

# RESEARCH *Works*

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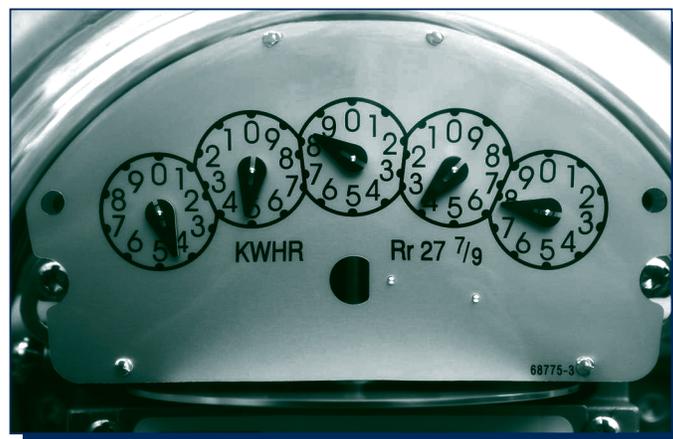
A Bridge Linking Housing Research and Practice

## Paying for Energy Infrastructure Upgrades

The residential sector accounts for 21 percent of all energy used in the United States, but homes consume as much as 30 percent more energy than what's required for comfort and affordability. Newly constructed homes feature energy-efficient technologies that reduce this consumption, but much of the nation's housing stock, with a median age of 36 years, lacks this advantage.<sup>1</sup>

Consumers are generally uncertain about the steps necessary to improve their homes' energy efficiency. Most homeowners are unaware of just how energy (in)efficient their homes are, what upgrades would be appropriate, or what outcomes to target. The typical homeowner often feels ill-equipped to make the necessary upfront investment and ill-prepared to evaluate the short- and long-term savings and benefits. A shortage of contractors trained in the most energy-efficient design and installation methods further complicates the matter.

Retrofitting an existing home with energy-efficient features can be expensive — one reason for offering federal energy tax credits and other financial incentives to homeowners who make “green” improvements. Owners of rental properties who invest in efficiency upgrades must be willing to do so without immediately realizing the benefits, because many tenants pay their own utility bills and therefore are the ones to benefit immediately and directly from the savings. The payoff for rental property owners lies in the future, with the appeal to tomorrow's renters of an energy-efficient home with lower utility bills.



*Repayment for energy improvements can attach to a residence's monthly utility meter billing as a special tariff or to an owner's annual property tax bill.*

One big challenge is to find ways to help low-income households with the highest energy cost burdens, with poor credit, and/or those who rent. Utilities, states, and regional organizations have all sponsored programs to stimulate consumer investment in energy-efficiency improvements, with mixed success. Many programs are small and have had little impact. Some struggle to ensure that their energy savings actually exceed scheduled repayment amounts. Others support basic weatherization and lighting improvements but would produce much larger savings with more comprehensive energy retrofits. Utility firms that participate have sometimes had difficulty making the necessary adjustments.<sup>2</sup>

To examine the types of financial mechanisms available for making energy savings accessible to low- and moderate-income families, the Energy and Resources Group (ERG) at the University of California at Berkeley recently reviewed 18

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## Paying for Energy Infrastructure Upgrades

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different types of programs in the United States and Canada that help finance residential energy-efficient improvements. Options already exist for current homeowners and new homebuyers in the form of favorable terms in mortgage refinancing to pay for energy upgrades or energy improvement mortgages, but ERG paid particular attention to on-bill financing programs that enable consumers to purchase and install energy-efficient products without incurring any upfront costs.<sup>3</sup>



Courtesy of DOE/NREL

*Many consumers are unaware of how energy efficient their homes are, what upgrades are appropriate, or what outcomes should be pursued.*

Tariffed installation programs (TIPs) and clean energy municipal financing (CEMF) are two programs that appeared to ERG to have the most potential for addressing some of the aforementioned problems. In the TIP model, energy improvements are funded with bond sales, public funds, utilities, or other sources of private capital. Repayment is scheduled

by attaching a monthly charge to a residence's utility meter as a special tariff paid by the occupant. This monthly tariff is capped at less than the amount saved from energy improvements, and it is spread over a period that is shorter than the anticipated life of the enhancements. CEMF for energy products and their installation is funded through a bond issued by the municipality. The homeowner repays this loan through a special fee assigned to the property tax bill over a period of 20 years. If the property sells during that time, the new owner pays the remainder of the loan in the same way — as part of the annual property tax bill.

