Sustainable Housing Design and Technology Adoption in *Colonias*, Informal Homestead Subdivisions, and the "Innerburbs"

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EXECUTIVE SUMMARY

This study was undertaken as part of a housing seminar through The University of Texas "Sustainable Cities" interdisciplinary graduate program anchored in the School of Architecture, Community & Regional Planning. It included graduate students from the LBJ, CRP, LAS and Sociology programs and the Law and Business schools. Directed by Dr. Peter M. Ward, the seminar class sought to provide a set of recommendations for sustainable housing rehabilitation in low-income and self-help settlements in Latin American and in the USA. Specifically, we wanted to expand our understanding of sustainable housing applications by considering not just the field of energy efficiency and renewable energy, but also the broader arenas of social, juridical and fiscal sustainability that may contribute to the adoption of policies related to "green" housing.

In the U.S., interest in energy savings and efficiency has become more widespread, technologies have improved, and applications have become more affordable. The current Obama administration has made sustainable home retrofitting an important component of its stimulus package. The American Recovery and Reinvestment Act of 2009 is investing over $20 billion towards increasing the energy efficiency of our nation's building stock. Cities throughout the country have pioneered their own plans, through tax incentives and utility programs, to promote similar goals. In Latin America, interest in housing sustainability is also gaining traction. Mexico and Brazil, for example, are actively thinking about housing sustainability through the proliferation of lower energy lighting fixtures, individual solar energy water heaters, and community recycling programs. Most often, however, this occurs in the context of urban sustainability, and is available to middle- or upper-income households.

Because they are often costly, sustainable applications are most easily adopted among the more economically advantaged sectors. As the negative impact of buildings on carbon emissions and total energy consumption continues to be documented, we are increasingly aware of the need to make sustainable housing solutions more widely available. Additionally, when accounting for the social equity component of the sustainable agenda, we must remember that a lack of energy-efficient housing in low-income communities means that low-income households are likely to incur higher costs relative to their incomes and capacity to pay. In fact, the U.S. Department of Housing and Urban Development has recognized that utility bills disproportionately burden the poor. Sustainable technologies must be applied to structurally sound homes in low-income settlements to make them more resource efficient, both to improve quality of life and to benefit the environment.

This study was designed to offer new policy approaches developed in the context of low-income, self-help or self-managed housing environments in the U.S. generally, and in Central Texas specifically. In addition we were interested in exploring how some of these possible housing applications might be applied more widely, especially in Latin America where poverty levels are more acute, and where self-build is the norm.

First, we identify the broad-brush variables that may constrain the application of new technologies or improvements in any context. These included climate and geography; relative poverty levels of the populations; the legal and regulatory environment; government and administrative capacity; social capital and organizational capacities. We present these (in Chapter 2) as important background "predisposition variables" that need to be considered when exploring the viability and appropriateness of any one set of policy applications.

Next we research the range of available options that might be applied at both the household or community level, regardless of income. Chapter 3 details our findings and is accompanied by a set of in-depth appendices of hands-on explanations, and a guide to further reading. Notably, we review four different types of technological interventions that are applicable to low-income, self-built, or self-managed housing:

- Microclimate design and technologies to support energy efficiency
- Renewable energy technologies to support enhanced energy access
- Water and wastewater technologies to promote water conservation and quality
- Waste systems to promote resource reuse and recycling

In the area of microclimate we focus on weatherization and passive solar design as crucial household-level changes that can greatly reduce energy usage and utility bills while promoting health and indoor-air quality. We give weatherization special attention since it has been the focus of the current Obama administration and has been heavily funded by the American Recovery and Reinvestment Act of 2009.

In the area of renewable energy we focus most on those technologies that are practical at the individual household level and affordable for low-income residents. The most accessible sources of renewable energy are individual solar water heaters, which use free solar energy to heat water through small, relatively inexpensive solar collectors.

For water and wastewater management we explore an array of practices, technologies, and systems that range from common-sense behavioral changes to community-wide water catchment, rainwater, or greywater systems. Nowhere is the range of technologies as expansive and diverse as in the field of water savings and reuse. We catalogue the many available options in a set of detailed appendices.

