ENERGY EFFICIENCY AS A CREDIT ENHANCEMENT:

PUBLIC UTILITIES AND THE

AFFORDABILITY OF FIRST-TIME HOMEOWNERSHIP

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This study examines how utility-sponsored energy efficiency programs might provide important partnerships for institutions developing and implementing "affordable housing" programs. The quantitative analysis then concentrates on first-time homeownership programs.

The hypothesis tested below is that utility energy efficiency programs, when operated in partnership with first-time homeowner programs, can in effect serve as a credit enhancement measure by: (1) lowering effective interest rates on the loan; (2) reducing the total number of monthly household energy bill payments each year; and (3) discounting the purchase price of the home to be paid by the low-income home purchaser. If this hypothesis proves correct, institutions involved with homeownership programs should become active players in seeking out utilities as program partners and *vice versa*.

The analysis below is set forth in five parts. *Part 1* discusses the potential number of low-income units that utilities could reach through low-income housing programs generally. *Part 2* discusses the relationship between *housing* affordability and *energy* affordability. *Part 3* introduces the substantive assessment pursued in this analysis and explains the methodology. *Part 4* sets forth the results of the analysis. A Base Case Scenario plus 80 alternative scenarios have been examined for each of the nine Census Divisions. *Part 5* sets forth a summary and major findings.

PART 1: UTILITY POTENTIAL TO BECOME INVOLVED IN AFFORDABLE HOUSING DEVELOPMENT

Public utilities offering energy efficiency improvements to low- and moderate-income households should tie these programs into existing housing and homeownership initiatives.[\1\] Having gas and electric companies become partners with agencies such as the Department of Housing and Urban Development (HUD), Rural Housing and Community Economic Development Service (RHCEDS),[\2\] Resolution Trust Corporation (RTC), Federal National Mortgage Association (FNMA), and others, would allow utilities to reach potentially millions of households.

At the least, representatives of institutions such as the National Association of Regulatory Utility Commissioners (NARUC), National Association of State Energy Offices (NASEO), National Association of State Community Service Programs (NASCSP), and the like, should

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\1\ For a general description of low-income energy efficiency measures, *see*, R.Colton, ***Energy Efficiency and the Low-Income Consumer: Planning, Designing and Financing*** (1995).

\2\ Formerly the Farmers Home Administration (FMHA).

join representatives of NAHRO, HUD, RHCEDS[3] and FNMA "at the table" in discussing how to make homeownership more affordable.

Federal Programs

The number of units of low- and moderate-income housing, the affordability of which might be improved by utility-sponsored energy efficiency investments, would represent a significant addition to the number of low- and moderate-income households reached by utility-sponsored energy efficiency programs. Consider that from the federal government alone:[4]

1. HUD's *National Homeownership Strategy* is aiming to increase the national number of homeowners by seven (7) million by the year 2000. The HUD *Strategy* is intended to rely on public/private partnerships. While strategy sessions for increasing homeownership have included HUD, RHCEDS, FNMA and the Federal Housing Finance Board (FHFB), no utility, regulator or other entity representing utility- or government-sponsored energy efficiency programs have been included.[5]

2. HUD's inventory of *foreclosed multifamily properties* is a second area where utilities might have access to targeting low-income assistance. HUD's inventory of foreclosed multifamily properties is substantial. The inventory grew from 10,000 units in 1990 to 27,000 units in 1992. By the beginning of Fiscal Year 1993, HUD initiated foreclosure on another 42,000 units, resulting in a total inventory of more than 69,000 units that are either HUD-owned or under foreclosure.[6] Of these 69,300 units, at 441 properties, the law requires that roughly 31,200 be preserved as affordable low-income units. Similar properties are available through RHCEDS.[7]

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[3] Formerly FMHA.

[4] This list is intended to be illustrative and not comprehensive.

[5] Such institutions might include associations of state agencies providing energy assistance such as the National Energy Assistance Directors' Association (NEADA) (LIHEAP providers) or the National Association of State Community Service Programs (NASCSP) (state WAP agencies). It might include regulators (National Association of Regulatory Utility Commissioners--NARUC or National Association of State Utility Consumer Advocates--NASUCA) or state energy offices (National Association of State Energy Offices-NASEO). It could include evaluators such as Oak Ridge National Laboratory (administrator of national weatherization evaluation). It could include residential energy service providers such as the Vermont Energy Investment Corporation (VEIC) or the National Association of Energy Service Companies (NAESCO).

[6] J.England-Joseph, ***Multifamily Housing: Impediments to Disposition of Properties Owned by the Department of Housing and Urban Development*** (May 1993).

[7] *See generally*, J.Harman (1995). ***Farm Loans: Actions Needed to Safeguard Taxpayers' Interests***, U.S. General Accounting Office: Washington D.C.

3. HUD's inventory of *foreclosed single family homes* is another source of housing to which utility energy efficiency efforts might be targeted. As of the summer of 1994, HUD had roughly 30,000 foreclosed single family homes for sale. Similar foreclosed properties are available through RHCEDS.

4. The Resolution Trust Corporation (RTC) reports that it has sold "thousands of housing units" through the *RTC's Affordable Housing Disposition* (AHD) program. The RTC, which takes over failed savings and loan institutions and disposes of their assets, had sold 575 multifamily properties, comprising more than 53,000 units through the AHD program as of December 1993. Of these, more than 22,000 units have been maintained as "permanently affordable."

5. The Resolution Trust Corporation, through its AHD program, has also sold about 20,000 *single family homes.* According to the RTC, the average sales price has been about $18,000 and the average buyer income has been about $21,800.

6. HUD's inventory of *Expiring Use Properties* is a source of housing that would benefit from targeted utility energy efficiency programs. These units were constructed or substantially rehabilitated in the late 1960's and early 1970s, with federally- or state-subsidized mortgages that could be prepaid after 20 years. With mortgage prepayment, restrictions requiring that the housing be devoted to low and moderate income families would be lifted and the housing could be transferred to market rate use. According to official HUD estimates, the inventory of federally-insured prepayment-eligible housing includes some 360,000 units in 3,200 projects nationwide.[8] While not all projects that are legally eligible to prepay are likely to do so, an economic model developed by the National Low Income Housing Preservation Commission predicts that 243,000 units, or two-thirds of the federally-insured prepayment-eligible housing stock, will be at risk over the next ten years.[9] *In addition*, there are some 282,000 Section 8 Loan Management Set-Aside units whose contracts will expire over the next ten years.

7. The National Commission on Native American Housing recently recommended creation of a *Native American Finance Authority* (NAFA). NAFA was recommended by the National Commission on American Indian, Alaskan Native, and Native Hawaiian Housing as a vehicle for financing housing and economic development in Native American communities. The Commission considering NAFA includes designees from the Treasury, the U.S. Attorney General's Office, the Office of Management and Budget, and Ginnie Mae, but

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[8] "Implications of the Prepayment Provisions in the Cranston-Gonzalez Housing Act," Congressional Budget Office Staff Memorandum (April 1992).

[9] The majority of expiring use projects and units are concentrated in ten states (Massachusetts, California, Texas, New York, Illinois, Ohio, and Michigan).

no energy representatives.[10]

8. In FY 1994, alone, HUD devoted a total of $200 million to its *Vacancy Reduction Program* for public housing authorities. The grants awarded by HUD to local housing authorities --23 in all in 1994-- ranged from $30 million to the Chicago Housing Authority to $50,000 for the Ann Arbor (Michigan) Housing Authority. These HUD grants are intended to help local housing authorities repair approximately 20,000 vacant public housing units, and address other problems that result in unit vacancies.[11]

9. *Section 8 Multifamily Needs Assessments*, as required by federal law, will help identify low-income rental housing owners and managers with whom utilities can work. Under the Housing and Community Development Act of 1992, owners of older, assisted multifamily properties are required to submit comprehensive needs assessments to HUD. Each assessment, which is to be prepared by an entity independent of the owner, must contain a description of the current and future financial or other assistance needed to ensure that the property is well maintained and financially viable.[12] The assessment must also describe any resources available for meeting the current and future needs of the property and the likelihood of obtaining these resources.[13] HUD provides Section 8 rental assistance to roughly 20,000 privately owned properties. The mortgages for about 10,000 of these properties are also insured or held by HUD.[14]

10. *Community Development Block Grant* funds are routinely used by local communities to build and rehabilitate low- and moderate-income housing. According to one report by the National Association of Housing and Redevelopment Officials (NAHRO), roughly 31 percent of all CDBG funds requested in small cities were for housing development and housing rehabilitation projects.[15] Similarly,

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[10] *See*, note **Error! Bookmark not defined.**, *supra*, and accompanying text.

[11] Vacancy reduction grants are targeted to local housing authorities that: (1) have vacancy rates of more than double the national average (roughly eight percent for public housing), or (2) are designated as troubled agencies, or (3) are in receivership.

[12] *See generally*, U.S. General Accounting Office, ***Federally-Assisted Housing: Conditions of Some Properties Receiving Section 8 Project-Based Assistance is Below Housing Quality Standards*** (July 1994).

[13] J.England-Joseph, ***Federally Assisted Housing: Expanding HUD's Options for Dealing with Physically Distressed Properties***, at 13 (Oct. 1994).

[14] *Id.*, at 1.

[15] ***The NAHRO Community Development Research Project: A Final Report***, at 7 - 9 (Sept. 1992).

large cities reported requests for housing and rehabilitation projects in 1991 representing more than 50 percent of the cost of all funding proposals submitted. "Overall," NAHRO found, "housing-related activities occupied the lion's share of funding requests in 1991, representing 44 percent of total requests" for CDBG funds. Between 1982 and 1988, forty-eight states (all but Hawaii and New York) administered roughly $7 billion in CDBG funds.[16]

11. One of the primary housing development, and homeownership, programs by the federal government is the *Home Investment Partnerships Program (HOME).* Created in 1990, the HOME program is a federal housing block grant, which provides funds to states and localities to undertake flexible, wide-ranging housing activities through partnerships among states, localities, private industry and non-profit corporations. Funds are distributed using a needs-based formula, and activities are targeted at a minimum to those with incomes below 80 percent of area median income.[17] Through May 1993, nearly $190 million in HOME funds had been awarded to the states,[18] assisting more than 13,000 affordable housing units.[19]

12. Federal *Low-Income Housing Tax Credits* are also used to help finance the construction or rehabilitation of affordable housing throughout the country. First created by the Tax Reform Act of 1986, the Tax Credit requires that housing be geared to incomes at 50 or 60 percent of area median income.[20] In 1993, the total tax credits available for allocation was $546 million, $425 million (78%) of which was actually allocated for low-income housing projects. From 1987 through 1992, states placed more than 267,000 total units in service using low-income housing tax credits.[21]

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[16] Ellen Bowyer Thompson and John Sidor, ***State Housing Initiatives: The 1990 Compendium***, at 8, Council of State Community Affairs Agencies: Washington D.C. (while occasionally updated, the 1990 edition is now the most recent).

[17] National Council of State Housing Agencies (1994). ***State HFA Factbook***, at 97 (National Council of State Housing Agencies: Washington D.C.).

[18] *Id.*, at 99.

[19] *Id.*, at 101.

[20] Joseph Guggenheim, ***Tax Credits for Low-Income Housing: Opportunities for Developers, Non-Profits, and Communities Under Permanent Tax Act Provisions*** (8th ed. 1994), at 1 (Simon Publications: Glen Echo, MD).

[21] ***State HFA Factbook***, *supra*, at 53 - 54.

Local, State and Private Programs

In addition to these federal efforts, much *non*-federal housing development work occurs through state and local institutions, both public and private. Consider that:

1. Local *Community Development Loan Funds* finance significant housing development. By 1993, 41 CDLFs existed in the country, with a total capitalization of $100.1 million. These institutions provided roughly $450 million in loans from 1986 through 1992, 44 percent of which went for affordable housing development. From 1986 through 1992, CDLFs financed 18,476 housing units, 86 percent of which were "permanently affordable" and 87 percent of which were affordable to low-income tenants. Each year, CDLF investments have grown, from $20 million in 1986 to $120 million in 1992. Moreover, CDLF lending from 1986 through 1992 leveraged an additional $1,678 million in funds, a 14:1 leveraging ratio.

2. State *Housing Trust Funds* represent permanent capital pools that offer a continuing source of financial assistance to support the creation and preservation of affordable housing. As of 1993, 37 states and the District of Columbia had housing trust funds. One estimate[\22\] is that these funds have collectively provided more than $780 million in funding for 80,000 housing units, and have leveraged more than $2.25 billion in funding from other sources.[\23\] Generally, state housing trust funds function as revolving loan funds, making loans and recycling loan repayments to make additional loans.

In general, state activity in the provision of affordable housing has been dramatic. Before 1980, only 44 state-funded housing programs existed. From 1980 to 1987, however, an additional 112 programs were created and from 1988 through early 1990, an additional 65 programs were developed.[\24\] Most of these programs are for special needs populations, or involve new construction and substantial rehabilitation.[\25\] A growing number of homeowner assistance programs are being created.

\22\ Glenn Petherick (1993). ***State Housing Trust Funds: Innovative Sources of Financing for Affordable Housing***, at i (National Council of State Housing Agencies: Washington D.C.).

\23\ Given that 14 of the 35 trust funds had been created in the three years preceding 1993, it is likely that the rate of investment, as well as the rate and amount of leveraged funds, will increase at a much quicker rate.

\24\ ***1990 Compendium***, *supra*, at 1.

\25\ *Id.*, at 3.

In addition to these figures are the thousands of units of affordable housing being constructed or rehabilitated each year through non-profit housing developers not included within the programs listed above.[26]

First Time Homeowners Programs

First time homeowner programs can be divided into two types: (1) those run by government; and (2) those run by private institutions. Each will be considered separately.[27]

State Government Homeownership Programs

State Housing Finance Agencies (HFAs) provide considerable assistance in promoting first time homeownership. By 1991, of the 600 affordable housing programs operated by HFAs around the country, 225 were homeownership programs.[28] According to the National Council of State Housing Agencies:

> The Mortgage Revenue Bond (MRB) Program is the primary homeownership program operated by State HFAs. Under this federally authorized program, HFAs issue tax-exempt bonds and use the proceedings raised from investors to fund mortgages through private lenders to lower income, first-time homebuyers purchasing modest-priced houses. MRB loans are made at interest rates as much as 2.5 percentage points below conventional rates. That means savings of as much as $100 per month on a typical MRB mortgage.
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> In general, MRB borrowers may not have incomes higher than 100% or 115% of the area or state median household income, whichever is greater. The average MRB loan goes to buyers at or below 80% of the national median income. In addition,

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[26] *See e.g.*, Alice Shabecoff (1992). ***Rebuilding Our Communities: How Churches Can Provide, Support, and Finance Quality Housing for Low-Income Families***, World Vision: Monrovia, CA.

[27] Clearly, this discussion is not intended to be a comprehensive review of such programs. It is instead intended to provide a sufficiently complete list to allow public and private managers of energy efficiency programs to gain an idea of the genres of programs to which an energy efficiency component might be attached.

[28] G.Petherick (ed.) (1992). ***State HFA Program Catalogue: Volume 1: Homeownership Programs***, National Council of State Housing Agencies: Washington D.C.

MRB loans may only be used to buy homes costing no more than 90% of the average area purchase price.[29]

The Council reports that from the program's inception through 1992, state HFAs had assisted more than 1.6 million lower income American homebuyers through the MRB Program.[30] More specifically:

> In 1990, State HFAs made more than 131,000 MRB loans to borrowers with an average income of $28,568, approximately 80% of the national median family income of $35,700. The level was well below the average income of $44,500 for homebuyers with conventional mortgages purchasing their first home and the average income of $53,000 for all conventional buyers. In 1990, MRB borrowers bought homes costing an average $59,705 -- far less than the average sales price of $111,100 for conventional first-time home purchases and the average sales price of $144,100 for all conventional home purchases.[31]

States operate other first-time homebuyer programs as well. One of the most prevalent is the "mortgage credit certificates" program, which provides a federal income tax credit to qualifying first-time buyers. Fewer states, but still a substantial number, provide assistance on downpayments and closing costs. Examples of these programs include:

- Alabama's "Down Payment Assistance Program," which provides a non-interest bearing second mortgage for up to 50 percent of the downpayment to households with incomes less than $23,600 and liquid asset under $3,000.

- Iowa's "Individual Home Acquisition Program," which provides grants, closing costs, and downpayment assistance and loan processing. The HAP matches the borrower's contribution dollar-for-dollar up to five percent of the mortgage amount, and is directed to households living at or below 80 percent of area median income.

- The Massachusetts "Borrower Assistance Program," which assists borrowers pay the closing costs associated with getting a mortgage. Buyers can borrow the lesser of $5,000 or five percent of the purchase price of the home. The interest, three percent, is deferred and

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[29] *Id.*

[30] National Council of State Housing Agencies, ***State HFA Factbook: 1992***, at v (1994).

[31] ***State HFA Program Catalogue***, *supra*.

repaid at the time of resale, refinancing, or transfer of the property.

- North Dakota's "Downpayment and Closing Cost Assistance Program," which lends up to $2,000 to households with incomes not to exceed $20,000.

- Pennsylvania's "Closing Cost Assistance Program," which provides a no-interest second mortgage of up to $2,000.[32] The program is available to households who are at or below 75 percent of the area median income and who would have less than $1,200 in liquid assets remaining after closing.

- South Dakota's "Single Family Down Payment Assistance Program," which provides low-interest loans for the lesser amount of 50 percent of the buyer's downpayment and closing costs or $2,000. This program is directed toward low- and moderate income households.

The attention devoted to affordable homeownership is not surprising. According to one study of state housing agencies:

> The most frequently mentioned problem was affordability (19 states, 10 of which identified it as their *highest* priority problem), generally defined as the lack of affordable housing for low- and moderate-income households, but specified for one state as housing for very low-income persons and the working poor.* * *Affordability is a problem that seems to affect every state with the one exception of Oklahoma, which noted that affordability was not a problem. (emphasis added).[33]

As is evident, there are a wide variety of state-government programs directed toward promoting homeownership by low- and moderate-income households today. Some programs are intended to help overcome the initial costs of home purchases. Other programs are directed toward longer-term affordability.

Private First-Time Home Buyer Programs

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[32] The Philadelphia County maximum is $2,500.

[33] E.Thompson and J.Sidor (1992). ***State Housing Initiatives: The 1990 Compendium***, at 7, National Council of State Community Affairs Agencies: Washington D.C.

