THE MASSACHUSETTS MODEL FOR LOW-INCOME ENERGY SERVICE DELIVERY[1]

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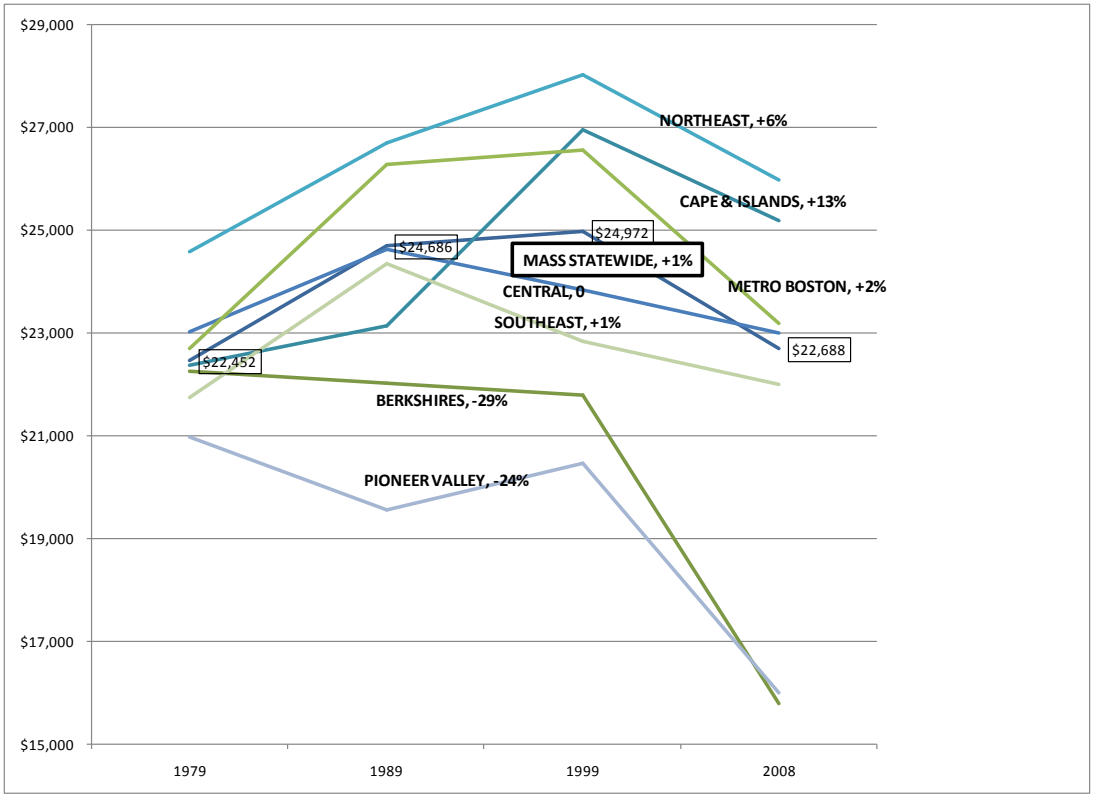
The resources of most low-income families in Massachusetts, as in most of the US, have not improved since at least 1979. Low-income in Massachusetts is usually defined as 60% of median income and encompasses about a third of the population. The Donahue Institute at the University of Massachusetts analyzed quintiles of Massachusetts incomes over time. Showing this for the bottom 20%:

LOWEST QUINTILE OF MASSACHUSETTS INCOMES
1979-2008 (2009 $)
LITTLE, NO, OR NEGATIVE INCOME GROWTH IN 30 YEARS
IN NEARLY ALL OF THE COMMONWEALTH
***Source:* UMass Donahue Institute**



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Significant advocacy on behalf of Massachusetts low-income energy consumers began in the 1970s and has continued since without a break.[4] The result is an enviable net of protections. The Massachusetts Department of Public Utilities (DPU) first approved utility discount rates for certain low-income customers in 1979.[5] Department-ordered low-income energy efficiency programs go back almost as far.[6] In the meantime, federal policy had pioneered along a similar track, with Congress enacting what is now the Low Income Home Energy Assistance Program (LIHEAP) in 1974[7] and what is now the Weatherization Assistance Program (WAP) in 1975.[8] However, in 1996 federal WAP funding was cut by about 50%.

While these programs came to be delivered by a network of community-based agencies, as provided by federal law, the network was not formalized under Massachusetts law until the Restructuring Act of 1997 (effective March 1998),[9] the major purpose of which was to transfer regulation of generation to the Federal Energy Regulatory Commission, which largely deregulated it. The Act specifically provided that "The low-income residential demand-side management and education programs shall be implemented through the low-income weatherization and fuel assistance program network and shall be coordinated with all electric and gas distribution companies in the commonwealth with the objective of standardizing implementation."[10]

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4 Advocates in addition to the authors include Liz Berube, Nancy Brockway, Roger Colton, Greater Boston Legal Services, Charlie Harak, John Howat, Elliott Jacobson, Massachusetts Law Reform Institute, National Consumer Law Center, Allan Rodgers, John Wells, Peter Wingate.

5 American Hoechest Corporation *et al.* vs. Department Of Public Utilities *et al.*, 379 Mass. 408, 411-412 (1980). The decision was pathbreaking at the time:

"There can be no question that the department's jurisdiction over the entire rate structure includes the authority to approve a reduced rate for certain customers. The question is whether the rate is unduly or irrationally discriminatory.

" It is "axiomatic in ratemaking" that "different treatment for different classes of customers, reasonably classified, is not unlawful discrimination." While cost of service is a well-recognized basis for utility rate structures, it need not be the sole criterion. Any number of factors may justify a separate classification. (particular customer may be placed in separate class because of some or all such factors as size, location or nature of business). "*The nature of the use and the benefit obtained from it*, the number of persons who want it for such a use, and the effect of a certain method of determining prices upon the revenues to be obtained by the city, and upon the interests of property holders, are all to be considered" (emphasis supplied). [citations omitted]"

6 *E.g.*, the Department of Public Utilities cited "the Commonwealth's long and successful history (dating back to the 1980s) of delivering energy efficiency services" in its Order regarding energy efficiency programs in Dockets 09-121 *et al.* at vii (Jan. 28, 2010).

7 First enacted in 1974 as Project Fuel (Office of Economic Opportunity). www.acf.hhs.gov/programs/liheap/library/history.html#74-79. LIHEAP was first enacted by P.L. 96-223 in 1981. *Id.;* http://www.liheapch.acf.hhs.gov/Funding/lhhist.htm. It is codified at 42 U.S.C. § 8621. *et. seq.*, 45 C.F.R. § 96.80 *et. seq.;* see LIHEAP Program, http://1.usa.gov/bO5nYy.

8 First enacted in 1975 as Emergency Energy Conservation Program (Community Services Administration). www.acf.hhs.gov/programs/liheap/library/history.html#74-79. WAP was enacted in 1977. http://www.liheapch.acf.hhs.gov/Funding/lhhist.htm. It is codified at 42 USC sec. 6861. *See* www.eere.energy.gov/weatherization, www.waptac.org/sp.asp?id=1437.

9 St. 1997, c. 164; low-income efficiency provisions affirmed by the Green Communities Act, G.L. c. 25, sec. 19(c) (St. 2008, c. 169, sec. 11).

10 G.L. c. 25, sec. 19 (St. 1997, c. 164, sec. 37). re-enacted by The Green Communities Act, G.L. c. 25, sec. 19(c) (St. 2008, c. 169, sec. 11). The Green Communities Act also designated a seat for the network on the newly created Energy

The Restructuring Act also codified important consumer protections (some previously only in DPU regulations),[11] including a mandate for utility energy efficiency investments financed by a system benefit charge.[12]

The Low-Income Energy Affordability Network (LEAN) was established shortly thereafter by the primary agencies of this network. Established originally to coordinate efficiency programs, LEAN has evolved to coordinate among program delivery agencies, program administrators (including utilities), and state and federal agencies to implement the entire panoply of low-income weatherization and fuel assistance programs in the Commonwealth. LEAN services include:

- Assistance in the development of the comprehensive low-income residential demand-side management and education programs, as required by statute.

- Assistance in monitoring and evaluating existing programs to improve cost-effectiveness and develop new program features. This includes development of evaluation strategies, coordination with evaluators, synthesizing statewide lessons from program evaluations, and coordinating a Best Practices effort.

- Support for the training of low-income weatherization and fuel assistance program network auditors, contractors, and administrators to achieve quality, cost-effectiveness, and consistency.

- Coordination among:

    - 11 PAs and their contractors,
    - 23 delivery agencies and their 94 auditors and 160 contractors,
    - the Energy Efficiency Advisory Council (EEAC) and its contractors,
    - the Massachusetts Department of Energy Resources (DOER),
    - the Department of Public Utilities (DPU),
    - the Massachusetts Clean Energy Centre (CEC),
    - the Massachusetts Department of Housing and Community Development (DHCD),
    - the US Department of Energy (DOE), and
    - the US Department of Health and Human Services (HHS), including a network of about 90 contracts, to deliver multiple state and federal programs,

Efficiency Advisory Council. St. 2008, §11; GL, c. 25, §22(a).

