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Non-Energy Benefits of Energy Efficiency and Weatherization Programs in Multifamily Housing:

The Clean Power Plan and Policy Implications

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ABSTRACT

Across the US, there is a significant shortage of safe, healthy, energy efficient and affordable housing options for low-income residents. Many families face two mutually reinforcing problems: lack of affordable housing and lack of quality housing. Furthermore, many of the government programs intended to alleviate energy and housing burdens are siloed, fragmented and increasingly cash-strapped. Pairing weatherization and energy efficiency programs with healthy homes interventions can amplify non-energy benefits of these investments, effectively address social determinants of health, and generate greater returns on investments. The opportunity to increase non-energy benefits is particularly strong in multifamily housing facilities. At the individual level, occupants of multifamily homes experience improvements in health, comfort, and financial stability. Building owners see lower operation and maintenance costs, increased asset values, and decreased vacancy. Benefits also accrue at the community level in terms of both immediate improvements in environmental quality and the economic benefits related to job creation. Through a review of the literature from 2000–2015, this paper identifies and explores how home-based energy efficiency and health interventions can confer positive economic, health and environmental non-energy benefits at the individual and community level, thereby leading to significant savings while improving the quality of life and resiliency of low income households. The paper closes with policy recommendations that leverage the Clean Power Plan and the Patient Protection and Affordable Care Act (ACA) to unlock the broader savings of non-energy benefits that arise from smart energy efficient investments.

Introduction

Across the United States (US), there is a significant shortage of safe, healthy, energy efficient and affordable housing options for low-income residents. The dwindling supply of affordable housing has increased the number of households that experience either a moderate to severe housing cost burden or an increased energy burden—many household experience both. In 2013, 52.3% of renters and 35.6% of homeowners were classified as having a moderate or severe housing cost burdens, meaning residents spent more than 30% or 50% of their annual income on housing costs, respectively (JCHS 2014). Furthermore, higher foreclosure rates and decreased homeownership among low-income residents has resulted in increased demand for available affordable units, which drives higher rents and mortgage payments (Eggers and Moumen 2015). Even when low-income residents are able to find a home, the cost of utilities, maintenance, repairs and improvements are often beyond their reach, which is often made worse by the housing's age and quality. Low-income households are less likely to have energy efficient

appliances, and 25% more likely to have energy intensive heating systems, which raises household utility costs and the risk of severe rent burden—spending more than 50% of income on rent (Berelson and Opower 2014). A recent report by the US Department of Housing and Urban Development (HUD) estimated that 7.7 million unassisted renter households qualify as worst case housing need based on income (50% below Area Median Income), the severity of rent burden, and level of inadequate housing (Steffen et al. 2015). Changes in climate, fuel costs and regional differences can cause significant variations in the degree to which utility costs contribute to rent burdens. To make matters worse, many of the government programs intended to alleviate energy and housing burdens are fragmented, increasingly cash-strapped, and do not reach all the households that are in need. The Low Income Home Energy Assistance Program (LIHEAP) reaches less than 25% of eligible households (HUD 2008). Historically, the WAP serves 100,000 households per year with a budget of approximately $200 million, which currently fails to meet the needs of low-income households (Bensch 2014).

Improvements in housing stability, affordability, and quality can be obtained from investments in energy efficiency, weatherization, or integrated housing programs. Referred to as non-energy benefits (NEBs), these are the impacts of energy efficiency programs beyond energy and utility bill savings. Over the past two decades, in part to meet federal air quality standards, states have increasingly included the reduction in greenhouse gases (GHG) and air pollutants as part of their energy policy plans, as well as state economic development goals. Yet many state-level clean energy benefit-cost analyses still do not quantify emission-related health effects, revealing a clear gap between best practices and practical implementation, and missed opportunities to realize positive returns on investment (Mulholland 2011).

Pairing weatherization and energy efficiency programs with healthy homes interventions can amplify non-energy benefits and effectively address social determinants of health. Healthy People 2010 defines social determinants of health as “the conditions in the environments in which people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks”(HHS 2016). These conditions can be organized into five categories: economic stability; education; social and community context; health and health care; neighborhood and built environment (HHS 2016). Integrated housing programs that combine weatherization and healthy home interventions directly address three of these social determinants: health and health care, economic stability, and neighborhood and built environment, as well as indirectly address factors related to education, and social and community context.