A variety of "private" first-time homeowner programs exist today that are backed by institutional investors ranging from financial institutions to religious organizations to large scale public and private pension plans. Consider that:

- The annual financial report for the *Comptroller of the City of New York* stated in 1992 that the City's Comptroller works with the city's pension funds "to develop innovative targeted investment programs." According to the Comptroller, "aggregate targeted investments in housing completed or in construction have reached $496 million representing the renovation or construction of nearly 20,000 affordable apartments and homes throughout the City."[34] The total targeted investments in 1992, the Report said, had doubled since 1989.

- The Pennsylvania Treasurer's office reported in 1993 that "nearly 3,000 Pennsylvania families have benefitted by receiving low-rate mortgages from the $200 million invested by the Pennsylvania Treasury in the Knoll HomeStart program."[35] In addition, the Pennsylvania Treasurer's office initiated a statewide program that "addresses the nagging problem of insufficient funds for down payments."[36] Finally, in August 1991, Pennsylvania committed $8.2 million to initiated a new guaranteed housing loan program "designed to help rural families achieve their dream of home ownership."[37]

- The AFL-CIO reported in 1993 that its Housing Investment Trust fund (HIT) had produced 3,000 units of affordable housing in 1992 alone. The AFL-CIO announced a program in 1993 that "will invest $660 million in housing and community development projects in 27 cities over the next five years." Amongst the impacts of this initiative, the AFL-CIO said, would be the production of 10,000 to 12,000 units of affordable housing.[38] Since that time, the Minneapolis newspapers have reported a program "to build an estimated $60 million in affordable housing and commercial space in the Twin Cities through 1998."[39] Detroit papers reported that that city

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[34] Elizabeth Holtzman, ***Comprehensive Annual Financial Report of the Comptroller for the Fiscal Year Ended June 30, 1992***, at p. xxix - xxxi.

[35] Catherine Baker Knoll, ***1992 Annual Shareholders Report: Pennsylvania Short-Term Investment Pool***, at Appendix III (February 8, 1993).

[36] *Id.* The state committed $15 million to this program in 1991 and 1992. *Id.*

[37] *Id.*

[38] AFL-CIO, ***National Partnership for Community Investment*** (April 1993).

[39] "Pension money will go back to work in inner=city projects," ***Minneapolis Star Tribune*** (May 5, 1993).

would get about $40 million in housing construction, or about 450 units.[40] Los Angeles was to receive about $75 million in low- and moderate-income housing units.[41] Other targeted cities include Atlanta, Boston, Columbus (Ohio), Dallas, Miami, New York, Philadelphia, Pittsburgh, San Antonio, St. Louis, Washington D.C., Baltimore, Chicago, Cleveland, Denver, Milwaukee, New Orleans, Oakland, Phoenix, Portland (Oregon), Seattle and St. Paul.[42]

- In 1994, the National Training and Information Center (NTIC) entered into a $25 million first time homeowners program in Chicago. NTIC, in conjunction with Neighborhood Housing Services of Chicago (NHS) and Freddie Mac, will develop a program focused on the renovation of 700 two-to-four unit properties with five local lenders. In addition to providing downpayment and closing cost assistance, NTIC will provide pre- and post-purchase buyer counselling.

Production Comparisons with WAP

While, clearly, introducing utility energy efficiency as a partner in the various initiatives described above will not reach all, or anywhere close to all, low-income households, it would be a significant addition to the provision of low-income energy efficiency. In fact, in contrast to the numbers of units discussed above, the federal low-income Weatherization Assistance Program (WAP), the primary federally-funded low-income energy efficiency endeavor, has weatherized roughly 4.0 million units nationwide since 1976, an average of roughly 220,000 per year.[43]

PART 2: ENERGY COSTS AND HOUSING AFFORDABILITY

Taking account of energy costs is crucial in any consideration of the affordability of shelter to low-income households. Energy costs, standing alone, can often drive total shelter expenses beyond affordable levels. One recent study of winter natural gas home heating bills found that

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[40] "AFL-CIO to invest in housing for poor," ***Detroit Free Press*** (May 12, 1993).

[41] "HUD, AFL-CIO Plan Joint Housing Effort," ***Los Angeles Times*** (March 24, 1993).

[42] "AFL-CIO Pension Fund to Invest $500 Million in Affordable Housing," ***Multi-Housing Newsletter*** (May 1993).

[43] Brown M., Berry, L. and Kinney L. (1994). ***Weatherization Works: Final Report of the National Weatherization Evaluation***, at 1 (Oak Ridge National Laboratory: Oak Ridge, TN). These funds, however, included oil overcharge dollars that are no longer available. Moreover, they included transfer from the Low-Income Home Energy Assistance Program (LIHEAP), which may also soon disappear.

low-income customers taking gas from 164 of the 199 utilities studied would pay "too much" for their winter home heating bills.[44] More than 2.7 million gas heating households would have winter home heating burdens exceeding 10 percent of income, the ceiling of "affordability." More than 1.0 million households in 47 states and the District of Columbia with incomes less than $6,000 would have winter natural gas home heating burdens exceeding 30 percent of their income.[45]

Moreover, a separate study of the "other part of the year" found that even modest amounts of summer electric consumption (500 kWh per month) exceeded 10 percent of income for 162 of the 185 electric companies studied.[46] More than 20 electric companies were found to have low-income burdens of more than 20 percent, and 88 companies had burdens exceeding 15 percent of income. Even at 500 kWh of summer electric consumption, the report found, none of the companies had burdens at or below five percent, the ceiling of electric affordability.

The relationship between utility costs and Fair Market Rents further demonstrates the role which utility costs play in the overall affordability of housing. FMR's are intended to reflect the sum of contract rents plus all utilities (with the exception of telephones).[47] A 1994 study of FMR's in 100 cities, however, found that the utility costs in those cities represented a *substantial* proportion of the total Fair Market Rent initially proposed by HUD.[48] Of the 100 communities studied, utility costs represented more than 50 percent of FMRs in seven, more than 40 percent in 19, more than 30 percent in 66, and more than 20 percent in 92. In only eight communities was the proportion of FMRs devoted to utility bills at or below 20 percent.[49] In contrast, Fannie Mae has indicated that energy costs should generally equal no more than 20 percent of total shelter costs.

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[44] Sheehan M. (1994). ***On the Brink of Disaster: A State-by-State Look at Winter Natural Gas Home Heating Bills***, Fisher, Sheehan & Colton, Public Finance and General Economics: Scappoose, OR.

[45] Three states did not report data on utility bills and were thus excluded from the analysis: Nebraska, Tennessee and New Mexico.

[46] Colton R. (1994). ***The Other Part of the Year: Low-Income Households and their Need for Cooling, A State-by-State Look at Summer Electric Bills***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA.

[47] Natural gas, electricity, and water/sewer.

[48] Colton, R. and Sheehan M. (1994). ***The Role of Utility Costs in Setting Fair Market Rents for Section 8 Housing***. *Presented in*, ***Section 8 Housing Assistance Payments Program--Fair Market Rent (FMR) Schedules for Use in the Rental Certificate Programs, Loan Management and Property Disposition Programs, Moderate Rehabilitation Program and Rental Voucher Program***, HUD Docket N-94-3754 (FR-3699-N-01) (October 1994).

[49] Of these eight communities, seven represented high cost rental markets such as San Francisco, Honolulu and San Jose. The low proportion of FMRs devoted to utilities in these locales, in other words, indicates more about the area contract rents than it does about area energy costs.

The FMR study concluded that any examination of the affordability of total shelter costs must include an examination of energy costs, since energy costs were such a substantial portion of the total. A summary distribution of the proportion of FMRs taken by utility costs is set forth below:[\50\]

Summary Distribution: Percent of Proposed FY 95 FMRs Devoted to Utility Bills 100 Selected U.S. Cities	
Percent of FMR	No. of Cities
10 percent and less	0
10.1 - 20 percent	8
20.1 - 30 percent	26
30.1 - 40 percent	47
40.1 - 50 percent	12
50.1 percent and more	7

While Fair Market Rents reflect rental costs rather than mortgage payments, the study nonetheless still provides important support for the conclusion that affordable energy and affordable housing initiatives march --or more aptly *should* march-- forward together as partners and collaborators.

\50\ Fair Market Rents (FMRs), by HUD definition, are contract rents plus energy costs for each designated local areas. Contract rents are set equal to the contract rents in the 45th percentile.

PART 3: ASSESSING THE IMPACT OF ENERGY EFFICIENCY IMPROVEMENTS ON HOMEOWNERSHIP AFFORDABILITY.

The purpose of the discussion below is to consider the impacts on homeownership affordability of combining an energy efficiency initiative pursued in partnership with first-time homeownership programs. The data is not comprehensive, nor is it intended to be. Instead, the data takes typical programs and uses reasonable assumptions about housing characteristics, housing costs, energy costs, and the like, to develop an overview.

The Energy Efficiency Initiative

The energy efficiency initiative discussed below involves a proposed modification to an existing "affordable homeownership" strategy. The initiative postulates a program involving reduced downpayments and diverts some of the downpayment amount to an investment in energy efficiency. The theory is that downpayments are to serve as a security for payment. One effective means of increasing the security of the mortgage payment in a low-income homeownership program, however, is to reduce the housing operating expenses which may compete for limited household funds. The energy efficiency investment in this proposed initiative is funded through three different sources:

1. The financial institution makes a contribution by devoting a portion of the household's downpayment to the energy efficiency investment and thus accepting a lesser prepayment of the total purchase price of the home;[\51\]

2. The local utility makes a contribution by matching the energy efficiency investment taken from the downpayment; and

3. The household makes a contribution equal to the cost of financing the amount of the efficiency investment not covered by the financial institution and the utility as described above.

[\51\] The proposal is to take two percent (2%) of a three percent (3%) downpayment and devote that amount to pay for the $3000 investment in energy efficiency improvements.

The Results to be Evaluated

The analysis below will compare the proposed energy efficiency/affordable housing strategy on four different points:

1. The net present value (NPV) savings/cost to the household arising from such a strategy over the life of the energy efficiency package;[52]

2. The effective pre-tax interest rate increase or decrease arising from such a strategy;[53]

3. The effective discount on the purchase price of the house represented by the Net Present Value savings;[54] and

4. The reduction in the effective number of monthly energy bills to be paid each year.[55]

To facilitate the analysis, energy bills are considered on an annual basis and are assumed to be paid in twelve equal monthly installments.[56]

The Research Methodology

The housing affordability partnership with utility energy efficiency programs studied below assumes that an energy efficiency investment of $3000 is made in each single family home.[57] To finance energy efficiency in the home, the mortgage institution takes two percent of the three

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[52] From the perspective of the household, are there net present value benefits over the life of the energy efficiency investment?

[53] From the perspective of the household, what interest rate break would be necessary to generate the same amount of savings generated by the energy efficiency improvement?

[54] From the perspective of the household, what reduction in the purchase price of the home would be equal to the savings generated by the energy efficiency improvements?

[55] From the perspective of the household, how many present value monthly energy bills would it take each year to generate the same amount of savings generated by the energy efficiency improvements?

[56] The significance of this is that equal monthly bills are added to the monthly mortgages. Total monthly shelter costs thus exhibit no seasonality.

[57] According to the ORNL study of federal weatherization (WAP) investments, "the average rate of increase in energy savings did not diminish as investments increased from $1,000 to $3,000." ***Weatherization Works***, at 47.

percent downpayment and uses that as a household payment toward energy efficiency improvements. The cost of the energy efficiency improvement is further offset by a utility match equal to 1.0x the diverted downpayment amount.[58] The amount of the energy efficiency investment not paid through these two funding sources is then financed as part of the cost of the home irrespective of traditional underwriting criteria.[59]

To illustrate this process, assume the purchase of a $35,000 home. The $3000 cost of the energy efficiency improvements is offset by a two percent downpayment ($35,000 x .02 = $700) plus the utility matching grant of 1.0x ($700). The remainder ($3000 - $700 - $700 = $1600) is then financed as part of the total mortgage. The mortgage in this instance would thus be $35,000 minus the one percent downpayment not devoted to energy efficiency plus the $1600 remaining cost of the energy efficiency improvement ($35,000 - $350 + $1600 = $36,250). Mortgage interest rates are assumed to be nine percent.

For purposes of this analysis, energy reductions are assumed to be realized at a rate that reflects differences in climatological factors.[60] Energy consumption and bills are set equal to those for a house with the same square feet occupied by households at or below 125 percent of the federal Poverty Level in each respective Census Division as found by the U.S. Department of Energy.

The life of the energy efficiency package is assumed to be 15 years. Real energy price increases are assumed to be four percent (4%) with an inflation rate of 2.5 percent (2.5%). A discount rate of four percent is used. The purchase price of the home is assumed to be the value of a home owned by a household with income at or below 100 percent of the federal Poverty Level in each Census Division, excluding homes valued at $100,000 or more.[61]

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[58] We will set aside for now cost-effectiveness concerns from the perspective of the utility. To calculate such cost-effectiveness is not the purpose of this analysis. For a discussion of the cost-effectiveness of piggyback utility programs generally, however, *see generally*, Oak Ridge National Laboratory, ***Standard Practice: Estimating the Cost-Effectiveness of Coordinated DSM Programs*** (December 1994). The December 1994 report is a companion report to an earlier work: ***Low-Income DSM Programs: Methodological Approach to Determining the Cost-Effectiveness of Coordinated Partnerships*** (May 1994).

[59] To assume away traditional underwriting criteria is made for simplifying purposes at this time.

[60] Total energy savings are set equal to 18 percent in colder regions, 15 percent in moderate regions, and 12 percent in warmer regions. *See generally*, ***Weatherization Works***, at 37 - 43.

[61] The values for homes were first set equal to the 1989 values obtained from the American Housing Survey for homes owned by households at or below 100 percent of the federal Poverty Level. Those 1989 values were escalated to 1994 dollars by the CPI-U index specific to each Census Region.

All starting prices, energy or housing, are set forth in 1994 dollars. The input data for each Census Division is set forth in Appendix A.

The Sensitivity Analyses

In addition to a Base Case Scenario, the results of the energy efficiency improvements were varied to test their sensitivity to certain variables that may reasonably be expected to vary from situation to situation. Four variables were modified in the sensitivity runs including:

1. Escalation rate of energy price (6.0, 6.5, 7.0%)

2. Interest rate (8.5, 9.0, 9.5%)

3. Discount rate (4, 5, 6%)

4. Amount of utility matching investment (.5x, 1.0x, 1.5x)\62\

Varying these factors results in 80 different scenarios being run in addition to the Base Case Scenario, using different changes in variables for each of the nine Census Divisions. The complete list of scenarios is set forth in Appendix B.

PART 4: THE RESULTS

The Base Case Scenario

The complete results of the Base Case analysis are set forth in Appendix C. In addition, the major Base Case Scenario results are summarized in Table 1 below. The Base Case Scenario yields significant positive results from the perspective of improving the affordability of homeownership.

\62\ Set forth as a multiplier of the household downpayment devoted to energy efficiency.

The Basic Results

Annual Cash Flows: Seven of the nine Census divisions had positive cash flows starting with Year One. The two Divisions that did not --the East South Central and Pacific-- experienced four interrelated factors that converged to lower initial cash savings. Each Division had smaller home sizes (#8 and #9 of the nine Divisions). As a result, they had the lowest initial "pre-energy efficiency" energy consumption (#8 and #9 of nine Divisions). Accordingly, even when the higher energy prices of the two Divisions were taken into consideration (the Pacific prices were third highest of the nine Divisions while the East South Central were fourth highest), the overall *bills* were still the two lowest amongst the nine Divisions. Finally, the East South Central Division had an estimated energy efficiency savings of only 12 percent, while the Pacific had an estimated savings of only 15 percent. These rates of savings, particularly when applied against a lower initial energy bill, simply were insufficient to offset the additional costs of the energy efficiency investment in Year One.

The two Divisions having negative cash flows did eventually generate positive results for the program. The "cross-over" in the East South Central came in Year 4 (of the 15 years)[63] while the cross-over in the Pacific Division came in Year Two.[64]

While there were only two Divisions with negative Year One cash flows, other Divisions experienced cash flows that were small (even if positive). The South Atlantic Division, for example, had a positive cash flow of only $15 in Year One, while the West South Central and Mountain Divisions had positive cash flows of $12 and $39 respectively. The small Year One benefits in these two Divisions would seem to confirm that the lesser cash flows arise substantially from lower Year One bills (thus yielding lower annual savings). Again, the small bills, in turn, flow from small housing units (in terms of square feet) rather than from lower energy prices.

In contrast, substantial Year One benefits were experienced in New England ($139) and the East North Central ($110) Divisions. These Divisions both had the highest level of energy efficiency savings (18%) and the highest Year One energy bills (New England: #2 of 9; East North Central: #3 of 9). The results here, however, do *not* support the notion that home purchase price is a major contributing factor, since the North Central Region has the lowest home purchase prices of the four Census Regions.[65]

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[63] The positive cash flows were sufficient to offset the accumulated negative cash flows by Year 6.

[64] The positive cash flow in Year 2 was sufficient to offset the negative cash flow in Year One.

[65] At first thought, it might appear that the purchase price of the home might make the ultimate cost of the energy efficiency measure less expensive. Since the total cost of the energy efficiency measure is offset by a payment equal to two percent (2%) of the purchase price, plus a matching utility grant, the higher the purchase price, the greater the 2% payment made and the greater the utility match. As a result, the total price of the energy efficiency measure financed would be smaller, and presumably, less expensive.

To examine what drives Year One savings, therefore, the Year One savings were regressed against three factors to assess which might have the greater explanatory power. The three factors were:

- o Home purchase price;
- o Year One energy bill; and
- o Energy efficiency savings.

The results are as follows:

Factor	R^2	Standard Deviation
Home purchase price	.19	.014
Year-1 energy bill	.68	.057
Energy efficiency savings	.70	443.12
Unit size	.39	.086

From this analysis, we can conclude that it is the Year One energy bill which is most likely to help explain whether there will be a Year One positive cash flow. This factor provides a far stronger explanation than either the unit size or the home purchase price. Moreover, it is a far more robust predictor than the estimated extent of energy efficiency savings.