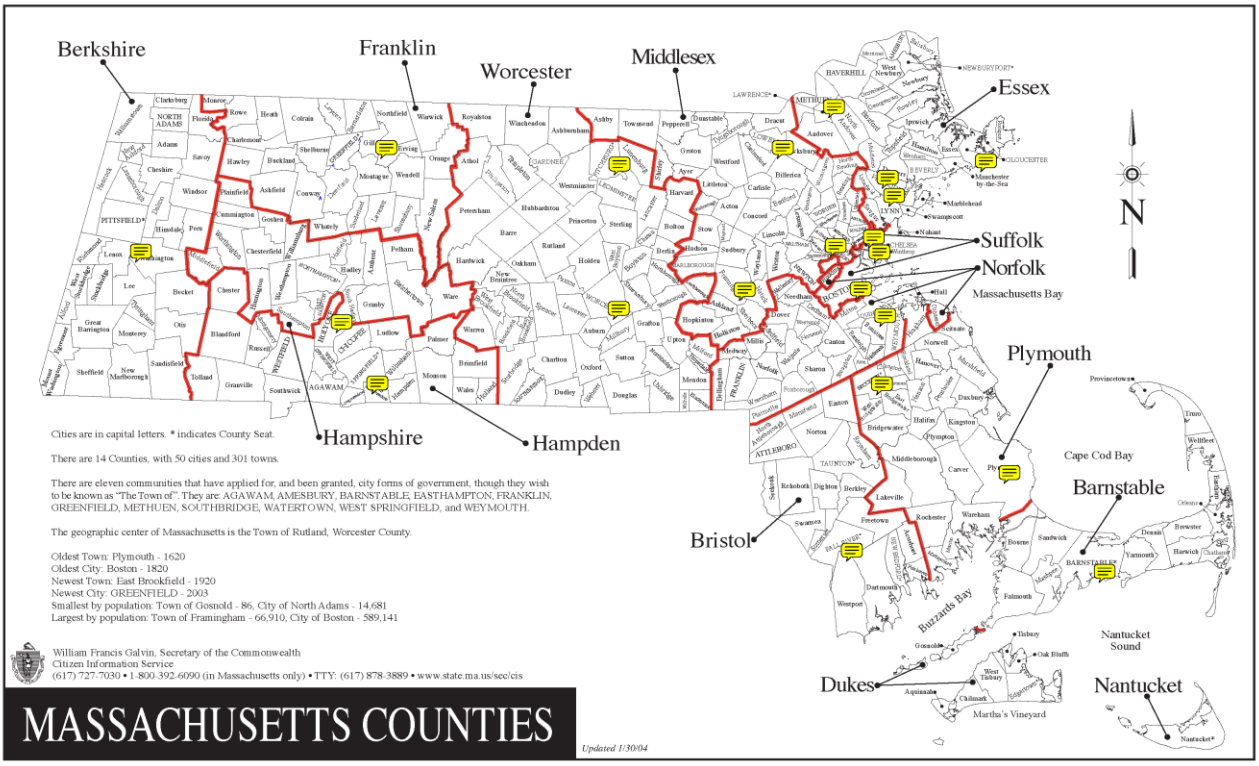
[11] For example, all existing DPU consumer protection regulations were adopted by the General Court, though the DPU is allowed to make them more protective. St. 1997, §193; GL, c.164, §1F(7). ("The department is authorized and directed to retain or make increasingly protective of retail ratepayers the rules adopted by the department and codified at Title 220 of the Code of Massachusetts Regulations, sections 25, 27, 28, and 29, and the policies reflected in the department's adjudication of customer complaints, and, notwithstanding anything in this chapter to the contrary, shall continue to apply them to generation and thus to all generation companies, generation facilities, aggregators, and suppliers.")

[12] St. 197, c. 164, § 37; GL, c.25, § 19. The DPU had been ordering utility-specific programs. This mandate was expanded and supported with additional funding by the Green Communities Act. St. 2008, c. 169, §11; GL, c. 25, §§19, 21(b), 21(d)(2).

including:

- Program Administrators' (PAs') efficiency programs under the Massachusetts Green Communities Act (GCA);
- DOE's Weatherization Assistance Program (WAP), administered by DHCD, including funds appropriated under the American Recovery and Reinvestment Act (ARRA);[13]
- HHS Low Income Home Energy Assistance Program (LIHEAP or fuel assistance), administered by DHCD to include the Massachusetts Heating System Repair and Replacement Program (HEARTWAP);
- the Arrearage Management Program created by the General Court[14] and overseen by the DPU; and
- research, development, and demonstration of innovative and renewable energy measures in low-income settings, overseen by the CEC pursuant to the GCA.

The LEAN network covers every corner of the Commonwealth:

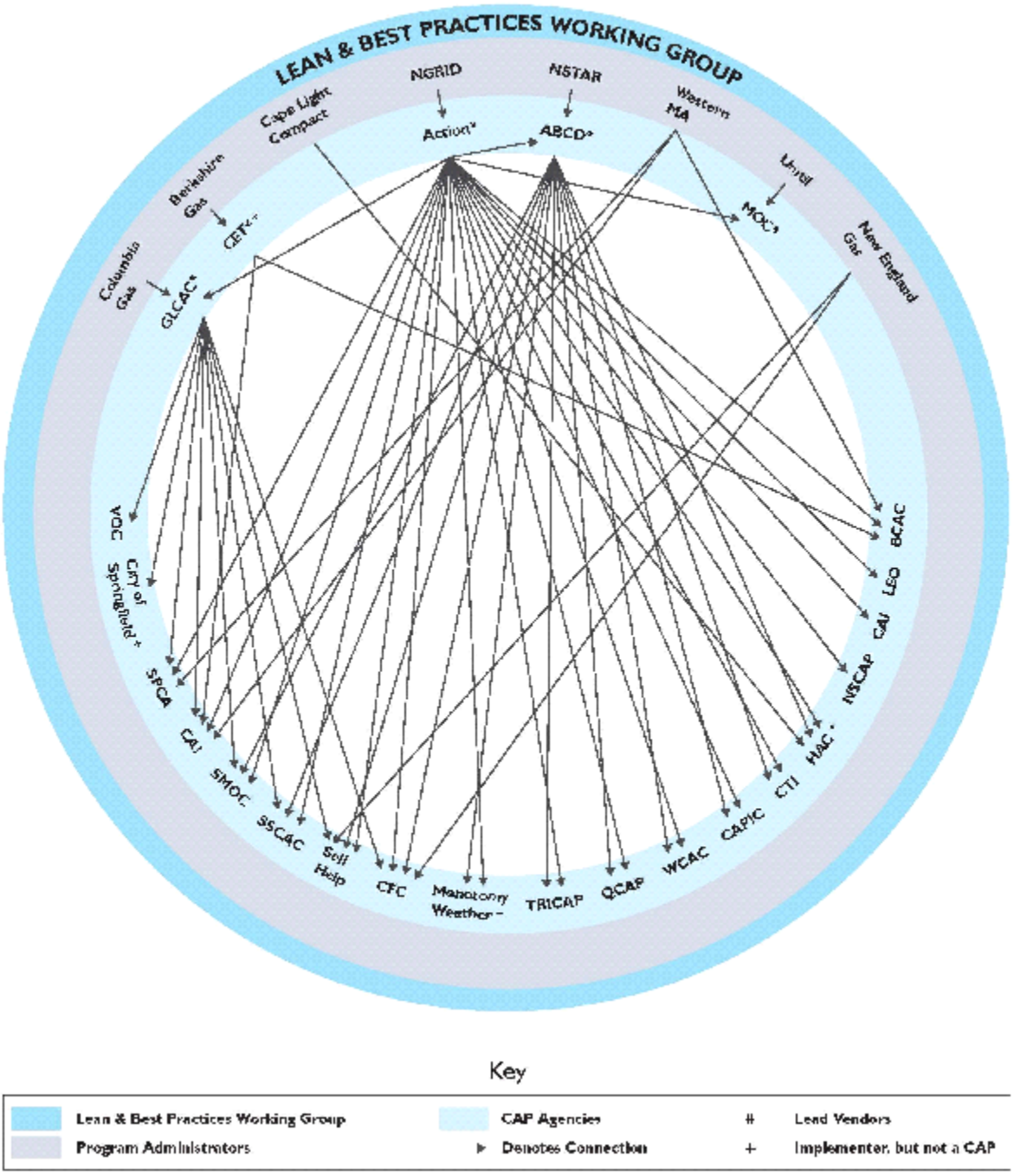


The LEAN network of agencies and PAs is well represented by this chart created by The Cadmus Group Inc.:[15]

[13] PL 111-5; http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h1enr.pdf.

[14] St. 2005, c. 240, §19(a).

[15] The Key indicates the agencies that are weatherization agencies but not Community Action Programs and which local



In 2010, LEAN delivered $80M in efficiency improvements alone – projected to rise to $93M in 2011, more than doubling its 2009 achievement. Over 20 years, LEAN has delivered almost $800M in efficiency improvements.

- 20,000 homes will be weatherized using American Recovery and Reinvestment

agencies are also Lead Vendors. Note that some PAs are served by one agency and therefore no lead vendor.

Act (ARRA) funding between fall 2009 and spring 2012, exceeding DOE goals.

- The network has added more than 400 full time jobs in Massachusetts since ARRA-funded Weatherization, at livable wages as established by federal law (Davis-Bacon or equivalent), which have been extended to all workers. The network now engages 94 auditors and 130 contractors.

- Measures are competitively priced. Contractors are licensed, insured, and fully trained.

- The network exceeded DOE WAP goals by 27%, weatherizing 822 units in 2011 as of June 15.

- The network served 24,000 units in PA programs in calendar 2010, expending $29.4 million, 97% of budgets.

- Deep, comprehensive, cost-effective investments are made in low-income homes, with a focus on upgrading inefficient heating systems and other large appliances as well as air sealing, lighting, health and safety. Savings to low-income families are typically 20% of heating bills (from air sealing), 10% of electricity bills.

- ARRA, WAP and PA programs are coordinated to maximize measure installation and efficiency of program administration.

- The network conducts 100% Quality Control (QC) inspections of contractor work to assure savings at a high level of confidence as well as customer satisfaction. In addition, there is a 20% independent QC inspection.

- Innovative and renewable measures in low-income settings include solar hot water, high efficiency domestic hot water and clothes washers, micro-combined-heat-and-power, high-efficiency wall insulation, smart electric strips, and LED lamps.