Figure 1 provides a social ecological framework that reviews the pathways through which integrated housing programs amplify non-energy benefits and address social determinants of health at different levels of society. Combining energy efficiency and healthy home interventions can improve the affordability of housing by reducing the energy cost burden on low-income households, and generate greater environmental, economic and health benefits for the occupant, owner, local community and region (EPA 2011). At the individual level, occupants of multifamily homes experience improvements in health, comfort, and financial stability, whereas building owners experience less operation and maintenance costs, increased asset value, and decreased vacancy. Benefits also accrue at the community level as improved environmental and air quality and the macro-economic benefits related to job and market creation. This paper identifies and explores how home-based energy efficiency and health interventions can confer non-energy benefits at the individual and community level, effectively address social

determinants of health, and drive significant savings and improved economic, health and environmental outcomes for the nation as a whole.

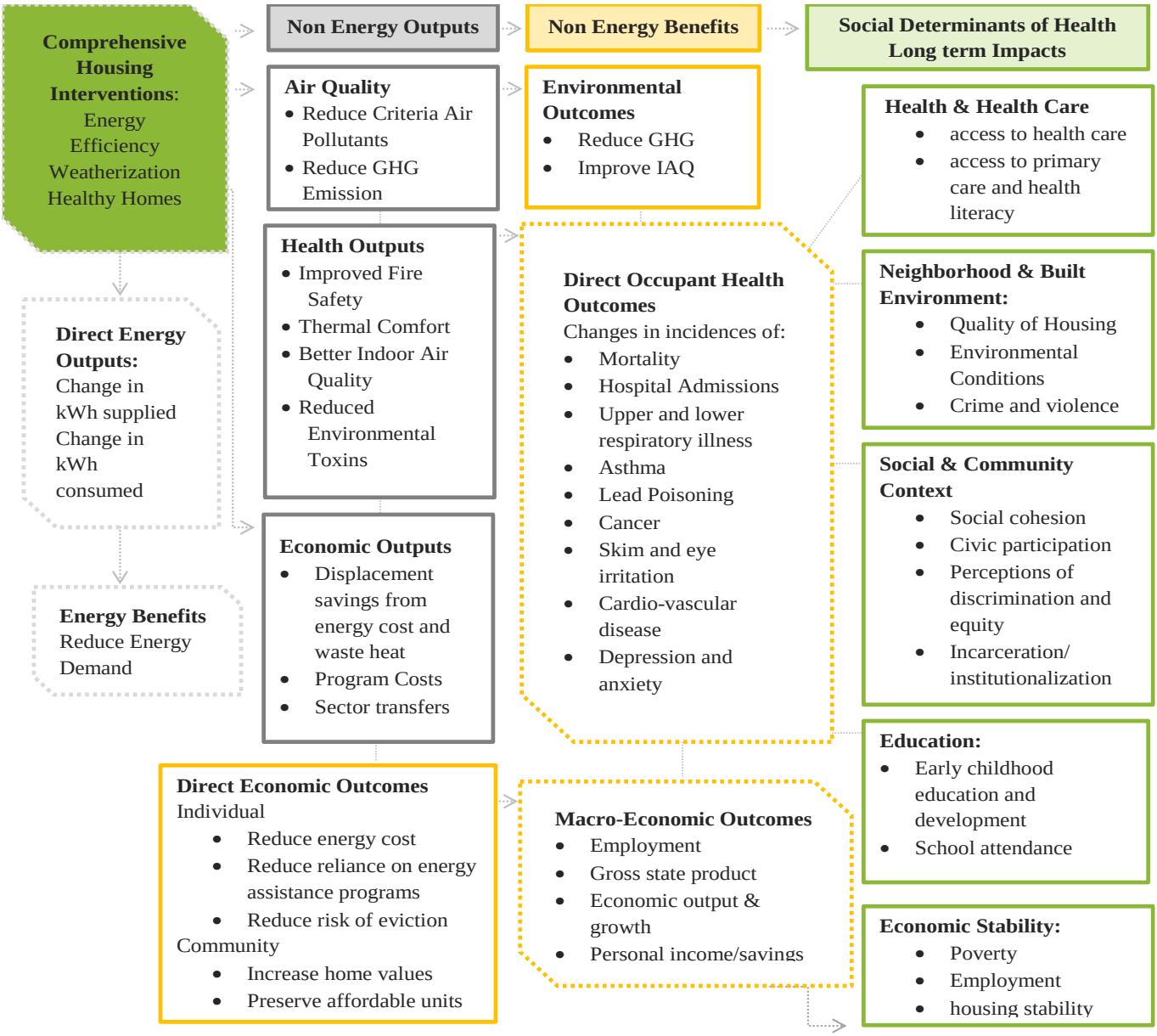

Figure 1 Conceptual Pathway linking Non-Energy Benefits to Social Determinants of Health. *Source: EPA 2011, DHHS 2015, Mulholland et al 2011.*

Occupant Health Outcomes

Poor quality housing exposes residents to health and safety hazards that can cause new incidences of disease or exacerbate pre-existing health conditions. Hazards include threats to fire safety, thermal discomfort from extreme temperatures, poor indoor air quality (IAQ), and environmental toxins. The health outcomes most commonly linked to these hazards include fire related injury or death, cardio-vascular disease (CVD), respiratory symptoms, asthma, lung

cancer, poor mental health, and skin irritation. (Thomson et al 2013) Infant children, pregnant women, and the elderly are at higher risk of suffering housing related health problems due to physiological vulnerabilities (Thomson et al 2013). The following reviews the data linking housing to poor health outcomes, and describes known practices for addressing housing issues to promote health.

