greater cooperation between DOE, EPA and HUD in the interest of improving energy performance and oversight in public housing (Energy Task Force 2008 & Power 2006). Conditions for capital funding that encourage improvements in energy performance of new housing may hold potential for reducing energy use and associated energy costs. Retrofit programs also contribute to the national effort towards energy efficiency (Sullivan 2012). However, housing subsidies and funding opportunities are very limited. Moreover, "the U.S. stock of publicly-owned housing is negligible; nearly all low-income Americans live in private housing, and only a small minority, between 7% and 15% enjoy any form of rent subsidy" (Power 2006). Furthermore questions are being raised about whether households are equally able to participate and benefit from energy-efficient housing programs and policies (Braubach and Ferrand 2013). Codes may hold potential for greater impact. Energy policy has lead to steady improvement in the International Energy Conservation Code (IECC) recommended energy performance standards since 2006. These improvements have also been reflected in the DOE ENERGY STAR certification program. However IECC recommendations are not uniformly adopted by all jurisdictions and ENERGY STAR is a voluntary program. Looking beyond the building the question of energy becomes even more difficult. The energy distribution system in the US lacks a structured means for policy regulation (Powers 2006). Furthermore, the legal status of community-scale distribution of energy through microgrid deployment is hindered by the lack of a nationally uniform definition (Iulo et al 2011). It is evident that policy is necessary and programs need the teeth of mandates that come down from a federal level. However some have warned against broad-brush national approaches since the climatic considerations of each state must be considered. Therefore the best path forward may be a push for stronger state regulations with federal oversight of minimal energy performance benchmarks (U.S. Senate 2014). Regardless a top-down approach needs to be fueled by inclusive initiative. Designers must maintain the foresight to consider equitable, holistic and inter-related multi-scaled energy solutions in the design of our built environment.

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ENDNOTES

[1] The 1937 Act set the standard for affordability at one fifth of a household's net income (including the value of the cost of heat, light, water and cooking fuel). Today affordable housing expenses, including utilities, is set at not more than 30% of income; housing expenses exceeding 30% are considered a "cost burden" resulting in the potential for diminished quality of life.

[2] In the National Housing Act of 1954 the term "urban renewal plan" was substituted for "redevelopment plan" and defined more broadly to indicate the scope of urban renewal projects.

[3] Initially the Section 8 program supported both leased and new housing development but the Section 8 new construction program was eliminated with the severe budget constraints that started in the 1980s. Housing Choice Vouchers remain the number one federal subsidy program for providing affordable housing.

[3] For example see: Jesse M. Keenan and Vishaan Chakrabarti, 2013, *NYC 2040: Housing the Next One Million New Yorkers* (New York: CURE).