- Winter activities of the Heating System Repair And Replacement Program (HEARTWAP) focus on responding to no-heat emergencies; Spring/Summer activities focus on efficiency measures. $12M in 2010 efficiency measures included 2,150 “clean and tunes,” 5,360 system repairs, 2,500 system replacements, and 300 oil tank replacements. Typical heating system savings are 25%, or $760 a year at current prices for oil heat.

- It is projected that 1,400 HUD “Expiring Use” units (private low-income housing with subsidized mortgages about to expire) will be weatherized in 2011 at a cost of $6M. The result is to preserve these units as low-income housing while making them more energy efficient.

- Utility Arrearage Management Programs were established by law in 2005 after

several LEAN-led pilots, some financed by HHS. They are overseen by the DPU, which expanded them in 2009. The programs resulted in 2010 debt forgiveness by the utilities of more than $14.5 million and payments of more than $13.6 million by low-income customers who would otherwise have faced service termination. The utility arrearage management programs are open to all verified low-income customers in arrears for at least 60 days who owe at least $300 on their gas bills and/or $100 on their electric bills. In exchange for debt forgiveness, customers agree to a levelized budget billing plan and to pay an affordable amount on time each month. Fuel assistance, or LIHEAP, is credited to the customer before the monthly payment amount is calculated, and participants receive the utility low-income discount rate. Program participants are referred to the Network for weatherization and energy efficiency services to permanently lower their bills.

- The federal LIHEAP, administered by DHCD, helped 211,000 households heat their homes in 2010, with $181M. This included 41,000 households with a vulnerable member; *i.e.*, someone elderly, under five, or disabled. The LIHEAP caseload grew nearly 45% since 2008, yet the federal budget is projecting that only half of 2010's benefit level will be available in 2012. LIHEAP eligibility for Massachusetts is set at 60% of the state median income, or just over $59,000 for a family of four.

- Low-income rate discounts now range to 35% of the total utility bill, depending on the utility, and include 25% for natural gas, the predominant heating fuel.[16]

- Underlying these programs is a longstanding safety net of customer service protections enacted by the General Court and the DPU over the years and codified in 1997 by the Restructuring Act.[17] These protections include:[18]

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[16] The statute directs the DPU to "require that distribution companies provide discounted rates for low income customers comparable to the low-income discount rate in effect prior to March 1, 1998...The cost of such discounts shall be included in the rates charged to all customers of a distribution company. Each distribution company shall guarantee payment to the generation supplier for all power sold to low-income customers at said discounted rates. Eligibility for the discount rates established herein shall be established upon verification of a low-income customer's receipt of any means tested public benefit, or verification of eligibility for the low-income home energy assistance program, or its successor program, for which eligibility does not exceed 175 per cent of the federal poverty level ... Each distribution company shall conduct substantial outreach efforts ... and shall report to said division, at least annually, as to its outreach activities and results. Outreach may include establishing an automated program of matching customer accounts with lists of recipients of said means-tested public benefits programs and based on the results of said matching program, to presumptively offer a low-income discount rate to eligible customers so identified." G.L. c.164, §1F(4)(i). *E.g.*, Fitchburg Gas and Electric Light Company, D.P.U. 11-01 (electric)/11-02 (gas) at 462 (electric), 480 (gas) (Aug. 1, 2011).

[17] "The department is authorized and directed to retain or make increasingly protective of retail ratepayers the rules adopted by the department and codified at Title 220 of the Code of Massachusetts Regulations, sections 25, 27, 28, and 29, and the policies reflected in the department's adjudication of customer complaints, and, notwithstanding anything in this chapter to the contrary, shall continue to apply them to generation and thus to all generation companies, generation facilities, aggregators, and suppliers." G.L. c.164, §1F(7).

[18] *See* Charlie Harak, Utilities Advocacy For Low-Income Households In Massachusetts (National Consumer Law Center, 2d ed. 2007), http://www.masslegalservices.org/system/files/utility-handbook-2d-ed.pdf. There are also rules regarding billing and collection.

- Protection from disconnection while a bill is in dispute.[19]
- A goal of universal service.[20]
- Arrearage management (forgiveness) for low-income customers in arrears who keep to payment plans.[21]
- Customers in arrears not in the arrearage management program have the right to negotiate a payment plan at least four months long to eliminate the arrears and cannot have service terminated during the repayment term.[22]
- Protections against service terminations ("No company may shut off or fail to restore utility service . . .") for customers with a serious illness in the household, with an infant in the household, and during the winter period of Nov. 15 to Mar. 15.[23]
- Service to households where all occupants are over age 65 cannot be terminated without permission of the DPU.[24]

The progress of low-income energy efficiency programs in Massachusetts can be seen in this chart:

[19] "No distribution or generation company may disconnect or discontinue service to a customer for a disputed amount if that customer has filed a complaint which is pending with the department." G.L. c.164,.§1F(2).

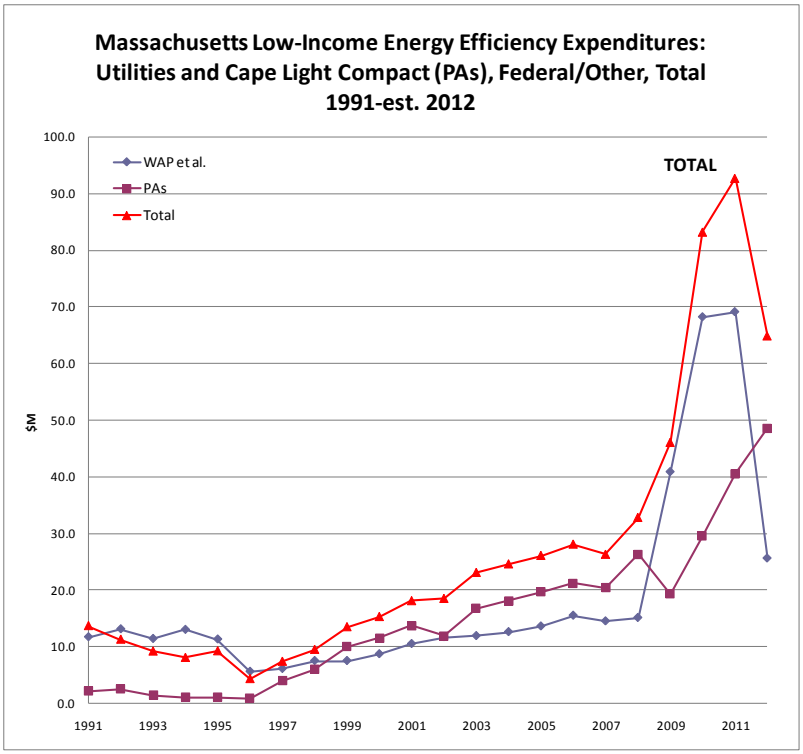
[20] "The department is authorized and directed to promulgate rules and regulations to establish service quality standards for each distribution, transmission, and gas company, including, but not limited to, standards for universal service ..." G.L.. c.164, §1F(7).

[21] St. 2005, c. 240, §19(a).

[22] St. 2005, c. 240, §19(b).

[23] G. L. c. 164, §§124A , 124 F, 124H ; 220 CMR 25.03(1). The DPU often extends winter moratoria to mid- or late-April, depending on the weather and energy prices.

[24] 220 CMR 25.05.



Regulatory oversight of these increasing expenditures has expanded on a similar scale and includes:

- Aggressive budgeting by the Massachusetts Energy Efficiency Advisory Council (EEAC), pursuant to the Green Communities Act and the Global Warming Solutions Act.[25]
- Development of programs and budgets by the newly established EEAC with stakeholder input that includes the Attorney General, residential and commercial customer interests, and environmental representatives.[26]
- Additional 5% quality control overseen by the EEAC, in addition to the 100% internal quality control already undertaken by the agencies (including in process QC) and 20% QC by DHCD.
- Updated process and impact evaluations overseen by the EEAC.
- Continued oversight by the DPU with particular focus on cost-effectiveness.[27]
- Significantly expanded Weatherization Assistance Program funding, including for innovative efficiency technologies, by the ARRA, with accompanying expansions in inspections and audits.
- Updated federal process and impact evaluations.
- Massachusetts Clean Energy Center oversight over innovative efficiency

[25] Green Communities Act. St. 2008, c. 169, §11; GL, c. 25, §§19, 21(b), 21(d)(2); Global Warming Solutions Act (GWSA), G.L. c. 21N; *see* http://www.mass.gov/dep/air/climate/gwsa.htm for regulatory actions under the GWSA.

[26] St. 2008, c. 169, §11; GL, c. 25, §22(a).

[27] St. 2008, c. 169, §11; GL, c. 25, §§21(b), 21(d)(2).

technologies.

Stakeholder communication is a key part of the low-income efficiency programs and is, in addition to daily management and the EEAC, accomplished largely through a Best Practices task force ("Best Practices") that brings together the implementing agencies and program administrators (mostly utilities) and all other interested stakeholders. Interested stakeholders usually include DHCD and a consultant on behalf of the EEAC; all others are welcome. Any topic can be raised at Best Practices, which usually focuses on training and recruitment of contractors and auditors, program delivery questions, and assessment of possible new measures and installation protocols. Where appropriate, statewide decisions are made.

A Best Practices working group has also been established for the utility arrearage management programs. The group meets at least quarterly to discuss implementation, participation rates, and outreach, as well to solve problems and share solutions. The working group comprises all of the utilities, the Network, the DPU, DHCD and the Attorney General.

Additional coordination of the agencies is conducted by periodic meetings of the lead agencies (LEAN), to which other stakeholders are also invited; as well as monthly meetings of agency energy directors (Massachusetts Energy Directors Association, MEDA). LEAN and MEDA oversee all low-income energy programs.

Research has shown that programs designed to keep essential utility services affordable for low-income families provides benefits not only to those families but also to society as a whole. Total benefits far outweigh the costs of the programs.