Annually, residential fires cause approximately 2,530 deaths, 13,000 injuries and $7 billion in damages in the US (USFA 2015). Fire hazards—such as faulty electric wiring, appliances, and heaters—are more prevalent in low-income housing and increase their risk of fire related injuries. Moreover, low-income residents frequently do not have functioning smoke detectors, which further elevates the risk for injuries and deaths. Weatherization interventions address many electrical fire hazards when faulty appliances are repaired and when smoke detectors are installed if detectors are missing or inoperable. Functioning smoke detectors can lower the fire death rate by 40 to 50% (DiGuiseppi et al. 2010, 5). Based on fires probabilities, fire incident estimates and their preventability for 2008 WAP participants, weatherization could have prevented about 47 fires, and $1,378,643 in related property damage and stopped 6 injuries, and 1 death from occurring (Tonn et al. 2014, 72).

Thermal comfort is an individual's subjective satisfaction with their indoor climate. When thermal comfort is greatly diminished by extreme heat or cold, it is called thermal stress. Thermal stress is detrimental to people with pre-existing conditions and can cause death. Studies estimating mortality risk during extreme heat found young children, the elderly, low-income households and non-white racial/ethnic groups were at increased risk (Basu, 2009). In the US, heat waves are responsible for more fatal events than all other weather events combined (Luber and McGeehin 2008). Several studies have also found strong correlations between increased mortality during heat waves and CVD prevalence (IOM 2011). Cold episodes have similarly been shown to increase the rate of CVD emergency department (ED) visits for those with a history of cardiac disease and kidney disease, compared to those without these morbidities (Lavigne et al. 2014). Building envelope issues, insufficient insulation, and inadequate ventilation leaves multifamily homes vulnerable to the harsh outdoor climates that cause thermal stress. As a best practice of remediation, Heat Ventilation Air Conditioning (HVAC) repair/replacement, conducted during weatherization renovations, is the most effective method of tackling heat related thermals stress (McGeehin and Mirabelli 2001). Weatherization measures that improve building insulation and address envelop issues effectively reduce heat seepage and mitigate thermal cold stress related mortality and morbidity. Reducing residents' thermal stress would not only reduce the incidence of heat and cold related mortality and morbidity, it would also confer substantial medical cost savings. The WAP 2008 Retrospective Evaluation calculated that the weatherized homes produce over $122,000 and $153,000 in benefits from reducing heat-related and cold-related medical cost, respectfully (Tonn et al. 2015a).