The Midwest Energy How\$mart<sup>SM</sup> pilot program in central and western Kansas is a demonstration of a TIP that lends money for energy-efficiency improvements like insulation, air sealing, and heating and cooling systems. The Kansas Housing Resources Corporation (a public source) and Midwest Energy (a private source) provide upfront capital at an interest rate of 4 percent for a repayment period of 15 years. Customers repay the loan by accepting a surcharge on their monthly utility bill of no more than 90 percent of the projected energy savings. The state's regulatory commission reviewed and approved this new tariff.

Any electric or gas customer whose utility bills are current is eligible. When a rental property is involved, the property owner and the tenant must both agree to participate. Midwest Energy first conducts a comprehensive energy audit in the home, makes recommendations on improvements needed, and estimates the savings outcome. Customers who decide to proceed choose an approved contractor to do the work according to Midwest's specifications, relieving the customer from having to make decisions about unfamiliar technologies. The utility pays the contractor after completing the work (only for the amount justified by energy savings) and adds the tariff to the customer's monthly bill. Midwest also files a Uniform Commercial Code form with the county's Register of Deeds for the obligation, letting potential buyers, brokers, or real estate agents know that the obligation exists and will transfer to the next owner. Before the end of the first year, 167 projects were approved with an average loan amount of \$4,000.<sup>4</sup>

This illustration of a TIP shows how one community is attempting to make residential energy-efficient upgrades accessible and affordable to both renters and

homeowners. Community planners and policymakers will be following the development of such energy retrofits in the interest of relieving the housing cost burden for many citizens, thus “greening” the nation’s housing and improving the environment.

<sup>1</sup>Joint Center for Housing Studies, *The State of the Nation’s Housing 2009*, p. 30, [www.jchs.harvard.edu/publications/markets/son2009/son2009.pdf](http://www.jchs.harvard.edu/publications/markets/son2009/son2009.pdf); ENERGY STAR Program, “Financing Guidebook for Energy Efficiency Program Sponsors,” December 2007, [www.energystar.gov/ia/home\\_improvement/downloads/FinancingGuidebook.pdf](http://www.energystar.gov/ia/home_improvement/downloads/FinancingGuidebook.pdf), p. 3.

<sup>2</sup>ENERGY STAR Program, pp. 3–6.

<sup>3</sup>Merrian Fuller, *Enabling Investments in Energy Efficiency: A Study of Energy Efficiency Programs That Reduce First-Cost Barriers in the Residential Sector*, May 2009, <http://uc-ciee.org/energyeff/documents/resfinancing.pdf>.

<sup>4</sup>Midwest Energy Services, How\$mart<sup>SM</sup> Program, [www.mwenergy.com/energyservices.aspx](http://www.mwenergy.com/energyservices.aspx).

## Powered by the Sun

**H**ousing and utility costs continue to be significant expenditures in most family budgets, prompting homeowners to try to cut costs using energy-efficient technologies. One such technology that, over time, limits the costs and environmental effects of heating and cooling residences is a photovoltaic (PV), or solar panel, system.

Solar panels absorb energy from the sun and convert it into electricity for home use. These systems, usually



Courtesy of DOE/NREL

*Shade-free, south-facing homes with sufficient roof surface area are good candidates for PV systems.*



Courtesy of DOE/NREL

*Federal, state, and local incentives make the cost of solar technology increasingly affordable for homeowners.*

built on rooftops, are composed of multiple solar panels, known as an array; an inverter that converts the power from the sun into usable electricity; and a panel that distributes electricity throughout the home. A common design is to combine residential PV systems with utility-supplied power. Electricity needs, if unmet by the PV system, are supplemented by utility-supplied electricity. Excess power can be routed back into the local electric grid so homeowners can receive credits or payment from the utility provider for the surplus.