Net Present Value Savings: While not all Census Divisions had positive cash flows starting with Year One, nonetheless, in all nine Census Divisions, the household obtains Net Present Value benefits from its investment in energy efficiency over a projected 15 year life of the energy efficiency measures. These positive benefits mean that the household energy bill savings generated by the efficiency investment will exceed repayment of the principal (along with interest) over the life of the efficiency measure.[\66\]

\66\ There are two sets of dollars that will be added to the mortgage in the "with energy efficiency" initiative. First, since a portion of the downpayment is diverted to paying for the energy efficiency measure, a greater portion of the original purchase price of the home will be financed through the mortgage. Second, since the combination of the diverted downpayment plus the utility matching grant will be insufficient to pay the entire cost of the energy efficiency investment, added to the mortgage, as well, will be the cost of the energy efficiency investment *not* covered by the

The *extent* of the Net Present Value (NPV) savings differs dramatically from Division to Division, ranging from a high of $3,231 in New England to a low of $517 in the East South Central Division. In the warm weather climate zones, Net Present Value savings over 15 years ranged from $517 to $1,106. In contrast, the colder weather states of the North East and North Central Regions experienced Net Present Value savings of from roughly $2,500 to more than $3,200.

There seems to be three regimes of Net Present Value savings. The top regime (with four of the nine Divisions) experienced NPVs of from roughly $2,500 to more than $3,000. A second level (South Atlantic, West South Central and Mountain) had NPV of roughly $1,000, while the third level (East South Central and Pacific) had NPV benefits of only a few hundred dollars.

Surprisingly, the NPV benefits are not well-explained by the rate of annual savings generated by the energy efficiency measures. While two of the three Divisions with assumed 18 percent savings had high NPV savings, two of the three Divisions with 12 percent savings were in the second tier.

The larger savings in the North East and North Central Regions can likely be attributed to several factors. Obviously, first and foremost, the national weatherization evaluation found that energy efficiency investments in these cold weather regions generate higher rates of savings (18%). Second, these higher rates of savings are then applied to higher initial energy bills with which to begin. The first year bills in the New England ($1,477) and East North Central ($1,380) Divisions significantly exceeded the bills in all other regions (other than the Mid Atlantic, which was in the top tier despite an estimated rate of efficiency savings of only 15 percent).

It is clear from this analysis that one cannot conclude much about the impact on home affordability simply through an examination of the rate of savings which energy efficiency measures are estimated to generate. In addition, one needs to know at least the total size of the home and the total size of the home energy bills to reach meaningful conclusions.

Measuring Impacts on Housing Affordability

The Net Present Value savings generated through the energy efficiency investments were translated into three practical measures of benefits to the first time homeowner. The purpose of this analysis is to develop and apply measures that would help assess the impact on housing

(..continued)

downpayment and utility matching payment.

affordability. The three measures of benefits include:

- The number of energy bills per year effectively saved under the energy efficiency scenario;[\67\]
- The effective discount on the initial purchase price of the home represented by the Net Present Value energy savings;[\68\] and
- The effective interest rate reduction which the energy efficiency savings represent.[\69\]

These three measures are disjunctive. They are, in other words, *alternative* ways of looking at the same savings. They can *not* be added together.

Number of Energy Bills Eliminated: The number of average monthly energy bills that can be eliminated by the energy efficiency initiative was calculated on a present value basis. This assessment calculated the present value of the net savings over the course of the 15 year period.[\70\] This present value savings figure was then divided by 180 (12 payments per year x 15 years) to obtain the average present value energy bill saved in dollars. Finally, this figure was divided by the average present value monthly energy bill in the "no efficiency" scenario to convert the dollar savings into a "bills-saved" measure.

The "bills-saved" measure is a better measure of impact on energy affordability than simply a "dollars saved" statistic. This measure allows more effective comparisons both across time periods and across geographic regions. To know that there is a savings of $100 in two different regions, in other words, does not communicate that households in those regions have obtained similar benefits. If the monthly energy bill in one region is $150 while the monthly energy bill in the other is only $75, the $100 savings would leave the household in the two regions in substantively different positions of gain.[\71\]

\67\ *See*, note **Error! Bookmark not defined.**, *supra*, and accompanying text.

\68\ *See*, note **Error! Bookmark not defined.**, *supra* and accompanying text.

\69\ *See*, note **Error! Bookmark not defined.**, *supra*, and accompanying text.

\70\ The *net* savings includes the energy savings after payment of the additional costs explained in note **Error! Bookmark not defined.**, *supra*.

\71\ This "bills-saved" statistic is similar to the "bills-behind" statistic developed by the Bureau of Consumer Services of the Pennsylvania Public Utility Commission. Bureau of Consumer Services:

The energy efficiency measures will eliminate the need to pay some number of energy bills on an annual basis.[72] In generating this result, of course, the efficiency measures free up household funds to pay for ongoing mortgage obligations. To the extent that these "fixed" household operating costs are reduced, particularly to low-income households, the security of the mortgage payments is enhanced.

The number of present value monthly energy bills that are reduced each year ranges from less than 0.5 to nearly 2.0 in the Base Case Scenario. The energy savings in the New England, East North Central and West North Central Divisions, for example, will result in households needing to pay only somewhat over 10 of the 12 monthly bills that would have been due in the absence of the efficiency improvements. Of the 180 utility bills that would have been due over the 15 years studied, in other words, New England households would be required to pay only 153 (180 - [15 x 1.8]); West North Central customers would be required to pay only 156 of the total 180 bills that would otherwise have been due (180 - [15 x 1.6]); and East North Central households would be required to pay only 154.5 (180 - [15 x 1.7]). In contrast, the Divisions with lower savings (*e.g.*, South Atlantic, East South Central, West South Central, Pacific) would save a *total* of only 5.0 to 8.5 bills over the 15 year period. Nonetheless, in these latter instances, the households eliminate more than one half year of the 15 years of energy bill payment obligations on a present value basis.

It is important to remember in this respect that the savings going into this analysis are not the gross savings from the energy efficiency measures. Rather, it is the *net* savings left after paying added mortgage costs associated with the energy and efficiency scenario.[73]

Effective Discount on Home Purchase Price: The second means of looking at the Net Present Value savings of the energy efficiency investment is to convert those savings into an effective discount on the original purchase price of the house. This measure sets forth the NPV

(..continued)

Utility Payment Problems: The Measurement and Evaluation of Responses to Customer Nonpayment (October 1983). The PUC's BCS said in 1983 that this measure calculates the average overdue bill divided by the average customer bill. It thus calculates the number of average bills contained in an average arrearage. Hence, if one customer has an arrears of $400 and an average monthly bill of $200, that customer has a weighted arrears of 2.0 "bills behind." If a different customer has an arrears of $400 and an average monthly bill of $140, that customer has a weighted arrears of 2.86 bills behind. The second customer, and thus the utility serving that customer, is in more serious payment trouble.

As BCS observes, use of a weighted arrears measure "permits comparisons to be drawn between companies by eliminating the effects of different customer bills on arrearages." Without such a measure, "the interpretations of average arrearages, either over time or in comparison between companies presents some difficulties."

[72] The bills do not reflect any seasonal variation.

[73] *See*, note **Error! Bookmark not defined.**, *supra*, and accompanying text.

savings as a percent of the original purchase price. By obtaining $3,000 in NPV energy efficiency savings, in other words, the homeowner has accomplished the same result as he would have accomplished by reducing the purchase price of a $30,000 home by ten percent.

The energy efficiency investment has the effect of reducing the purchase prices from roughly 1.5 to 7.5 percent. The effective purchase price reductions in four Divisions (New England = 7.6%; Mid Atlantic = 5.9%; East North Central = 7.1%; West North Central = 6.0%) are all in the six to eight percent range. A second tier would see effective purchase price reductions of 3.0 to 4.0 percent (South Atlantic=2.8%, West South Central=2.7%, Mountain=3.6%), with the remaining two Divisions (East South Central=1.3%, Pacific=1.9%) being at roughly 1.5 to 2.0 percent.

Effective Discount on Interest Rate: A final alternative way of viewing the Net Present Value savings from the perspective of the household is to calculate the effective interest rate discount that the energy efficiency investment "buys." To calculate this discount, the present value of the payments[\74\] in the "without energy efficiency" scenario is determined. The present value of the payments[\75\] in the "with energy efficiency" scenario is next determined. The effective discount on the interest rate is thus the Internal Rate of Return (IRR) needed to make those two payment streams equal.

The effective interest rate discount ranges from 11 to almost 60 basis points.[\76\] Three tiers of rate breaks are evident. In the top tier, consisting o the New England (.59%), Mid Atlantic (.45%), East North Central (.54%) and West North Central (.48%) Divisions, the effective interest discount is from roughly 1/2 to 5/8 points per year. The second tier, consisting of the South Atlantic (.22%), West South Central (.21%) and Mountain (.30%) Divisions, the effective discount is roughly 1/4 to 3/8 of a point per year. In the third tier (East South Central=.11%; Pacific=.17%), the effective discount is roughly 1/8 of a point.

This measure shows the household savings on an annual basis. In New England, for example, the energy efficiency investment generates the same benefits that would have been generated by reducing the interest rate from 9.0 percent to 8.4 percent. In the worst case scenario, the savings are sufficient to have the effective result being to lower the interest rate from 9.0 percent to 8 7/8 percent.

\74\ Energy plus mortgage.

\75\ Again, energy plus mortgage.

\76\ In fact, the savings is greater because the effective interest rate is reduced while maintaining the tax deductibility of the entire 9.0 percent.

Base Case Scenario Discussion and Conclusions

There is significance to both the utility company and the financial institution from these different measures of reduced costs. As described in Part 2 above, utility payments represent a significant contribution a household's total shelter costs. To the extent that competing expenses are reduced, the security of the home mortgage payment is increased. The role of home energy bills in this regard is evidenced by the frequent treatment of home utility bills as "long-term debt" for purposes of calculating the marginal long-term debt a household is capable of carrying *vis a vis* a mortgage. The *net* elimination of several utility bills a year should increase the ability of households to meet their mortgage obligations.[77]

The effective reduction in interest rates and the purchase price should be of interest to the financial institution as well as to the homeowner. The factors that a lender will consider in underwriting a loan include the borrower's ability to repay.[78] Some financial institutions factor in monthly utility expenses as a part of the "total monthly housing expense" (along with items such as property taxes and insurance). Other financial institutions consider utility bills in the nature of long-term debt. Still other financial institutions simply calculate utility costs as a part of the disposable monthly income. Whichever way is used, it is clear that the energy efficiency affordability measures discussed above should positively affect underwriting decisions.

Moreover, from a utility's perspective, contributing to a household's stable homeownership situation should result in financial benefits as well. Ample research has found that customers with long-term residences not only generate less bad debt, but carry lower arrears, and cause fewer credit and collection problems.[79] Households with long-term residency, for example, were found to involve fewer customers who made few or no payments during a winter shutoff moratorium in Maine.[80] Accordingly, not only will the energy efficiency initiative discussed have resulted in traditional avoided capacity and energy costs, it will result in the additional expense savings arising from the promotion of stable homeowner customers as well.

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[77] This observation could be documented by a study over time of the number of foreclosures on energy efficient homes as opposed to non-energy efficient homes.

[78] K.Fisher (ed.), ***Loan Underwriting: A Workbook on Analyzing and Committing to Lend***, National Reinvestment Training Institute: Washington D.C. (1993).

[79] *See*, R.Colton. (1990). ***Controlling Uncollectible Accounts in Pennsylvania: A Blueprint for Action***, National Consumer Law Center: Boston.

[80] R.Colton. (1988). ***Low-Income Utility Protections in Maine***. (3 volumes). **Volume 1: *An Evaluation of Low-Income Utility Protections in Maine: Winter Requests for Disconnect Permission***, National Consumer Law Center: Boston.

The Non-Base Case Scenarios

The results of the 80 alternative non-base-case scenarios within each Census Division are summarized in Table 2 below. The results of the 80 alternative scenarios are set forth completely in Appendix D. The first part of this section looks at the summary data. The second part looks in more detail at data from particular Census Divisions.

The Summary Data

The energy efficiency scenarios do not universally yield Net Present Value benefits across the country in all circumstances. As Table 2 shows, the nine Census Divisions fall into three rough categories. In Category 1, the New England and East North Central Divisions see Net Present Value benefits for all 80 sensitivity runs. The savings in these Divisions are not only ubiquitous, they are substantial as well. In these two Divisions, the Year One savings exceeded $100 in 44 and 45 of the 90 alternative scenarios respectively. The savings are reflected in both the effective discount of the interest rate generated by the energy efficiency and in the effective discount off the purchase price of the home. New England and East North Central saw 60 and 57 scenarios respectively where the interest rate break exceeded one-quarter point. Finally, the high NPV savings in this top tier translated into high effective discounts off the purchase price of the home. In both regions, the effective purchase price discount exceeded five percent in 53 of the 80 non-base-case scenarios.

Category 2 encompasses the Mid-Atlantic and West North Central Divisions. In each of these Divisions, there were minimal numbers of scenarios, but nonetheless some, where the Net Present Value benefits of the energy efficiency investments were negative. In these cases, in other words, the energy efficiency savings were not sufficient to offset the increased mortgage payments associated with the energy efficiency investment.[81] Category 2 involves the Mid-Atlantic and West North Central Divisions, where there were 71 and 72 of the 80 scenarios which resulted in Net Present Value benefits.

Not surprisingly, the reduced number of positive scenarios were reflected in the other measures as well. The number of scenarios with Year-1 savings greater than $100, for example, was somewhat fewer, as well as the number of scenarios with effective interest rate reductions of greater than one-quarter point.

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[81] The increased payment was explained in note **Error! Bookmark not defined.**, *supra*.

Category 2 was identical (or nearly so) to Category 1 in the number of scenarios with positive cash flows in Year One. In three of the four cases (New England, Mid-Atlantic, and West North Central), there were 53 scenarios with positive cash flows in Year One (with East North Central having 55). While the magnitude of the respective Year One benefits unquestionably differed on a scenario-to-scenario basis, the extent to which there *were* benefits did not differ between these four Census Divisions.

Finally, Category 3 consists of the three southern Divisions (South Atlantic, East South Central, West South Central) and the two western Divisions (Mountain and Pacific). The extent to which there are positive Net Present Value scenarios from the 80 alternative scenarios ranged from a low of 51 (East South Central) to a high of 55 (South Atlantic).

Category 3 is less homogenous than the top two Categories, however. While the number of scenarios with large Year One cost savings over $100 was nearly identical in all five Divisions (split between 27 and 28 scenarios each), the comparisons begin to break down on other factors. For example, the number of scenarios with positive Year One cash flows saw one sub-category in the mid-40s of the mid-50s with positive life-cycle NPV benefits (Pacific=44 of 53; West South Central=45 of 53; South Atlantic=46 of 55) with the second sub-category falling to the mid-30s (East South Central=36 of 51; Pacific=36 of 53). Moreover, the effective interest rate discounts showed even greater dispersion, with 44 of the 80 Mountain scenarios having an effective discount of greater than one quarter point; the South Atlantic, West South Central and Pacific seeing discounts of that magnitude 38, 37 and 36 times respectively; and the East South Central seeing a quarter point discount in only 27 of the 80 alternative non-base-case scenarios.

One significant phenomenon that runs throughout all Divisions is the extent to which Scenarios that present life-cycle Net Present Value benefits do *not* necessarily involve positive cash flows in the first year. To discover the extent of this phenomenon, one need only compare the number of scenarios setting forth life-cycle NPV benefits with the number of scenarios with monthly cost reductions in Year One. As can be seen, even in the two Divisions where all 80 non-base-case scenarios generated life-cycle benefits, only somewhat less than two-thirds had positive cash flows in the first year (53 of 80).

The other Census Divisions showed somewhat lesser disparity between scenarios that had both positive life-cycle NPV benefits *and* positive cash flows in the first year. The Category 2 Divisions described above (Mid Atlantic and West North Central) saw roughly 75 percent of their life-cycle NPV benefits scenarios generate positive cash flows in Year One (53 of 71). The Category 3 Divisions saw from 68 percent (Pacific=36 of 53) to 85 percent (West South Central=45 of 53) of the life-cycle NPV scenarios start with Year One positive cash flows.

As is evident, the impact of energy efficiency measures on improving the affordability of homeownership has two components to it. On the

one hand, there is the immediate impact on affordability from Year One/Day One. On the other hand, there is the impact on affordability over the life of the energy efficiency measure. The two are not the same. And to conclude that negative Year One cash flows reveal a "bad deal" from an energy efficiency perspective can empirically be demonstrated to be wrong.

The Individual Census Divisions

In addition to looking at the summary data presented in Table 2, it is important to look at some of the lessons to be learned from a more detailed look at the data from individual census Divisions as presented in Appendix D. This discussion will concentrate its analysis on Divisions from the two opposite ends of the spectrum of results: the New England Division (where results were generally and substantially positive) and the East South Central Division (where results were less generally, and less substantially positive). The purpose of this analysis is to review what factors have a substantial impact on the outcome of whether, and to what extent, the implementation of energy efficiency measures will positively affect the affordability of the low-income housing in question.

New England Results:

The results of energy efficiency improvements in low-income New England housing are reviewed from two different perspectives. On the one hand, the results will be reviewed on a life-cycle basis. The cumulative Net Present Value benefits, as well as the effective discounts as discussed above, will be examined. On the other hand, the results will be reviewed on a Year One basis. This second level of analysis ignores the cumulative results over the life-cycle of the energy efficiency measures and looks only at what happens during the first year of the mortgage.

Life-Cycle Impacts: Amongst the 80 non-base-case scenarios, the highest Net Present Value savings involve savings to participating homeowners of from $5,000 to $6,000 in New England. The factor which has the single greatest influence on the magnitude of the NPV benefits is the interest rate charged on the mortgage.[82] Three different annual interest rates were studied in the various sensitivity runs: 8.5 percent, 9.0 percent, and 9.5 percent.[83] The eight scenarios with the highest NPV benefits[84] all had annual interest rates of 8.5 percent.[85]

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[82] As outlined above, the variables that were varied in the sensitivity runs included the energy price escalation, the interest rate on the mortgage, the discount rate, and the amount of the utility matching investment. *See* note **Error! Bookmark not defined.**, *supra*, and accompanying text.

[83] The base case scenario assumed a 9.00 percent annual interest rate.

[84] A band of eight scenarios was chosen since this represents the top decile.

