



UMASS DONAHUE INSTITUTE



## Heat Rises

### The Growing Burden of Residential Heating Costs on Massachusetts Households

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## Executive Summary

Between 2003 and 2008, the regional retail price of home heating oil rose more than 175 percent, from \$1.43 per gallon to an annual average price of \$4.00 per gallon.<sup>1</sup> During the same period, residential prices for natural gas rose nearly 48 percent, and household electric utility customers saw a 43 percent increase.<sup>2</sup> This trend is expected to continue into 2009, with oil prices projected to rise 10.75 percent from 2008, and gas and electricity prices projected to rise 15.6 percent and 7.6 percent, respectively.<sup>3</sup>

The rising cost of home heating is placing a growing economic burden on Massachusetts residents. Based on average consumption in recent years and the most recent federal energy price forecasts, our estimates suggest that Massachusetts household expenditures on home heating oil and natural gas heat are likely to increase by \$927.2 million in 2008 and an additional \$469.85 million in 2009, a 2-year aggregate increase of \$1.397 billion.

More than a third of Massachusetts households heat with oil, and they will bear a disproportionate share of the burden of rising energy prices. Expenditures on oil heat account for more than 70 percent of the projected two-year increase in aggregate expenditures. The average Massachusetts household oil heat bill is projected to exceed \$3,000 in 2009.

It is low-income households that heat with oil, however, that will be the most severely affected by the rising cost of home heating. Using a conservative approach to estimate the economic burden of home heating, the UMass Donahue Institute estimates that at least 163,224 low and low-to-moderate-income households will experience difficulty paying their heating oil bills in 2009. The vast majority of these households are single family homes occupied by homeowners. Approximately two-thirds, or 108,870 of the 163,224 burdened households will experience *severe* difficulty paying their oil heat bills. Nearly two-thirds, or 69,595 of these *severely burdened* households are headed by persons over the age of 60, including almost 25,000 households headed by residents who are over the age of 80.

Massachusetts law protects low-income and elderly residents, people who are ill and families with infants from having their gas or electric heat shut off during the winter months. It also requires gas and electric utilities to provide discounted service to low-income customers, and regulated utilities must establish payment plans for residential customers who fall behind on their bills. However, these protections are not available to households that rely on heating oil, because heating oil distributors are not regulated utilities.

The federal Low Income Home Energy Assistance Program (LIHEAP) is the primary safety net for low-income Massachusetts households that depend on heating oil. Most households that earn up to 200 percent of the Federal Poverty Level are eligible for fuel assistance. In 2008, LIHEAP provided approximately \$39 million in fuel assistance to 40,808 oil-heated households in the Commonwealth.<sup>4</sup> The number of households receiving LIHEAP assistance with heating oil bills in 2008 represents only 25 percent of the 163,224 oil-heated households that will be burdened by oil heat bills in 2009. Approximately 42 percent of the 163,224 low-to-moderate-income

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<sup>1</sup> U.S. Energy Information Administration regional retail heating oil price data for Northeast, 2008 data based on EIA Short-Term Energy Outlook projections.

<sup>2</sup> U.S. Energy Information Administration regional residential retail utility gas and electricity energy price data for New England, 2008 data based on EIA Short-Term Energy Outlook projections.

<sup>3</sup> U.S. Energy Information Administration, Short-Term Energy Outlook, published July 8, 2008.

<sup>4</sup> LIHEAP selected data, dated June 24, 2008, provided to authors by Gerald Bell, Director of Community Services Programs, Massachusetts Department of Housing and Community Development, July 16, 2008.

households that we estimate will be burdened in 2009 will not be eligible for LIHEAP assistance due to incomes that exceed eligibility criteria.

While the costs of providing fuel assistance to the low and low-to-moderate-income households that are likely to need it this winter will be substantial, literature on the impacts of energy insecurity suggests that the price of not addressing the short-term need for heat may be paid in the form of serious health and safety consequences for the most vulnerable residents of the Commonwealth.

## Introduction

While many Massachusetts families are preoccupied with the cost of gasoline during the peak summer driving season, federal, state and local policymakers are struggling with the question of how low-income residents of the Commonwealth will pay for the increased cost of heating their homes this winter. There is growing consensus that government action is necessary to avoid a crisis.

At a June 25 Congressional hearing on rising home heating oil prices, Senator John Kerry raised the specter of a “snowy Katrina” in Massachusetts if the federal government did not fully fund fuel assistance programs.<sup>5</sup> At a recent hearing on energy costs held by a Massachusetts State Senate committee, advocates for low-income residents reported that more than 125,000 Massachusetts households owe their electric and gas utility companies between \$500 and \$1000 in unpaid energy bills, totaling \$90 million, and warned that many of these households risk termination of service this summer.<sup>6</sup> On July 24, Governor Patrick announced the formation of a statewide energy task force that will develop strategies to help residents with the cost of household heating.<sup>7</sup> At the local level, selectmen in the small western Massachusetts town of Buckland recently proposed the use of Federal Emergency Management Agency funds to help residents pay their heating bills.<sup>8</sup>

A significant number of Massachusetts households will have severe difficulty heating their homes during the upcoming winter because of rapidly increasing costs. The purpose of this report is to inform short-term policy solutions to this issue by identifying the magnitude of need and the characteristics of households most likely to require assistance. Our analysis includes:

- Estimates of aggregate and average increases in household expenditures for heating oil and natural gas heat;
- A profile of Massachusetts households by fuel type;
- Estimates of increases in expenditures on heating oil at the individual household level between 2006 and 2009;
- Estimates of the number of oil-heated households that meet conservative thresholds for moderate and severe heating oil cost burden and a demographic profile of these households;
- Review of literature on the public health and safety impacts that typically result when households are unable to pay heating bills.

Our findings and analysis are subject to the following limitations:

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<sup>5</sup> Remarks of U.S. Senator John Kerry, Opening Statement on Congressional hearing held June 25, 2008, titled “Examining Solutions to Cope with the Rise in Home Heating Oil Prices.” <[http://www.sbc.senate.gov/press/record\\_statement.cfm?id=299673](http://www.sbc.senate.gov/press/record_statement.cfm?id=299673)>

<sup>6</sup> Testimony of Attorney Charles Harak, National Consumer Law Center, cited in *Running on Empty: Massachusetts Faces Record Energy Costs*. Massachusetts State Senate Committee on Post Audit and Oversight Report, July 1, 2008. Low-income and other vulnerable gas and electric utility customers are protected from having their heat shut off during the winter. However, service may be terminated for non-payment during the summer, and the utility is then not obligated to reestablish service during the heating season if bills remain unpaid.

<sup>7</sup> Ebbert, Stephanie. “Governor Launches Energy Task Force.” *Boston Globe*, July 24, 2008.

<[http://www.boston.com/news/local/articles/2008/07/24/governor\\_launches\\_energy\\_task\\_force/](http://www.boston.com/news/local/articles/2008/07/24/governor_launches_energy_task_force/)>

<sup>8</sup> Broncaccio, Diane. “Buckland board considers local assistance for heating.” *Recorder*, July 3, 2008.

<[http://www.recorder.com/story.cfm?id\\_no=5158860](http://www.recorder.com/story.cfm?id_no=5158860)>



- Aggregate and average expenditure estimates were performed only for the two primary residential heating fuels and thus do not address the impact of increases in the price of electricity, propane or cordwood.
- All expenditure estimates are based on prices reported or projected by the U.S. Energy Information Administration Short-Term Energy Outlook (STEO). The STEO is a national model, with regional components, that forecasts U.S. supplies, demands, imports, stocks, and prices of various forms of energy on a monthly basis.<sup>9</sup> Heating oil expenditure estimates use STEO's forecast of regional residential retail prices for the Northeast Census region; natural gas prices estimates are based on utility gas residential retail rates for New England. Actual future prices may be higher or lower than current projections by the Short-Term Energy Outlook, and Massachusetts prices may differ from regional averages.
- Household-level expenditure analysis was performed for heating oil only. Therefore, the analysis of households burdened by heating costs does not include any households that use utility gas, electricity, propane or cordwood as their primary source of heat.
- Rental households that pay for the cost of oil heat as a component of rent were also excluded from the analysis. Due to this, and to the fact that renters are also more likely to use gas and electricity for heating purposes than homeowners, our analysis significantly understates the problem facing rental households.
- Projections of household-level expenditures on oil heat are based on the same level of consumption as in 2006, and thus do not consider the extent to which higher prices may reduce use of heating oil.
- All annual consumption and expenditure estimates are for calendar years rather than heating seasons.
- Expenditure data were estimated by inflating the cost of 2006 heating oil consumption and 2007 utility gas consumption in nominal dollars.

Finally, this study does not address the impact of the rising cost of household heat in the context of the mortgage crisis, increased prices for food and gasoline, and growing unemployment. Clearly, all of these factors contribute to growing economic insecurity and are likely to result in reduced resources available to pay for heat, particularly among low and low-to-moderate-income households in Massachusetts.

This report implies a need for increased short-term energy assistance and expanded investment in household energy conservation. However, due to the fact that detailed analysis was focused primarily on only one category of households—low- and low-to-moderate-income homeowners that heat with oil—the authors do not feel that they have sufficient information to make policy recommendations.

In the short term, more information on the consumption of heating oil by renters and on energy use in households that heat with utility gas and electricity could help inform decisions about fuel assistance programs. Over the longer term, more research on the relationships between multiple factors that influence consumption of heat—including housing type and size; heating fuel and equipment; income, expenditures and other information about householders; energy prices and weather—is needed to inform public and private investment in weatherization, upgraded fuel-burning systems, energy-efficient home construction and expanded use of alternative sources of household heat.

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<sup>9</sup> The STEO model is fully described on the Energy Information Administration website, <http://www.eia.doe.gov/emeu/steo/pub/document/overview.pdf>

## Findings

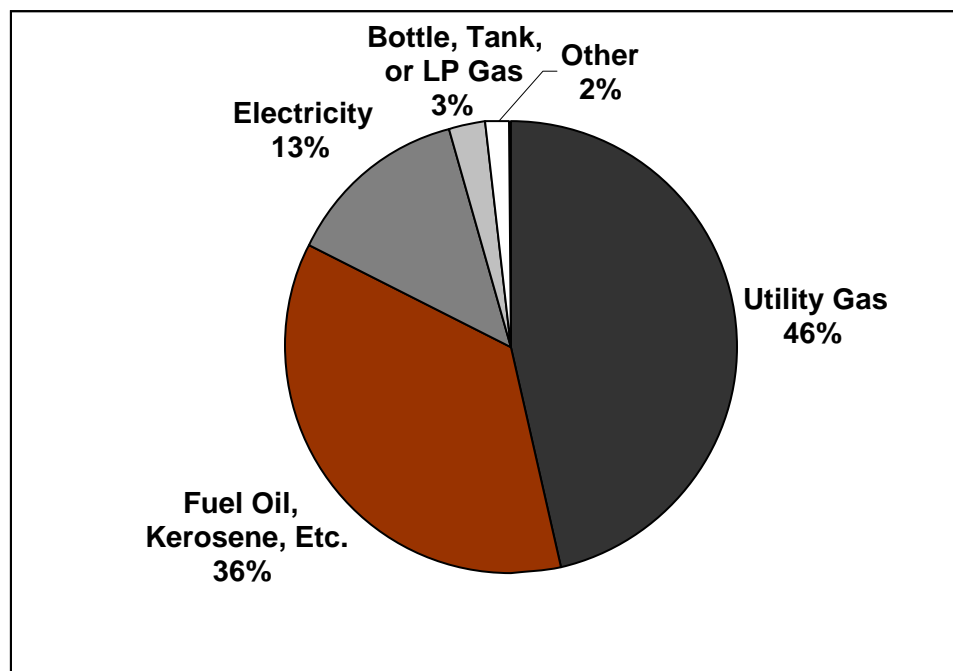
The findings are presented in the following order:

- Demographic profile of heating fuel use by Massachusetts households and fuel use by geographic region;
- Annual aggregate and average household expenditures on heating oil and gas heat;
- Identification of households most likely to be burdened by rising oil heat costs and demographic profile of moderately burdened and severely burdened oil-heated households.