In the recycling and solid waste section, we review several different technological, social, behavioral and economic models for solid waste collection, reuse, and recycling. These include: basic reduction and reuse strategies, composting systems, traditional home recycling, recycling cooperatives, informal recycling businesses, commercial recycling, “upcycling”, and municipal solid waste.

In Chapter 4 we narrow our focus to examine the modest and low-cost approaches that might find more immediate and widespread adoption among lower income residents. We outline the range of housing improvements that exist across the four areas listed above and we documented their relative costs, and the ease of their implementation. We conclude that the primary constraining factors that determine the feasibility of an intervention are the economic investment required, the technological complexity of the proposed intervention, and the labor and human capital involved in its installation. Thus we determined the suitability of different technologies in terms of their cost, their ease of operation, and their ability to be installed using the sweat equity of the homeowner his or herself.

These findings are presented graphically through a series of individual charts for each of the four areas discussed in the preceding chapter: microclimate, renewable energy, water & wastewater, and recycling & solid waste. This series of diagrams rates various technologies according to a rubric in the following categories:

- Ease of Maintenance
- Savings
- Initial Cost Outlay
- Human Capital

We also developed a home energy savings calculator in the form of a spreadsheet. The spreadsheet is meant to be an instrument to help individual households gain a clear understanding of the economic benefit associated with various sustainable interventions in their home. With the help of an energy auditor a household could use the spreadsheet to determine the actual savings on their monthly utility bill for a range of different improvements (or combinations of those improvements).

Together the diagrams and spreadsheet can provide a powerful tool to demonstrate the range of possible technologies for rehab and new development, the contexts in which they are most suited, and the actual benefits to individual households that can result. The graphics depict many low-cost, low-tech options that have the potential to produce significant savings for low-income households.

These technologies cannot be implemented in a vacuum. It is also critical to understand the contexts in which they are applied. The success of any technology to promote energy, water, and other resource conservation will depend significantly on social support and the participation of community members, regulatory constraints and existing legal structures, and fiscal opportunities. To explore the context within which sustainable policies take place, in Chapter 5 we return to our set of precondition variables and discuss these constraining factors more broadly in terms of social, juridical and fiscal sustainability.

For instance, even if a technology is affordable, practical, available, and easy to maintain (i.e. it meets the preconditions outlined in our series of charts and diagrams), homeowners many not implement that technology if they do not know if its existence, are not educated about its benefits, experience social stigma against it, or have difficulty mobilizing advocates on their behalf. To begin to understand how some how some of these potential setbacks might be remedied, we outline key elements of successful community engagement and mobilization in the first part of Chapter 5.

In the juridical (legal and regulatory) arena, Texas Local Government Code explicitly prohibits municipalities from regulating land use and zoning within their extraterritorial jurisdictions. While this ostensibly limits energy-efficiency standards from being implemented in these areas, it can also allow for the development of innovative technologies or community-wide projects that are prohibited within city limits. Working against this flexibility often, are “clouded” titles to land in low-income or informal settlements which generally present obstacles to accessing credit, receiving certain types of federal subsidy or obtaining local funding to undertake improvements.

The economic feasibility and available funding for sustainable upgrades and new development is perhaps the most decisive factor in determining whether these technologies will reach low-income communities. Thus, we pay special attention to the arena of fiscal sustainability by outlining not only current funding sources but also opportunities for “green” jobs training. It is our belief that the benefits of sustainable home improvements come not only from the increased health, comfort and energy-efficiency of the homes themselves but also from the creation of new jobs and sources of sustainable economic development within low-income communities.

In sum, we hope this report will serve as comprehensive guide to developing policy that addresses the many unique challenges of extending sustainable housing applications to low-income populations. If initiatives can be made to address the factors that shape community involvement, education, local leadership, and capacity building while working within existing regulatory and legal frameworks and taking advantage of fiscal opportunities, then a more holistic sustainable housing policy will emerge.

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