COST-EFFECTIVENESS

In Massachusetts, as is typical, budgets are set mostly with reference to the desired level of efficiency to be achieved and constrained primarily by bill impacts. Budgeting is thus largely a function of political decisions.

Once a budget is set, the role of cost-effectiveness analysis is to help determine which measures are best deployed to achieve the desired level of efficiency. Cost-effectiveness does also play a role in budget-setting, however. In some states, such as Massachusetts, the statutory mandate is to achieve "all available energy efficiency and demand reduction resources that are cost effective."[28] In others, cost-effectiveness analysis is used to demonstrate the economic rationale for making efficiency improvements in the first place.[29]

Cost-effectiveness analysis is usually reduced to a benefit:cost ratio (BCR), where cost is the program cost (measures plus all overheads) and benefits are the net present value of an array of benefits. The most obvious benefits are costs directly avoided by energy efficiency -- avoided energy commodity costs, and avoided transmission and distribution costs, projected over the measure life of the efficiency improvements. Also included are other internalized costs, principally charges related to environmental pollution.[30] Somewhat more controversial is demand-reduction-induced price effects (DRIPE), a calculation of price reductions due to reductions in demand for commodity.[31]

For many measures in high-cost utility service territories, cost-effectiveness can be established on this basis alone.[32] However, non-energy benefits (NEBs) are often also determined. As a result, additional measures (and programs with additional measures) will pass cost-effectiveness screening. Thus, although some NEBs represent additional direct utility cost reductions, to some extent NEBs represent social or policy judgements about valuation of benefits that flow from energy efficiency other than direct energy savings. Prominent examples include low-income affordability, job development, and clean air.

NEBs are generally classified as utility (ratepayer) benefits, participant benefits, or

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[28] Stat. 2008 c. 169, §11; GL c. 25, §21(b)(1). Note, however, that bill impacts must also be taken into account. E.g., "the lowest reasonable customer contribution" is required. *Ibid.*

[29] *E.g.*, J. Oppenheim and T. MacGregor,, "The Economics Of Low-Income Electricity Efficiency Investment In Arkansas" (Entergy Corp., Feb. 2002).

[30] Internalized environmental costs are typically measured by renewable energy credits and federal and regional cap-and-trade credits (such as under the Regional Greenhouse Gas Initiative (RGGI) in the Northeast) and projections thereof. *See* R. Hornby *et al.*, Avoided Energy Supply Costs in New England: 2011 Report (Synapse Energy Economics, July 21, 2011) at c. 2, pp. 14-19; c. 6 at pp. 26-27; secs. 6.6, 7.2. *But see* the discussion of environmental benefits below for broader definitions of avoided internal environmental costs; *see* Hornby *et al.* at secs. 6.6, 7.2)..

[31] R. Hornby *et al.*, Avoided Energy Supply Costs in New England: 2011 Report (Synapse Energy Economics, July 21, 2011) at sec. 6.3.

[32] Cost-effectiveness is usually reviewed on a program basis, not on a measure basis. *E.g.*, "A Program Administrator shall perform cost-effectiveness screening on an Energy Efficiency Program-specific basis." Energy Efficiency Evaluation Guidelines, sec. 3.4.3.1, D.P.U. 08-50-B (Mass., Oct. 26, 2009).

societal benefits, in accordance with the principal beneficiary. Examples of such benefits follow.

Utility benefits

Historically, less than one half of utility arrearages are actually attributable to low-income customers.[33] Low-income customers are more likely to be in arrears due to lack of funds with which to pay utility bills than are non-low-income customers. Since studies show these customers want to pay their bills if they can,[34] energy efficiency measures that release funds are more likely to result in payments against arrearages (and thus fewer write-offs) from low-income customers than from others. The benefits flowing from arrearage reduction (cost of money, uncollectibles, collection costs) have been long and widely studied.[35]

Other utility benefits that have been studied include:

- Reduced costs of termination for non-payment and subsequent reconnection,[36]
- Low-income discounts avoided (where they exist) due to reduced sales,[37]
- Reduced administrative expenses from customer calls and billing notices,[38] and
- Reduced gas emergency calls.

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[33] Quaid, M., and Pigg, S., "Measuring the Effects of Low-Income Energy Services on Utility Customer Payment Behavior," *Proceedings of the 1991 Fifth International Energy Program Evaluation Conference*, 1991.

[34] R. Grosse, "Win-Win Alternatives to Credit & Collections" (Wisconsin Public Service Co. 1997).

[35] *See e.g.*, Mass. DTE 98-100 Guideline 3.3.2(e)(i,ii,iv). Some examples include: Linda G. Berry, et al., "Progress Report of the National Weatherization Assistance Program," at 38, 45 (Oak Ridge National Laboratory, 1997); Biewald, et.al., "Non-Price Factors of Boston Edison's Demand-Side Management Programs: A Review of the Societal Benefits of Energy Efficiency," (1995) at pp. 14-2 - 14-5; J.K. Magouirk, "Evaluation of Non-energy benefits from the Energy $avings Partners Program," 1995 Energy Program Evaluation Conference, Chicago, pp. 155-175 (1995); Jane Peters, et al., "Final Report: Non-Energy Benefits Accruing to Massachusetts Electric Company From the Appliance Management Program" (Research Into Action, Dec. 1999); Lisa A. Skumatz, Chris Ann Dickerson, "Extra! Extra! Non-Energy Benefits Swamp Load Impacts for PG&E Program!" 1998 Summer Study on Energy Efficiency in Buildings Proceeding, pp. 8.301-8.307 (American Council for and Energy Efficient Economy, 1998).

[36] *See e.g.*, DTE 98-100 Guideline 3.3.2(e)(iii) (Mass.). The cost of a visit may be based on a utility's tariffed fee for reconnection, which may be assumed to be cost-based. There is typically no disconnect fee.

[37] Every low-income participant is typically enrolled in the Company's low-income discount rate, e.*g.*, PEPCo tariff P.S.C. No. 1, 2d rev. p. no.R-3.1, 2d rev. p. no. R-20.1, with perhaps a negligible number of exceptions. The rate provides a stated per kWh discount (or percentage discount off a stated rate). Thus, when a participant's usage is reduced, the discount (foregone revenue) provided to the participant is also reduced.

[38] Skumatz Economic Research Associates, "Massachusetts ESP Program Non-Energy Benefits" at 6-4 (Northeast Utilities Service Co., March 2002) estimates number and duration of calls as well as number and cost of collection notices. *See also* TecMRKT Works *et al.*, "The Low-Income Public Purpose Test, v. 2.0, A Microsoft Excel Based Model" (RRM Cost Effectiveness Subcommittee, May 2001) (re: California). Other collection cost savings, such as avoided administration of payment plans, litigation, and office visits, are more difficult to estimate, although there is much agreement that low-income efficiency programs reduce utility administrative and regulatory costs. *See e.g.*, DTE 98-100 Guideline 3.3.2(e)(ii) (Mass.). For example, the Columbia Gas Company reported that, accounting for time of customer service representatives and clerical worker along with associated overhead, in 1989 it incurred a cost of $14.64 for each individual payment plan negotiation. R. Colton, "Identifying Savings Arising from Low-Income Programs" (National Consumer Law Center, 1994) at 7.

A recent literature search in Massachusetts[39] found a range in these benefits totaling $3.45 to $92.86 per participant per year (including 26 cents to $32 for arrears reduction alone)[40] and recommended that a value of $16.43 (including $8.43 with respect to gas emergency calls) per participant per year be included in utility avoided costs. Thus, while important, collective utility NEBs are relatively small.

Participant benefits[41]

BILL REDUCTIONS GENERALLY

Most, though not all, participant benefits from energy efficiency flow in one way or another from reduced energy use or reduced bills. As described above, utilities benefit from reduced arrears, reduced bad debt write-offs, reduced costs of terminations for non-payment and subsequent reconnection, and reduced low-income discounts. Participant benefits flowing from reduced energy bills include health benefits from ability to spend more on health improvements, reduced forced mobility from increased ability to prevent termination of utility service for non-payment, increased property values due to lower energy bills.

It has been argued that it is inappropriate to count as non-energy benefits any that flow from bill (or energy) reductions since the latter are already counted in the analysis of avoided energy supply costs.[42] The argument largely negates the concept of non-energy benefits since so many non-energy benefits result from lower bills. The benefit to low-income customers from bill reductions is not fully measured by counting dollars of bill reductions since so limiting the analysis ignores benefits that result from being better able to afford such necessities as food, medicine, other health care, and rent. These benefits include improvements in health and reduced forced mobility due to terminations of utility for nonpayment, which are not included in the analysis of reduced energy supply costs from the viewpoint of utilities. For such reasons, the Massachusetts regulator's guidelines require the

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[39] NMR, "Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation" (Tetra Tech, Aug. 15, 2011). It is expected that this study will be submitted for regulatory approval.

[40] A literature search by Lisa Skumatz found individual low-income utility benefits totaling as much as $552, including $76 in arrears costs, though a total utility perspective up to $31. L. Skumatz, "Non-Energy Benefits: Status, Findings, Next Steps, and Implications for Low Income Program Analysis in California" (Skumatz Economic Research Associates/The Cadmus Group, May 11, 2010).

[41] See e.g., DTE 98-100 Guideline 3.3.3(a) (Mass.).