### Demographic profile of Massachusetts households by heating fuel

There were about 2.7 million households in Massachusetts in 2006.<sup>10</sup> Approximately 82 percent of these households used either utility gas or heating oil to heat their homes, as shown in Figure 1.

**Figure 1: All Massachusetts households by heating fuel, 2006**

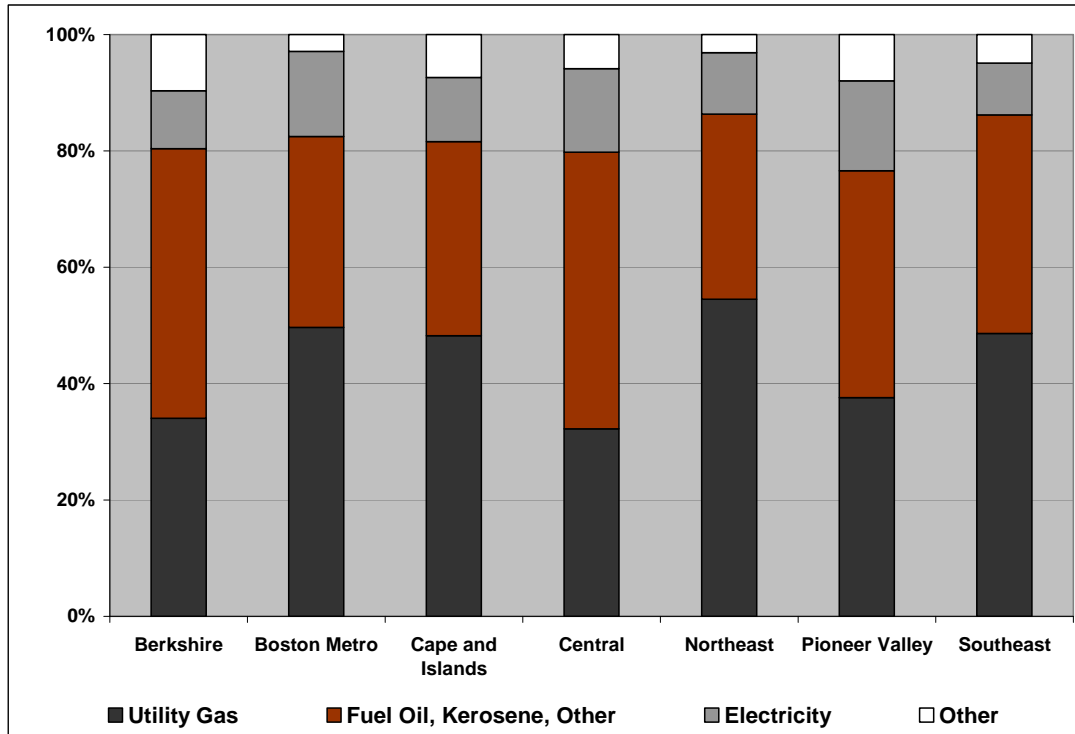


Source: U.S. Census Bureau, American Community Survey, 2005 - 2006

Figure 2 shows the distribution of households in each region by fuel type. Figure 3 shows the share of all Massachusetts households heated with utility gas, oil and electricity by region. Together, these two figures illustrate that while the majority of oil-heated households are located in the Boston Metro and Southeast regions, Central Massachusetts and the Berkshires have higher concentrations of households that heat with oil.

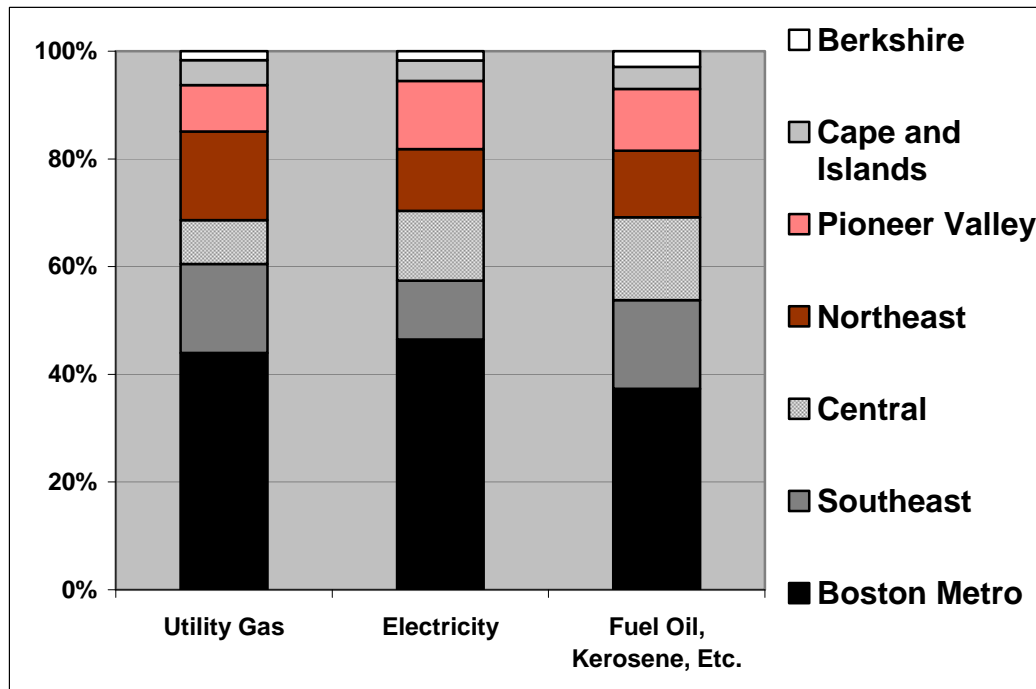
<sup>10</sup>US Census Bureau, American Community Survey, 2006

Figure 2: Household fuel use by region, 2005-2006



Source: U.S. Census Bureau, American Community Survey, 2005 - 2006

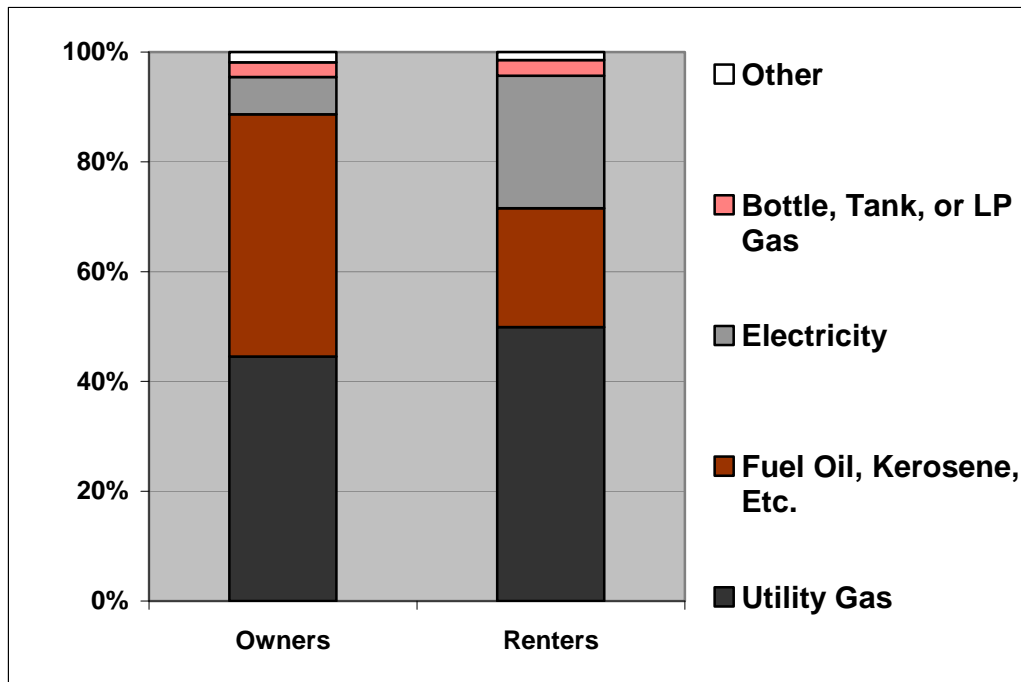
Figure 3: Share of all state households heated by gas, electricity and heating oil by region, 2005-2006



Source: U.S. Census Bureau, American Community Survey, 2005 - 2006

Approximately 64 percent of Massachusetts households are occupied by homeowners, and homeowners are much more likely to heat with oil than renters, as shown in Figure 4.

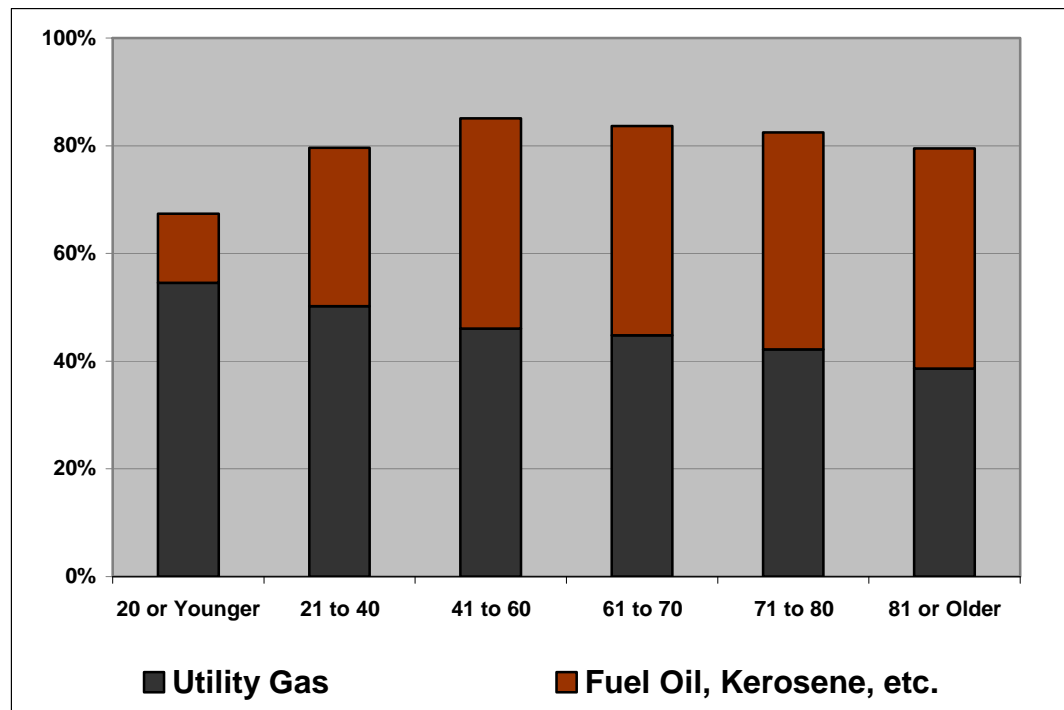
**Figure 4: Fuel type by tenure, 2005-2006**



Source: U.S. Census Bureau, American Community Survey, 2005 - 2006

Figure 5 shows the percentage of households that use utility gas and heating oil by age category. Older residents rely on oil heat more than younger residents.