Combustion gases, such as carbon monoxide (CO), sulfur dioxide, nitrogen oxides, and particulate matter (PM), can cause negative health effects. Unvented gas stoves, heater, furnace, and wood-burners are the primary source of combustion gases and indoor air quality (IAQ) contamination, yet there is also strong evidence that combustion gases can also seep in from outdoor sources (EPA 2015). Acute high level CO exposure can cause death whereas low-level sustained exposure is associated with fatigue, dizziness, and increase the risk of carboxyl-hemoglobin formation (ATSDR 2012). Repairing or removing unvented combustion appliances is the most effective means of reducing exposure to all indoor gas contaminants. Oak Ridge National Laboratory estimated that well-maintained weatherization repairs and CO monitors

would have prevented all potential CO-related health emergencies among at risk 2008 WAP participants and avoided $2,525,000 in cost (Tonn et al 2014, 86). There is consistent evidence of a causal relationship between PM exposure and cardiovascular morbidity and mortality and strong associations with pulmonary disease. Short-term exposure to $PM_{2.5}$ can trigger CVD-related mortality and non-fatal events, especially in susceptible individuals.[1] The American Heart Association's comprehensive review of evidence linking $PM_{2.5}$ exposure with CVD reported that long-term exposure causes a greater increase in cardiovascular mortality risk when compared to short-term acute exposure (Brook et al. 2010). However, there is no discernible "safe" threshold for long term or short term PM exposure, which provides further evidence that any reduction in PM exposure will produce health benefits for the general population.

Housing conditions are responsible for 40% of asthma episodes and can exacerbate other respiratory illnesses (RWJF 2009). Structural leaks, damp foundations, pest infestations, and inadequate ventilation are common issues in poor quality housing and can lead to bacteria, mold, viruses, and dust mites. All these contaminants can lead to serious health problems among vulnerable residents. Bedding, carpets, and air system frequently harbor dust mites, which are conduits for lead, pesticides, other carcinogens, and asthma triggers (Roberts et al 2009). Damp indoor air environments can also cause asthma and other respiratory illnesses among otherwise healthy children (CDC 2014). Pest infestations increase the risk of low income residents' exposure to rodent and cockroach allergens, which can exacerbate asthma symptoms and lead to higher rates of hospitalization and emergency services utilization among asthmatic children (Wang et al. 2008). A multifaceted tailored approach that includes repairing home moisture intrusion points and the removing of moldy items was found to reduce asthma morbidity and respiratory allergies (Mendell 2004). An effective intervention may include a home environmental assessment, education, allergen-impermeable bedding distribution, installing high-efficiency particulate air (HEPA) filter, and integrated pest management (IPM).Two evaluations of home visiting programs that provided access to vacuum cleaners with dirt finders and HEPA filters, allergy control bedding covers, and high-quality doormats to households with children with poorly control asthma, found than a 100% return on investment in one year in terms of reduced healthcare costs (Roberts et al 2009). A review of six minor to moderate asthma interventions found that three of the studies reported cost-benefit ratios between $5 and $14, whereas the remaining studies reported cost-effectiveness ratios between $12 and $57 per additional asthma symptom-free day (Crocker et al 2011, 20).

Lead poisoning from poor quality housing is known to cause serious health issues. Major lead exposure sources include paints, water, food, dust, soil, kitchen utensils, and leaded gasoline. Because the US did not ban lead paint until 1978, older homes—which constitute the majority of low-income housing—are much more likely to contain lead. Children are often poisoned after ingesting lead paint chips or inhale lead dust at home. Childhood lead poisoning can lead to hyperactivity, decreased attention, lowered IQ, learning disabilities, and other neurological disorders (Papanikolaou et al 2015). Given that the majority of childhood lead poisoning effects are irreversible, prevention and early interventions are critical. All WAP crews working in pre-1978 housing are trained in Lead Safe Weatherization (LSW) practices to ensure that any renovation that takes place does not put the work crews and occupants at increased risk to lead exposure (DOE 2011). Lead abatement interventions that are sometimes performed in addition to WAP services include encapsulation (neutral paint barrier), enclosure (rigid barrier), and window replacement or treatments. An evaluation of the HUD's 1993/1994 Lead Hazard