While, not surprisingly, other factors contributed to the generation of significant total NPV benefits, no other single factor was universally present in the top decile of savings. Top tier savings were evenly distributed, for example, throughout alternative cases involving all three levels of energy escalation rates (6%, 6.5% and 7.0%). Moreover, while no top tier savings arose in scenarios involving six percent (6%) discount rates, the top decile of savings was evenly distributed between the four percent (n=5) and five percent (n=3) discount rates. Similarly, while no scenario with a utility match of 0.5x made the top decile of savings, some scenarios with an interest rate of 8.5% and a utility match of 1.0x made the top tier (n=2) while some scenarios with an interest rate of 8.5% and a utility match of 1.5x did not (n=3). The six percent discount rate, even when coupled with an interest rate of 8.5% and a utility match of 1.5x, was sufficient to drop total NPV savings below certain scenarios with the lower four percent (4%) discount rate. A summary of the relevant factors within the top tier of NPV savings is set forth below:

Number Non-Base Case Scenarios by Various Sensitivity Factors
New England: Top Decile of Life-Cycle NPV Savings

Escalation Rate			Interest Percent			Utility Match			Discount Rate		
6%	6.5%	7%	8.5%	9.0%	9.5%	0.5x	1.0x	1.5x	4%	5%	6%
2	3	3	8	0	0	0	2	6	5	3	0

This analysis is born out by expanding the examination of NPV benefits from the top decile to all non-base-case scenarios that generated benefits of $5,000 or more. A total of 13 of the 80 non-base-case scenarios resulted in life-cycle NPV benefits of more than $5,000. Of these results, all involved interest rates of 8.5 percent. The impact of escalation rates on this expanded "top tier" is shown. Of the five additional cases, two had escalation rates of 7 percent, two had escalation rates of 6.5 percent, and only one had an escalation rate of 6.0 percent. In contrast, the marginal impact of the utility match is less. Of the five additional scenarios, only two involved utility matches of 1.5x, while two involved matches of 1.0x, and one involved a match of 0.5x.

(..continued)

\85\ Stated another way, there were 27 scenarios which involved interest rates of 8.5 percent. Those 27 scenarios generated all eight scenarios in the top decile of total NPV benefits.

The opposite end of the spectrum of savings yielded similar results. All eight of the non-case-case scenarios with the lowest NPV benefits involved annual interest rates of 9.5 percent. Moreover, all eight involved utility matches of 0.5x. In contrast, the escalation rates for energy prices, as well as the discount rates, were evenly distributed over the bottom decile of NPV savings. The results for the bottom decile are set forth below:

Number Non-Base Case Scenarios by Various Sensitivity Factors New England: Bottom Decile of Life-Cycle NPV Savings											
Escalation Rate			Interest Percent			Utility Match			Discount Rate		
6%	6.5%	7%	8.5%	9.0%	9.5%	0.5x	1.0x	1.5x	4%	5%	6%
3	3	2	0	0	8	8	0	0	2	3	3

Again, the interest rate part of this analysis is born out by expanding the analysis to all non-base-case scenarios with a NPV savings of less than $1,000. There were 13 scenarios with savings in this range, all of which involved annual interest rates of 9.5 percent. Utility matches of 1.0x, however, began to have a significant presence, with four of the five new scenarios involving matches of 1.0x. The scenarios in this decile remained evenly distributed over the full range of escalation rates and discount rates.

There is not a total coincidence between the scenarios which yield the highest levels of NPV benefits in dollar terms and the scenarios which yield the highest effective discounts on the mortgage interest rates in percentage terms. While the overlap is substantial, as is to be expected, it is not complete. There are 13 scenarios, for example, in which the NPV benefits are equal to effective interest rate discounts of more than 1.0 percent.[\86\] This means, in other words, that if the mortgage interest rate is 8.5 percent, it would require an interest rate reduction to 7.5 percent or less to generate the same life-cycle NPV savings that the energy efficiency measures would generate.

Fully 25 percent (4 of 13) of the scenarios do not match between the range of non-base-case scenarios which result in the highest NPV benefits and the range of non-base-case scenarios which result in the highest effective discounts on the interest rates. What that means, of course, is that there are eight non-matching cases (4 in the top 13 NPV benefits which do not match the top 13 interest rate reductions and,

[\86\] An additional two scenarios have effective interest rate reductions of *exactly* 1.0 percent.

correspondingly, 4 in the top 13 interest rate reductions which do not match the top 13 NPV benefits).

The difference occurs in the discount rate. Each of the four NPV top tier scenarios that fall out of the top tier interest rate scenarios involve discount rates of four percent. In contrast, each of the four top tier interest rate scenarios which fall out of the top tier NPV scenarios involve discount rates of six percent. The other factors which cross-over --these include energy price escalation rates, interest rates (all of which are 8.5%), and the extent of the utility match-- are reasonably distributed throughout both groups.

The same impacts do not arise with the bottom tier. The 13 scenarios with the lowest NPV benefits also represent the 13 scenarios representing the smallest interest rate reductions. It is not clear why this lack of symmetry exists.

Year One Cash Flow Impacts: New England represents a good region in which to study the impacts of energy efficiency over time since, while positive life-cycle benefits arise in the base-case scenario plus all 80 alternative scenarios, not all scenarios have positive cash flows from Year One. There are some instances, in other words, where, while the energy efficiency savings start out negative, the projected escalation rates in energy prices will ultimately yield total NPV benefits over the life-cycle of the energy efficiency measures. Indeed, in New England, of the 80 non-case-case scenarios, 27 involve negative Year One cash flows.

There are three levels of negative Year One cash flows in New England. An interest rate of 8.5 percent yields, in some instances, a negative Year One cash flow of $8; an interest rate of 9.0 percent yields, in some instances, a negative Year One cash flow of $51; an interest rate of 9.5 percent yields, in some instances, a negative Year One cash flow of $94. Interest rates have an ascertainable impact on Year One cash flows, of course, because they are the only factor that varies between non-base-case scenarios in that year. Escalation rates, discount rates, and the like, will have no impact until Year Two.

Despite the Year One negative cash flows in some non-base-case scenarios, the NPV benefits over the 15 year life of the measures is positive in all 27 of these scenarios. The magnitude of these benefits varies substantially. The benefits, however, range up to more than $1,700. In fact, in 12 of the 27 scenarios, the NPV benefits exceed $1,200; in 14 scenarios, the NPV benefits exceed $1,000; and in 16 scenarios, the NPV benefits exceed $800.

The turn-around time in those situations where cash flows begin negative shows that an initial negative cash flow need not burden the household pursuing energy efficiency financing for long. Of the 27 scenarios with negative Year One cash flows, the cross-over to a positive cash flow occurred in Year 2 in nine cases, in Year 4 in nine case, in Year 6 in six cases, and in Year 7 in three cases.

	Year in Which Initial Cross-Over From Negative to Positive Cash Flow Occurs					
	2	3	4	5	6	7
Initial cross-over point	9	0	9	0	6	3

On a cumulative basis,[\87\] the cross-over points ranged from Year 2 to Year 13. Not surprisingly, the cross-over points directly corresponded with the magnitude of the negative cash flow in Year One of each scenario. The scenarios with $8 negative cash flows had both initial and cumulative cross-overs in Year 2. The scenarios with $51 negative cash flows had initial cross-over points in year 4 and cumulative cross-over points in Year 7 or Year 8. The Year One negative cash flows of $94 had later cross-over points.

	Year in Which Cumulative Cross-Over From Negative to Positive Cash Flow Occurs					
	2	7	8	11	12	13
Cumulative cross-over point	9	5	4	5	3	1

Both the existence and timing of the cross-overs should have significance for the structure of an energy efficiency program which is made part of an affordable housing program. The Year One negative cash flows of $8 are insubstantial enough, both in terms of magnitude and timing, to affect the decision of whether, or how, to structure the transaction. They should be treated as positive for purposes of program design and evaluation. The scenarios involving the $51 and $94 negative Year One cash flows should be addressed differently. One mechanism through which to address these cash flows is to capitalize the negative cash flow in the early years to be repaid during the subsequent years of greater savings. A second mechanism to address these negative cash flows during the early years is to postpone, in whole or part, repayment of the energy efficiency financing until later years. In this fashion, while overall costs would be greater due to the accrual of additional financing costs

\87\ Over time, the accumulation of the positive cash flows will equal and then exceed the accumulation of previous negative cash flows. The point at which this happens is what has been labelled the "cumulative" cross-over point.

on the unpaid balance, the stream of repayments would more closely match the stream of savings from the energy efficiency measures.\88\

East South Central Results:

Like in New England, there is a need to examine the non-base-case scenarios for the East South Central Division from two different perspectives: (1) a life-cycle perspective; and (2) a Year One perspective. Unquestionably, the East South Central results are less positive than in New England. While in New England, all 80 non-base-case scenarios ultimately yielded positive life-cycle benefits, in the East South Central Division, only 51 of the 80 did. While in New England, 27 non-base-case scenarios had negative Year One cash flows, in the East South Central Division, 44 did.\89\ While in New England, the largest negative Year One cash flow was $94, in the East South Central Division, the largest negative cash flow in Year One was $237 (with the next largest being $197).

The East South Central Division fares more poorly not simply when compared to New England, however. It fares more poorly than the rest of the country generally. This is the Division that has the largest number of negative Year One cash flow scenarios, the smallest number of life-cycle NPV benefit scenarios, and the smallest number of scenarios with significant effective interest rate discounts, purchase price discounts, or foregone utility bills. The issue to be discussed below, therefore, is "why." Can we determine what it is about the East South Central Division that yields these less favorable results?

In structuring the inquiry in this fashion, however, one must not lose sight of the fact that the results for even the East South Central Division were largely favorable. Of the 80 non-base-case scenarios, 51 generated positive NPV life-cycle benefits. Moreover, nearly 40 percent of these non-base-case scenarios generated significant effective savings off the interest rate, purchase price, or utility bills foregone.\90\ On a life-

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\88\ These types of financing techniques are not uncommon in other circumstances. A description of such financing mechanisms can be found in R.Colton, ***Third Party Financing of Low-Income Conservation: Replacing Reliance on Government and Utility Funds*** (July 1992). Such debt instruments are sometimes known as "near equity." "Debt instruments can be made to appear more like equity investments through a variety of mechanisms. The debt may include a moratorium on the payment of principal or interest during the early years of the loan so that the enterprise has an opportunity to become established and to start generating sufficient revenues to guarantee its long-term survival. The debt may involve an actual forgiveness of interest during these early days, or it may simply tie the level of interest to the level of profit for the enterprise." *Id.*, at 8 - 9.

\89\ Since 44 non-base-case scenarios had negative Year One cash flows, but only 29 had life-cycle negative benefits, it is clear that in 15 East South Central scenarios, cash flows began as negative but experienced cross-over points as discussed above.

\90\ In this sense, "significant" was defined as an effective discount off of the purchase price of 10 percent or more, an effective discount off the interest rate of one-quarter point or more, or at least 1.0 foregone utility bills per year.

cycle basis for the East South Central Division, the top decile of NPV benefit non-base-case scenarios (n=8) provides substantial financial advantage. The maximum benefit exceeds $3,000, ranging down to $2,600. Moreover, even outside the top decile, there is not a rapid falloff in NPV benefits. Overall, 22 of the 80 non-base-case scenarios in the East South Central Division yielded life-cycle benefits exceeding $2,000, while 11 yielded benefits of roughly $2,500 or more.

Nonetheless, at the other end of the spectrum, the life-cycle *negative* cash flows were of a somewhat, but not substantially, smaller magnitude. The largest negative life-cycle cash flow was over $2,000 ($2,053), with the bottom decile of NPV benefits ranging down to a negative cash flow of $1,789. There were 12 non-base-case scenarios with negative cash flows of $1,500 or more, and 23 with negative cash flows of $1,000 or more. We turn now to a discussion of what factors affect these numbers.

Changes in Energy Prices: Due to the smaller energy bills in the East South Central Division, and the smaller rate of savings generated by the energy efficiency investments (12 percent vs. either 15 or 18 percent elsewhere), changes in the price of energy do not generate substantial additional benefits over the life of an energy efficiency measure. As a result, if Year One benefits are small, they do not become bigger with any speed over time. Moreover, if Year One benefits are negative, they do not become positive with any speed, let alone substantially enough positive to yield a cumulative cross-over point within the life-cycle of the energy efficiency measure.

It is possible to illustrate the extent to which the small energy bill combined with the lower rate of savings make a difference by comparing the New England (18 percent savings; second highest Year One energy bill) and East South Central Divisions. This comparison looks at the change in bottom line results as the energy escalation rate is incrementally changed leaving everything else constant. It is possible to look at a scenario that is neither particularly favorable nor particularly detrimental from a NPV perspective. This scenario is then studied by changing, one step at a time, the factor which involves only the energy price escalation rate. The beginning scenario for this analysis is the 8.5/7.0/1.5 scenario, a scenario that provides the greatest escalation in energy prices over time (and thus the most positive impact on NPV benefits).[\91\] Given these factors, along with a discount rate of 4.0 percent, we find the NPV benefits for New England and East South Central to be $1,713 and ($986) respectively.

This analysis then adjusts the energy price escalation factor downward incrementally to allow an examination of how changes will affect both the dollar magnitude of savings and the percentage of projected savings. The purpose, again, is to look at the difference between Divisions in the rate of change as the factor is adjusted. The results are as follows:

[\91\] The interest rate is 8.5 percent. The energy price escalation is 7.0 percent. The utility matching grant is 1.5x.

Changes in NPV Benefits as Energy Price Escalation Changes							
Scenario	Scenario No.	New England			East South Central		
		NPV $$$	$$$ Change	Pct Dollar Change	NPV $$$	$$$ Change	Pct $$$ Change
8.5/7.0/1.5	26	$1713	---	---	($986)	---	---
8.5/6.5/1.5	14	$1546	$167	9.8%	($1060)	($74)	7.5%
8.5/6.0/1.5	20	$1387	$326	19.0%	($1132)	($146)	14.8%

As can be seen, the postulated result in fact occurred. The identical change in the energy price escalation factor yields a change for New England that is bigger both in terms of absolute dollars and in terms of percentage variations. Not only is the dollar change more than twice as great in New England as in East South Central, but the percentage change is roughly 25 percent greater as well. Accordingly, if the Year One benefits in the East South Central start small, they will more likely stay small; if they start negative, they will less likely become positive and, if they do, they will less likely become substantially positive.

The result of smaller incremental changes attributable to energy price escalations, of course, is not entirely an adverse phenomenon. For the East South Central Division, the significance in this lack of variability lies in the stability, or robustness, of the NPV savings projected to arise in the energy efficiency scenarios. While the total NPV savings may be less overall in the East South Central than in the New England Division, these savings are less likely to vary substantially with changes in external factors such as energy prices. There will not, in other words, be the potential for savings to unexpectedly or suddenly, disappear if prices moderate. What is predicted as a NPV benefit in East South Central is more likely to occur in fact than in New England.

Year One NPV Savings: Given the discovery that energy price escalations over time do not affect life-cycle benefits in East South Central as they do in New England, the next inquiry is into to what extent changing a factor which influences the Year One cash flow also affects life-cycle benefits. The factor chosen for analysis is the amount of the utility matching grant.

In contrast to the relative stability generated by changes in energy price escalations, changes in the amount of the utility matching grant toward

the energy efficiency measure does, indeed, significantly affect the life-cycle NPV benefits. As in the analysis above, we start with one scenario and then change the factor to be considered one step at a time, leaving everything else constant. The impacts which result are particularly pronounced in the East South Central Division. The Table below shows that although the absolute dollar magnitude of the change in contribution will be roughly the same as between the New England and East South Central Divisions, because of the lower initial bills and lesser projected annual savings rate in East South Central, the *percentage* difference in the East South Central Division is much more significant.

Scenario	Scenario No.	New England			East South Central		
		NPV $$$	$$$ Change	Pct Dollar Change	NPV $$$	$$$ Change	Pct $$$ Change
8.5/7.0/1.5	26	$1713	---	---	($986)	---	---
8.5/7.0/1.0	8	$1217	$496	29.0%	($1446)	($460)	46.7%
8.5/7.0/0.5	23	$722	$981	57.3%	(1907)	($921)	93.4%

As can be seen from this data, each decrease in a 0.5x match will generate roughly a loss of $460 - $500 in life-cycle NPV benefits for both New England and East South Central. As between the two regions, neither the single step (0.5x) nor cumulative loss of benefits differs substantially ($460 vs. $496 and $921 vs. $981 respectively), However, the smaller dollar amount in the East South Central Division represented a far larger proportion of the beginning set of NPV benefits. While the move from a 1.5x to a 0.5x match nearly doubled the losses in East South Central, it "only" decreased benefits in New England by 57 percent.

From this analysis, we can conclude that significant improvement in life-cycle benefits can be generated by relatively modest contributions toward offsetting the initial price of the energy efficiency measure.[\92\] Such an offset positively affects the amount of the Year One savings, which carries through to the ultimate accrual of life-cycle benefits.

[\92\] The source of revenue for this contribution is irrelevant. It could be an additional utility contribution, as postulated in this analysis. The additional funds could alternatively come from Weatherization Assistance Program (WAP) dollars, from Community Development Block Grant (CDBG) dollars, or from other sources, as well.

Cumulative variability amongst the scenarios: Having identified some of the that do and do not contribute to changes in the life-cycle benefits arising from energy efficiency, the last step in the analysis is to determine the extent to which the life-cycle NPV savings might vary from an average scenario. Two different measures of this variability are used here. The first examines the *maximum* change from the Base Case scenario, both positive and negative. The second considers all 81 scenarios, including the Base Case with the non-base-case, to assess the extent to which, if at all, there is more or less of a dispersion between the opposite ends of the continuum of results.

Consistent with the findings above, the East South Central Division strays less (either positive or negative) from the Base Case Scenario than does the New England Division. The actual difference between Divisions, however, is surprisingly small. The Base Case Scenario yields a positive life-cycle NPV benefit of $517 in the East South Central Division. Under the most ideal circumstances,[\93\] these NPV benefits increase to $3,023. In contrast, under the worst of circumstances,[\94\] the NPV "benefits" yield a *negative* cash flow of $2,053. This $2,500 band around the East South Central Base Case[\95\] does not differ to any great degree from the band around the New England Base Case scenario.

In New England, the Base Case NPV life-cycle benefits reached $3,231. The maximum benefits,[\96\] however, were $6,001 while the minimum NPV benefits --New England differs from East South Central in that even the minimum is positive-- fell to $260.[\97\] The similarity in the maximum gain in benefits ($2,500 for East South Central vs. $2,800 for New England), as well as in the maximum loss of benefits ($2,600 for East South Central vs. $3,000 for New England) indicates a similar degree of overall security for the various Divisions. The conclusion is that it is the *starting point*, and not the variation which occurs over time, which is the important factor to look at in deciding what the ultimate life-cycle NPV savings will be.