Figure 5: Gas and oil-heated households by age of householder, 2005-2006



Source: U.S. Census Bureau, American Community Survey, 2005 - 2006

## Aggregate and Average Expenditures on Heating Oil and Natural Gas Heat

The regional retail price of heating oil rose from \$1.63 to \$2.73 between 2004 and 2007, and is projected to average \$4.00 per gallon in 2008 and \$4.43 per gallon in 2009.<sup>11</sup> The latest data on residential heating oil consumption are for the 2006 calendar year. Heating oil consumption decreased steadily between 2002 and 2006. The steepest decrease was in 2006, which was a very warm winter. Without data for 2007, it is difficult to determine whether the decline in consumption will continue in 2008 and 2009 (see Methodology section for historic consumption data and discussion). Price is obviously a factor in reducing demand, but there is also likely a minimum level of consumption that cannot be decreased without widespread investment in new technology.

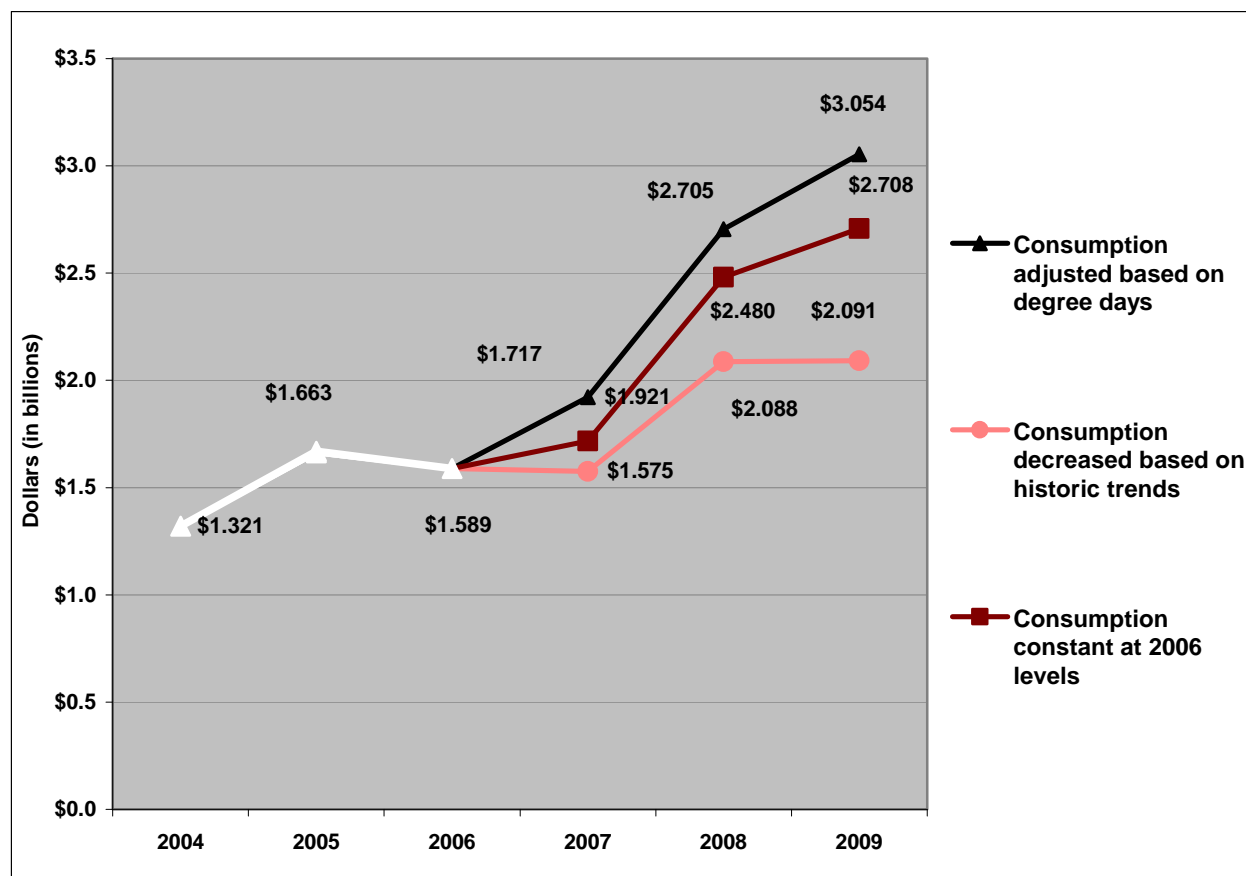
Figure 6 displays estimated aggregate Massachusetts household expenditures on heating oil between 2004 and 2006 that are based on consumption and prices during these years, and estimates for 2007, 2008 and 2009 under three different scenarios. In the first scenario, represented by the red line, average consumption per household is held constant at 2006 levels. In the second scenario, represented by the black line, average consumption in 2007, 2008 and 2009 is increased based on the actual or predicted increase in heating degree days relative to 2006. In the third scenario, represented by the pink line, average consumption in 2007, 2008 and 2009 is decreased based on the trend between 2002 and 2006. Data, calculations and assumptions are explained fully in the Methodology section of this report.

Based on projected regional retail prices of \$4.00 per gallon in 2008 and \$4.43 per gallon in 2009, we estimate that the two-year *increase* in aggregate household expenditures on heating oil will be \$991.25 million if average consumption per household remains at 2006 levels, \$1.132 billion if consumption increases as predicted under the

<sup>11</sup> Short-Term Energy Outlook. *Energy Information Administration*. July 8, 2008.

weather-adjusted scenario, and \$515.92 million if consumption declines based on the trend between 2002 and 2006.

**Figure 6: Estimated aggregate household expenditures on heating oil, 2004-2009**



Source: Energy Information Administration, U.S. Census Bureau American Community Survey and UMDI estimates

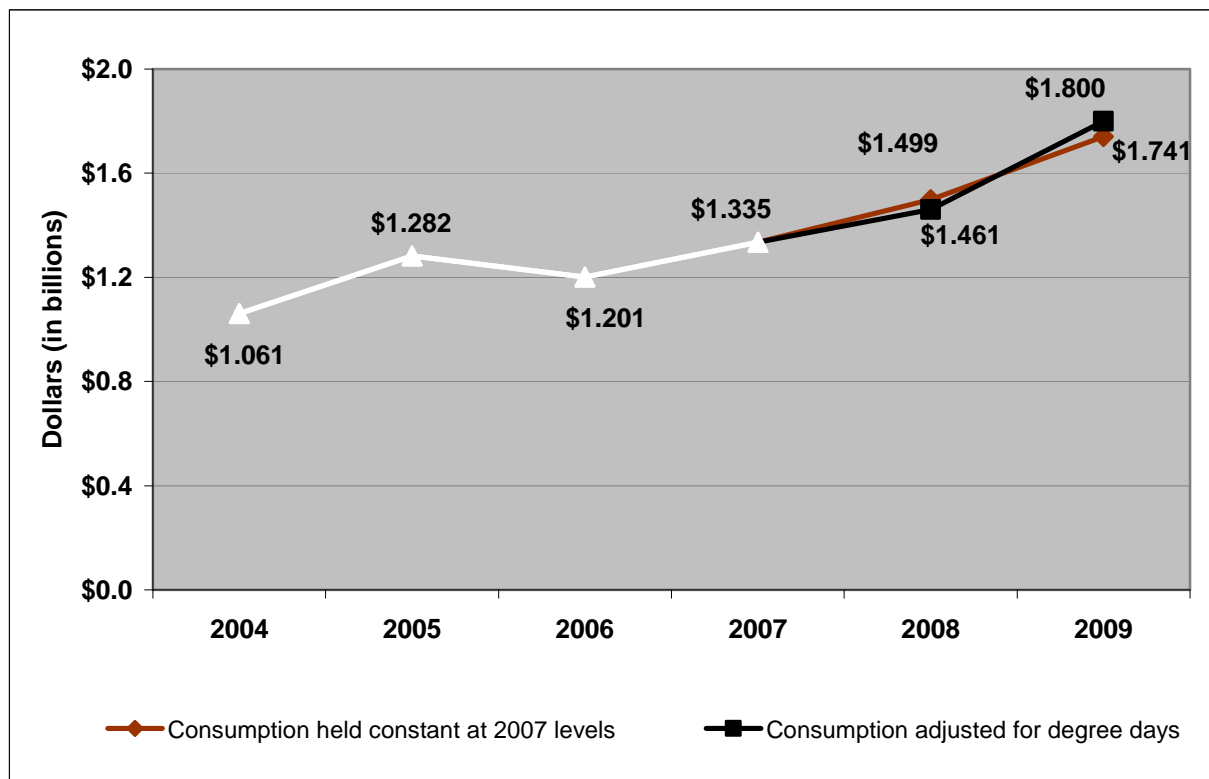
Small changes in assumptions about consumption and price have significant impacts on these aggregate expenditure estimates. A 2.5 percent increase in the price of heating oil, equivalent to 10 cents in 2008 and 11 cents in 2009, would result in a two-year aggregate expenditure increase of \$129.72 million in scenario one, \$143.96 million in scenario two and \$104.47 million in scenario three (see Table 5 for calculations). On the other hand, reducing average household consumption of heating oil by just 1 percent in 2008 and 2009 from the scenarios shown in Figure 6 would decrease aggregate expenditures by \$48.65 million in scenario one, \$57.59 million in scenario two and \$41.79 million in scenario three over the two year period (see Table 6 for calculations).

Data on consumption of natural gas are available through 2007. Regional residential retail prices for utility gas fell approximately 6 percent between 2006 and 2007, but are projected to increase by 11 percent in 2008 and 15 percent in 2009.<sup>12</sup> Figure 7 shows the estimated impact of these price increases on utility gas heat expenditures by all Massachusetts households under two different scenarios. In the first scenario, represented by the red line, average consumption per household is held constant at 2007 levels. In the second scenario, represented by the black line, average consumption in 2008 and 2009 are adjusted based on the predicted change in heating degree days relative to 2007.