Not every home can be equipped with a PV system. Generally, homes with roofs that are shaded or facing north, east, or west do not receive the necessary sun exposure to support the purchase and installation costs of a solar panel system; shade-free, south-facing homes are ideal. In addition, the roof must have sufficient surface area to support the required panels. If the home is a good candidate, its construction, size, and electricity demand will determine the features of its solar panel system. For example, a house with significant amounts of natural light and cross-ventilation will rely less on artificial light, air conditioning, and heating, necessitating a smaller system, whereas a home with poor lighting and ventilation will have greater electricity demands.

As the configuration of the solar panel system is determined by the characteristics of the home, so too are the costs. Although PV systems have decreased in price since their introduction, the \$8,000 to \$10,000 per kilowatt (kW) cost, including installation, is substantial. According to the Partnership for Advancing Technology in Housing, a typical home would need a 4kW solar panel system to meet its

## Powered by the Sun

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electricity needs. If all costs, including those required for installation and maintenance, are calculated over the lifetime of the technology, the cost of the electricity produced is 25 to 50 cents per kilowatt-hour (kWh), whereas utility-supplied power currently averages 9.53 cents per kWh.<sup>1</sup>

To make solar panels more widely affordable, as well as to encourage homeowners to view them as a viable tool combating rising electricity use and expenditures, the federal government offers a significant rebate for PV systems through the Emergency Economic Stabilization Act of 2008. This legislation eliminated the \$2,000 rebate cap on solar panels and extended the homeowner tax credit through 2016.

Many jurisdictions, including the states of California and New Jersey, offer benefits that can be combined with the federal rebate. California, the state with the largest solar panel market, provides per-watt rebates for PV-generated electricity. Participants in the program can also take advantage of benefits provided by local jurisdictions, some of which offer production incentives (often fee waivers or expedited processing) and additional rebates or incentives.

New Jersey, with the second-largest and fastest-growing market, also offers rebates for installing solar panel systems. One estimate to install a 6.75kW solar panel system (projected to produce 8,075kWh of electricity) on 430 square feet of a New Jersey home's rooftop totaled \$50,625. However, New Jersey's state rebate, the federal tax credit, and a state-sponsored loan program reduced the homeowner's upfront cost to less than 12 percent of that total, or \$6,049 (see table 1).<sup>2</sup>

The projected energy savings in this New Jersey home would lower the home's monthly electric bill by \$127.08, resulting in an annual savings of \$1,524.92 with an expected payback period of 4 years. The estimated increase in home value is \$30,500. In addition, because the home will consume less utility-supplied electricity, it will reduce its carbon dioxide emissions by 13,558 pounds per year. With concomitant reductions in nitrous oxide and sulfate emissions, the

**Table 1. Initial Outlay for Solar Panel System on New Jersey Home**

Cost	\$50,625
New Jersey Rebate	(11,812)
PSEG Solar Loan for SRECs generated by system*	(21,120)
Federal Energy Tax Credit	(11,644)
Cost After Federal Tax Credit	\$6,049

\*PSEG = Public Service Electric and Gas Company; SREC = Solar Renewable Energy Certificate.

environmental advantage of this home's PV system would be comparable to planting two acres with trees.

Property owners may encounter other barriers to installing PV systems. Many homeowner associations and jurisdictions restrict or prohibit solar panel systems, often for aesthetic reasons. A lack of personnel trained to install PV systems also inhibits use in some areas. To address these issues, some states limit the restrictions that localities and homeowner associations can place on solar panels, while local (often university-based) organizations expand the supply of skilled installers.

With the implementation of federal, state, and local installation incentives, solar panel systems show promise as an affordable, viable alternative to traditional sources of residential heating and cooling. More information about solar panel systems is available through the Department of Energy's Energy Efficiency and Renewable Energy website at [http://www1.eere.energy.gov/solar/photovoltaics\\_program.html](http://www1.eere.energy.gov/solar/photovoltaics_program.html), as well as through *Own Your Power! A Consumer Guide to Solar Electricity for the Home* at <http://www1.eere.energy.gov/solar/pdfs/43844.pdf>. See also *Tracking the Sun*, produced by the Lawrence Berkeley National Laboratory at <http://eetd.lbl.gov/ea/EMS/reports/lbnl-1516e.pdf>, and the North Carolina Solar Center's database of state and

local financial incentives for renewable energy at [www.dsireusa.org](http://www.dsireusa.org).