To explain this last conclusion further, one can examine the *bands* of variability around the norm. This examination provides information as to

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\93\ This is Scenario 17, involving an energy escalation rate of 6.0 percent, an interest rate of 8.5 percent, and a utility match of 0.5x.

\94\ This is scenario 25, involving an energy escalation rate of 7.0 percent, an interest rate of 9.0 percent, and a utility matching contribution of 1.5x.

\95\ The increase in benefits from $517 to $3,023 is a difference of $2,506. The decrease in life-cycle benefits from $517 to $2,053 is a difference of $2,570.

\96\ This was scenario 25, involving an energy escalation rate of 7.0 percent, an interest rate of 9.0 percent, and a utility matching contribution of 1.5x.

\97\ This is scenario 11, involving an energy escalation rate of 6.5 percent, an interest rate of 8.5 percent, and a utility matching contribution of 0.5x.

the uncertainty which inheres in the various scenarios. Again, New England and East South Central, the two Divisions at the opposite ends of the continuum of life-cycle benefits, show remarkable consistency in their variability. While 25 scenarios in the East South Central Division had NPV life-cycle benefits within $500 of the mid-point (12 with benefits greater and 13 with benefits lesser), 18 scenarios in the New England Division fell within a similar band (9 each greater and lesser).[98] In *both* cases, the number of scenarios showing little variability from the norm was substantial.

The tightness in the middle groupings is significant because that is where the variability in factors that are indeterminate lie. The data show, in other words, that the most substantial variations from the Base Case arise as a result of determinate variables. These variables --they include, for example, the amount of the utility match, the interest rate on the mortgage, and the like-- are known at the time the deal is consummated. Thus, while a different scenario involving different choices might make a large difference in life-cycle NPV benefits, the factor will not change once a choice is made. For example, a 9.5 percent interest rate rather than an 8.5 percent interest rate will substantially affect the magnitude of the life-cycle benefits. Once the mortgage is entered into, however, the interest rate will not change. Accordingly, while there may be substantial differences between scenarios, there is no uncertainty with*in* a scenario.

In contrast, the data show also that the scenarios that involve factors that cannot be "chosen," such as energy price escalation, do not generate substantial variability in the ultimate level of life-cycle benefits. Of the non-base-case scenarios around the mid-point in each Division,[99] there was an almost totally even distribution of the energy escalation factors. This even distribution did not occur for other factors.[100]

Each of these observations lends support to the conclusion that if one can affect the level of the initial Year One savings in an energy efficiency measure, one can affect the ultimate level of NPV benefits.

SUMMARY AND MAJOR FINDINGS

Several major conclusions flow from the quantitative analysis set forth above. The conclusions lead to the ultimate finding that utilities

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[98] For purposes of this analysis, the term "similar" means within $500 of the mid-point.

[99] The same factors resulted in the same distributions around the mid-point in the two Divisions. Thus, in other words, all 19 scenarios that were within the band around the mid-point for New England were also within the band around the mid-point for East South Central.

[100] The one exception is the discount rate, which tracked the energy escalation factors.

interested in reaching low-income customers should aggressively seek out housing programs directed toward low- and moderate-income households. Conversely, developers, service providers and financiers of low- and moderate-income housing should aggressively seek out utility-financing for increased energy efficiency in their developments.

Energy efficiency improvements in low- and moderate-income housing will significantly reduce the cost of housing, improve the overall affordability of the units being developed, enhance the creditworthiness of the households who are responsible for repayment of loans, and thus reduce the risk associated with the overall mortgage. Indeed, these results arise even when the capital cost is increased due to the need to finance some increment of the energy efficiency improvement not covered by the utility contribution.

Energy efficiency improvements generate significant life-cycle benefits for every region of the country. These benefits arise even when differences in rates of energy savings, differences in energy prices, differences in housing prices, and the like, are taken into consideration. While, obviously, not all regions realize the same amount of savings, no region goes without positive life-cycle benefits.

Despite this finding, however, there must be a recognition that there are two components to housing affordability as affected by energy efficiency investments. On the one hand, there are life-cycle benefits, benefits that arise over the life of the energy efficiency measure. On the other hand, there are year-by-year cash flows. Some geographic regions of the country will not generate Year One positive cash flows because of energy efficiency investments. Indeed, in two of the nine geographic areas studied, there were negative Year One cash flows. However, even in those two areas, the subsequent benefits were sufficiently high to offset the early year losses and result in life-cycle net present value benefits. Programs that require positive cash flows from Year One inappropriately exclude cost-effective investments in energy efficiency measures, investments that will over time, reduce the overall cost of housing on a net present value basis.

The benefits which arise from the installation of energy efficiency measures can be equated to other means of reducing housing costs to participants in low- and moderate-income housing programs. Depending on the geographic region of the country, energy efficiency measures will have the same effect as reducing the initial purchase price of the home by 1.5 to nearly eight percent. Similarly, again depending on the geographic region of the country, energy efficiency measures will have the same effect as reducing the interest rate on the mortgage by 11 to 60 basis points. What this means, in other words, is that to generate the same life-cycle savings as the installation of energy efficiency measures, a household who is paying 9.5 percent interest would need to obtain a mortgage at 8.9 percent interest instead. Similarly, to generate the same life-cycle savings as the installation of energy efficiency measures, a household who is purchasing a home for $30,000 would need to obtain a discount on that purchase price to $27,600.

Not surprisingly, the level of NPV benefits associated with energy efficiency measures are sensitive to changes in a variety of factors, including energy price escalations, interest rates, initial cash payments toward the energy efficiency measure, discount rates, and the like. What *is* surprising, however, is that there is little variability in NPV savings that cannot be controlled. The factors which may change over time without notice, such as energy price escalation rates, have very little effect on the ultimate NPV benefits to be experienced. In contrast, the factors that have substantial impacts are those that can be decided at the time of the initial investment, including how much of the total price of the energy efficiency investment is to be paid in cash and how much is to be financed, what the interest rate is going to be, and so on.

Moreover, the variation over time between geographic regions is very small. The differences which exist between the New England and East South Central Divisions, in other words, exist from Year One. They can, therefore, be recognized and controlled. The differences between geographic areas will not develop over time.

In sum, there are innumerable housing programs which would benefit from the development of aggressive partnerships with utility energy efficiency endeavors. Some of these programs involve public and private development of new construction or substantial and moderate rehabilitation of existing housing for low- and moderate-income households. Some of these programs involve efforts to facilitate first-time homeownership, such as those efforts advanced through Mortgage Revenue Bonds. Some of these programs seek to advance affordable housing through the disposition of defaulted and foreclosed single and multi-family homes. In each of these instances, involving hundreds of thousands of units around the country each year, the pursuit of a joint housing/utility undertaking would result in mutual benefits to the institutions, and substantial benefits to the affected homeowner or tenant.

Table 1: Base Case Results										
Census Division	Yes/No on Base Case Scenario ("+" = yes/"-" = no)						Effective Reduction in Home Price	Total Life-cycle NPV Savings	Total Interest Break (x%)	No. of Energy Bills Reduced
	Life-cycle NPV?	Year 1 Annual Cost Reduction > $100	Avg Bill Savings > 1.0x	Effective Discount on Principal > 5%	Interest break > 0.25%	Monthly cost reduction in Year 1				
NE	+	+	+	+	+	+	7.6%	$3,231	0.59%	1.8x
MA	+	-	+	+	+	+	5.9%	$2,491	0.45%	1.3x
SA	+	-	-	-	-	+	2.8%	$1,106	0.22%	0.7x
ESC	+	-	-	-	-	-	1.3%	$517	0.11%	0.4x
WSC	+	-	-	-	-	+	2.7%	$1064	0.21%	0.7x
ENC	+	+	+	+	+	+	7.1%	$2,781	0.54%	1.7x
WNC	+	-	+	+	+	+	6.0%	$2,350	0.48%	1.6x
MTN	+	-	+	-	+	+	3.6%	$1,494	0.30%	1.1x
PAC	+	-	-	-	-	-	1.9%	$779	0.17%	0.7x
Total +'s	9	2	5	4	5	7	n/a	n/a	n/a	n/a

Table 2: Non-Base-Case Results (80 total)							
Census Division	Number of Scenarios with Yes Results for 80 non-base-case alternative scenarios						
	Lifecycle NPV	Year 1 Annual Cost Reduction > $100	Annual Bills Savings > 1.0x	Effective Discount on Principal > 5%	Interest break > 0.25%	Monthly Cost Reduction in Year 1	Lifecycle NPV > Base Case
NE	80	44	53	53	60	53	35
MA	71	36	52	44	53	53	36
SA	55	27	29	27	38	46	37
ESC	51	27	27	22	27	36	37
WSC	53	28	28	27	36	45	37
ENC	80	45	53	53	57	55	35
WNC	72	36	53	46	53	53	36
MTN	53	27	44	28	44	44	37
PAC	53	27	36	26	37	36	37

Appendix A: Inputs for Each Census Division									
	New England	Mid-Atlantic	South Atlantic	East South Central	West South Central	East North Central	West North Central	Mountain	Pacific
Home size	1,179	1,504	1,216	1,157	1,231	1,583	1,389	1,179	971
Sales price	$42,537	$42,537	$39,559	$39,559	$39,559	$39,334	$39,334	$41,076	$41,076
Downpayment	$1,276	$1,276	$1,187	$1,187	$1,187	$1,180	$1,180	$1,232	$1,232
Mortgage	$41,261	$41,261	$38,372	$38,372	$38,372	$38,154	$38,154	$39,844	$39,844
Interest	9%	9%	9%	9%	9%	9%	9%	9%	9%
Energy use (mmBtu) for home size	96.5	104.5	59.6	64.3	75.4	117.9	99.7	87.6	52.7
Energy price ($/mmBtu)	$11.90	$11.10	$16.60	$12.00	$12.90	$9.10	$9.70	$10.10	$12.80
Energy efficiency reduction	18%	15%	12%	12%	12%	18%	18%	15%	15%
Energy Price Escalator	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
Discount Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Life of energy efficiency measure	15	15	15	15	15	15	15	15	15
Year 1 Energy Bill	$1,477	$1,492	$1,272	$993	$1,252	$1,380	$1,244	$1,139	$868

Appendix B: Sensitivity Run Variables						
Scenario	Escalation Rate	Interest Rate	Downpayment	Discount Rate	Utility Match	Useful Life (Years)
Base	6.5	9.0	3	4	1x	15
2	6.5	8.5	3	4	1x	15
3	6.5	9.5	3	4	1x	15
4	6.0	9.0	3	4	1x	15
5	6.0	8.5	3	4	1x	15
6	6.0	9.5	3	4	1x	15
7	7.0	9.0	3	4	1x	15
8	7.0	8.5	3	4	1x	15
9	7.0	9.5	3	4	1x	15
10	6.5	9.0	3	4	0.5x	15
11	6.5	8.5	3	4	0.5x	15
12	6.5	9.5	3	4	0.5x	15
13	6.5	9.0	3	4	1.5x	15
14	6.5	8.5	3	4	1.5x	15
15	6.5	9.5	3	4	1.5x	15
16	6.0	9.0	3	4	0.5x	15
17	6.0	8.5	3	4	0.5x	15
18	6.0	9.5	3	4	0.5x	15
19	6.0	9.0	3	4	1.5x	15
20	6.0	8.5	3	4	1.5x	15
21	6.0	9.5	3	4	1.5x	15

Appendix B: Sensitivity Run Variables						
Scenario	Escalation Rate	Interest Rate	Downpayment	Discount Rate	Utility Match	Useful Life (Years)
22	7.0	9.0	3	4	0.5x	15
23	7.0	8.5	3	4	0.5x	15
24	7.0	9.5	3	4	0.5x	15
25	7.0	9.0	3	4	1.5x	15
26	7.0	8.5	3	4	1.5x	15
27	7.0	9.5	3	4	1.5x	15
Second set of calculations: Same variables but discount rate equals five percent (5%) Third set of calculations: Same variables but discount rate equals six percent (6%)						

Appendix C
Base Case Scenario Results: New England Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$4,140	$1,477	$5,617	$4,267	$1,211	$5,478	$139	$139	$139
2	1995	$4,140	$1,573	$5,713	$4,267	$1,290	$5,557	$157	$150	$289
3	1996	$4,140	$1,675	$5,815	$4,267	$1,374	$5,641	$175	$161	$450
4	1997	$4,140	$1,784	$5,924	$4,267	$1,463	$5,730	$195	$172	$622
5	1998	$4,140	$1,900	$6,040	$4,267	$1,558	$5,825	$216	$183	$805
6	1999	$4,140	$2,024	$6,164	$4,267	$1,659	$5,926	$238	$194	$999
7	2000	$4,140	$2,155	$6,295	$4,267	$1,767	$6,034	$262	$205	$1,204
8	2001	$4,140	$2,295	$6,435	$4,267	$1,882	$6,149	$287	$215	$1,419
9	2002	$4,140	$2,444	$6,584	$4,267	$2,004	$6,271	$314	$226	$1,645
10	2003	$4,140	$2,603	$6,743	$4,267	$2,135	$6,402	$342	$237	$1,882
11	2004	$4,140	$2,773	$6,913	$4,267	$2,273	$6,540	$373	$248	$2,130
12	2005	$4,140	$2,953	$7,093	$4,267	$2,421	$6,688	$405	$259	$2,389
13	2006	$4,140	$3,145	$7,285	$4,267	$2,579	$6,846	$440	$269	$2,658
14	2007	$4,140	$3,349	$7,489	$4,267	$2,746	$7,013	$476	$280	$2,938
15	2008	$4,140	$3,567	$7,707	$4,267	$2,925	$7,192	$516	$291	$3,229

Appendix C
Base Case Scenario Results: Mid-Atlantic Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$4,140	$1,492	$5,632	$4,267	$1,268	$5,535	$97	$97	$97
2	1995	$4,140	$1,589	$5,729	$4,267	$1,351	$5,618	$112	$107	$204
3	1996	$4,140	$1,692	$5,832	$4,267	$1,438	$5,705	$127	$117	$321
4	1997	$4,140	$1,802	$5,942	$4,267	$1,532	$5,799	$144	$127	$448
5	1998	$4,140	$1,919	$6,059	$4,267	$1,631	$5,898	$162	$137	$585
6	1999	$4,140	$2,044	$6,184	$4,267	$1,738	$6,005	$180	$147	$732
7	2000	$4,140	$2,177	$6,317	$4,267	$1,850	$6,117	$200	$157	$889
8	2001	$4,140	$2,319	$6,459	$4,267	$1,971	$6,238	$221	$166	$1,055
9	2002	$4,140	$2,469	$6,609	$4,267	$2,099	$6,366	$244	$176	$1,231
10	2003	$4,140	$2,630	$6,770	$4,267	$2,235	$6,502	$268	$186	$1,417
11	2004	$4,140	$2,801	$6,941	$4,267	$2,381	$6,648	$294	$195	$1,612
12	2005	$4,140	$2,983	$7,123	$4,267	$2,535	$6,802	$321	$205	$1,817
13	2006	$4,140	$3,177	$7,317	$4,267	$2,700	$6,967	$350	$215	$2,032
14	2007	$4,140	$3,383	$7,523	$4,267	$2,876	$7,143	$381	$224	$2,256
15	2008	$4,140	$3,603	$7,743	$4,267	$3,063	$7,330	$414	$234	$2,490

Appendix C
Base Case Scenario Results: South Atlantic Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$3,851	$1,272	$5,123	$3,989	$1,119	$5,108	$15	$15	$15
2	1995	$3,851	$1,355	$5,206	$3,989	$1,192	$5,181	$25	$24	$39
3	1996	$3,851	$1,443	$5,294	$3,989	$1,270	$5,259	$35	$32	$71
4	1997	$3,851	$1,537	$5,388	$3,989	$1,352	$5,341	$46	$41	$112
5	1998	$3,851	$1,636	$5,487	$3,989	$1,440	$5,429	$58	$50	$162
6	1999	$3,851	$1,743	$5,594	$3,989	$1,534	$5,523	$71	$58	$220
7	2000	$3,851	$1,856	$5,707	$3,989	$1,633	$5,622	$85	$66	$286
8	2001	$3,851	$1,977	$5,828	$3,989	$1,739	$5,728	$99	$75	$361
9	2002	$3,851	$2,105	$5,956	$3,989	$1,853	$5,842	$115	$83	$444
10	2003	$3,851	$2,242	$6,093	$3,989	$1,973	$5,962	$131	$91	$535
11	2004	$3,851	$2,388	$6,239	$3,989	$2,101	$6,090	$149	$99	$634
12	2005	$3,851	$2,543	$6,394	$3,989	$2,238	$6,227	$167	$107	$741
13	2006	$3,851	$2,708	$6,559	$3,989	$2,383	$6,372	$187	$115	$856
14	2007	$3,851	$2,884	$6,735	$3,989	$2,538	$6,527	$208	$122	$978
15	2008	$3,851	$3,072	$6,923	$3,989	$2,703	$6,692	$231	$130	$1,108

Appendix C
Base Case Scenario Results: East South Central Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$3,851	$993	$4,844	$3,989	$874	$4,863	($19)	($19)	$(19)
2	1995	$3,851	$1,058	$4,909	$3,989	$931	$4,920	($11)	($11)	$(30)
3	1996	$3,851	$1,126	$4,977	$3,989	$991	$4,980	($3)	($3)	$(33)
4	1997	$3,851	$1,199	$5,050	$3,989	$1,056	$5,045	$6	$5	$(28)
5	1998	$3,851	$1,277	$5,128	$3,989	$1,124	$5,113	$15	$13	$(15)
6	1999	$3,851	$1,360	$5,211	$3,989	$1,197	$5,186	$25	$21	$6
7	2000	$3,851	$1,449	$5,300	$3,989	$1,275	$5,264	$36	$28	$34
8	2001	$3,851	$1,543	$5,394	$3,989	$1,358	$5,347	$47	$35	$69
9	2002	$3,851	$1,643	$5,494	$3,989	$1,446	$5,435	$59	$43	$112
10	2003	$3,851	$1,750	$5,601	$3,989	$1,540	$5,529	$72	$50	$162
11	2004	$3,851	$1,864	$5,715	$3,989	$1,640	$5,629	$86	$57	$219
12	2005	$3,851	$1,985	$5,836	$3,989	$1,747	$5,736	$100	$64	$283
13	2006	$3,851	$2,114	$5,965	$3,989	$1,860	$5,849	$116	$71	$354
14	2007	$3,851	$2,252	$6,103	$3,989	$1,981	$5,970	$132	$78	$432
15	2008	$3,851	$2,398	$6,249	$3,989	$2,110	$6,099	$150	$85	$517