<sup>12</sup> Short-Term Energy Outlook. *Energy Information Administration*. July 8, 2008.

Based on projected prices of \$18.35 per thousand cubic feet of gas in 2008 and \$21.11 in 2009,<sup>13</sup> we estimate that aggregate expenditures will increase by \$405.8 million over the two-year period under the “constant consumption” scenario, and \$464.59 million under the weather-adjusted scenario.

**Figure 7: Estimated aggregate household expenditures on natural gas heat, 2004-2009**

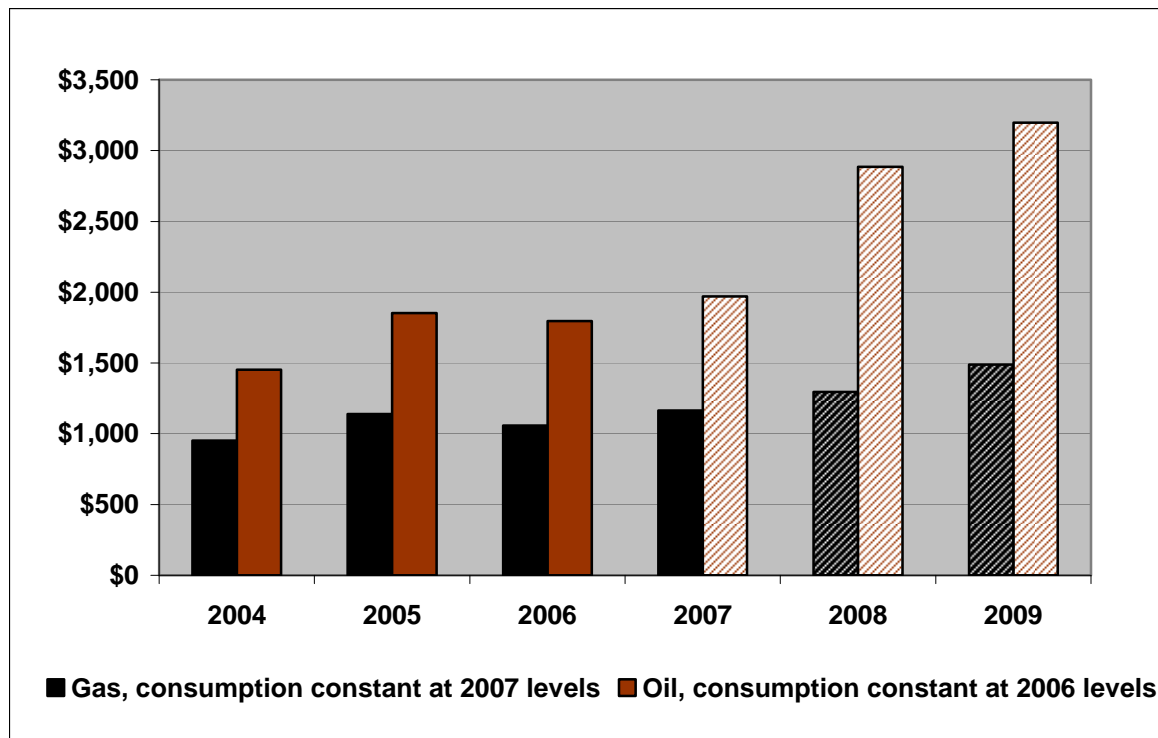


Source: Energy Information Administration, U.S. Census Bureau American Community Survey and UMDI estimates

A one percent decrease in average household consumption of natural gas heat in 2008 and 2009 would reduce aggregate expenditures by approximately \$32 million over two years compared to the scenarios shown in Figure 7. A 2.5 percent change in the price of gas would result in a change of approximately \$81 million in annual aggregate expenditures (see Table 11 for calculations).

Figure 8 shows trends in average household utility gas heat and heating oil bills from 2004 to 2009. Figures are shown using “constant consumption” scenarios, based on average household consumption in 2006 for heating oil and 2007 for utility gas heat. Estimates that rely on projected consumption are displayed using hatched lines.

<sup>13</sup> Short-Term Energy Outlook. *Energy Information Administration*. July 8, 2008.

**Figure 8: Estimated average household gas heat and heating oil bills, 2004-2009**

Source: Energy Information Administration, U.S. Census Bureau American Community Survey and UMDI estimates

### Massachusetts households burdened by residential heating oil costs

All Massachusetts households will be affected by the rising cost of household heat this winter. However, it is clear from the data on aggregate and average expenditures that households that heat with oil will experience much larger cost increases. Massachusetts law protects low-income and elderly residents, people who are ill and families with infants from having their gas or electric heat shut off during the winter months. It also requires gas and electric utilities to provide discounted service to low-income customers, and regulated utilities must establish payment plans for residential customers who fall behind on their bills. However, these protections are not available to households that rely on heating oil, because heating oil distributors are not regulated utilities.<sup>14</sup> Low-income households that depend on fuel oil are thus likely to experience the most severe difficulty paying their heating bills this winter.

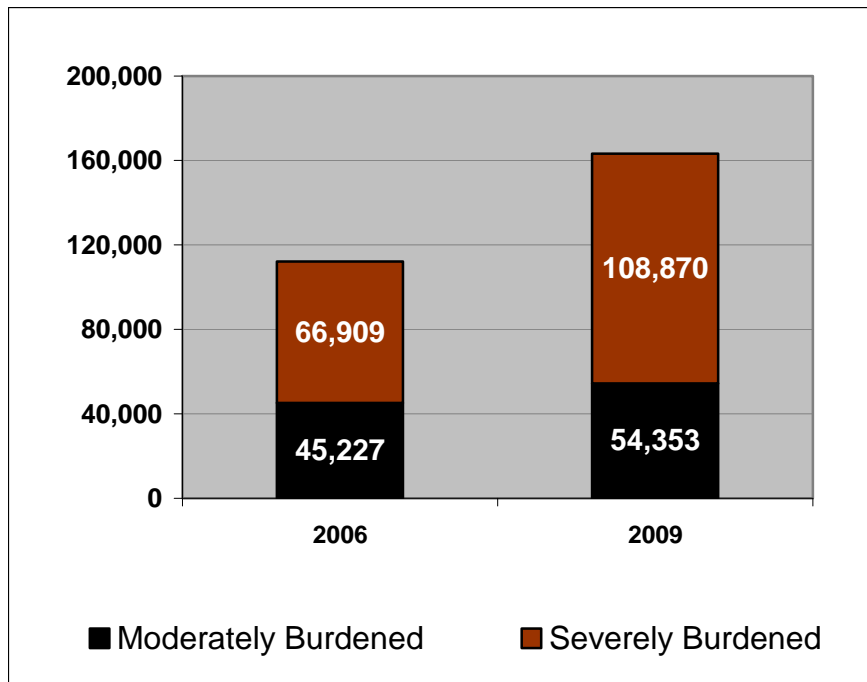
To quantify and describe the households most affected by increases in the price of home heating oil, we established conservative thresholds for “moderate oil heat cost burden” and “severe oil heat cost burden” by calculating the projected cost of oil heat bills as a percentage of income for low and low-to-moderate-income households. “Moderately burdened” households are defined as low-income households that spend more than 2.5 percent of their income on heating bills, and low-to-moderate-income households with oil bills totaling more than 5 percent of income. Low-income households spending more than 5 percent of their income on oil heat bills and low-to-moderate-income households spending more than 10 percent of income on heating oil are defined as “severely burdened.” Income groups, thresholds and the process used to establish them are described fully in the

<sup>14</sup> Gas and electric utility customers may qualify for winter shut-off protection and discount rates based on income, age or illness. Low-income oil heat households may be eligible for fuel assistance through LIHEAP, which negotiates a discount rate with heating oil retailers, but the discount is available only for those households that qualify, and only for the number of gallons provided by LIHEAP.



methodology section of this report. Figure 9 shows the increase in households burdened by oil heat bills between 2006 and 2009.

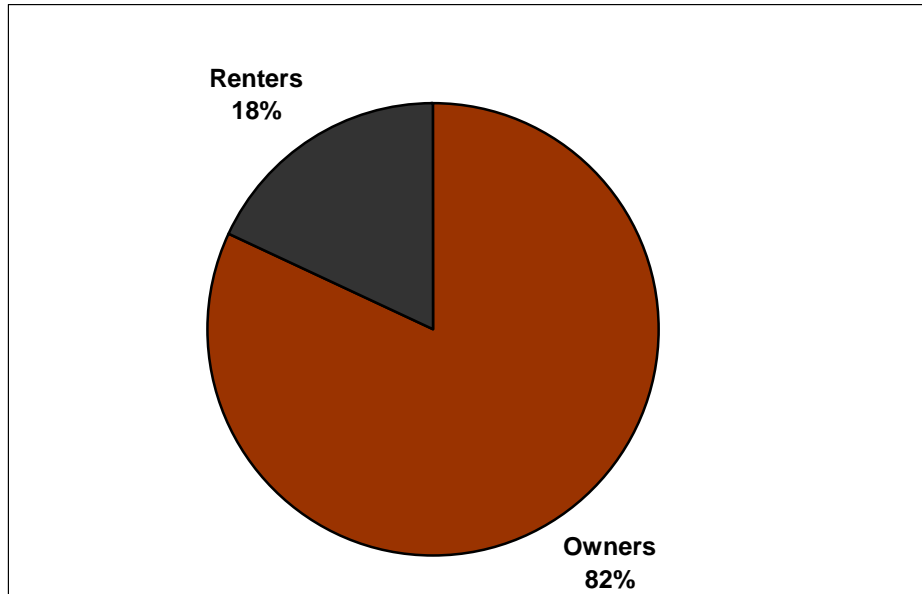
**Figure 9: Households burdened by oil heat costs, 2006 and 2009**



Source: U.S. Census Bureau, American Community Survey, 2005 – 2006, Energy Information Administration and UMDI projections

Homeowners are over-represented among households burdened by oil heat bills, as shown in Figure 10. There are at least two reasons why this is the case. First, homeowners are more likely to heat with oil than renters. Second, many renters who do depend on oil heat pay for it as a component of their rent, and are thus not included in the data set used for analysis. We estimate that renters whose heat is included in their rent represent between 8 and 9 percent of oil-heated households, a total of approximately 79,000 homes. It is important to note that these households are not included in our estimates of households burdened by oil heat bills.