<sup>1</sup> Partnership for Advancing Technology in Housing; see [www.toolbase.org/Technology-Inventory/Electrical-Electronics/pv-systems](http://www.toolbase.org/Technology-Inventory/Electrical-Electronics/pv-systems).

<sup>2</sup> Written estimate for installing a solar panel system obtained by a New Jersey homeowner.

<sup>3</sup> As suggested by the Department of Energy, the estimated change in home value is based on a \$20 increase for every \$1 saved on annual utility bills; see <http://www1.eere.energy.gov/solar/pdfs/43844.pdf>.

## The Health of Our Cities' Housing

The National Center for Healthy Housing (NCHH) has conducted the first assessment of the health of housing in America's cities. The assessment focuses on 20 housing conditions closely associated with health and safety problems. NCHH further explored consumer awareness and attitudes pertaining to the healthiness of their domiciles.

For a measure of housing health, NCHH drew on American Housing Survey (AHS) data collected for HUD by the Census Bureau. The AHS is the most detailed, national housing sample survey in the United States that regularly updates housing

statistics. National data are collected every other year from a fixed sample of about 50,000 homes, plus new construction. The survey began in 1973 and has maintained the same sample since 1985, permitting users to see changes in homes and households over time. Additional samples are surveyed every 4 to 6 years in some metropolitan areas to measure local conditions. The AHS variables selected by the NCHH for its study of housing conditions that are potential health and safety risks to residents are as follows:

- Holes in floors and walls
- Open cracks in walls
- Broken plaster, peeling paint
- Signs of mice
- Signs of rats
- Water leaks from inside
- Water leaks from outside
- Water supply stoppage
- Flush toilet breakdown
- Sewage disposal breakdown
- Incomplete plumbing
- Exposed wiring in unit
- Room heater without flue
- Heating equipment breakdown
- Roofing problems
- Siding problems
- Window problems
- Foundation problems
- Lacking kitchen facilities
- Rooms without electrical outlets

Analysts have created a rating system based on AHS data collected on these conditions between 1998 and 2007 for 45 metropolitan statistical areas and 44 of their central cities. Housing in these localities was ranked in two ways, with composite scores for health and overall quality. For example, Charlotte, North Carolina — the metropolitan area with the highest healthy housing score — ranked average or better in 19 of the 20 housing conditions evaluated. Although 31.6 percent of Charlotte's metropolitan area housing has at least one identified problem, fewer owner-occupied homes (28.6%) than rental homes (39%) possess at least one health or safety risk, which reflects the discrepancy between rental and nonrental housing conditions nationwide. The Charlotte metropolitan area ranks ninth in overall quality of housing. This information is valuable to researchers and students of housing affairs, and to local planners and policymakers who must prioritize the allocation of resources.



Courtesy of CDC/ATSDR/HPCIB

*NCHH found that only 10 percent of adults who lived in pre-1978 built homes had tested for the presence of lead-based paint.*

## The Health of Our Cities' Housing

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Overall, of the homes surveyed nationwide...

- 42 percent had at least one healthy housing problem;
- 11 percent had water leaks from the outside;
- 8 percent had water leaks from the interior;
- 6 percent had roofing problems;
- 5 percent had damage to interior walls;
- 5 percent had signs of mice;
- Rental properties had more problems than owner-occupied homes; and
- Central city housing had more problems than other homes.

In a related study, NCHH sponsored a July 2009 telephone survey of 1,000 adults regarding their perceptions of healthy housing issues, how they understand common health and safety risks in the home, and how they cope with these hazards. The poll included the AHS-based measures noted above, which were supplemented with questions on radon, smoking, roaches, toxic cleaning materials, and other health-related concerns. Surveyors learned that, although most respondents realized that conditions in homes could have health and safety implications, many have not acted to eliminate such risks. For example, only two-thirds (68%) check their smoke alarm twice a year, less than half (41%) have repaired water damage or plumbing leaks, and just 10 percent of those in homes built before 1978 have tested for the presence of lead-based paint.