[1]Elderly, patients with pre-existing coronary artery disease, diabetics, women, and the obese (Brooks et al. 2010)

Control Grant program, where the aforementioned lead prevention measures were employed, found that children's blood lead levels (BLL) fell at every successive test period—6 months, 1 year, 2 years and 3 year post intervention (Clark et al 2011). Gould (2009) estimated lead abatement could produce $192–$270billion in total health, social and crime related savings.

Important measures of a resident's quality of life include wellness and ability to perform routine daily activities at home, school or work. When surveyed, residents of poor quality housing indicated that living in poor environments lead to stress and anxiety, which is known to complicate management of asthma symptoms (Sandel and Wright 2006). Poor housing conditions can also lead to depression, especially when combined with economic stress (Saxena et al 2006). The hazards that cause chronic illnesses can increase hospital utilization which increases school absences. In 2008, for example, asthma caused an estimated 10.5 million lost school days among children with an asthma episode in the previous year (Akinbami et al. 2012). Caregivers often have to miss work to care for their sick child resulting in lost wages and increased economic stress. It is estimated that the US loses $4.28 billion annually due to lost work productivity and school absenteeism when a child is sick (Esteban et al. 2014). Weatherization interventions can reduce the psychosocial stress associated with poverty and poor living conditions by lowering energy cost related economic stress and mitigating the stress associated with managing housing-related health issues. Reducing caregivers' stress and depressive symptoms can relieve children's psychosocial stress, and allows both children and caregivers to be productive in educational and professional settings (Tonn et al. 2014).

Community Benefits

Weatherization and energy efficiency retrofits can lower the operation and maintenance cost for owners of multifamily housing. Basic energy weatherization retrofits have the potential to reduce energy consumption by up to 15% while deeper and more extensive retrofits can reduce consumption up to 50% (McCabe 2011, 23). The analysis of the HUD's Green Retrofit Program (GRP) data set, which included 227 multifamily properties in Illinois, revealed that GRP properties achieved a total energy saving of 18% and a total waters saving of 26% post retrofit, worth $3.1 million and $1.2 million per year respectively (Braman et al. 2014). In addition to lowering energy bills, energy-efficient housing units can also reduce vacancy rates and inconsistent rent revenues associated with higher residential mobility among low income renters. WAP recipients self-reported having less difficulty paying household energy bills post weatherization, which indicates improved housing affordability, and is associated with increased housing security and lower residential mobility (Tonn et al 2014). Finally, energy-efficient properties are protected against potentially costly changes in building regulation and volatile energy prices and are thus seen as a safer investment (McCabe 2011).

Energy efficient, safe, and healthy homes will also build community resilience to climate change, which is predicted to bring more extreme changes in temperature and more frequent, powerful storms. This weather trajectory will increase overall energy demands and threatens US energy production and distribution infrastructure. There is also evidence that indicates climate change will exacerbate the effects of poor indoor environment on health (IOM 2011). Every community in the US is subject to adverse climate changes, but low-income communities are at the greatest risk for suffering the negative economic and health effects associated with extreme weather events because they are more likely to live in vulnerable housing units. Weatherization and energy efficiency renovations directed at low-income households mitigates the effects of extreme weather events associated with climate change. Furthermore, weatherization and energy

efficiency renovations can prevent strains on public health resources by removing the housing related health hazards, exacerbated by climate change (IOM 2011).

Weatherization and energy efficiency investments have the potential to stimulate job creation directly and indirectly. In 2008, the WAP spent $420 million and was responsible for 8,560 full time jobs in the private sector, creating $476 million in annual incomes. The resulting economic output for 2008 totaled to $1.22 billion (Burton 2014, 15). The American Recovery and Reinvestment Act (ARRA) of 2009 significantly increased available funding by providing an additional $5 billion over three years (2010-13) for WAP. The ARRA funding was intended not only to extend WAP benefits to more households, but was also a policy response to the national drop in employment. The White House supported WAP as a 'shovel ready' project—easy to ramp up and quickly creates jobs—that also met US clean energy goals (Tonn et al 2015b, 3). During the ARRA period, total WAP expenditure supported roughly 28,000 jobs and an economic output of $4 billion (Tonn et al 2015b).