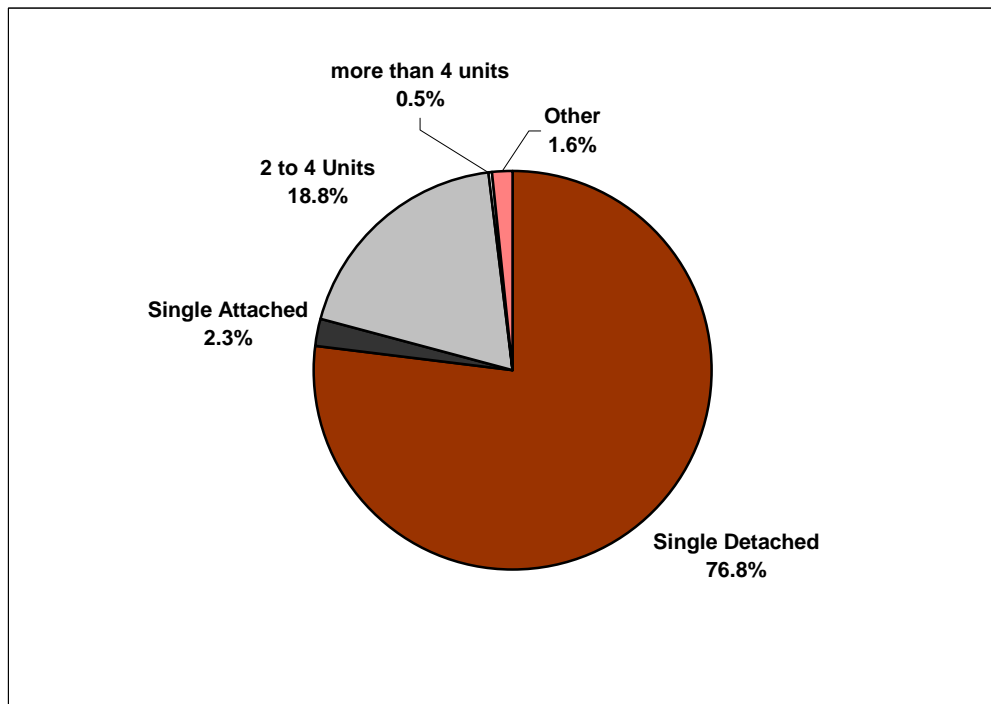
Figure 10: Burdened oil heat households by tenure, 2006 and 2009



Source: U.S. Census Bureau, American Community Survey, 2005 – 2006, Energy Information Administration and UMDI projections

Figure 11 shows all burdened households by type of housing. The “other” category likely represents mobile homes.

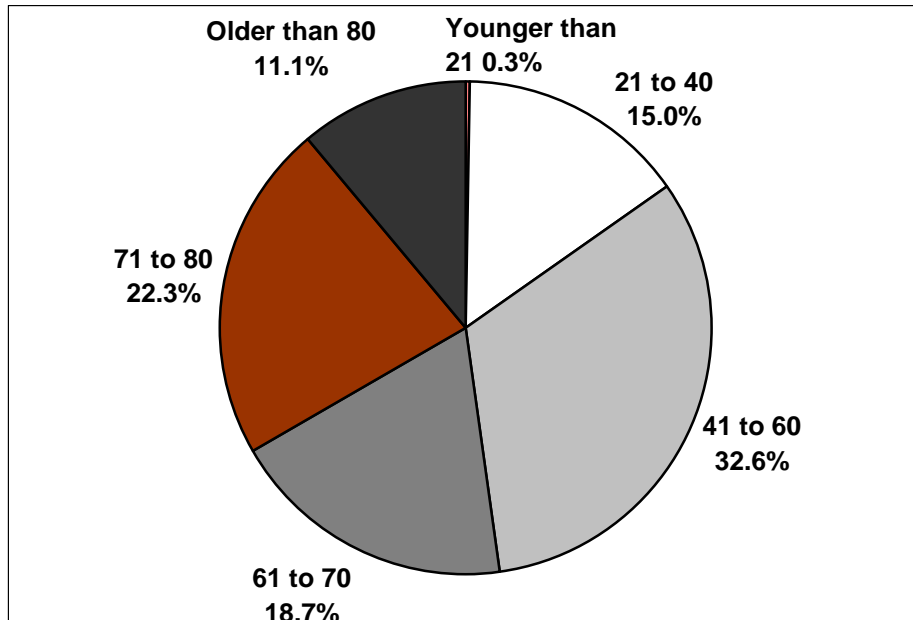
Figure 11: Burdened households by housing type, 2009



Source: U.S. Census Bureau, American Community Survey, 2005 – 2006, Energy Information Administration and UMDI projections

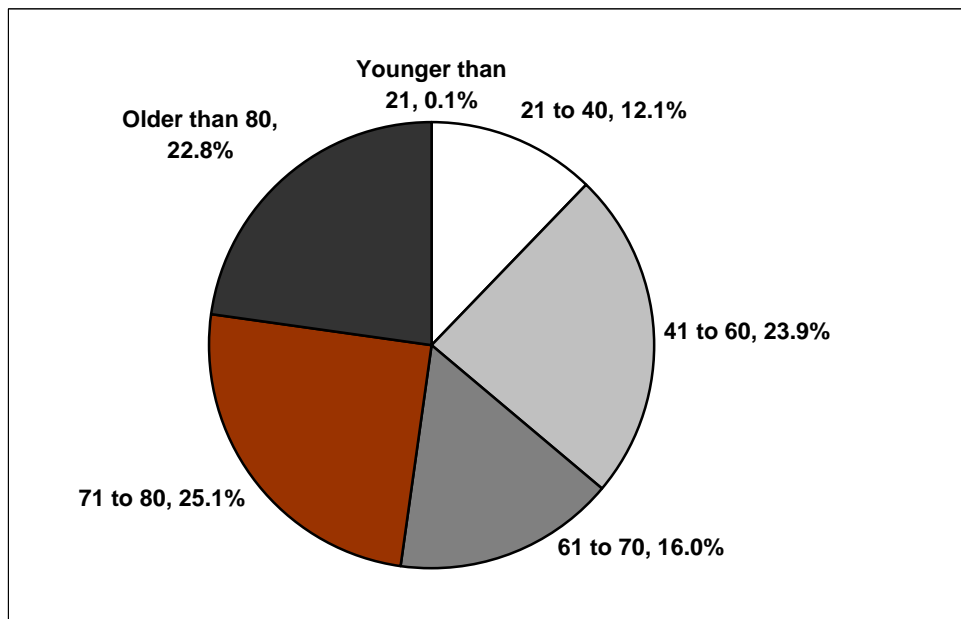
Figures 12 and 13 show moderately and severely burdened oil heat households by age of householder. Approximately 52 percent of moderately burdened households and 64 percent of severely burdened households are headed by residents over the age of 60.

**Figure 12: Moderately burdened oil heat households by age of householder, 2009**



Source: U.S. Census Bureau, American Community Survey, 2005 – 2006, Energy Information Administration and UMDI projections

**Figure 13: Severely burdened oil heat households by age of householder, 2009**



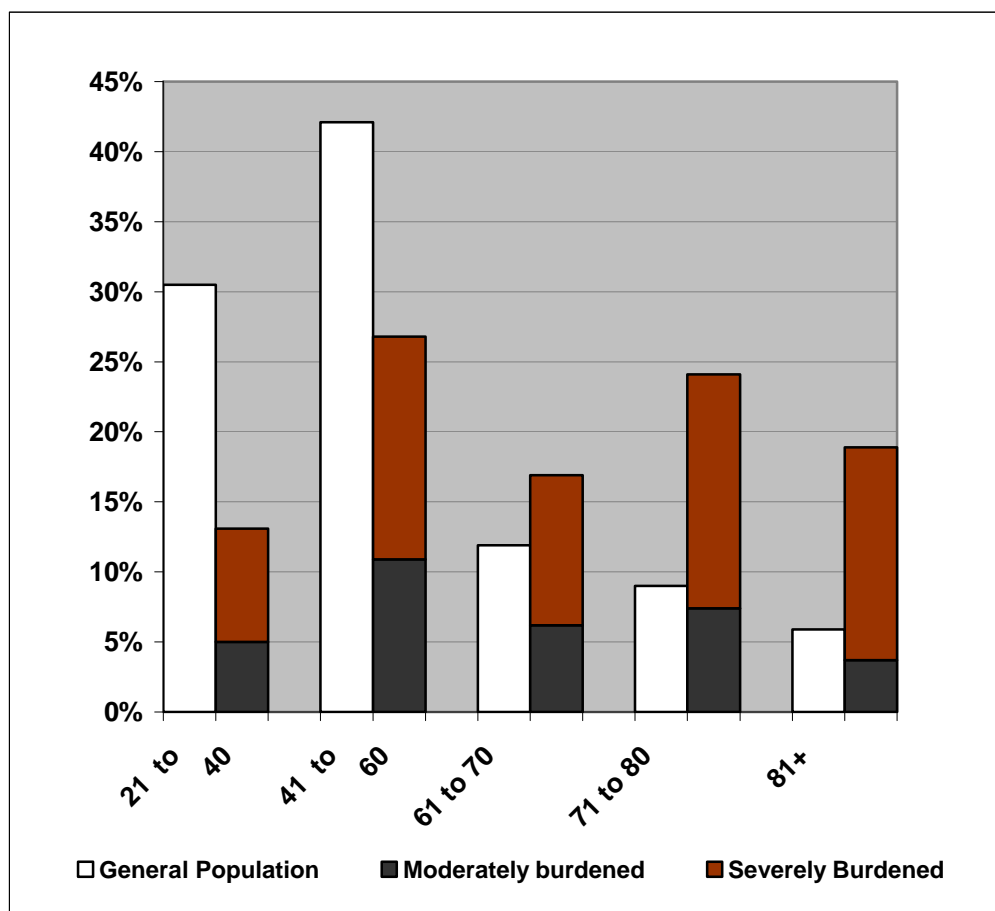
Source: U.S. Census Bureau, American Community Survey, 2005 – 2006, Energy Information Administration and UMDI projections

Figure 14 shows the percentage of moderately burdened and severely burdened households by age compared to all Massachusetts households by age. The white bars in Figure 14 represent all Massachusetts households by age

of householder. The colored bars represent the 163,224 Massachusetts households burdened by oil heat bills by age of householder. The bottom section of the colored bars, shown in gray, represents moderately burdened oil heat households, while the top section, shown in red, represents severely burdened oil heat households. For example, the figure shows that householders over the age of 80 represent approximately six percent of all Massachusetts households, but they make up nearly 19 percent of the 163,224 households that will be burdened by high oil heat bills in 2009. Of these 30,883 oil heated households occupied by residents over the age of 80, 6,053 are moderately burdened, and 24,830 are severely burdened.

Together, figures 12, 13 and 14 demonstrate that elderly Massachusetts residents who depend on heating oil to keep warm will be disproportionately impacted by the rising cost of heat this winter. Approximately 60 percent of all burdened oil heat households are headed by residents over the age of 60, compared to only 27 percent of Massachusetts households in general. This is particularly significant given the fact that seniors are more likely to have illnesses and physical disabilities and less likely to be away from home in a heated environment during the day.