Appendix C
Base Case Scenario Results: West South Central Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$3,851	$1,252	$5,103	$3,989	$1,102	$5,091	$12	$12	$12
2	1995	$3,851	$1,333	$5,184	$3,989	$1,173	$5,162	$22	$21	$33
3	1996	$3,851	$1,420	$5,271	$3,989	$1,250	$5,239	$32	$30	$63
4	1997	$3,851	$1,512	$5,363	$3,989	$1,331	$5,320	$43	$38	$101
5	1998	$3,851	$1,611	$5,462	$3,989	$1,417	$5,406	$55	$47	$148
6	1999	$3,851	$1,715	$5,566	$3,989	$1,510	$5,499	$68	$55	$203
7	2000	$3,851	$1,827	$5,678	$3,989	$1,608	$5,597	$81	$64	$267
8	2001	$3,851	$1,946	$5,797	$3,989	$1,712	$5,701	$95	$72	$339
9	2002	$3,851	$2,072	$5,923	$3,989	$1,823	$5,812	$111	$80	$419
10	2003	$3,851	$2,207	$6,058	$3,989	$1,942	$5,931	$127	$88	$507
11	2004	$3,851	$2,350	$6,201	$3,989	$2,068	$6,057	$144	$96	$603
12	2005	$3,851	$2,503	$6,354	$3,989	$2,203	$6,192	$162	$104	$707
13	2006	$3,851	$2,666	$6,517	$3,989	$2,346	$6,335	$182	$111	$818
14	2007	$3,851	$2,839	$6,690	$3,989	$2,498	$6,487	$203	$119	$937
15	2008	$3,851	$3,023	$6,874	$3,989	$2,661	$6,650	$225	$127	$1,064

Appendix C
Base Case Scenario Results: East North Central Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$3,829	$1,380	$5,209	$3,967	$1,132	$5,099	$110	$110	$110
2	1995	$3,829	$1,470	$5,299	$3,967	$1,205	$5,172	$126	$121	$231
3	1996	$3,829	$1,565	$5,394	$3,967	$1,283	$5,250	$143	$132	$363
4	1997	$3,829	$1,667	$5,496	$3,967	$1,367	$5,334	$161	$143	$506
5	1998	$3,829	$1,775	$5,604	$3,967	$1,456	$5,423	$181	$153	$659
6	1999	$3,829	$1,891	$5,720	$3,967	$1,550	$5,517	$201	$164	$823
7	2000	$3,829	$2,014	$5,843	$3,967	$1,651	$5,618	$224	$175	$998
8	2001	$3,829	$2,145	$5,974	$3,967	$1,758	$5,725	$247	$186	$1,184
9	2002	$3,829	$2,284	$6,113	$3,967	$1,873	$5,840	$272	$196	$1,380
10	2003	$3,829	$2,432	$6,261	$3,967	$1,995	$5,962	$299	$207	$1,587
11	2004	$3,829	$2,590	$6,419	$3,967	$2,124	$6,091	$327	$218	$1,805
12	2005	$3,829	$2,759	$6,588	$3,967	$2,262	$6,229	$358	$228	$2,033
13	2006	$3,829	$2,938	$6,767	$3,967	$2,409	$6,376	$390	$239	$2,272
14	2007	$3,829	$3,129	$6,958	$3,967	$2,566	$6,533	$424	$250	$2,522
15	2008	$3,829	$3,333	$7,162	$3,967	$2,733	$6,700	$461	$260	$2,782

Appendix C
Base Case Scenario Results: West North Central Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$3,829	$1,244	$5,073	$3,967	$1,020	$4,987	$85	$85	$85
2	1995	$3,829	$1,325	$5,154	$3,967	$1,086	$5,053	$100	$96	$181
3	1996	$3,829	$1,411	$5,240	$3,967	$1,157	$5,124	$115	$106	$287
4	1997	$3,829	$1,503	$5,332	$3,967	$1,232	$5,199	$132	$116	$403
5	1998	$3,829	$1,600	$5,429	$3,967	$1,312	$5,279	$149	$127	$530
6	1999	$3,829	$1,704	$5,533	$3,967	$1,398	$5,365	$168	$137	$667
7	2000	$3,829	$1,815	$5,644	$3,967	$1,488	$5,455	$188	$147	$814
8	2001	$3,829	$1,933	$5,762	$3,967	$1,585	$5,552	$209	$157	$971
9	2002	$3,829	$2,059	$5,888	$3,967	$1,688	$5,655	$232	$167	$1,138
10	2003	$3,829	$2,193	$6,022	$3,967	$1,798	$5,765	$256	$177	$1,315
11	2004	$3,829	$2,335	$6,164	$3,967	$1,915	$5,882	$281	$187	$1,502
12	2005	$3,829	$2,487	$6,316	$3,967	$2,039	$6,006	$309	$197	$1,699
13	2006	$3,829	$2,649	$6,478	$3,967	$2,172	$6,139	$338	$207	$1,906
14	2007	$3,829	$2,821	$6,650	$3,967	$2,313	$6,280	$369	$217	$2,123
15	2008	$3,829	$3,004	$6,833	$3,967	$2,463	$6,430	$402	$227	$2,350

Appendix C
Base Case Scenario Results: Mountain Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$3,998	$1,139	$5,137	$4,130	$968	$5,098	$39	$39	$39
2	1995	$3,998	$1,213	$5,211	$4,130	$1,031	$5,161	$50	$48	$87
3	1996	$3,998	$1,292	$5,290	$4,130	$1,098	$5,228	$62	$57	$144
4	1997	$3,998	$1,376	$5,374	$4,130	$1,169	$5,299	$74	$66	$210
5	1998	$3,998	$1,465	$5,463	$4,130	$1,245	$5,375	$88	$74	$284
6	1999	$3,998	$1,561	$5,559	$4,130	$1,326	$5,456	$102	$83	$367
7	2000	$3,998	$1,662	$5,660	$4,130	$1,413	$5,543	$117	$92	$459
8	2001	$3,998	$1,770	$5,768	$4,130	$1,504	$5,634	$133	$100	$559
9	2002	$3,998	$1,885	$5,883	$4,130	$1,602	$5,732	$151	$109	$668
10	2003	$3,998	$2,008	$6,006	$4,130	$1,706	$5,836	$169	$117	$785
11	2004	$3,998	$2,138	$6,136	$4,130	$1,817	$5,947	$189	$125	$910
12	2005	$3,998	$2,277	$6,275	$4,130	$1,935	$6,065	$209	$134	$1,044
13	2006	$3,998	$2,425	$6,423	$4,130	$2,061	$6,191	$232	$142	$1,186
14	2007	$3,998	$2,583	$6,581	$4,130	$2,195	$6,325	$255	$150	$1,336
15	2008	$3,998	$2,751	$6,749	$4,130	$2,338	$6,468	$280	$158	$1,494

Appendix C
Base Case Scenario Results: Pacific Census Division

		A	B	C	D	E	F	G	H	I
		Without Energy Efficiency			With Energy Efficiency			Total Nominal Savings/(Cost)	Discounted Savings	
		Mortgage Payment	Energy Payment	Mortgage plus Energy	Mortgage Payment	Energy Payment	Mortgage plus Energy		Annual	Aggregate
1	1994	$3,998	$868	$4,866	$4,130	$738	$4,868	($2)	($2)	$(2)
2	1995	$3,998	$924	$4,922	$4,130	$786	$4,916	$7	$6	$4
3	1996	$3,998	$985	$4,983	$4,130	$837	$4,967	$16	$14	$18
4	1997	$3,998	$1,049	$5,047	$4,130	$891	$5,021	$25	$22	$40
5	1998	$3,998	$1,117	$5,115	$4,130	$949	$5,079	$35	$30	$70
6	1999	$3,998	$1,189	$5,187	$4,130	$1,011	$5,141	$46	$38	$108
7	2000	$3,998	$1,267	$5,265	$4,130	$1,077	$5,207	$58	$45	$153
8	2001	$3,998	$1,349	$5,347	$4,130	$1,147	$5,277	$70	$53	$206
9	2002	$3,998	$1,437	$5,435	$4,130	$1,221	$5,351	$83	$60	$266
10	2003	$3,998	$1,530	$5,528	$4,130	$1,300	$5,430	$97	$67	$333
11	2004	$3,998	$1,629	$5,627	$4,130	$1,385	$5,515	$112	$75	$408
12	2005	$3,998	$1,735	$5,733	$4,130	$1,475	$5,605	$128	$82	$490
13	2006	$3,998	$1,848	$5,846	$4,130	$1,571	$5,701	$145	$89	$579
14	2007	$3,998	$1,968	$5,966	$4,130	$1,673	$5,803	$163	$96	$675
15	2008	$3,998	$2,096	$6,094	$4,130	$1,782	$5,912	$182	$103	$778

Appendix D: Non-Base-Case Results New England					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of Monthly Utility Bills Eliminated Each Year
Base Case	$3,231	$139	7.6%	.59%	1.8
1	$5,382	$327	12.7%	.98%	3.0
2	$1,051	($51)	2.5%	.19%	0.6
3	$3,072	$139	7.2%	.57%	1.8
4	$5,223	$327	12.3%	.97%	3.0
5	$892	($51)	2.1%	.16%	0.5
6	$3,398	$139	8.0%	.61%	1.8
7	$5,548	$327	13.0%	1.00%	3.0
8	$1,217	($51)	2.9%	.22%	0.7
9	$2,757	$98	6.5%	.50%	1.6
10	$4,929	$288	11.6%	.90%	2.8
11	$556	($94)	1.3%	.10%	0.3
12	$3,705	$181	8.7%	.67%	2.1
13	$5,835	$367	13.7%	1.07%	3.3
14	$1,546	($8)	3.6%	.28%	0.9
15	$2,598	$98	6.1%	.48%	1.5
16	$4,769	$288	11.2%	.88%	2.8
17	$397	($94)	0.9%	.07%	0.2
18	$3,546	$181	8.3%	.66%	2.1
19	$5,676	$367	13.3%	1.06%	3.3

Appendix D: Non-Base-Case Results New England					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of Monthly Utility Bills Eliminated Each Year
20	$1,387	($8)	3.3%	.25%	0.8
21	$2,924	$98	6.9%	.52%	1.6
22	$5,095	$288	12.0%	.91%	2.8
23	$722	($94)	1.7%	.13%	0.4
24	$3,872	$181	9.1%	.69%	2.1
25	$6,001	$367	14.1%	1.08%	3.3
26	$1,713	($8)	4.0%	.30%	0.9
27	$2,976	$139	7.0%	.59%	1.8
28	$4,993	$327	11.7%	1.00%	3.0
29	$932	($51)	2.2%	.18%	0.6
30	$2,833	$139	6.7%	.57%	1.8
31	$4,849	$327	11.4%	.99%	3.0
32	$789	($51)	1.9%	.16%	0.5
33	$3,126	$139	7.3%	.61%	1.8
34	$5,143	$327	12.1%	1.02%	3.0
35	$1,082	($51)	2.5%	.21%	0.6
36	$2,532	$98	6.0%	.50%	1.5
37	$4,568	$288	10.7%	.92%	2.8
38	$468	($94)	1.1%	.09%	0.3
39	$3,421	$181	8.0%	.68%	2.1

Appendix D: Non-Base-Case Results New England					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of Monthly Utility Bills Eliminated Each Year
40	$5,418	$367	12.7%	1.09%	3.3
41	$1,397	($8)	3.3%	.28%	0.8
42	$2,388	$98	5.6%	.48%	1.5
43	$4,424	$288	10.4%	.90%	2.8
44	$324	($94)	0.8%	.07%	0.2
45	$3,277	$181	7.7%	.67%	2.1
46	$5,274	$367	12.4%	1.08%	3.3
47	$1,253	($8)	2.9%	.25%	0.8
48	$2,682	$98	6.3%	.53%	1.6
49	$4,718	$288	11.1%	.93%	2.8
50	$618	($94)	1.5%	.12%	0.4
51	$3,571	$181	8.4%	.70%	2.1
52	$5,568	$367	13.1%	1.10%	3.3
53	$1,547	($8)	3.6%	.30%	0.9
54	$2,745	$139	6.5%	.60%	1.8
55	$4,638	$327	10.9%	1.02%	3.0
56	$826	($51)	1.9%	.18%	0.5
57	$2,615	$139	6.1%	.58%	1.8
58	$4,509	$327	10.6%	1.01%	3.1
59	$696	($51)	1.6%	.15%	0.5

Appendix D: Non-Base-Case Results New England					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of Monthly Utility Bills Eliminated Each Year
60	$2,880	$139	6.8%	.62%	1.8
61	$4,774	$327	11.2%	1.04%	3.0
62	$961	($51)	2.3%	.21%	0.6
63	$2,328	$98	5.5%	.51%	1.5
64	$4,239	$288	10.0%	.93%	2.8
65	$390	($94)	0.9%	.08%	0.3
66	$3,162	$181	7.4%	.69%	2.1
67	$5,037	$367	11.8%	1.11%	3.3
68	$1,262	($8)	3.0%	.27%	0.8
69	$2,198	$98	5.2%	.49%	1.5
70	$4,110	$288	9.7%	.92%	2.8
71	$260	($94)	0.6%	.06%	0.2
72	$3,032	$181	7.1%	.68%	2.1
73	$4,907	$367	11.5%	1.10%	3.3
74	$1,132	($8)	2.7%	.25%	0.8
75	$2,463	$98	5.8%	.53%	1.6
76	$4,375	$288	10.3%	.95%	2.8
77	$525	($94)	1.2%	.11%	0.3
78	$3,297	$181	7.8%	.71%	2.1
79	$5,172	$367	12.2%	1.12%	3.3

Appendix D: Non-Base-Case Results New England					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of Monthly Utility Bills Eliminated Each Year
80	$1,397	($8)	3.3%	.30%	0.9

Appendix D: Non-Base-Case Results Mid-Atlantic					
Non-Base Case Scenario	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
Base	$2,491	$97	5.9%	.45%	1.3
1	$4,642	$285	10.9%	.84%	2.5
2	$311	($93)	0.7%	.06%	0.2
3	$2,357	$97	5.5%	.43%	1.3
4	$4,508	$285	10.6%	.83%	2.5
5	$177	($93)	0.4%	.03%	0.1
6	$2,631	$97	6.2%	.47%	1.4
7	$4,782	$285	11.2%	.85%	2.5
8	$451	($93)	1.1%	.08%	0.2
9	$2,017	$56	4.7%	.36%	1.1
10	$4,189	$246	9.8%	.76%	2.3
11	($184)	($136)	(0.4%)	(.03%)	(0.1)
12	$2,965	$139	7.0%	.53%	1.6
13	$5,095	$325	12.0%	.93%	2.7
14	$806	($50)	1.9%	.14%	0.4
15	$1,883	$56	4.4%	.34%	1.0
16	$4,055	$246	9.5%	.75%	2.3
17	($318)	($136)	(0.7%)	(.06%)	(0.2)
18	$2,831	$139	6.7%	.52%	1.6
19	$4,961	$325	11.7%	.92%	2.8

Appendix D: Non-Base-Case Results Mid-Atlantic					
Non-Base Case Scenario	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
20	$672	($50)	1.6%	.12%	0.4
21	$2,157	$56	5.1%	.38%	1.1
22	$4,329	$246	10.2%	.77%	2.2
23	($44)	($136)	(0.1%)	(.01%)	(0.0)
24	$3,105	$139	7.3%	.55%	1.6
25	$5,235	$325	12.3%	.93%	2.7
26	$946	($50)	2.2%	.17%	0.5
27	$2,291	$97	5.4%	.45%	1.3
28	$4,308	$285	10.1%	.86%	2.5
29	$247	($93)	0.6%	.05%	0.1
30	$2,170	$97	5.1%	.44%	1.3
31	$4,186	$285	9.8%	.85%	2.5
32	$126	($93)	0.3%	.03%	0.1
33	$2,417	$97	5.7%	.47%	1.4
34	$4,434	$285	10.4%	.87%	2.5
35	$373	($93)	0.9%	.07%	0.2
36	$1,847	$56	4.3%	.36%	1.1
37	$3,883	$246	9.1%	.77%	2.3
38	($217)	($136)	(0.5%)	(.04%)	(0.1)
39	$2,735	$139	6.4%	.54%	1.6

Appendix D: Non-Base-Case Results Mid-Atlantic					
Non-Base Case Scenario	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
40	$4,732	$325	11.1%	.94%	2.7
41	$711	($50)	1.7%	.14%	0.4
42	$1,725	$56	4.1%	.35%	1.0
43	$3,762	$246	8.8%	.76%	2.3
44	($339)	($136)	(0.8%)	(.07%)	(0.2)
45	$2,614	$139	6.1%	.53%	1.6
46	$4,611	$325	10.8%	.94%	2.8
47	$590	($50)	1.4%	.12%	0.4
48	$1,973	$56	4.6%	.38%	1.1
49	$4,009	$246	9.4%	.78%	2.2
50	($91)	($136)	(0.2%)	(.02%)	(0.1)
51	$2,862	$139	6.7%	.56%	1.6
52	$4,859	$325	11.4%	.95%	2.7
53	$837	($50)	2.0%	.16%	0.5
54	$2,109	$97	5.0%	.46%	1.3
55	$4,003	$285	9.4%	.88%	2.5
56	$190	($93)	0.4%	.04%	0.1
57	$2,000	$97	4.7%	.44%	1.3
58	$3,893	$285	9.2%	.87%	2.5
59	$81	($93)	0.2%	.02%	0.1