Almost half (49%) of the respondents reported living with one or more health or safety hazards, such as a dwelling that is too warm (24%) or cold (19%), pests such as roaches or rodents (14%), mold problems (11%), electrical problems (10%), aggravations to allergies or asthma (10%), or dampness and mustiness (8%). When making home improvements, however, respondents tended to give greater priority to saving money, improving a home's value, and making a home more energy efficient than they did to making their home safer and healthier. The results of these studies clearly indicate that Americans can do more to create and maintain safer, healthier homes.

The results of NCHH's assessment, *State of Healthy Housing*, are available online at [www.nchh.org/Policy/State-of-Healthy-Housing.aspx](http://www.nchh.org/Policy/State-of-Healthy-Housing.aspx) and the 2009

Consumer Survey can be read or downloaded at [www.nchh.org/LinkClick.aspx?fileticket=uOQnnhazFrs%3d&tabid=368](http://www.nchh.org/LinkClick.aspx?fileticket=uOQnnhazFrs%3d&tabid=368). Both tools can help localities decide how best to improve the health and safety of their existing and new housing.

## Reevaluating Affordable Housing Policy Tools

In recent decades, states and localities have turned to a number of regulatory tools — such as smart growth policies, inclusionary zoning (IZ), in-lieu fees for developers, density bonuses, and land use regulations — to expand their stock of affordable housing. For decades, HUD has been a leader in addressing barriers to affordable housing through our research and development efforts, and the latest *Cityscape* symposium continues this tradition by examining some of the most innovative and popular affordable housing policy tools.<sup>1</sup> The following synopsis of symposium articles shows how researchers are exploring the impact of these tools on consumers and local economies.

The lead article, "Housing Market Effects of Inclusionary Zoning" by Antonio Bento, Scott Lowe, Gerrit-Jan Knaap, and Arnab Chakraborty, examines the effects of IZ policies on housing prices and starts in California from 1988 to 2005. Adopted to counter the exclusionary zoning once commonly used to keep low-cost housing out of a locality, IZ mandates that a specified share of new residential construction be affordable to low- and moderate-income families. The study found, within the context of the superheated housing market of the 1990s, that IZ boosted the supply of multifamily housing by 7 percent, but increased housing prices 2 to 3 percent faster than in comparable locales. Housing price effects were greater in higher-priced markets, suggesting that builders of single-family units passed on the increase in building costs to homebuyers, especially in higher-end markets. Finally, researchers learned that the size of market-rate houses in cities with IZ grew more slowly, with reduced square footage in less expensive units.

Many communities structure IZ to provide alternatives for residential developers who would otherwise be required to include a set allotment



*Researchers are assessing the impact of local regulatory policies on affordable housing objectives.*

of housing priced below market rate within the confines of market-priced projects. In “Evaluation of In-Lieu Fees and Offsite Construction as Incentives for Affordable Housing Production,” Douglas R. Porter and Elizabeth B. Davison examine two such practices. One allows developers of market projects to build the required affordable houses offsite; the other allows them to pay an in-lieu fee to a housing nonprofit or trust fund, which then applies the money toward affordable housing construction at a site of their choosing. The authors studied three communities that instituted these alternatives — Boulder, Colorado; Montgomery County, Maryland; and Pasadena, California. In-lieu fees/offsite options worked well in enabling two of the communities to “produce affordable units in satisfactory locations” while mitigating developer costs. In the third community, however, a perceived lack of transparency in setting fees politicized the program, and the ensuing controversy made in-lieu fees unacceptable to local officials.

Can the adverse effects of excessive local land-use regulatory barriers be remedied? In “Removing Regulatory Barriers to Affordable Housing in Development Standards, Density Bonuses, and Processing of Permits in Hillsborough County, Florida,” Sam Casella and Stuart Meck describe a recommended regulatory makeover, (which has subsequently been approved), based on an assessment of the county’s comprehensive plan, land development code, building code, development review process, and interviews with the county’s Affordable Housing Office. The authors focused on three issues: county development standards, such as minimum lot size or housing setbacks that can arbitrarily increase housing prices; the use of a density bonus designed to override code limits on the number and size of houses on a given parcel to realize affordable housing benefits; and the processing of development and building permits, considered a source of uncertainty and delay

by homebuilders in many localities. Problems were traced to an elaborate rezoning procedure, narrow targeting of only large-scale developments, and stringent criteria for approval — such as the presence of substandard housing, resident households with low or moderate incomes and proximity to an economic development area that provides employment. The analysis concluded that the county would benefit from substantial downsizing of setbacks and lots, as well as from modifying density bonuses, simplifying permitting, and accelerating development reviews.