**Figure 14: Moderately burdened and severely burdened oil heated households by age compared to all households by age, 2009**

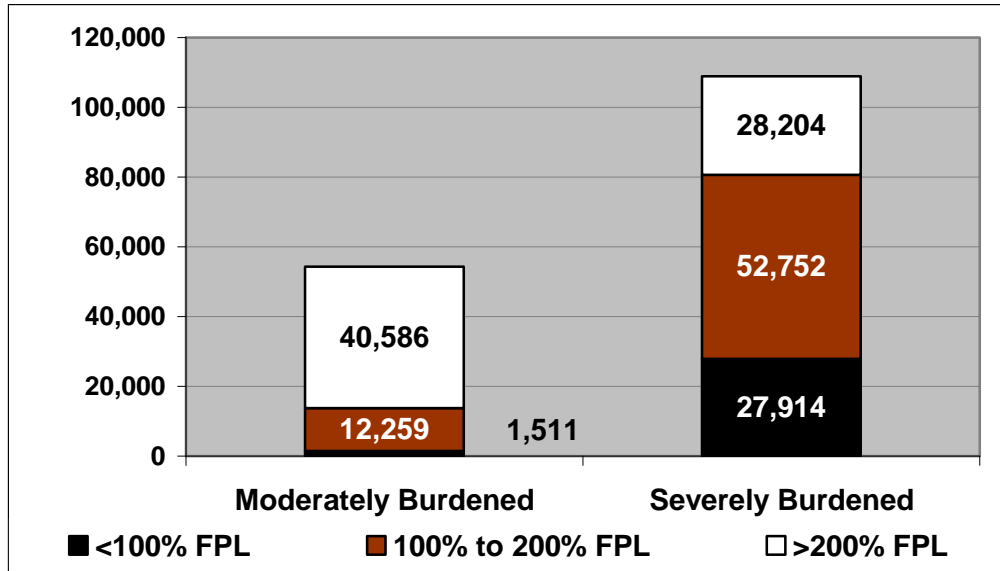


Source: U.S. Census Bureau, American Community Survey, 2005 – 2006, Energy Information Administration and UMDI projections

Figure 15 shows moderately burdened and severely burdened households by federal poverty level status. The analysis shows that 94,436 of the households identified as burdened by heating oil bills in 2009 are eligible for federal fuel assistance programs. However, nearly 69,000 additional households will be burdened by oil heat costs in 2009 but ineligible for fuel assistance programs. 40,586 moderately burdened households (approximately

75 percent) and 28,204 severely burdened households (approximately 26 percent) will be ineligible for federal fuel assistance programs in 2009 if the threshold for eligibility remains at 200 percent of federal poverty level.

**Figure 15: Moderately burdened and severely burdened oil heat households by federal poverty level status, 2009**



Source: U.S. Census Bureau, American Community Survey, 2005 – 2006, Energy Information Administration and UMDI projections

## Conclusion

While most households in the Commonwealth will feel the financial sting of increasing home heating costs this winter, low- and low-to-moderate-income households that heat with oil will be disproportionately affected. Our analysis identifies more than 163,000 low and low-to-moderate-income households that will be burdened by the cost of heating oil this winter. The vast majority of burdened households are homeowners living in single-family homes. Among the households that will be burdened, senior citizens are over-represented. Many of these low-income elderly homeowners who heat with oil will not be eligible for federal fuel assistance programs under current Massachusetts regulations.

Dramatic increases in the cost of heating oil and other fuels are creating a growing need for fuel assistance. In federal Fiscal Year 2008 (October 1, 2007 – September 30, 2008), Massachusetts had \$130.86 million available in federal and state funds for fuel assistance to low-income households. As of May 31, 2008, the Commonwealth had distributed approximately \$109 million of this funding to 133,827 households. Approximately 47 percent of funds were spent to assist households that heated with utility gas. Nearly \$39 million was distributed to 40,808 oil-heated households, accounting for approximately 30.5 percent of fuel assistance recipients and 35.7 percent of fuel assistance funds. The average recipient household received \$738 in assistance.<sup>15</sup>

If the Massachusetts fuel assistance program distributed the same \$39 million to the 94,435 oil-heated households that we identify as “moderately burdened” or “severely burdened” with household incomes at or below 200 percent of the federal poverty level in 2009, each oil-heated household would receive approximately \$412, or enough to purchase approximately 100 gallons of heating oil at prices projected by the Massachusetts LIHEAP program.<sup>16</sup> According to LIHEAP program administrators, the average LIHEAP oil heat recipient burns 900 gallons of fuel oil during the heating season.<sup>17</sup>

Clearly, if federal and state fuel assistance programs are funded at historic levels and eligibility is limited to households earning less than 200 percent of federal poverty level, there will be a significant gap between the need for fuel assistance and the funds available to provide it. Without access to fuel assistance, low and low-to-moderate-income households will be forced to make choices between paying for heat and expenditures on other necessities, including other shelter costs (mortgage payments, real estate taxes and rent), food and medicine. These choices will have serious implications for public health and safety.

A 2005 survey of families receiving fuel assistance found that 20 percent of recipients in the Northeast reported going without food, 28 percent reported going without medical or dental care, and 23 percent did not make full rental or mortgage payments because of high energy bills.<sup>18</sup> While entire households are negatively affected, “heat or eat” decisions are particularly harmful for children because there is substantial evidence that “food insecurity,” or uncertain or limited availability of adequate supplies of food, can have serious long-term effects, including decreased immune function, compromised brain development, and increased risk of illness. Coupled with insufficient health care, the health consequences for children of these budget trade-offs are severe.<sup>19</sup>

<sup>15</sup> 2008 LIHEAP data provided to authors by Gerald Bell, Director of Community Service Programs, Massachusetts Department of Housing and Community Development, July 16, 2008.

<sup>16</sup> Ibid. LIHEAP pays a negotiated Margin-Over-Rack (MOR) price for heating oil, determined daily or weekly by adding a 30 cents per gallon margin over wholesale prices, or retail prices, whichever are lower.

<sup>17</sup> Ibid.

<sup>18</sup> “2005 National Energy Assistance Survey”. National Energy Assistance Directors, 2005.

<sup>19</sup> “Unhealthy Consequences: Energy Costs and Child Health, A Child Health Impact Assessment of Energy Costs and the Low Income Home Energy Assistance Program”, Child Health Impact Working Group, 2006.

Additional research investigating the relationship between high heating and cooling costs and its impact on household food supply has shown that households that consist entirely of elderly persons experienced significant seasonal differences in access to sufficient amounts of food as compared to households with no elderly persons (and no children).<sup>20</sup> In regions with high heating costs, the likelihood of “very low food security” (the USDA term to describe the severe range of access to sufficient amounts of food) was 43 percent lower in the summer months than in the winter for low-income, elderly households.<sup>21</sup> The “heat or eat” dilemma for senior citizens may be exacerbated by budget shortfalls and cutbacks in “meals on wheels” programs in 2009 due to the increased cost of food and gasoline.<sup>22</sup>

In addition, low-income families that are confronted with high heating costs often resort to substitute, and risky, heat sources. Portable space heaters, kitchen stoves, and fireplaces replace traditional and more costly forms of heat and as a result, families are exposed to greater health risks, including carbon monoxide poisoning, contact burns, and accidental house fires. The 2005 survey of LIHEAP recipients found that 22 percent of fuel assistance recipients in the Northeast used their stove or oven to provide heat because of very high energy costs.<sup>23</sup> The same LIHEAP survey found that nationally, 17 percent of elderly households and 29 percent of families with children under the age of 18 reported using alternative heating sources at some point during the year because of high fuel costs. The consequences of improvised heat sources can be fatal and each year carbon monoxide poisoning and fire claim lives. In 2000, two Mattapan children were killed in a house fire that began as a result of a space heater.<sup>24</sup>

While the costs of providing fuel assistance to the low and low-to-moderate-income households that are likely to need it this winter will be substantial, literature on the impacts of energy insecurity suggest that the price of *not* addressing the short-term need for heat may be paid in the form of serious health and safety consequences for the most vulnerable residents of the Commonwealth.

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<sup>20</sup> Nord, Mark and Kantor, Linda S. “Seasonal Variation in Food Insecurity is Associated with Heating and Cooling Costs among Low-income Elderly Americans.” U.S. Department of Agriculture/Economic Research Service, *The Journal of Nutrition*, 2006.

<sup>21</sup> Ibid.

<sup>22</sup> Scheible, Sue. “Tough Times for Meals on Wheels.” *Quincy Patriot Ledger*, posted July 14, 2008, update July 15, 2008. <[www.patriotledger.com](http://www.patriotledger.com)>; “Hungry for gas: Gas prices threaten Meals on Wheels programs. *AARP Bulletin Today*, July 2, 2008. <[http://bulletin.aarp.org/states/ma/articles/hungry\\_for\\_gas\\_gas\\_prices\\_threaten\\_meals\\_on\\_wheels\\_programs.html](http://bulletin.aarp.org/states/ma/articles/hungry_for_gas_gas_prices_threaten_meals_on_wheels_programs.html)>

<sup>23</sup> “2005 National Energy Assistance Survey”. National Energy Assistance Directors Association, 2005.

<sup>24</sup> Klein, R and Watson, J. Two Boys Killed in Mattapan House Fire; Blaze is Blamed on Space Heater, *Boston Globe*, December 28, 2000.

## Methodology

### Estimating aggregate and average expenditures on heating fuel

Due to limitations in time and available data, we chose to focus our analysis of the rising cost of household heating on the two primary heating fuels used by Massachusetts households. More than eighty percent of households in the Commonwealth use either utility gas or oil to heat their homes.<sup>25</sup>

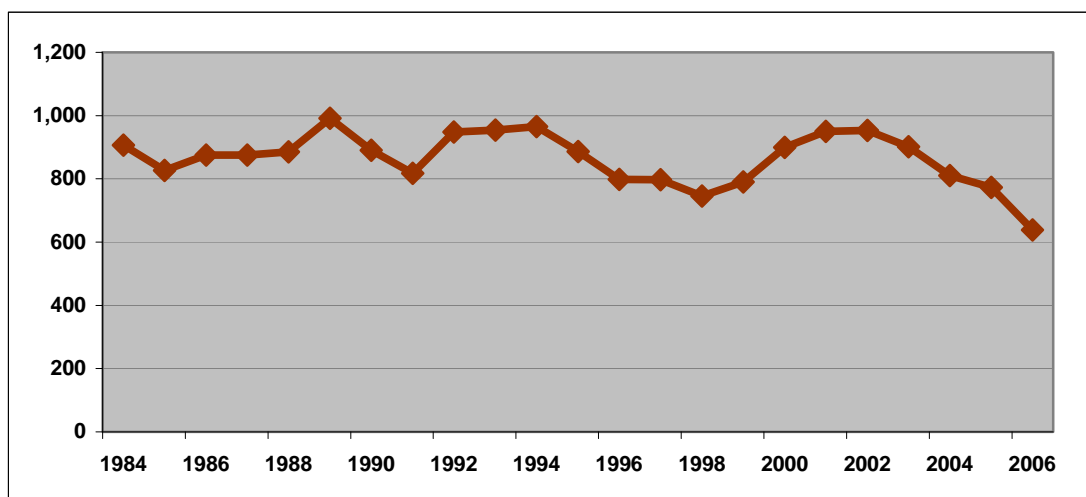
The U.S. Energy Information Administration reports annual retail sales of heating oil to Massachusetts households. The most recent data available are for calendar year 2006. Information on residential sales of natural gas is available on a monthly basis through April 2008, but the data do not distinguish between use of gas for heat and gas used for other residential purposes, such as cooking and clothes dryers. To estimate aggregate and average household expenditures on heating oil and natural gas, we needed to develop methodologies to project residential consumption of these fuels in 2008 and 2009.