Appendix D: Non-Base-Case Results Mid-Atlantic					
Non-Base Case Scenario	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
60	$2,223	$97	5.2%	.48%	1.3
61	$4,116	$285	9.7%	.89%	2.5
62	$304	($93)	0.7%	.06%	0.2
63	$1,692	$56	4.0%	.37%	1.1
64	$3,604	$246	8.5%	.79%	2.3
65	($246)	($136)	(0.6%)	(.05%)	(0.2)
66	$2,526	$139	5.9%	.55%	1.6
67	$4,401	$325	10.3%	.98%	2.8
68	$626	($50)	1.5%	.14%	0.4
69	$1,583	$56	3.7%	.35%	1.0
70	$3,494	$246	8.2%	.78%	2.3
71	($355)	($136)	(0.8%)	(.08%)	(0.2)
72	$2,417	$139	5.7%	.53%	1.6
73	$4,292	$325	10.1%	.96%	2.8
74	$517	($50)	1.2%	.11%	0.3
75	$1,806	$56	4.2%	.39%	1.1
76	$3,717	$246	8.7%	.80%	2.3
77	($132)	($136)	(0.3%)	(.03%)	(0.1)
78	$2,640	$139	6.2%	.57%	1.6
79	$4,515	$325	10.6%	.97%	2.7

Appendix D: Non-Base-Case Results Mid-Atlantic					
Non-Base Case Scenario	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
80	$740	($50)	1.7%	.16%	0.4

Appendix D: Non-Base-Case Results South Atlantic					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
Base	$1,106	$15	2.8%	.22%	0.7
1	$3,117	$190	7.9%	.62%	1.9
2	($932)	($163)	(2.4%)	(.18%)	(0.6)
3	$1,015	$15	2.6%	.21%	0.6
4	$3,025	$190	7.6%	.62%	1.9
5	($1,023)	($163)	(2.6%)	(.21%)	(0.6)
6	$1,202	$15	3.0%	.24%	0.7
7	$3,212	$190	8.1%	.63%	1.9
8	($836)	($163)	(2.1%)	(.16%)	(0.5)
9	$665	($24)	1.7%	.13%	0.4
10	$2,695	$153	6.8%	.54%	1.6
11	($1,392)	($204)	(3.5%)	(.27%)	(0.8)
12	$1,547	$53	3.9%	.31%	0.9
13	$3,538	$227	8.9%	.71%	2.2
14	($471)	($123)	(1.2%)	.09%	(0.3)
15	$574	($24)	1.5%	.12%	0.4
16	$2,604	$153	6.6%	.53%	1.6
17	($1,484)	($204)	(3.8%)	(3.30%)	(0.9)
18	$1,456	$53	3.7%	.29%	0.9
19	$3,447	$227	8.7%	.70%	2.2

Appendix D: Non-Base-Case Results South Atlantic					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
20	($563)	($123)	(1.4%)	(.11%)	(0.4)
21	$761	($24)	1.9%	.15%	0.4
22	$2,791	$153	7.1%	.55%	1.6
23	($1,297)	($204)	(3.3%)	(.25%)	(0.8)
24	$1,643	$53	4.2%	.32%	1.0
25	$3,634	$227	9.2%	.72%	2.1
26	($376)	($123)	(0.9%)	(.07%)	(0.2)
27	$1,007	$15	2.5%	.22%	0.7
28	$2,892	$190	7.3%	.64%	1.9
29	($904)	($163)	(2.3%)	(.20%)	(0.6)
30	$924	$15	2.3%	.21%	0.6
31	$2,809	$190	7.1%	.63%	1.9
32	($987)	($163)	(2.5%)	(.22%)	(0.7)
33	$1,093	$15	2.8%	.24%	0.7
34	$2,978	$190	7.5%	.65%	1.9
35	($818)	($163)	(2.1%)	.17%	(0.5)
36	$593	($24)	1.5%	.13%	0.4
37	$2,497	$153	6.3%	.55%	1.6
38	($1,336)	($204)	(3.4%)	(.29%)	(0.9)
39	$1,420	$53	3.6%	.31%	0.9

Appendix D: Non-Base-Case Results South Atlantic					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
40	$3,287	$227	8.3%	.72%	2.2
41	($472)	($123)	(1.2%)	(.10%)	(0.3)
42	$511	($24)	1.3%	.11%	0.3
43	$2,414	$153	6.1%	.54%	1.6
44	($1,419)	($204)	(3.6%)	(.31%)	(1.0)
45	$1,337	$53	3.4%	.30%	0.9
46	$3,204	$227	8.1%	.72%	2.2
47	($555)	($123)	(1.4%)	(.12%)	(0.4)
48	$679	($24)	1.7%	.15%	0.4
49	$2,583	$153	6.5%	.56%	1.6
50	($1,250)	($204)	(3.2%)	(.27%)	(0.8)
51	$1,506	$53	3.8%	.32%	1.0
52	$3,373	$227	8.5%	.73%	2.1
53	($386)	($123)	(1.0%)	(.08%)	(0.2)
54	$917	$15	2.3%	.22%	0.7
55	$2,687	$190	6.8%	.65%	1.9
56	($877)	($163)	(2.2%)	(.21%)	(0.6)
57	$842	$15	2.1%	.21%	0.6
58	$2,612	$190	6.6%	.64%	2.9
59	($952)	($163)	(2.4%)	(.23%)	(0.7)

Appendix D: Non-Base-Case Results South Atlantic					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
60	$994	$15	2.5%	.24%	0.7
61	$2,764	$190	7.0%	.66%	1.9
62	($800)	($163)	(2.0%)	(.19%)	(0.5)
63	$529	($24)	1.3%	.13%	0.4
64	$2,316	$153	5.9%	.56%	1.6
65	($1,283)	($204)	(3.2%)	(.31%)	(0.9)
66	$1,305	$53	3.3%	.31%	0.9
67	$3,058	$227	7.7%	.74%	2.2
68	($472)	($123)	(1.2%)	(.11%)	(0.3)
69	$454	($24)	1.1%	.11%	0.3
70	$2,241	$153	5.7%	.55%	1.6
71	($1,357)	($204)	(3.4%)	(.33%)	(1.0)
72	$1,230	$53	3.1%	.30%	0.9
73	$2,983	$227	7.5%	.73%	2.2
74	($547)	($123)	(1.4%)	(.13%)	(0.4)
75	$606	($24)	1.5%	.14%	0.4
76	$2,393	$153	6.0%	.57%	1.6
77	($1,205)	($204)	(3.0%)	(.28%)	(0.8)
78	$1,382	$53	3.5%	.33%	0.9
79	$3,135	$227	7.9%	.75%	2.2

Appendix D: Non-Base-Case Results South Atlantic					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
80	$202	($85)	0.5%	.05%	0.1

Appendix D: Non-Base-Case Results East South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
Base	$517	$119	1.3%	.11%	0.4
1	$2,528	$157	6.4%	.55%	2.0
2	($1,521)	($197)	(3.8%)	(.33%)	(1.2)
3	$446	($19)	1.1%	.10%	0.4
4	$2,456	$157	6.2%	.54%	2.0
5	($1,592)	($197)	(4.0%)	(.35%)	(1.3)
6	$592	($19)	1.5%	.13%	0.4
7	$2,602	$157	6.6%	.56%	2.0
8	($1,446)	($197)	(3.7%)	(.31%)	(1.1)
9	$76	($57)	0.2%	.02%	0.1
10	$2,106	$120	5.3%	.46%	1.6
11	($1,981)	($237)	(5.0%)	(.42%)	(1.5)
12	$958	$20	2.4%	.21%	0.7
13	$2,949	$194	7.5%	.64%	2.3
14	($1,060)	($157)	(2.7%)	(.23%)	(0.8)
15	$5	($57)	0.0%	.00%	0.0
16	$2,035	$120	5.1%	.45%	1.6
17	($2,053)	($237)	(5.2%)	(.45%)	(1.7)
18	$886	$20	2.2%	.19%	0.7
19	$2,877	$194	7.3%	.64%	2.3

Appendix D: Non-Base-Case Results East South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
20	($1,132)	($157)	(2.9%)	(.25%)	(0.9)
21	$151	($57)	0.4%	.03%	0.1
22	$2,181	$120	5.5%	.47%	1.6
23	($1,907)	($237)	(4.8%)	(.40%)	(1.4)
24	$1,032	$20	2.6%	.22%	0.8
25	$3,023	$194	7.6%	.65%	2.3
26	($986)	($157)	(2.5%)	(.21%)	(0.7)
27	$461	($19)	1.2%	.11%	0.4
28	$2,346	$157	5.9%	.56%	2.0
29	($1,450)	($197)	(3.7%)	(.34%)	(1.2)
30	$397	($19)	1.0%	.10%	0.3
31	$2,282	$157	5.8%	.55%	2.0
32	($1,514)	($197)	(3.8%)	(.36%)	(1.3)
33	$528	($19)	1.3%	.12%	0.4
34	$2,413	$157	6.1%	.57%	2.0
35	($1,383)	($197)	(3.5%)	(.32%)	(1.1)
36	$48	($57)	0.1%	.01%	0.0
37	$1,951	$120	4.9%	.47%	1.6
38	($1,882)	($237)	(4.8%)	(.44%)	(1.6)
39	$874	$20	2.2%	.21%	0.7

Appendix D: Non-Base-Case Results East South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
40	$2,741	$194	6.9%	.66%	2.3
41	($1,018)	($157)	(2.6%)	(.24%)	(0.9)
42	($17)	($57)	(0.0%)	.00%	(0.0)
43	$1,886	$120	4.8%	.46%	1.6
44	($1,946)	($237)	(4.9%)	(.46%)	(1.7)
45	$810	$20	2.0%	.19%	0.7
46	$2,677	$194	6.8%	.65%	2.3
47	($1,083)	($157)	(2.7%)	(.20%)	(0.9)
48	$115	($57)	0.3%	.03%	0.1
49	$2,018	$120	5.1%	.48%	1.6
50	($1,814)	($237)	(4.6%)	(.42%)	(1.5)
51	$941	$20	2.4%	.22%	0.8
52	$2,808	$1194	7.1%	.66%	2.3
53	($951)	($157)	(2.4%)	(.22%)	(0.8)
54	$411	($19)	1.0%	.11%	0.4
55	$2,180	$157	5.5%	.57%	2.0
56	($1,384)	($197)	(3.5%)	(.36%)	(1.3)
57	$352	($19)	0.9%	.09%	0.3
58	$2,122	$157	5.4%	.56%	2.0
59	($1,442)	($197)	(3.6%)	(.38%)	(1.4)

Appendix D: Non-Base-Case Results East South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
60	$471	($19)	1.2%	.12%	0.4
61	$2,241	$157	5.7%	.58%	2.0
62	($1,323)	($197)	(3.3%)	(.34%)	(1.2)
63	$22	($57)	0.1%	.01%	0.0
64	$1,809	$120	4.6%	.47%	1.6
65	($1,789)	($237)	(4.5%)	(.46%)	(1.6)
66	$799	$20	2.0%	.21%	0.7
67	$2,551	$194	6.4%	.67%	2.3
68	($978)	($157)	(2.5%)	(.25%)	(0.9)
69	($36)	($57)	(0.1%)	(.01%)	(0.0)
70	$1,751	$120	4.4%	.46%	1.6
71	($1,847)	($237)	(4.7%)	(.48%)	(1.7)
72	$740	$20	1.9%	.20%	0.7
73	$2,493	$194	6.3%	.66%	2.3
74	($1,036)	($157)	(2.6%)	(.27%)	(1.0)
75	$83	($57)	0.2%	.02%	0.1
76	$1,870	$120	4.7%	.48%	1.6
77	($1,728)	($237)	(4.4%)	(.44%)	(1.5)
78	$859	$20	2.2%	.22%	0.8
79	$2,612	$194	6.6%	.68%	2.3

Appendix D: Non-Base-Case Results East South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
80	($918)	($157)	(2.3%)	(.23%)	(0.8)

Appendix D: Non-Base-Case Results West South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
Base	$1,064	$12	2.7%	.21%	0.7
1	$3,074	$188	7.8%	.62%	1.9
2	($974)	($166)	(2.5%)	(.19%)	(0.6)
3	$974	$12	2.5%	.20%	0.6
4	$2,984	$188	7.5%	.61%	1.9
5	($1,064)	($166)	(2.7%)	(.21%)	(0.7)
6	$1,158	$12	2.9%	.23%	0.7
7	$3,168	$188	8.0%	.63%	1.9
8	($880)	($166)	(2.2%)	(.17%)	(0.5)
9	$623	($26)	1.6%	.12%	0.4
10	$2,653	$151	6.7%	.53%	1.6
11	($1,434)	($206)	(3.6%)	(.28%)	(0.9)
12	$1,505	$51	3.8%	.30%	0.9
13	$3,496	$225	8.8%	.71%	2.2
14	($513)	($126)	(1.3%)	(.10%)	(0.3)
15	$533	($26)	1.3%	.11%	0.3
16	$2,563	$151	6.5%	.52%	1.6
17	($1,524)	($206)	(3.9%)	(.31%)	(1.0)
18	$1,415	$51	3.6%	.29%	0.9
19	$3,406	$225	8.6%	.70%	2.2

Appendix D: Non-Base-Case Results West South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
20	($603)	($126)	(1.5%)	(.12%)	(0.4)
21	$717	($26)	1.8%	.14%	0.4
22	$2,747	$151	6.9%	.54%	1.6
23	($1,340)	($206)	(3.4%)	(.26%)	(0.8)
24	$1,599	$51	4.0%	.32%	1.0
25	$3,590	$225	9.1%	.71%	2.1
26	($419)	($126)	(1.1%)	(.08%)	(0.3)
27	$968	$12	2.4%	.21%	0.6
28	$2,853	$188	7.2%	.63%	1.9
29	($943)	($166)	(2.4%)	(.21%)	(0.6)
30	$886	$12	2.2%	.20%	0.6
31	$2,771	$188	7.0%	.62%	1.9
32	($1,025)	($166)	(2.6%)	(.23%)	(0.7)
33	$1,052	$12	2.7%	.23%	0.7
34	$2,937	$188	7.4%	.64%	1.9
35	($859)	($166)	(2.2%)	(.18%)	(0.6)
36	$554	($26)	1.4%	.12%	0.4
37	$2,458	$151	6.2%	.54%	1.6
38	($1,375)	($206)	(3.5%)	(.30%)	(0.9)
39	$1,381	$51	3.5%	.30%	0.9

Appendix D: Non-Base-Case Results West South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
40	$3,248	$225	8.2%	.72%	2.2
41	($511)	($126)	(1.3%)	(.11%)	(0.3)
42	$473	($26)	1.2%	.11%	0.3
43	$2,376	$151	6.0%	.53%	1.6
44	($1,456)	($206)	(3.7%)	(.32%)	(1.0)
45	$1,300	$51	3.3%	.29%	0.9
46	$3,166	$225	8.0%	.71%	2.2
47	($593)	($126)	(1.5%)	(.13%)	(0.4)
48	$639	($26)	1.6%	.14%	0.4
49	$25,423	$151	6.4%	.55%	1.6
50	($1,298)	($206)	(3.3%)	(.28%)	(0.8)
51	$1,466	$51	3.7%	.32%	0.9
52	$3,332	$225	8.4%	.73%	2.2
53	($427)	($126)	(1.1%)	(.09%)	(0.3)
54	$880	$12	2.2%	.21%	0.6
55	$2,650	$188	6.7%	.64%	1.9
56	($914)	($166)	(2.3%)	(.22%)	(0.7)
57	$807	$12	2.0%	.20%	0.6
58	$2,577	$188	6.5%	.64%	1.9
59	($987)	($166)	(2.5%)	(.24%)	(0.7)

Appendix D: Non-Base-Case Results West South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
60	$957	$12	2.4%	.23%	0.7
61	$2,727	$188	6.9%	.65%	1.9
62	($837)	($166)	(2.1%)	(.20%)	(0.6)
63	$492	($26)	1.2%	.12%	0.4
64	$2,279	$151	5.8%	.55%	1.6
65	($1,319)	($206)	(3.3%)	(.32%)	(1.0)
66	$1,268	$51	3.2%	.31%	0.9
67	$3,021	$225	7.6%	.74%	2.2
68	($508)	($126)	(1.3%)	(.12%)	(0.4)
69	$419	($26)	1.1%	.10%	0.3
70	$2,206	$151	5.6%	.54%	1.6
71	($1,393)	($206)	(3.5%)	(.34%)	(1.0)
72	$1,195	$51	3.0%	.29%	0.9
73	$2,948	$225	7.5%	.73%	2.2
74	($582)	$126	(1.5%)	(.14%)	(0.4)
75	$569	($26)	1.4%	.14%	0.4
76	$2,356	$151	6.0%	.56%	1.6
77	($1,243)	($206)	(3.1%)	(.29%)	(0.9)
78	$1,345	$51	3.4%	.32%	0.9
79	$3,098	$225	7.8%	.74%	2.2

Appendix D: Non-Base-Case Results West South Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
80	($432)	($126)	(1.1%)	(.10%)	(0.3)

Appendix D: Non-Base-Case Results East North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
Base	$2,781	$110	7.1%	.54%	1.7
1	$4,781	$284	12.2%	.94%	2.9
2	$754	($68)	1.9%	.15%	0.5
3	$2,632	$110	6.7%	.52%	1.6
4	$4,632	$284	11.8%	.93%	2.9
5	$605	($68)	1.5%	.12%	0.4
6	$2,937	$110	7.5%	.56%	1.7
7	$4,936	$284	12.6%	.96%	2.9
8	$909	($68)	2.3%	.17%	0.5
9	$2,343	$71	6.0%	.46%	1.4
10	$4,362	$248	11.1%	.86%	2.6
11	$296	($108)	0.8%	.06%	0.2
12	$3,220	$148	8.2%	.63%	1.9
13	$5,200	$321	13.2%	1.02%	3.1
14	$1,212	($28)	3.1%	.24%	0.7
15	$2,194	$71	5.6%	.44%	1.4
16	$4,213	$248	10.7%	.84%	2.6
17	$147	($108)	0.4%	.03%	0.1
18	$3,071	$148	7.8%	.61%	1.9
19	$5,051	$321	12.8%	1.01%	3.2

Appendix D: Non-Base-Case Results East North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
20	$1,063	($28)	2.7%	.21%	0.7
21	$2,498	$71	6.4%	.48%	1.5
22	$4,517	$248	11.5%	.87%	2.6
23	$456	($108)	1.1%	.09%	0.3
24	$3,375	$148	8.6%	.65%	2.0
25	$5,355	$321	13.6%	1.04%	3.1
26	$1,367	($28)	3.5%	.26%	0.8
27	$2,552	$110	6.5%	.55%	1.7
28	$4,433	$284	11.3%	.96%	2.9
29	$657	($68)	1.7%	.14%	0.4
30	$2,424	$110	6.2%	.53%	1.6
31	$4,299	$284	10.9%	.94%	2.9
32	$523	($68)	1.3%	.11%	0.4
33	$2,698	$110	6.9%	.57%	1.7
34	$4,573	$284	11.6%	.97%	2.9
35	$797	($68)	2.0%	.17%	0.5
36	$2,147	$71	5.5%	.46%	1.4
37	$4,040	$248	10.3%	.87%	2.6
38	$228	($108)	0.6%	.05%	0.1
39	$2,969	$148	7.5%	.64%	1.9