[42] NMR, "Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation" (Tetra Tech, Aug. 15, 2011)." NMR does not recommend including any NEIs that are derived from participant bill savings because it would amount to double counting of benefits. To count benefits that derive from bill savings would amount to valuing the additional disposable income (i.e., bill savings) and the ways in which the participants spend the disposable income. For example, a participant may spend the bill savings on food or medicine, leading to improved health. Similarly, participants may use their bill savings to pay energy bills, reducing the incidence of service terminations and the costs associated with service termination and reconnection. But to count both the bill savings and the health benefits or the benefit of reduced service terminations that are derived entirely from the way bill savings are spent is to count the same benefit twice. Other examples of NEIs derived from bill savings include reduced bill-related calls and reduced need to move or forced mobility." At p. 5-1. NMR does not apply this idea consistently. The issue has not been addressed by the regulatory commission for the benefit of which the study was done.

counting as non-energy benefits of "all benefits associated with providing energy efficiency services to Low-Income Customers"[43] as well as such bill-reduction-caused benefits as "reductions in all costs to the electric Distribution Company associated with reduced customer arrearages and reduced service terminations and reconnections."[44]

HEALTH AND SAFETY[45]

Fire, carbon monoxide (CO)

Many low-income households have old and poorly maintained space and water heating systems that present safety risks to occupants. High utility bills and service disconnections lead to use of fire-hazardous alternative heating sources, such as electric space heaters, or gas ovens or grills.[46]

The danger of fire in low-income homes can be reduced, at least by elimination of the use of electric space heaters that cause fires both from contact and from overuse on inadequate wiring. Reduced lighting wattage also reduces fires due to inadequate wiring. Estimates of this value are as high as $425.78.[47]

A middle ground, based on the literature, is an avoided cost of $38.67 per heating system participant per year for avoided deaths, injuries and property damage due to fire, and $6.38 for avoided CO poisoning.[48]

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[43] *E.g.*, Energy Efficiency Evaluation Guidelines, sec. 3.4.4.1(b)(ii)(D), D.P.U. 08-50-B (Mass., Oct. 26, 2009).

[44] *E.g.*, Energy Efficiency Evaluation Guidelines, sec. 3.4.4.1(a)(viii), D.P.U. 08-50-B (Mass., Oct. 26, 2009).

[45] See e.g., DTE 98-100 Guideline 3.3.3(a)(iii) (Mass.).

[46] Spade, et al., "The Energy Affordability Crisis of Older Americans: An Examination of the Hazards to Health and Well-being Posed by the Growing Incidence of Unmet Home Energy Needs," p. 36 (National Consumer Law Center, 1995).

[47] J. Riggert et al., "An Evaluation of the Energy and Non-energy impacts of Vermont's Weatherization Assistance Program" (TecMRKT Works, 1999).

[48] NMR, "Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation" (Tetra Tech, Aug. 15, 2011), estimates as follows (at p. 5-38), noting that "low-income households that cannot afford to pay their heating bills, or have been terminated from service due to nonpayment, have been known to resort to alternative sources of home heating, which are more likely to cause fires and carbon monoxide poisoning. Similarly, households that have had electric service shut off and resort to candles for lighting are at an elevated risk of experiencing a fire" (at p. 5-34). Note that the values below are with respect to participants, not society at large.

- Avoided fire deaths:$37.40
  - [(0.004 (Rate of fire deaths caused by residential heating equipment per 1,000 households, US) * $9,100,000 (Value of lost life, US EPA) * (Number of heating systems replaced & repaired by PA programs / 1,000)]
- Avoided fire-related injuries: $0.03
  - [(0.014 (Rate of fire injuries caused by residential heating equipment per 1,000 households, US) * $7,421 (Value of medical costs for treating fires, CDC) * (Number of heating systems replaced & repaired by PA programs / 1,000) * 0.25 (percentage of heating system related fire injuries avoided, Brown et al., 1993)]
- Avoided fire-related property damage: $1.24

Illness

Considerable research shows that there are substantial low-income health problems caused by lack of heat.[49]

Perhaps the leading research on the connection between childhood health and the lack of consistent access to adequate energy to support health and safety – as measured by the existence of a notice of termination for non-payment or a lack of heat due to non-payment – has been conducted by John T. Cook and Deborah A. Frank of Boston Medical Centre, and others.[50] They found important impacts of such energy insecurity on food insecurity, hospitalization (up to 22% worse), fair/poor health (up to 36% worse), and significant developmental concerns (up to 82% worse).[51]

A significant study that also includes adults is based on a project in Southwest Minnesota that rehabilitated low-income housing using "green and healthy principles." "Immediately after homes were renovated, large and statistically significant improvements were reported for adults in general health, chronic bronchitis, hay fever, sinusitis and asthma. Hypertension in adults also improved ….there were also improvements in children's general health, children's respiratory allergies, children's ear infections, comfort, safety and ease of housecleaning. … these improvements were detected even though the baseline population in the

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- [(0.566 (Rate of fires caused by residential heating equipment per 1,000 households, US) * $17,483 (Average value of residential property loss) * (Number of heating systems replaced & repaired by PA programs / 1,000) * 0.25 (percentage of fires avoided, Brown et al., 1993))/ 2 (Brown et al., 1993)]

- Avoided deaths attributable to CO poisonings: $6.38

  - [(0.0007 (Rate of deaths attributable to CO poisonings due to residential heating equipment per 1,000 households, US) * $9,100,000 (Value of lost life, US EPA) * (Number of heating systems replaced & repaired by PA programs / 1,000)]

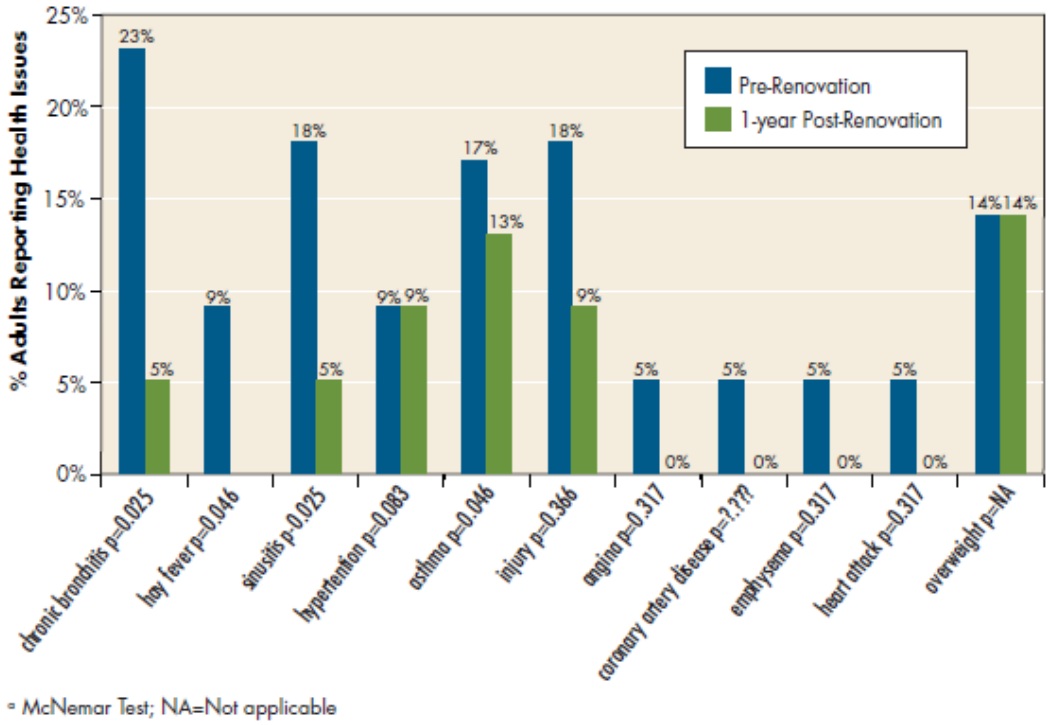
[49] See e.g., J. Riggert et al., "An Evaluation of the Energy and Non-energy impacts of Vermont's Weatherization Assistance Program" (TecMRKT Works, 1999).

[50] *E.g.*, John T. Cook *et al.*, "A Brief Indicator of Household Energy Security: Associations With Food Security, Child Health, and Child Development in US Infants and Toddlers," 122 Pediatrics at e867-e875 (No. 4, Oct. 2008).

[51] See also John T. Cook, "Household Energy Security: Part of a Constellation of Hardships That Harm Child Health ," presentation to National Energy and Utility Affordability Conference (June 27-28, 2011), http://www.energyandutilityconference.org/Assets/2011%20Conference/2011%20Presentations/5E_John%20Cook.pdf (also citing Frank, et al., "Heat or Eat: The Low Income Energy Assistance Program and Nutritional Risk Among Children Less Than 3 Years of Age," Pediatrics, Nov 2006, 118(5):e1293-e1302.: lack of LIHEAP increases nutritional risk for growth problems by 23%, acute hospital admissions by 32%). See Deborah A. Frank MD, "Heat Or Eat: Children's Health Watch," presentation to International Energy Agency workshop Evaluating The Co-Benefits Of Low-Income Weatherization Programmes (Jan. 28, 2011), http://www.iea.org/work/2011/poverty/pres13_FRANK.pdf; P. Howden-Chapman, "Reducing fuel poverty by improving housing," presentation to International Energy Agency workshop Evaluating the co-benefits of low-income weatherization programmes (Jan. 27, 2011); R. Chapman, P. Howden-Chapman, et al., Retrofitting houses with insulation: a cost-benefit analysis of a randomised community trial, J Epidemiol Community Health. 2009 Apr;63(4):271-7 (Reduced hospital respiratory admissions, NZ$2231, reduced lost school days NZ$242, reduced lost work days, NZ$179; present values at 5%, NZ$=US$0.7589 at October 3, 2011).

buildings was generally in good health at the time of renovation."[52] For example:[53]

Figure 3-3. Changes in Reports of Specific Adult Health Issues (N=22): Pre-Renovation (T0) versus One-Year Post-Renovation (T2)*



* McNemar Test; NA=Not applicable

It has been well-known for decades that children in low-income families and the elderly poor are particularly susceptible to weather-induced health problems. Indeed, hypothermia and hyperthermia are examples of potentially fatal health conditions that are most common among elderly people with limited ability to pay for adequate levels of energy service.[54] For example, among those most likely to develop hypothermia are the poor who cannot afford to pay for adequate home heating.[55] Older people living in poverty are more likely than their non-poor counterparts to experience rapidly declining health and to develop difficulties performing routine daily activities as they age. Thus, low-income individuals are at a much higher risk of requiring nursing home care as they age.[56] Finally, high energy burdens cause low-income households to forego expenditures on preventive health measures and

[52] Enterprise Community Partners, Inc. (Columbia, Md.), " Case Study: Creating Green and Healthy Affordable Homes for Families at Viking Terrace, Worthington, Minn. (National Center for Healthy Housing, 2010).