### Projecting aggregate residential consumption and cost of heating oil

For the purposes of our analysis, we assume that all residential consumption of heating oil is for space heating. While some homes also use their oil-burning furnaces to heat water for domestic use, the way that data on heating oil consumption are reported does not allow us to distinguish between these uses.

Long-term trends in sales of heating oil are shown in Figure 16. Massachusetts home heating oil consumption started declining in 2003 and fell sharply in 2006. Massachusetts households purchased approximately 638,000 gallons of home heating oil in 2006, which was 17.5 percent less than in 2005, and 27 percent less than average consumption over a 20-year period.

**Figure 16: Heating oil sales to Massachusetts households, 1984-2006 (millions of gallons)**



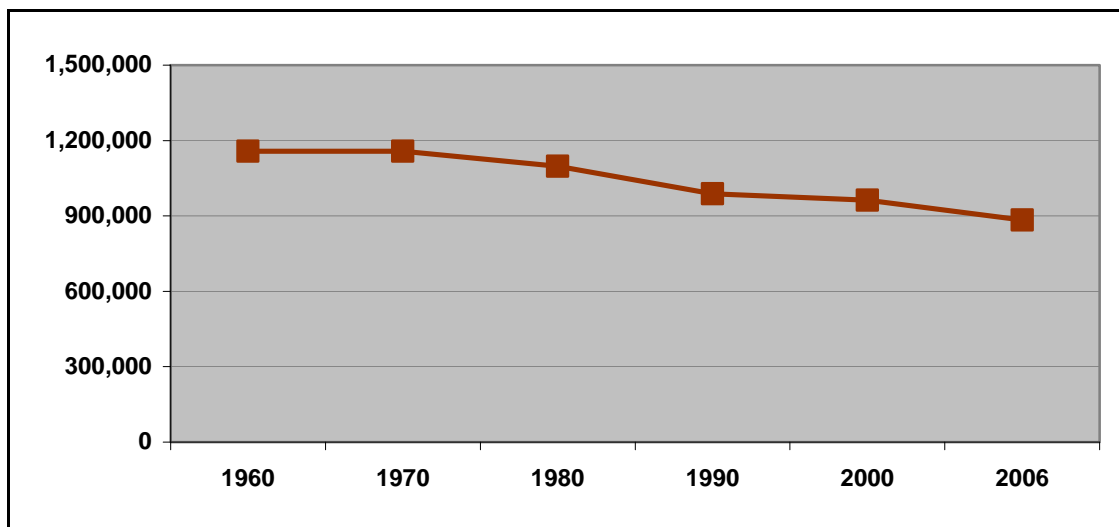
Source: Energy Information Administration, Massachusetts Sales of Distillate Fuel by End Use, 12/13/07

<sup>25</sup> American Community Survey, U.S. Census Bureau, 2006.



We considered possible explanations for low consumption in 2006 and whether it would be a reliable indicator of future consumption. Fuel switching is clearly an important factor in declining consumption of heating oil. The percentage of households that heat with oil has decreased steadily from 1960, when more than 75 percent of Massachusetts homes heated with oil, to 2006, when slightly more than 36 percent of homes in the Commonwealth used oil as the primary source of heat.<sup>26</sup> The total number of households that heat with oil has been falling since 1970, as shown in Figure 17. Based on data reported by the 2000 census and 2006 American Community Survey, we estimate that 260,000 fewer homes heated with oil in 2006 than in 2000.

**Figure 17: Number of Massachusetts households that heat with oil, 1960-2006**



Source: U.S. Census Bureau, Historical Census of Housing and American Community Survey, 2006

While the trend away from oil as a primary source of household heat is clear, it is difficult to predict how fuel switching will impact consumption in any given year. Presumably, access to alternative sources of fuel, financial ability to purchase new equipment, and expected return on investment figure into household decisions on fuel choice, but these choices are not readily modeled.

Investment in energy efficiency is another factor in declining oil consumption. According to the Massachusetts Oilheat Council, households that heat with oil have been purchasing more efficient systems in recent years.<sup>27</sup> As prices rise, homeowners may be investing in additional insulation, new windows, programmable thermostats, and other forms of weatherization. They may also be keeping their homes at cooler temperatures than when oil was less expensive.

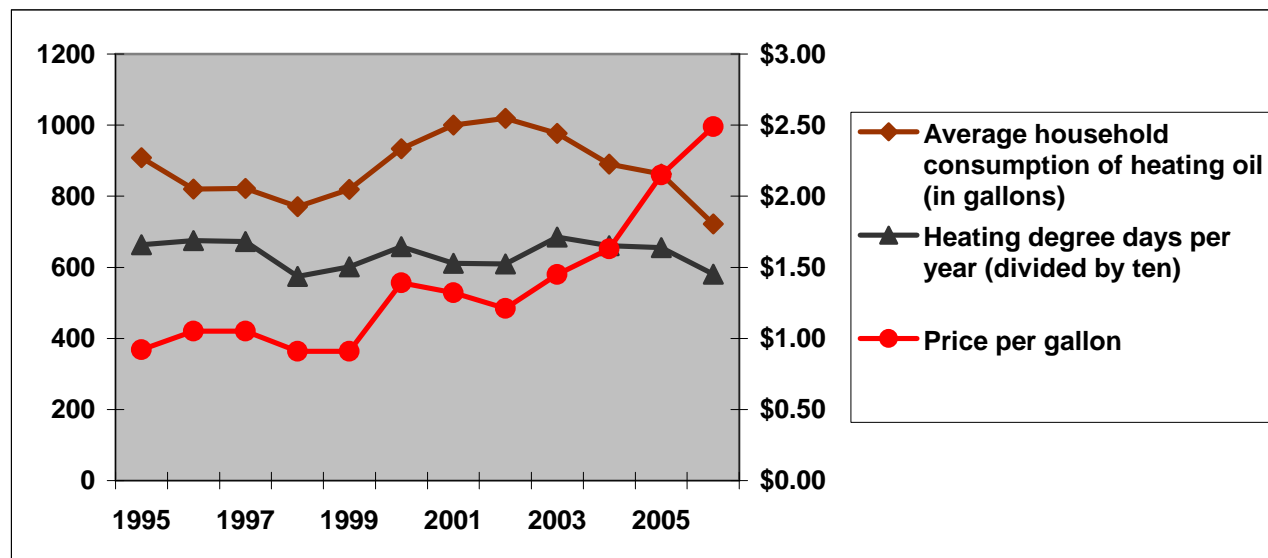
Finally, oil consumption is likely to increase during cold winters. Separating the effect of price and weather on consumption is problematic, because cold weather increases demand, which places an upward pressure on prices, and higher prices in turn tend to decrease demand. We conducted a simple regression analysis of heating oil consumption over a ten-year period using consumption as the dependent variable and price and heating degree days as the independent variables, but results did not indicate a simple linear relationship between these factors, either together or separately, that could be used to predict future consumption. Yet the factors are clearly related. Figure 18 shows trends in prices, weather and consumption between 1995 and 2006. Consumption is shown as an

<sup>26</sup> United States Census Bureau, American Housing Census and American Community Survey, 2006.

<sup>27</sup> Michael Ferrante, Executive Director, Massachusetts Oilheat Council, conversation with Robin Sherman, July 15, 2008.

average per household, thus accounting for the fact that the number of households using oil heat declined sharply over this period.

**Figure 18: Heating oil prices, heating oil consumption and heating degree days, 1995-2006**



Sources: Energy Information Administration, U.S. Census Bureau, Historical Census of Housing and American Community Survey, 2006 and UMass Donahue Institute estimates

As shown in Figure 18, oil prices were approximately 16 percent higher in 2006 than during the previous year, and the winter months of 2006 were much warmer than 2005 and the long-term averages. Both higher prices and warmer temperatures likely contributed to the low consumption of heating oil in 2006. 2008 and 2009 are projected to be approximately 10 percent colder than 2006,<sup>28</sup> and STEO projects oil prices to be 60.6 percent higher in 2008, and an additional 10.75 percent higher in 2009.<sup>29</sup> It is very difficult to predict the combined impact of moderately colder weather and much higher prices on consumption. Conservation and fuel switching are likely to continue, but there are limits to the number of households that have access to alternative sources of fuel and sufficient capital to invest in efficiency. Also, there is obviously some minimum level of consumption that is necessary to keep homes and their occupants from freezing.

We used three different consumption scenarios to estimate oil heat expenditures for 2007, 2008 and 2009. In the first scenario, we assumed that 2006 consumption of 722 gallons of oil per household would remain constant in 2007, 2008 and 2009 in spite of colder weather. In the second scenario, we increased average consumption per household to account for the actual or projected increase in heating degree days.<sup>30</sup> In the third scenario, we decreased average consumption in 2007, 2008 and 2009 by 8.259 percent per year, which is equivalent to the annualized rate of decline in average consumption between 2003 and 2006.

We used average consumption per household to calculate aggregate consumption to allow all three scenarios to assume that fuel switching will continue at the same rate as it did between 2000 and 2006. To estimate the total

<sup>28</sup> U.S. regional weather data accessed from Energy Information Administration website, <<http://www.eia.doe.gov/emeu/steo/pub/contents.html>>. Historical weather data from U.S. Department of Commerce, National Oceanic and Atmospheric Association (NOAA), projections are based on forecasts by NOAA Climate Prediction Center.

<sup>29</sup> Short-Term Energy Outlook. *Energy Information Administration*. July 8, 2008.

<sup>30</sup> According to the National Weather Service, degree day is a quantitative index demonstrated to reflect demand for energy to heat or cool houses and businesses. A mean daily temperature (average of the daily maximum and minimum temperatures) of 65°F is the base for heating degree day computations. Heating degree days are summations of negative differences between the mean daily temperature and the 65°F base. <[http://www.cpc.noaa.gov/products/analysis\\_monitoring/cdus/degree\\_days/ddayexp.shtml](http://www.cpc.noaa.gov/products/analysis_monitoring/cdus/degree_days/ddayexp.shtml)>

number of oil-heated households in 2007, 2008 and 2009, we multiplied total households in 2000 by the percentage of households that reported using oil to calculate the number of oil-heated households in 2000, and performed the same calculation for 2006 (step 1, Table 1). We then annualized the rate of change, yielding a compound average growth rate of negative 1.4096% per year (step 2, Table 2). We applied this rate of decline to the number of oil-heated households in 2006 to estimate the number of households using heating oil in 2007, 2008 and 2009 (step 3, Table 3).