The final article, “Urban Sprawl and the Transition to First-Time Homeownership,” shifts the focus to smart growth policies. Casey J. Dawkins challenges the conventional wisdom that “sprawl creates a mismatch between jobs and housing, leads to ineffective transportation systems, and restricts housing choice.” Instead, the author observes that “sprawl actually enhances housing opportunities, particularly for low-income working minorities who make the transition from renters to first-time homebuyers.” Dawkins used data from the Panel Study on Income Dynamics (waves 1978 through 1997) matched to U.S. Census data to explore first-time homeownership transition. The sample tended to be younger, nonwhite, and to “belong to single-parent family or nonfamily households with a combined household income of about \$12,000 less than that of other recent homebuyers.” Measures of sprawl — density of urban settlement, local government fragmentation, and the presence of regional urban growth boundaries (UGBs) intended to contain growth inside an urbanized parameter — indicated “for the average renter in the sample, first-time homeownership occurs sooner in areas with lower urban densities, increased local government fragmentation, and in the presence of a UGB.”

The research shared in this symposium can help communities assess their own policies and find ways to further their affordable housing objectives. Other resources available from HUD USER include the Regulatory Barriers Clearinghouse ([www.regbarriers.org](http://www.regbarriers.org)) and a previous *Cityscape* that focuses on regulatory barriers to affordable housing (Volume 8, Number 1 at [www.huduser.org/periodicals/cityscape/vol8num1/index.html](http://www.huduser.org/periodicals/cityscape/vol8num1/index.html)).

<sup>1</sup>This issue of *Cityscape* (Volume 11, Number 2) can be downloaded at [www.huduser.org/periodicals/cityscape/vol11num2/index.html](http://www.huduser.org/periodicals/cityscape/vol11num2/index.html). Print copies can be ordered by calling HUD USER at 800.245.2691, option 1.

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## In the next issue of ... **RESEARCH** *Works*

- The Chicago Housing Authority's "hard to house" families inspired an innovative service delivery model that helps vulnerable families maintain safe and stable housing. The Chicago Family Case Management Demonstration is testing this model of intensive and comprehensive case management, relocation support, and long-term follow-up services with households in two large public housing developments. We'll explore model features, interim outcomes, and lessons learned in the first year of this initiative.
- Researchers who analyzed the performance of HOME and American Dream Downpayment Initiative (ADDI) home-buyer assistance programs conclude that these efforts have helped low-income families sustain homeownership. We will examine comparisons between foreclosure and delinquency rates of ADDI- and HOME-assisted loans and the FHA-insured portfolio for the period of 2001–2005, and what researchers found as contributing factors to rate variations.
- The Neighborhood Stabilization program (NSP) counters the impact of foreclosures through the purchase and rehabilitation of foreclosed, vacant properties to create more affordable housing and to renew neighborhoods. Enterprise Community Partners has analyzed a sample of state and local plans to use NSP funds. We'll discuss the analysis, along with data from HUD's Office of Policy Development and Research, to learn about local priorities for stabilizing neighborhoods and their planned strategies, financing mechanisms, and program models.
- In October, HUD co-hosted World Habitat Day 2009 at the National Building Museum in Washington, DC. This year's event focused on planning for affordable and sustainable urban communities in the face of rapid urbanization and its challenges, a theme that resonates with a guiding principle of the American Recovery and Reinvestment Act of 2009: promoting sustainable, stable communities. An American finalist in the 2009 World Habitat Awards competition for innovative and sustainable housing solutions, ecoMOD is doing exactly that with its production of affordable and environmentally sustainable housing for low-income households. We'll review highlights of this project.