[53] *Ibid* at p. 16.

[54] Spade, et al., "The Energy Affordability Crisis of Older Americans: An Examination of the Hazards to Health and Well-being Posed by the Growing Incidence of Unmet Home Energy Needs," p. 28 (National Consumer Law Center, 1995).

[55] Bonnie Guiton, "Special Report on Cold Stress and Heat Stress," p. 1 (U.S. Office of Consumer Affairs).

[56] Interview with Raymond Coward, Dean of the School of Health and Human Services, University of New Hampshire from "USA Today Magazine," April 1998, v 126 n2635 p. 5.

nutritional food items.[57]

A modest estimate of the cost of lost work days and over-the-counter medicine, currently adopted by most Massachusetts utilities, is $150 per weatherized home per year, which does not include the intrinsic value of lost good health and other medical care costs such as nursing homes. Also not accounted for here are health benefits that result from increased disposable income due to lower utility bills, which can be devoted to improved nutrition and preventive medical care.[58]

While the research described here is instructive from a health policy point of view, there is a gap in quantifying the dollar benefit per energy efficiency (or LIHEAP) participant. More work is needed to translate the health benefits to dollars, *e.g.,* value of reduced ER visits, reduced number of hospital days, and reduced need for medicine. In addition, the participant monetary benefit needs to be separated from societal benefits (*e.g.*, savings to Medicaid) since many jurisdictions will only consider the participant monetary benefit.

PROPERTY VALUES

Studies confirm that efficiency investments increase the value of a home proportionately to the energy and utility savings achieved. The leading study establishes the value of these energy savings in increased property value as $20.70 for each dollar in annual energy savings.[59] However, subsequent studies have found higher values:[60]

Property value increases due to $1 in energy bill savings

Study	Result	Year	Result Inflated to 2011$ (CPI - housing inflation >)

[57] Cambridge Systematics, Inc., "Hard to Quantify Benefits and Costs Scoping Study" (Prepared for the New York Low-Income Evaluation Task Force, 1994).

[58] Lisa A. Skumatz (Skumatz Economic Research Associates), Chris Ann Dickerson (PG&E), "Extra! Extra! Non-Energy Benefits Swamp Load Impacts for PG&E Program!" 1998 Summer Study on Energy Efficiency in Buildings Proceeding, p. 8.307 (American Council for and Energy Efficient Economy, 1998). Because of its narrow scope, we use the high end of this estimate. L. Skumatz and C. A. Dickerson, "Recognizing All Program Benefits: Estimating the Non-Energy Benefits of PG&E's Venture Partners Pilot Program (VPP)," 1997 Energy Evaluation Conference (Chicago) 279; Skumatz and Dickerson, "What Do Customers Value? What Benefits Utilities? Designing to Maximize Non-Energy Benefits From Efficiency Programs in the Residential Sector, 1999 Energy Program Evaluation Conference (Denver) 415. The NMR literature search found estimates up to $330. NMR, "Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation" (Tetra Tech, Aug. 15, 2011).

[59] Nevin, et al., "Evidence of Rational Market Valuations for Home Energy Efficiency," The Appraisal Journal, p. 403 (Appraisal Institute, 1998). Nevins/Watson regressed actual home sale prices against homeowner bill reductions from identified energy savings.

[60] *See* B. Hoen, R. Wiser, P. Cappers, and M. Thayer, "An Analysis of the Effects of Residential Photovoltaic Energy Systems on Home Sales Prices in California" (Lawrence Berkeley National Laboratory, April 2011), http://eetd.lbl.gov/ea/emp/reports/lbnl-4476e.pdf ("When expressed as a ratio of the sales price premium to estimated annual electricity cost savings associated with PV, an average ratio of 14:1 to 22:1 can be calculated; these results are consistent with those of the more-extensive existing literature on the impact of energy efficiency (and energy cost savings more generally) on home sales prices." At 3.)

	$		$
Johnson	20.73	1978	71.73
	$		$
Longstreth	13.88	1980	38.03
	$		$
Laquatra	48.64	1980?	133.27
	$		$
Dinan	11.63	1988?	22.21
Nevin; Nevin *et al.*	$ 20.73	1996?	$ 29.85

Sources:
*J. Dubin, "Market Barriers to Conservation: Are Implicit Discount Rates Too High? (CalTech, June 1992),
http://www.hss.caltech.edu/SSPapers/sswp802.pdf
*Johnson, R. C. and Kaserman, D. L. (1983) Housing Market Capitalization of Energy-Saving Durable Good
Investments. Economic Inquiry. 21: 374 - 386.
*Longstreth, M., Coveney, A. R. and Bowers, J. S. (1984) Conservation Characteristics among Determinants
of Residential Property Value. Journal of Consumer Research. 11(1): 564-571.
*Laquatra, J. (1986) Housing Market Capitalization of Thermal Integrity. Energy Economics. 8(3): 134-138.
*Dinan, T. M. and Miranowski, J. A. (1989) Estimating the Implicit Price of Energy Efficiency Improvements
in the Residential Housing Market: A Hedonic Approach. Journal of Urban Economics.
25(1): 52-67.
*Nevin, R., Bender, C. and Gazan, H. (1999) More Evidence of Rational Market Values for Energy Efficiency.
The Appraisal Journal. 67(4): 454-
460.

Note that, unlike most non-energy benefits, these are one-time benefits rather than annual.

OTHER PARTICIPANT BENEFITS

Avoided appliance purchase[61]

Where the program purchases a refrigerator or other appliance for a participant, it replaces a refrigerator that would eventually have been replaced using the participant's own funds. Thus the participant gains the present value of the funds that would have been expended at the end of the refrigerator's operating life.

[61] See e.g., DTE 98-100 Guideline 3.3.3(a)(ii) (Mass.).

Moving expenses, homelessness[62]

Research shows that termination of utility service is a frequent cause of a low-income family's moving to other shelter or even to homelessness. For example, a Philadelphia study found that 32% of low-income households move after utility termination. [63] Similarly, a study of homelessness in Northern Kentucky indicates that utility shutoffs were among the primary causes of homelessness in that region.[64]

An analysis conducted by the Upjohn Institute of the determinants of the decision of low-income renters to move out of their dwellings reveals that low-income renters are willing to pay sizable portions of their annual incomes to not move.[65] The study further reveals that there is a very high psychological and financial cost of mobility among low-income renters, particularly those who are elderly or whose households include children. The study found average moving costs for "typical" low-income households to be between ten percent and 20 percent of annual income.[66] Thus there is high value to programs that reduce the need of low-income households to move.

Low-income energy efficiency improvements reduce forced mobility by reducing the level of energy/utility expenditure required to attain a minimal living standard, thus freeing up funds to pay rent or other required housing costs. In addition, weatherization improvements ameliorate dangerous or substandard conditions in heating equipment or building shell that might otherwise force a household to relocate.

Thus reducing terminations for non-payment reduces the need for families to move. The benefit of avoiding this cost could be computed as the number of avoided annual terminations times average moving cost times the 32% incidence of terminations causing forced mobility. One study[67] computes this value as $50 per

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62 See e.g., DTE 98-100 Guideline 3.3.3(a)(iv) (Mass.).

63 Liz Robinson, "An Examination of the Relationship between Utility Terminations, Housing Abandonments and Homelessness," pp. 1, 2 (Energy Coordinating Agency of Philadelphia, 1991). (A Maine survey found 42%.) Through a name match between Philadelphia Electric Company's list of termination notices and lists of homeless adults served by the City of Philadelphia, the study found a discernable relationship between utility termination and homelessness. In surveys of individuals living in emergency shelters, 7.9 percent of respondents cited utility terminations as the reason for their homelessness. (Higher percentages cited related causes, such as "eviction for non-payment" and lack of housing in the income range as the causal factors.) The study noted that of the many factors contributing to homelessness, mitigation of high energy costs is among those "most susceptible to remedy."

64 William K. Woods, et al., "Homelessness and Low-Cost Housing in Northern Kentucky," p. 2 (Northern Kentucky Coalition for the Homeless and Applied Information Resources, 1990).

65 Bartik, et al., "Maximum Score Estimates of the Determinants of Mobility: Implications for the Value of Residential Attachment and Neighborhood Amenities," Upjohn Institute Staff Working Paper 90-01, pp. 1, 10-11(1990).