Opportunities for Action

Investments in the affordable housing market, especially directed towards multifamily housing facilities, offer a significant opportunity for savings on the demand side of energy efficiency. Multifamily housing units account for 24.4 million (21% of US) households, and three-fifths of the 40.2 million (35% of US) households who live in renter-occupied housing units (US Census Bureau 2013). Multifamily renters spend $30 billion on energy expenses each year, accounting for 13% of national spending on residential energy. According to a report by the Benningfield Group (2009), multifamily housing could become 28.6% more energy efficient by 2020 and could generate $8.7 billion in energy cost savings each year. In addition to energy savings, there are significant savings from the non-energy benefits, especially healthcare cost savings due to improved health outcomes of residents. There is great potential for leveraging energy efficiency investments with health care investments to produce positive health and economic outcomes. Potential health care funding sources include hospital community benefit funds, preventive health programs, and health care related pay for success (PFS) projects. Housing provides a critical platform to leverage public and private investments from the energy, health, and finance sectors to improve the housing infrastructure, health, economic and social outcomes for low-income individuals and families. The following outlines some of the more salient opportunities for funding that could be harnessed to achieve these goals: (1) Energy sector: the Clean Power Plan and state energy plans; (2) Health Care sector: new payment and service delivery models, and (3) Financial sector: innovative mechanisms from infrastructure banks (aka Green Banks) or social impact investments.

Clean Power Plan and State Energy Plans

The 2015 Clean Power Plan (CPP) constitutes a critical step toward clean energy by reducing carbon emissions in the US. The CPP establishes standards for existing fossil fuel plants to operate more efficiently and promote the nation's capacity of clean energy derived from low or zero emitting power sources. As part of the CPP, the Clean Energy Incentive Program (CEIP) is designed to reward early investment in wind or solar generation and demand-side energy efficiency programs in low income communities that originally produce results in 2020-2021.The CEIP will provide emission rate credits to states who encourage such investments, in addition to other incentives to promote energy efficiency investments in low income

communities. As states have a range of options to reduce carbon emissions, now is the time to set affordability, health, and well-being as priorities in state energy plans to ensure there are direct energy efficiency investments in affordable housing that result in measurable benefits for occupants, owners, and low-income communities. State energy plans have many opportunities to harness energy investments that improve social determinants of health. Possible opportunities include utility or rate-payer funded investments in affordable multifamily housing as a means to cut carbon emissions or purchase emission rate credits from an entity, public or private (e.g., state agency, utility, energy performance contractor), that achieves measurable energy savings in affordable housing (EEFA 2015).

Health

The overall US health care spending is staggering. According to the US Centers for Medicare and Medicaid Services, in 2014 spending topped $3 trillion, or $9,523 per person. (CMS 2014). The ACA was intended to expand health insurance coverage, incentivize innovation in health care payment structures, improve care, reduce per capita cost and improve population health (Berwick et al 2008). In order to improve the effectiveness of population health and reduce costs, communities will need to scale effective, evidenced-based solutions that address social determinants underlying the unequal distribution of diseases and resulting health inequities. Social determinants of health, such as housing, education, access to resources, behaviors, etc. have an estimated 60% impact on overall health while medical care only accounts for 20%, (and 20% is genetics) (Taylor et al. 2015). Without the financial capacity and access to resources to buffer against negative social determinants of health, low income communities are more vulnerable to the cumulative exposure to health hazards in their built environment and neighborhoods, which leads to greater inequalities in health outcomes. Direct investments in the form of integrated energy efficiency and healthy homes interventions are the vaccine that this nation's affordable housing needs. The opportunity to leverage or integrate health care and energy funding to better serve low-income communities through home-based interventions presents an enormous challenge as well as a great opportunity for innovations.