Appendix D: Non-Base-Case Results East North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
40	$4,826	$321	12.3%	1.04%	3.1
41	$1,087	($28)	2.8%	.23%	0.7
42	$2,013	$71	5.1%	.44%	1.4
43	$3,906	$248	9.9%	.86%	2.6
44	,$94	($108)	0.2%	.02%	0.1
45	$2,835	$148	7.2%	.62%	1.9
46	$4,692	$321	11.9%	1.03%	3.2
47	$952	($28)	2.4%	.21%	0.6
48	$2,287	$71	5.8%	.48%	1.4
49	$4,180	$248	10.6%	.89%	2.6
50	$368	$108	0.9%	.08%	0.2
51	$3,109	$148	7.9%	.06%	2.0
52	$4,966	$321	12.6%	1.06%	3.1
53	$1,227	($28)	3.1%	.26%	0.8
54	$2,355	$110	6.0%	.56%	1.7
55	$4,116	$284	10.5%	.98%	2.9
56	$571	($68)	1.5%	.13%	0.4
57	$2,234	$110	5.7%	.53%	1.6
58	$3,995	$284	10.2%	.96%	2.9
59	$449	($68)	1.1%	.11%	0.3

Appendix D: Non-Base-Case Results East North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
60	$2,482	$110	6.3%	.58%	1.7
61	$4,242	$284	10.8%	.99%	2.9
62	$697	($68)	1.8%	.16%	0.5
63	$1,969	$71	5.0%	.46%	1.4
64	$3,747	$248	9.5%	.89%	2.6
65	$168	($108)	0.4%	.04%	0.1
66	$2,741	$148	7.0%	.65%	1.9
67	$4,485	$321	11.4%	1.07%	3.1
68	$974	($28)	2.5%	.23%	0.7
69	$1,848	$71	4.7%	.44%	1.3
70	$3,626	$248	9.2%	.87%	2.6
71	,$46	($108)	0.1%	.01%	0.0
72	$2,620	$148	6.7%	.63%	1.9
73	$4,364	$321	11.1%	1.05%	3.2
74	$852	($28)	2.2%	.20%	0.6
75	$2,096	$71	5.3%	.49%	1.4
76	$3,873	$248	9.8%	.90%	2.6
77	$294	($108)	0.7%	.07%	0.2
78	$2,867	$148	7.3%	.67%	1.9
79	$4,611	$321	11.7%	1.07%	3.1

Appendix D: Non-Base-Case Results East North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
80	$1,100	($28)	2.8%	.25%	0.7

Appendix D: Non-Base-Case Results West North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
Base	$2,350	$85	6.0%	.48%	1.6
1	$4,350	$260	11.1%	.89%	2.9
2	$323	($92)	0.8%	.07%	0.2
3	$2,216	$85	5.6%	.46%	1.5
4	$4,216	$260	10.7%	.88%	2.9
5	$189	($92)	0.5%	.04%	0.1
6	$2,491	$85	6.3%	.50%	1.6
7	$4,490	$260	11.4%	.90%	2.9
8	$463	($92)	1.2%	.09%	0.3
9	$1,912	$47	4.9%	.39%	1.3
10	$3,931	$223	10.0%	.80%	2.6
11	($134)	($132)	(0.3)%	.03%	(0.1)
12	$2,789	$123	7.1%	.57%	1.9
13	$4,769	$296	12.1%	.98%	3.2
14	$781	($52)	2.0%	.16%	0.5
15	$1,778	$47	4.5%	.37%	1.2
16	$3,797	$223	9.7%	.79%	2.6
17	($269)	($132)	(0.7%)	(.05%)	(0.2)
18	$2,654	$123	6.7%	.55%	1.8
19	$4,635	$296	11.8%	.96%	3.2

Appendix D: Non-Base-Case Results West North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
20	$647	($52)	1.6%	.13%	0.4
21	$2,052	$47	5.2%	.41%	1.3
22	$4,071	$223	10.4%	.82%	2.6
23	$6	($132)	0.0%	.00%	0.0
24	$2,929	$123	7.4%	.59%	1.9
25	$4,909	$296	12.5%	.99%	3.2
26	$921	($52)	2.3%	.18%	0.6
27	$2,159	$85	5.5%	.48%	1.6
28	$4,034	$260	10.3%	.91%	2.9
29	$258	($92)	0.7%	.06%	0.2
30	$2,038	$85	5.2%	.46%	1.5
31	$3,913	$260	9.9%	.89%	2.9
32	$137	($92)	0.3%	.03%	0.1
33	$2,285	$885	5.8%	.50%	1.6
34	$4,160	$260	10.6%	.92%	2.9
35	$385	($92)	1.0%	.08%	0.3
36	$1,748	$47	4.4%	.39%	1.3
37	$3,641	$223	9.3%	.82%	2.6
38	($171)	($132)	(0.4%)	(.04%)	(0.1)
39	$2,570	$123	6.5%	.57%	1.9

Appendix D: Non-Base-Case Results West North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
40	$4,427	$296	11.3%	1.00%	3.2
41	$688	($52)	1.7%	.15%	0.5
42	$1,627	$47	4.1%	.37%	1.2
43	$3,520	$223	8.9%	.80%	2.6
44	($292)	($132)	(0.7%)	(.07%)	(0.2)
45	$2,449	$1123	6.2%	.55%	1.8
46	$4,306	$296	10.9%	.98%	3.2
47	$566	($52)	1.4%	.13%	0.4
48	$1,874	$47	4.8%	.41%	1.3
49	$3,768	$223	9.6%	.83%	2.6
50	($45)	($132)	(0.1%)	(.01%)	0.0
51	$2,696	$123	6.9%	.59%	1.9
52	$4,553	$296	11.6%	1.01%	3.2
53	$814	($52)	2.1%	.18%	0.6
54	$1,985	$85	5.0%	.49%	1.5
55	$3,746	$260	9.5%	.92%	2.9
56	$201	($92)	0.5%	.05%	0.2
57	$1,876	$85	4.8%	.47%	1.5
58	$3,637	$260	9.2%	.91%	2.9
59	$91	($92)	0.2%	.02%	0.1

Appendix D: Non-Base-Case Results West North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
60	$2,099	$85	5.3%	.51%	1.6
61	$3,860	$260	9.8%	.94%	2.9
62	$314	($92)	0.8%	.08%	0.2
63	$1,599	$47	4.1%	.39%	1.2
64	$3,377	$223	8.6%	.83%	2.6
65	($202)	($132)	(0.5%)	(.05%)	(0.2)
66	$2,371	$123	6.0%	.58%	1.8
67	$4,115	$296	10.5%	1.02%	3.2
68	$604	($52)	1.5%	.15%	0.5
69	$1,490	$47	3.8%	.37%	1.2
70	$3,268	$223	8.3%	.82%	2.6
71	($312)	($132)	(0.8%)	(.08%)	(0.3)
72	$2,262	$123	5.8%	.56%	1.8
73	$4,005	$296	10.2%	1.00%	3.2
74	$494	($52)	1.3%	.12%	0.4
75	$1,713	$47	4.4%	.41%	1.3
76	$3,491	$223	8.9%	.85%	2.6
77	($89)	($132)	(0.2%)	(.02%)	(0.1)
78	$2,485	$123	6.3%	.60%	1.9
79	$4,229	$296	10.8%	1.03%	3.2

Appendix D: Non-Base-Case Results West North Central					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
80	$718	($52)	1.8%	.17%	0.5

Appendix D: Non-Base-Case Results Mountain					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
Base	$1,494	$39	3.6%	.30%	1.1
1	$3,576	$221	8.7%	.73%	2.5
2	($616)	($146)	(1.5%)	(.12%)	(0.4)
3	$1,392	$39	3.4%	.29%	1.0
4	$3,474	$221	8.5%	.72%	2.5
5	($718)	($146)	(1.7%)	(.15%)	(0.5)
6	$1,601	$39	3.9%	.32%	1.1
7	$3,683	$221	9.0%	.74%	2.5
8	($509)	($146)	(1.2%)	(.10%)	(0.3)
9	$1,037	($1)	2.5%	.21%	0.7
10	$3,139	$182	7.6%	.64%	2.2
11	($1,094)	($187)	(2.7%)	(.22%)	(0.8)
12	$1,952	$79	4.8%	.40%	1.4
13	$4,014	$259	9.8%	.82%	2.8
14	($138)	($104)	(0.3%)	(.03%)	(0.1)
15	$934	($1)	2.3%	.19%	0.7
16	$3,036	$182	7.4%	.63%	2.2
17	($1,197)	($187)	(2.9%)	(.24%)	(0.9)
18	$1,850	$79	4.5%	.38%	1.3
19	$3,911	$259	9.5%	.81%	2.9

Appendix D: Non-Base-Case Results Mountain					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
20	($240)	($104)	(0.6%)	(.05%)	(0.2)
21	$1,143	($1)	2.8%	.23%	0.8
22	$3,245	$182	7.9%	.65%	2.2
23	($987)	($187)	(2.4%)	(.20%)	(0.7)
24	$2,059	$79	5.0%	.41%	1.4
25	$4,121	$259	10.0%	.83%	2.8
26	($31)	($104)	(0.1%)	(.01%)	(0.0)
27	$1,367	$39	3.3%	.30%	1.0
28	$3,319	$221	8.1%	.74%	2.5
29	($612)	($146)	(1.5%)	(.14%)	(0.5)
30	$1,274	$39	3.1%	.29%	1.0
31	$3,227	$221	7.9%	.73%	2.5
32	($704)	($146)	(1.7%)	(.16%)	(0.6)
33	$1,463	$39	3.6%	.32%	1.1
34	$3,415	$221	8.3%	.75%	2.5
35	($516)	($146)	(1.3%)	(.11%)	(0.4)
36	$938	($1)	2.3%	.21%	0.7
37	$2,909	$182	7.1%	.65%	2.2
38	($1,060)	($187)	(2.6%)	(.23%)	(0.8)
39	$1,796	$79	4.4%	.40%	1.4

Appendix D: Non-Base-Case Results Mountain					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
40	$3,729	$259	9.1%	.84%	2.8
41	($164)	($104)	(0.4%)	(.04%)	(0.1)
42	$8,445	($1)	2.1%	.19%	0.7
43	$2,816	$182	6.9%	.64%	2.2
44	($1,153)	($187)	(2.8%)	(.26%)	(0.9)
45	$1,704	$79	4.1%	3.38%	1.3
46	$3,637	$259	8.9%	.83%	2.9
47	($256)	($104)	(0.6%)	(.06%)	(0.2)
48	$1,034	($1)	2.5%	.23%	0.8
49	$3,005	$182	7.3%	.66%	2.2
50	($964)	($187)	(2.3%)	(.21%)	(0.7)
51	$1,892	$79	4.6%	.42%	1.4
52	$3,826	$259	9.3%	.85%	2.8
53	($67)	($104)	(0.2%)	(.01%)	(0.0)
54	$1,251	$39	3.0%	.31%	1.0
55	$3,084	$221	7.5%	.76%	2.5
56	($606)	($146)	(1.5%)	(.15%)	(0.5)
57	$1,168	$39	2.8%	.29%	1.0
58	$3,001	$221	7.3%	.75%	2.5
59	($690)	($146)	(1.7%)	(.17%)	(0.6)

Appendix D: Non-Base-Case Results Mountain					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
60	$1,338	$39	3.3%	.32%	1.1
61	$3,171	$221	7.7%	.77%	2.5
62	($520)	($146)	(1.3%)	(.12%)	(0.4)
63	$848	($1)	2.1%	.21%	0.7
64	$2,699	$182	6.6%	.66%	2.2
65	($1,027)	($187)	(2.5%)	(.25%)	(0.8)
66	$1,654	$79	4.0%	.40%	1.4
67	$3,469	$259	8.4%	.85%	2.8
68	($186)	($104)	(0.5%)	(.05%)	(0.2)
69	$765	($1)	1.9%	.19%	0.6
70	$2,616	$182	6.4%	.65%	2.2
71	($1,111)	($187)	(2.7%)	(.27%)	(0.9)
72	$1,571	$79	3.8%	.39%	1.3
73	$5,386	$259	8.2%	.85%	2.9
74	($269)	($104)	(0.7%)	(.07%)	(0.2)
75	$935	($1)	2.3%	.22%	0.7
76	$2,786	$182	6.8%	.67%	2.2
77	($941)	($187)	(2.3%)	(.22%)	(0.7)
78	$1,741	$79	4.2%	.42%	1.4
79	$3,556	$259	8.7%	.86%	2.8

Appendix D: Non-Base-Case Results Mountain					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
80	($99)	($104)	(0.2%)	(.02%)	(0.1)

Appendix D: Non-Base-Case Results Pacific					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
Base	$779	($2)	1.9%	.17%	0.7
1	$2,861	$180	7.0%	.63%	2.6
2	($1,331)	($186)	(3.2%)	.29%	(1.2)
3	$701	($2)	1.7%	.16%	0.7
4	$2,783	$180	6.8%	.62%	2.7
5	($1,409)	($186)	(3.4%)	(.31%)	(1.3)
6	$860	($2)	2.1%	.19%	0.8
7	$2,942	$180	7.2%	.64%	2.6
8	($1,250)	($186)	(3.0%)	(.27%)	(1.1)
9	$321	($42)	0.8%	.07%	0.3
10	$2,423	$142	5.9%	.53%	2.2
11	($1,809)	($228)	(4.4%)	(.39%)	(1.7)
12	$1,237	$38	3.0%	.27%	1.1
13	$3,298	$218	8.0%	.73%	3.0
14	($853)	($144)	(2.1%)	(.19%)	(0.8)
15	$243	($42)	0.6%	.05%	0.2
16	$2,345	$142	5.7%	.52%	2.2
17	($1,887)	($228)	(4.6%)	(.41%)	(1.8)
18	$1,159	$38	2.8%	.26%	1.1
19	$3,220	$218	7.8%	.72%	3.1

Appendix D: Non-Base-Case Results Pacific					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
20	($931)	($144)	(2.3%)	(.21%)	(0.9)
21	$403	($42)	1.0%	.09%	0.4
22	$2,505	$142	6.1%	.55%	2.2
23	($1,728)	($228)	(4.2%)	(.37%)	(1.5)
24	$1,318	$38	3.2%	.29%	1.2
25	$3,380	$218	8.2%	.74%	3.0
26	($772)	($144)	(1.9%)	(.17%)	(0.7)
27	$704	($2)	1.7%	.17%	0.7
28	$2,656	$180	6.5%	.64%	2.7
29	($1,274)	($186)	(3.1%)	(.30%)	(1.3)
30	$634	($2)	1.5%	.15%	0.7
31	$2,686	$180	6.3%	.63%	2.7
32	($1,345)	($186)	(3.3%)	(.32%)	(1.4)
33	$778	($2)	1.9%	.19%	0.8
34	$2,730	$180	6.6%	.65%	2.6
35	($1,201)	($186)	(2.9%)	(.28%)	(1.2)
36	$275	($42)	0.7%	.07%	0.3
37	$2,246	$142	5.5%	.54%	2.2
38	($1,723)	($228)	(4.2%)	(.41%)	(1.7)
39	$1,133	$38	2.8%	.27%	1.1

Appendix D: Non-Base-Case Results Pacific					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
40	$3,067	$218	7.5%	.75%	3.1
41	($826)	($144)	(2.0%)	(.20%)	(0.8)
42	$205	($42)	0.5%	.05%	0.2
43	$2,176	$142	5.3%	.53%	2.2
44	($1,793)	($228)	(4.4%)	(.43%)	(1.9)
45	$10,663	$38	2.6%	.26%	1.1
46	$2,996	$218	7.3%	.74%	3.1
47	($897)	($144)	(2.2%)	(.22%)	(0.9)
48	$349	($42)	0.8%	.08%	0.3
49	$2,320	$142	5.6%	.56%	2.2
50	($1,649)	($228)	(4.0%)	(.39%)	(1.6)
51	$1,207	$38	2.9%	.29%	1.2
52	$3,140	$218	7.6%	.75%	3.0
53	($753)	($144)	(1.8%)	(.18%)	(0.7)
54	$637	($2)	1.6%	.17%	0.7
55	$2,470	$180	6.0%	.66%	2.7
56	($1,221)	($186)	(3..0%)	(.32%)	(1.3)
57	$573	($2)	1.4%	.15%	0.6
58	$2,406	$180	5.9%	.65%	2.7
59	($1,284)	($186)	(3.1%)	(.34%)	(1.4)

Appendix D: Non-Base-Case Results Pacific					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
60	$703	($2)	1.7%	.18%	0.7
61	$2,536	$180	6.2%	.67%	2.6
62	($1,155)	($186)	(2.8%)	(.30%)	(1.2)
63	$234	($42)	0.6%	.06%	0.3
64	$2,085	$142	5.1%	.55%	2.2
65	($1,642)	($228)	(4.0%)	(.43%)	(1.8)
66	$1,040	$38	2.5%	.28%	1.1
67	$2,855	$218	7.0%	.76%	3.1
68	($800)	($144)	(1.9%)	(.21%)	(0.9)
69	$170	($42)	0.4%	.05%	0.2
70	$2,021	$142	4.9%	.54%	2.2
71	($1,705)	($228)	(4.2%)	(.45%)	(1.9)
72	$976	$38	2.4%	.26%	1.1
73	$2,791	$218	6.8%	.75%	3.1
74	($864)	($144)	(2.1%)	(.23%)	(1.0)
75	$300	($42)	0.7%	.08%	0.3
76	$2,151	$142	5.2%	.57%	2.2
77	($1,576)	($228)	(3.8%)	(.41%)	(1.6)
78	$1,106	$38	2.7%	.29%	1.2
79	$2,921	$218	7.1%	.77%	3.0

Appendix D: Non-Base-Case Results Pacific					
	Lifecycle NPV	Year 1 Annual Cost Reduction	Effective Discount on Principal	Interest break	Number of monthly bills eliminated
80	($734)	($144)	(1.8%)	(.19%)	(0.8)