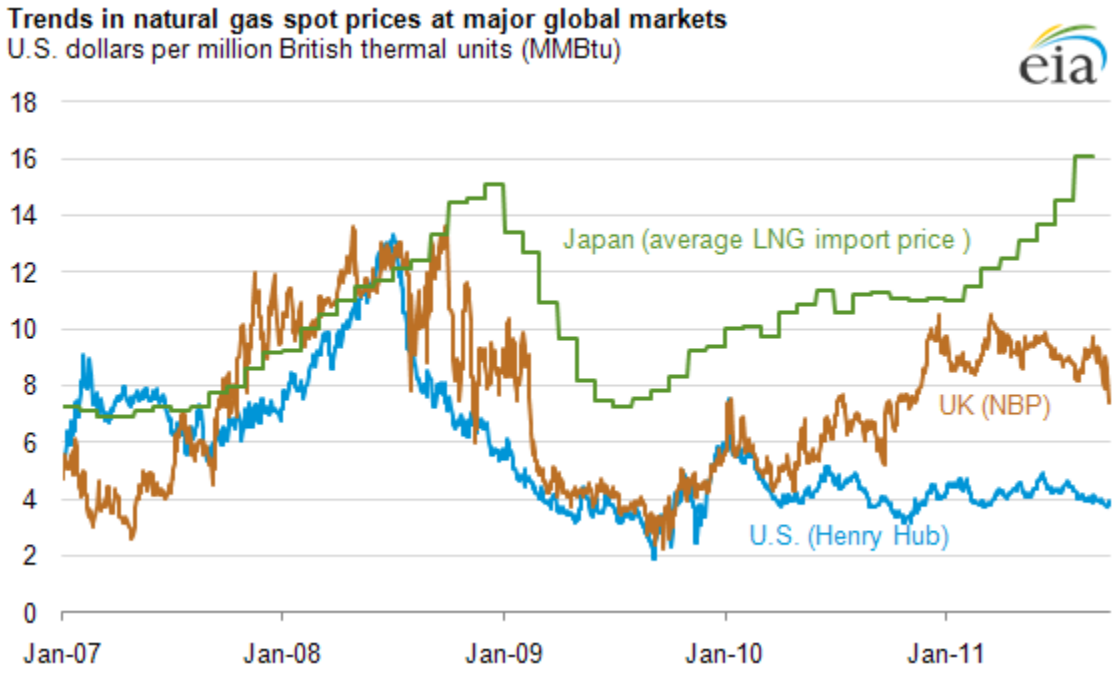
66 Id. at 10-11. A "typical" low-income household, based on overall means of the sample population, consisted of a non-minority household, with no spouse present, two children, and a head age 44, which had been at its current residence for 48 months.

67 J. Riggert et al., "An Evaluation of the Energy and Non-energy impacts of Vermont's Weatherization Assistance Program" (TecMRKT Works, 1999). One might conservatively assume a $500 (avoided) moving cost, as well as the lost value of education. Full-time, year-round workers without a high school diploma earn more than 30 percent less than

household annually.

Price stability

Natural gas is used for most US home heating and, at the margin, for much US electricity production. The US price of gas has been volatile in recent years, though considerably less so in the most immediate past:[68]



During a time of higher volatility in US gas prices, it was estimated that "natural gas consumers have had to pay a premium of roughly 0.50¢/kWh over expected spot prices to lock in natural gas prices for the next 10 years," a measure of the price stability value of a technology that reduced reliance on natural gas.[69]

Customer time

Increases in customer calling were noted above in the discussion of avoided utility administrative costs. Customers save the same amount of time calling as utilities save taking calls. This time might be valued at the minimum wage and has been estimated at up to $20 per participant per year.[70]

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those with a diploma. In the period 2000-2005, only those with doctorates or the equivalent (including MBAs) enjoyed income increases that outpaced inflation. D. Wessel, "Why It Takes a Doctorate to Beat Inflation," *Wall St. Journal* at A2 (Oct. 19, 2006) (based on US Census CPS).

[68] U.S. Energy Information Administration, based on Bloomberg, L.P. Note: Average Japanese LNG prices available only monthly, latest figures are for August. http://www.eia.gov/todayinenergy/detail.cfm?id=3310 (accessed Oct. 3, 2011).

[69] Mark Bolinger et al., "Quantifying The Value That Wind Power Provides As A Hedge Against Volatile Natural Gas Prices" (Lawrence Berkeley National Laboratory, LBNL-50484, June 2002). The NMR literature search found estimates of this value ranging between $161 and $611 per participant per year.

[70] L. Skumatz, "Non-Energy Benefits: Status, Findings, Next Steps, and Implications for Low Income Program Analysis

Survey research re subjective participant benefits

Survey research is well suited to more subjective participant benefits of energy efficiency, such as increased comfort. Work has been done in the last decade or so to make these estimates somewhat more objective by such means as comparing the value of the benefit to the value of energy saved.

Customers place a high value on continuous electricity service, i.e., reduced service terminations.[71] Valuation of lost service due to outages has been performed in connection with service quality cases. Skumatz estimates this value, based on survey research, at $13.03 per participant.[72]

Comfort is also an important benefit. Customers used to old, noisy refrigerators are understandably thrilled with the comparative ease of use of a new one. Similarly, customers place a high value on the elimination of drafts and other benefits of a fully weatherized home.

This inherently subjective value has also been estimated by Skumatz, based on survey techniques, at 12% of the total benefit.[73] Skumatz survey results show that customers value this comfort almost as highly as the bill savings themselves, the midpoint ranging between 75% and 92% of bill savings.[74] The NMR Massachusetts survey found a value of at least $101 per participant per year.[75]

Similarly, customers appreciate improved lighting quality, assigning a value of at least $56 per participant per year according to NMR survey research.[76] Customers

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in California" (Skumatz Economic Research Associates/The Cadmus Group, May 11, 2010).

71 See e.g., DTE 98-100 Guideline 3.3.3(a)(iv) (Mass.).

72 The midpoint of the lower of two studies summarized in Skumatz and Dickerson, "What Do Customers Value? What Benefits Utilities? Designing to Maximize Non-Energy Benefits From Efficiency Programs in the Residential Sector, 1999Energy Program Evaluation Conference (Denver) 415. See Lisa A. Skumatz (Skumatz Economic Research Associates), Chris Ann Dickerson (PG&E), "Extra! Extra! Non-Energy Benefits Swamp Load Impacts for PG&E Program!" 1998 Summer Study on Energy Efficiency in Buildings Proceeding, p. 8.307 (American Council for and Energy Efficient Economy, 1998); L. Skumatz and C. A. Dickerson, "Recognizing All Program Benefits: Estimating the Non-Energy Benefits of PG&E's Venture Partners Pilot Program (VPP)," 1997 Energy Evaluation Conference (Chicago) 279.

73 The lower result of two studies summarized in Skumatz and Dickerson, "What Do Customers Value? What Benefits Utilities? Designing to Maximize Non-Energy Benefits From Efficiency Programs in the Residential Sector, 1999Energy Program Evaluation Conference (Denver) 415. See Lisa A. Skumatz (Skumatz Economic Research Associates), Chris Ann Dickerson (PG&E), "Extra! Extra! Non-Energy Benefits Swamp Load Impacts for PG&E Program!" 1998 Summer Study on Energy Efficiency in Buildings Proceeding, p. 8.307 (American Council for and Energy Efficient Economy, 1998); L. Skumatz and C. A. Dickerson, "Recognizing All Program Benefits: Estimating the Non-Energy Benefits of PG&E's Venture Partners Pilot Program (VPP)," 1997 Energy Evaluation Conference (Chicago) 279.

74 Not surprisingly, this high value translates to high marks for the utility among program participants, who are 14% more likely to rate their utility highly than non-participants. Jane Peters, et al., "Process and Impact Evaluation of New England Power Service Company's Appliance Management Program" (Research Into Action, July 1998) at 15.

75 NMR, "Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation" (Tetra Tech, Aug. 15, 2011).

76 *Ibid.*

valued noise reduction at least $30 per participant per year in NMR survey research.[77] Home and equipment maintenance savings are valued at $89.[78]

SOCIETAL BENEFITS

The largest societal benefits of energy efficiency are preservation of the environment and creation of economic development (jobs).

Environmental

Low-income energy efficiency is a "twofer" – not only does it help protect the most economically vulnerable families, but it also helps make us all less vulnerable to climate change.

> Days with temperatures greater than 32°C (90°F) are predicted to increase from the 5 to 20 days annually that Massachusetts experiences today to between 30 to 60 days annually; while up to 28 days annually are predicted to reach above 38°C (100°F), compared to up to two days annually today. Sea surface temperatures are also predicted to increase by 4°C (8°F), while winter precipitation—mostly in the form of rain—is expected to increase by 12 to 30 percent. The number of snow events is predicted to decrease from five each month to one to three each month. [Higher temperatures, especially the higher incidence of extreme heat days, will have a negative impact on air quality and human health. In general, impacts from climate change on human health can include respiratory illnesses, exacerbation of allergies and asthma, an increase in vector borne diseases, and degraded water quality.]
>
> Massachusetts' vast coastline makes it particularly vulnerable to climate change. Assuming that sea level continues to increase at its current rate, by the end of the century, it is expected to rise by another one foot … By the end of this century, under the IPCC high emissions scenario with ice melt, it has been suggested that sea level rise resulting from all these factors could reach six feet … A sea level rise of 0.65 meters (26 inches) in Boston by 2050 could

[77] *Ibid.*, although NMR's literature search shows reports as high as $132.50. The Skumatz survey indicates $37. L. Skumatz, "Non-Energy Benefits: Status, Findings, Next Steps, and Implications for Low Income Program Analysis in California" (Skumatz Economic Research Associates/The Cadmus Group, May 11, 2010).

[78] *Ibid.*, although NMR's literature search shows reports as high as $202 (home) and $150 (equipment). Note that all NMR survey results are scaled to an additional question about total non-energy benefits. Raw responses are about twice as high.

damage assets worth an estimated $463 billion.[79]

The benefits of helping to avoid or minimize such environmental damage may be internalized (costs of compliance with air pollution regulations and carbon requirements) or externalities, an important distinction in jurisdictions that do not count externalities. In Massachusetts, for example, as noted above, the calculation of avoided energy costs includes carbon compliance costs that assume the current regional carbon cap-and-trade arrangement and projecting a federal cap-and-trade plan starting in 2017.[80]

Under this analysis, the difference between such costs and a carbon damage cost of $80 per ton (determined by analysis of a literature search) is regarded as an externality. The difference between the internality and the externality so calculated is shown in this table:[81]

Exhibit 6-57: CO2 Externality Calculations

year	Internal	External	
2011	$80	$1.89	*$78.11*
2012	$80	$1.89	*$78.11*
2013	$80	$1.89	*$78.11*
2014	$80	$1.89	*$78.11*
2015	$80	$1.89	*$78.11*
2016	$80	$1.89	*$78.11*
2017	$80	$1.89	*$78.11*
2018	$80	$15.30	*$64.70*
2019	$80	$18.28	*$61.72*
2020	$80	$21.25	*$58.75*
2021	$80	$24.23	*$55.77*
2022	$80	$27.20	*$52.80*
2023	$80	$30.18	*$49.82*
2024	$80	$33.15	*$46.85*
2025	$80	$36.13	*$43.87*
2026	$80	$39.10	*$40.90*

Values expressed in 2011 Dollars

[79] Massachusetts Climate Change Adaptation Report (Massachusetts Executive Office of Energy and Environmental Affairs, Sept. 2011), Executive summary at 1-2 (citations omitted). http://www.mass.gov/Eoeea/docs/eea/energy/cca/eea_climate_adaptation_ExecSummary.pdf. Full report at http://www.mass.gov/Eoeea/docs/eea/energy/cca/eea_climate_adaptation_report.pdf.