Finance

Smart investments in energy efficiency, public health promotion, and housing infrastructure can have powerful returns in terms of economics, community health and environmental preservation. The opportunity to structure private and public investment funds to scale evidence-based integrated housing interventions and environmental health services in the community requires financial models capable of overcoming two obstacles to realizing returns on energy efficiency investments in low income multifamily housing. Three significant obstacles to investing in multifamily housing are the large upfront investments, long performance period to generate savings, and savings accruing to sectors other than energy. Many states have established infrastructure banks to provide revolving and/or long-term loans to support energy efficiency investments that can take a long time to manifest as a return. Yet this model is often directed to only realizing primary energy savings to finance. The innovative financial model of social impact bonds or pay for success offers an opportunity to realize cashable savings in the form of both energy savings and lower medical costs due to the health outcomes accrued by occupants of multifamily housing.

Policy Recommendations

Evidence from this literature review has shown the benefits of addressing broader health and safety issues simultaneously with energy efficiency programs and identified opportunities to leverage new investments from the CPP. Even while the US Supreme Court decision stays CPP implementation, state energy plans could use energy efficiency investments in affordable housing as a compliance measure to achieve their carbon reduction targets. The residential sector accounts for 35% of the end-use efficiency potential in the US, thus, this sector has the potential to save the nation $41 billion each year (Granade et al. 2009). Investments in energy efficiency integrated with health and safety improvements in the existing housing stock can cost less than updating the generation and distribution capacity of power plants, and provides multiple economic and environmental benefits. The effects of climate change, are predicted to increase negative health outcomes and health care costs. Consequently, the cost and risk of heat related health emergencies will increase accordingly (McGeehin and Mirabelli 2001). Broad energy efficiency investments, especially in low income communities, are a cost-effective preventive anitdote for the effects of climate change. To ensure community resilience the nation needs to commit resources towards building and maintaining affordable, safe and healthy homes. The following discussion outlines policy recommendations that can facilitate investment in energy efficiency in low-income multifamily housing.

Include Affordable Housing in the Federal Implementation Plan

Under the CPP, states are given considerable flexibility in the design of their implementation plans. States can utilize several mechanism aimed at including energy efficiency in low-income multifamily housing. In the development of state implementation plans, States can meet their goals through emissions trading, in which affected power plants may meet their emission standards via emission rate credits (for a rate-based standard) or allowances (for a mass-based standard). Revenue generated either from emission rate credits or the sale of allowances should be used to benefit communities that have historically not received their share of the benefits from energy efficiency and climate change mitigation strategies.

Encourage Utilities to Invest in Energy Efficiency and Weatherization Programs.

The CPP provides states with additional leverage to encourage Load Serving Entities (LSEs) to create utility sponsored energy efficiency and weatherization programs. Prior to the CPP, the potential revenue lost was a strong disincentive for LSEs to comply with EERS. As a result, states developed several incentives and penalties that can still be applied under the CPP. One such incentive is revenue decoupling, in which the drop in revenues below a negotiation level due to EERS are matched by the state, monetary performance bonuses, and non-compliance penalties. States that include non-energy benefits in the cost effectiveness testing could verify cashable savings from health outcomes, so the state can be more comfortable providing that match. Compliance measures are most effective when combined, so states should use several of the compliance methods in concert with the CPP to encourage utilities to invest in energy efficiency programs.

Energy Efficiency Resource Standard Guidance from EPA for States

Over the past few decades, individual states developed energy saving programs that also reduced GHG emission, lowered environment related health concerns and encouraged economic development, which are collectively referred to as Energy Efficiency Resource Standards (EERS) (Steinberg and Zinaman. 2014). By August 2014, 24 states had fully funded EERS (ACEEE 2015). Despite each EERS containing similar core elements, EERS design varies significantly between states, which impedes efforts to compare state performances. The starkest differences concern which energy efficiency measures are included in state energy efficiency program, and which non-energy benefits, if any, are included in the state's program evaluation procedures. The EPA, the Health and Human Services (HHS) and the DOE should collaboratively issue guidance on using non-energy benefits in the evaluation, measure and verification procedures. Such national direction and guidance would facilitate consistency in reporting and ensure that states implement programs that provide the maximum benefit at all levels of society.