[80] The inclusion of environmental (and economic development) externalities in Massachusetts is currently uncertain. Massachusetts Electric Co. v. Department of Public Utilities, 419 Mass. 239 (1994), *but* Green Communities Act (GCA), St. 2008, c. 169; Global Warming Solutions Act (GWSA), (G.L. c. 21N); (Massachusetts Electric Co. long-term contracts to purchase wind power [Cape Wind], D.P.U. 10-54 (Nov. 22, 2010) at 172-173.

[81] R. Hornby *et al.*, Avoided Energy Supply Costs in New England: 2011 Report (Synapse Energy Economics, July 21, 2011) at p. 6-100.

Other estimates of both (internalized) carbon compliance costs and externalities are higher.[82] The impact of the various estimates depends on, for example, the generation mix in a particular place. In New England, it ranges to as much as 6.2 cents per kWh above projected avoided energy costs..

Economic development

In a study for the Entergy Corp.,[83] we analyzed the economic benefits of low-income energy efficiency, including how such investments multiply through the economy. We show that the investments:

- create jobs, the wages from which are spent on goods and services, thus creating more jobs, the wages from which are spent on more goods and services, and so on multiplying through the economy (net of the lesser multiplier effect of leaving these funds in household hands);
- lower energy bills, which puts more cash in the hands of low-income households to be spent on goods and services, multiplying as above (this is partially offset by the negative multiplier effect of reduced utility revenue);
- reduce pollution – particularly emissions of carbon dioxide, which in turn reduces property and health damage from climate change, conservatively measured as the cost of controlling carbon dioxide (*i.e.,* the projected price for an allowance to emit carbon dioxide); and
- result in other benefits not otherwise accounted for, such as reduced fires, lower crime rates, increased health, and reduced costs of utility collections and terminations, the value of which also multiply through the economy.

We found that, considering all these economic benefits, the economic multiplier for low-income energy efficiency in the US nationwide is more than 34, with 337 jobs created per million dollars of investment. Using a conventional benefit:cost analysis, we recently re-computed the conventional benefit:cost ratio of energy efficiency to be 9.5 – thus investments in efficiency return to society (including utilities, participants, taxpayers, and the environment) almost ten times their investment.

[82] *E.g., ibid.* at sec. 7.2. Another calculation relies on Renewable Portfolio Standard costs and computes a carbon-equivalent cost of $113. None of this is resolved at this time in Massachusetts.

[83] J. Oppenheim and T. MacGregor, "Energy Efficiency Equals Economic Development: The Economics of Public Utility System Benefit Funds" (Entergy Corp., June 2008), http://www.democracyandregulation.com/detail.cfm?artid=135&row=0.

National multipliers For every $1,000,000 in investment	Increased economic output	*Jobs*
ENERGY EFFICIENCY		
Net effect of investment	$5,773,943	*47*
Net effect of bill savings	$5,217,648	*105*
Effect of environmental improvement	$5,743,952	*36*
Effect of non-energy benefits	$17,437,091	*150*
TOTAL	**$34,172,634**	***337***

(Our economic multiplier studies also show that each dollar in LIHEAP assistance generates $5.40 of economic activity. A large part of this economic activity is jobs – 104 per million dollars spent.)

A more conventional Massachusetts-specific input-output study showed:

Exhibit A - 1: Economic Development Impacts of Massachusetts Electric and Gas Energy Efficiency (EE) (Net Impact Multipliers per $1 million)[2]

	Electric EE Net Impact	Gas EE Net Impact
MULTIPLIERS (per $1 million, 2009 $)		
Employment (job-years)	22.9	19.1
Earnings	$1,126,900	$885,200
Value-Added	$1,478,300	$891,500

This translates to 7 cents per kWh (about equal to avoided electric energy costs) and 36.5 cents per therm (about equal to 25% of avoided gas heating costs).[84]

TAXPAYER BENEFITS

Energy efficiency creates benefits to taxpayers from cost reductions, including reduced fire department costs due to reduction in fires, reduced Medicaid costs due to improvements in health,[85] reduced building and health department costs due to improvements in structures, reduced homeless shelter costs due to reductions in terminations that cause homelessness,[86] and increases in the real estate tax base due to increases in property values.[87]

[84] I. Goodman, "Value of Economic Development for Massachusetts," *in* R. Hornby et al., Avoided Energy Supply Costs in New England: 2009 Report (Synapse Energy Economics, August 21, 2009) at Appendix A.

[85] See the discussion of health, above.

[86] See the discussion of moving and homelessness, above.

[87] See the discussion of property values, above.

Little work has been done to quantify these taxpayer benefits. However, we did examine avoided taxpayer costs of fires[88] as part of our Economic Development study and found savings of $3.95 per participant per year in reduced firefighter injuries and $27.19 in lower fire department and volunteer costs.

INCREASED EQUITY

The societal benefit of increasing the level of equity in society is very difficult to measure. The energy cost burden[89] of a low-income household is three to four times higher than that of a median income household.[90] Paying energy and utility bills requires that other necessities must be foregone. This energy budget dilemma is faced uniquely by the poor.[91] For example, expenditures for electricity by low-income households represent, on average, 7.7 percent of their total income; the very poor, living at less than 50 percent of the federally-determined poverty level spend 23 percent. In contrast, the average residential consumer spends only 2.4 percent of income on electricity.[92] The societal benefit stemming from the reduction of this gap is reflected not only by increased fairness, but also by the reduced requirement of low-income households to forego other necessities. The public, in recognition of the benefit associated with reduction of the energy burden gap, has shown strong support for taking care of the energy needs of low-income households.[93]

CONCLUSION

It is increasingly difficult to live as a poor family in one of the world's richest

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88 In addition to the participant savings described above.

89 The energy burden refers to percentage of household income devoted to home energy costs.

90 *E.g.*, Tannenbaum, et. al. "Low-Income Energy Services in a Competitive Environment," Energy Center of Wisconsin. 1998. Also, Argonne National Laboratory, "Residential Energy Consumption Survey" reported in Rabago, et. al. "An Alternative Framework for Low-Income Electric Ratepayer Service." 1992. p. 2. This analysis has been repeated countless times since with remarkably stable results.

91 The concept of "Shelter Poverty" was developed initially by Michael E. Stone in the mid-1970s and more recently in Shelter Poverty: New Ideas on Housing Affordability, (Temple University Press, 1993) Shelter Poverty is a framework used to demonstrate that non-shelter necessities must compete for left-over dollars after shelter (housing and utility) costs are paid in order to avoid homelessness.

92 Computed by J. Oppenheim, "The Utilities," Access to Utility Service, National Consumer Law Center, 1998 Supplement, pp. 30-31, from U.S. Department of Energy/Energy Information Administration, "Electric Sales and Revenue, 1996," Table 14 (1997); U.S. Census, March 1998; "Current Population Survey," Table H-8; U.S. Census, 1990 summary tape, file 3A, Tables H3, P3, P80, P121. .

93 There has been strong public support for programs to ensure that all households have their basic energy needs met. For example, a national survey found that 89 percent of those with an opinion favored federal low-income energy payment assistance and 79 percent of those with an opinion favoredt an increase in such funding. Behavior Research Center, "Public Opinion National Survey on Low-Income Home Energy Assistance Program," p. 2 (1998). In a 1997 survey conducted by El Paso Electric Company, respondents in aggregate rated the factor of meeting everyone's basic energy needs as highly important. This factor received an aggregate rating of 8.9 on a scale of 0 (not at all important) to 10 (extremely important). Guild, et al., "Southwest Town Meeting on Electricity Issues" (El Paso Electric Company, 1997). In addition, results of a 1987 residential survey of Connecticut residents demonstrate strong public support for energy cost assistance to low-income and elderly persons. Further, the study identified strong public support for the notion that access to energy for residential use is a right in our society. John M. Kennedy, "Public Support for Residential Energy Assistance," 71 Sociology and Social Research 308 (1987).

nations. Being poor in America means not knowing whether enough food for dinner will be in the pantry tomorrow, or even whether essential prescriptions will be in the medicine cabinet. Being poor in America means being unable to find a job – or to have a job that does not pay enough to buy the essentials of life. Being poor in America may even mean not having a telephone or glass in every window.

Energy is a significant part of a family's budget – some elderly recipients who live on fixed incomes pay as much as 35 percent of their annual incomes for energy bills.[94] So as energy prices have doubled and tripled, poor families have fallen further and further behind. Yet helping families meet essential needs, such as that for energy, helps them work toward addressing their other fundamental problems, such as hunger, ill health, lack of education, unemployment, and industrial relocation. In this way, energy efficiency and energy assistance complement other public policy anti-poverty efforts.

Reducing poverty is a moral imperative, but reducing poverty also represents economic opportunity. Low-income energy efficiency is not commonly seen as a tool for economic development, yet this investment to fight poverty creates a powerful engine of economic opportunity for all. Low-income energy efficiency and assistance is a large lost opportunity for broad economic development.

[94] US DOE EERE, http://www.eere.energy.gov/weatherization/reducing.html.