Target Direct Energy Efficiency Investments to Low-Income and Multifamily Households.

State energy plans are recommended to adopt health outcome goals and fund the scaling of cost-effective integrated housing interventions as a means to both improve public health and support affordable multifamily housing. For example the Maryland's Multifamily Energy Efficiency and Housing Affordability (MEEHA)-EmPOWER program. As part of the EmPOWER Maryland Energy Efficiency Act's goal of reducing energy consumption by 15% by 2015, the MEEHA-EmPOWER Program was implemented to promote energy efficiency and affordability by directing funds to multifamily rental housing developments for low and moderate income households. The program is part of the State's efforts to promote energy efficiency and renewable energy sources and create and preserve affordable rental housing opportunities.

Incorporate Health Care Financing As Multi-Sector Funding Source

The ACA established new funding sources at the local level as hospital community benefit policies have increasingly moved beyond a focus on financial assistance to pursue strategies that address the social determinants of health and promote community health (Nelson et al. 2015). Community needs assessments that include energy efficiency and housing quality can improve the likelihood that hospitals invest in comprehensive housing interventions to improve community health. Multi-sector funding strategies involving government health care as a payer frequently include various Medicaid waivers and demonstrations. Housing services that address environmental hazards related to health could be covered through state Medicaid waivers, performance based contracts with managed care organizations (MCOs), or classifying the services as part of targeted case management. Another model of sustainable financing includes braiding funding sources from hospital community benefits or other health care payers with county, city, and state general funds at the local level. Blended or co-mingled funding at the state level is now possible as the health care payment system moves away from fee for services towards value based payment arrangements of global capitation and shared savings, which could allow healthcare payers to more effectively fund what works.

Incorporate Social Impact Financing as a Program Funding Source

In order for multifamily residents to receive the health and well-being related non-energy benefits, it is vital that weatherization services be included in state implementation plans. Together the DOE and LIHEAP account for roughly 77% of total funding provided to grantees weatherization programs (Bensch et al 2014). Despite this funding, WAP services do not reach all eligible residents. As a result, future weatherization services incorporated in the state implementation plans should include alternative financing mechanisms, such as Social Impact Financing (SIF) to increase private sector investment. States can use SIF to attract private investors for integrated services that target health inequities in communities. Investors or social entrepreneurs contribute the upfront cost for implementing evidence based weatherization practices. If the program produces the desired health and energy outcomes within the negotiated time frame, the state or another designated payer reimburses the investor's costs. For example, if the investor's weatherization program spares state utilities from "firing-up" their less reliable power stations during peak demand, then the state utility can reimburse the investor. On the other hand, if the investor-funded weatherization program can reduce asthma hospitalization rates, then the state health provider can reimburse the investor. The transaction structuring for this kind of pay for success project overcomes many barriers without any cost to the healthcare entity, state or federal government, as all financial risks are borne by the private sector investors.

Conclusion

In conclusion, findings from this research demonstrates that energy efficiency and weatherization measures are not only mechanisms to lower national energy costs, but also have the potential to be a source of sustainable reinvestment in communities to maintain affordable housing and support positive social, environmental, economic and health outcomes (Granade et al. 2009). Integrated energy efficiency and home health interventions directly address three social determinants of health; economic stability through lower energy cost, neighborhood and built environment by improving housing quality; and health and health care by the abatement of housing related hazards. Combining the best practices of energy efficiency and healthy homes allows communities to simultaneously address home-based energy inefficiencies and hazards that cause health problems for residents and contribute to health inequalities in the community. Thus, green and healthy homes interventions not only constitute a pathway to housing affordability and reduced financial stress through lowered energy costs, but can also mitigate the built environment-related health hazards by improving housing quality. Beyond the occupant health benefits, these investments can contribute to community benefits such as resiliency to the impact of climate change. Expansion of energy efficiency investments for low income communities is possible through state energy plans, incorporating healthcare related funding, and private sector social impact financing.

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