**Table 1: Calculate number of Massachusetts heating oil households, step 1**

Year	Total Massachusetts Households	% of households that heat with oil	Massachusetts households that heat with oil
2000	2,443,580	39.40%	962,771
2006	2,446,485	36.14%	884,160

Source: U.S. Census Bureau, Housing and Household Economic Statistics Division and American Community Survey, 2006

**Table 2: Calculate rate of change in number of Massachusetts heating oil households, step 2**

Calculating CAGR for Oil Heat Households, 2000-2006:	
Oil households, 2000	962,771
Oil households, 2006	884,160
Number of years	6
CAGR=(Oil households 2006/Oil households 2000) <sup>^(1/number of years)-1</sup>	-1.4096%

**Table 3: Project number of Massachusetts oil heat households in 2007, 2008 and 2009, step 3**

Year	Oil heat households in previous year	Adjustment for fuel switching (1+ CAGR)	Oil heat households in current year
2007	884,160	98.5904%	871,697
2008	871,697	98.5904%	859,409
2009	859,409	98.5904%	847,295

To estimate aggregate consumption and expenditures, we multiplied the number of heating oil households by our three different assumptions about average consumption per household. We then multiplied the aggregate consumption estimate by the regional retail price of heating oil reported or projected by the U.S. Energy Information Administration Short-Term Energy Outlook (STEO) to calculate aggregate annual expenditure estimates for 2007, 2008 and 2009, as shown in Table 4.

Table 4: Calculating aggregate heating oil expenditures, 2007-2009, three scenarios

<b>Scenario 1: average consumption per household remains at 2006 levels</b>						
Calendar year	Number of oil-heated households	Average consumption (gallons)	Total consumption (gallons)	Retail price of oil per gallon	Aggregate expenditure estimate	
2007	871,697	722	628,969,362	\$2.73	\$1,717,086,358	
2008	859,410	722	620,103,483	\$4.00	\$2,480,413,932	
2009	847,296	722	611,362,577	\$4.43	\$2,708,336,214	
<b>Scenario 2: average consumption per household increases based on percentage increase in degree days relative to 2006</b>						
2007	871,697	807	703,753,819	\$2.73	\$1,921,247,926	
2008	859,410	787	676,222,848	\$4.00	\$2,704,891,393	
2009	847,296	814	689,311,305	\$4.43	\$3,053,649,081	
<b>Scenario 3: average consumption per household decreases based on trend 2002-2006</b>						
2007	871,697	662	577,023,524	\$2.73	\$1,575,274,220	
2008	859,410	607	521,905,924	\$4.00	\$2,087,623,695	
2009	847,296	557	472,053,187	\$4.43	\$2,091,195,618	

Sources: Energy Information Administration, U.S. Census Bureau, Housing and Household Economic Statistics Division and American Community Survey, 2006 and UMass Donahue Institute estimates

Actual retail prices for heating oil in Massachusetts may exceed or fall short of STEO regional projections. Table 5 shows the impact of a 2.5 percent price increase over STEO projections on aggregate expenditure estimates in 2008 and 2009.

Table 5: Impact of 2.5 percent price increase on aggregate oil expenditure estimates, 2008 and 2009

<b>Scenario 1: average consumption per household remains at 2006 levels</b>						
Calendar year	Number of oil-heated households	Average consumption (gallons)	Total consumption (gallons)	Retail price increase per gallon	Aggregate expenditure increase estimate	
2008	859,410	722	620,103,483	\$0.10	\$62,010,348	
2009	847,296	722	611,362,577	\$0.11	\$67,708,405	
<b>Two year total impact</b>					<b>\$129,718,754</b>	
<b>Scenario 2: average consumption per household increases based on percentage increase in degree days relative to 2006</b>						
2008	859,410	787	676,222,848	\$0.10	\$67,622,285	
2009	847,296	814	689,311,305	\$0.11	\$76,341,227	
<b>Two year total impact</b>					<b>\$143,963,512</b>	
<b>Scenario 3: average consumption per household decreases based on trend 2002-2006</b>						
2008	859,410	607	521,905,924	\$0.10	\$52,190,592	
2009	847,296	557	472,053,187	\$0.11	\$52,279,890	
<b>Two year total impact</b>					<b>\$104,470,483</b>	

Conversely, energy conservation has the potential to decrease expenditures dramatically. Table 6 shows the impact of a 1 percent decrease in average household heating oil consumption on the aggregate oil heat expenditure estimates presented in Table 4.

**Table 6: Impact of a 1 percent decrease in average consumption on aggregate oil heat expenditure estimates, 2008 and 2009**

<b>Scenario 1: average consumption per household remains at 2006 levels</b>						
Calendar year	Number of oil-heated households	Average consumption (gallons)	Total consumption (gallons)	Retail price of oil per gallon	Aggregate expenditure estimate	Change from original scenario
2008	859,410	714	613,902,448	\$4.00	\$2,455,609,793	-\$24,804,139
2009	847,296	714	605,248,951	\$4.43	\$2,681,252,852	-\$27,083,362
<b>Two year total impact</b>						<b>-\$51,887,501</b>
<b>Scenario 2: average consumption per household increases based on percentage increase in degree days relative to 2006</b>						
2008	859,410	779	669,460,620	\$4.00	\$2,677,842,479	-\$27,048,914
2009	847,296	805	682,418,192	\$4.43	\$3,023,112,590	-\$30,536,491
<b>Two year total impact</b>						<b>-\$57,585,405</b>
<b>Scenario 3: average consumption per household decreases based on trend 2002-2006</b>						
2008	859,410	601	516,686,865	\$4.00	\$2,066,747,459	-\$20,876,237
2009	847,296	552	467,332,655	\$4.43	\$2,070,283,662	-\$20,911,956
<b>Two year total impact</b>						<b>-\$41,788,193</b>

### Projecting aggregate residential consumption and cost of natural gas heat

The Energy Information Administration reports data on residential consumption of natural gas for all uses. In comparison to heating oil, natural gas is used for a wider variety of purposes at the household level. Fortunately, the availability of monthly data on residential gas consumption through 2007 allowed us to estimate the annual quantity of gas used for space heating. To do this, we assumed that in any given year, all gas consumption during the months of June, July, August and September was for non-heating purposes.<sup>31</sup> Then, for each year, we averaged consumption over the four summer months to estimate non-heating consumption for the remaining eight months of the year. We multiplied this figure by eight and added it to summer consumption to estimate total non-heating consumption. We then subtracted this figure from total consumption to estimate consumption of gas for heating purposes.

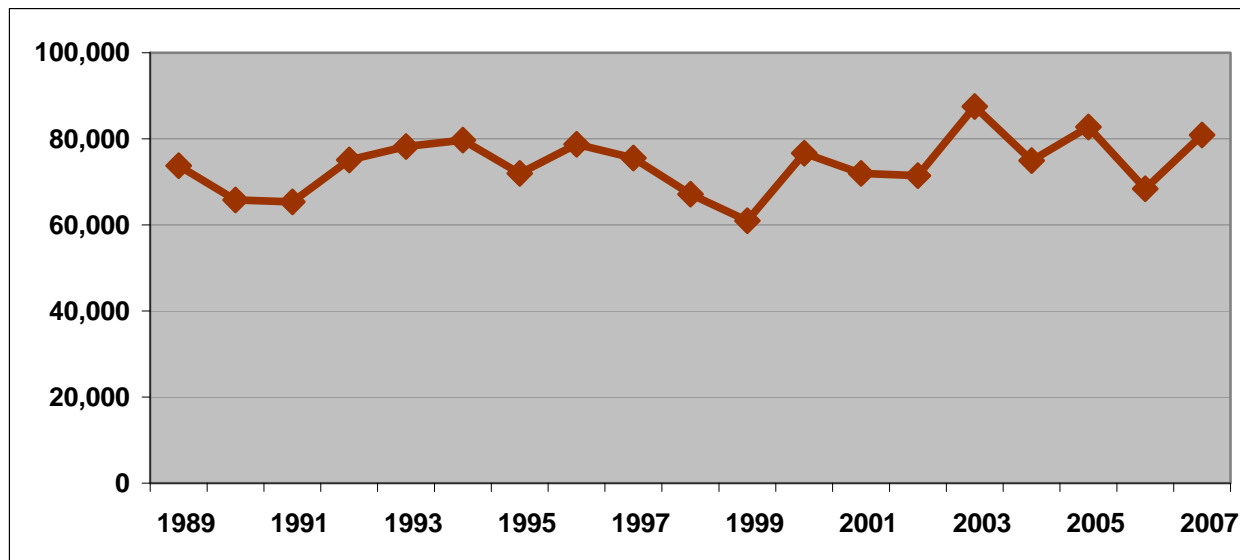
Step 1: Summer consumption = Consumption in June + July + August + September

Step 2: Non-heating consumption for other months = (average consumption for summer months) \* 8

Step 3: Total heating consumption = Total consumption – (summer consumption) – (non-heating consumption for other months)

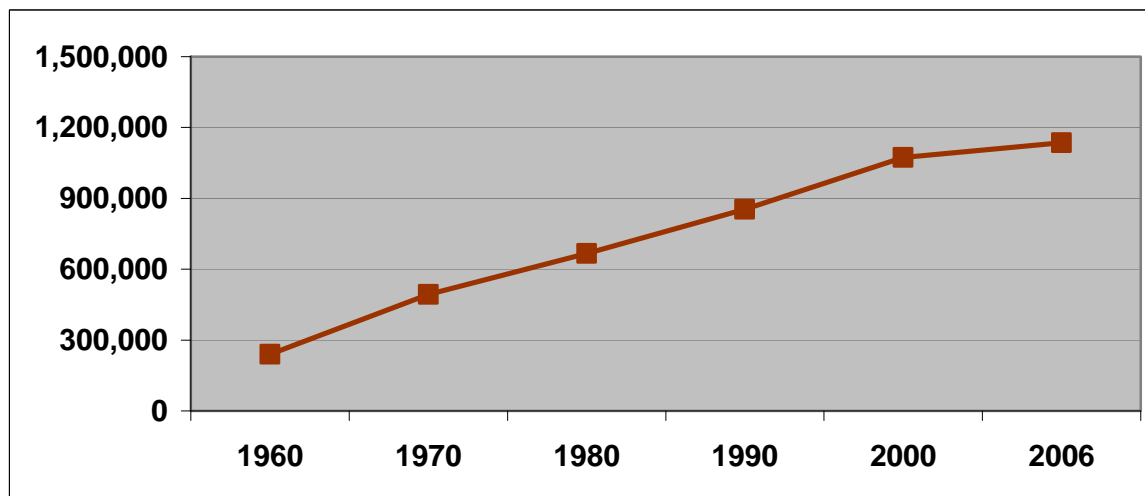
Using this method, we determined that approximately two-thirds of residential gas consumption is for heating purposes. The long-term trend in consumption of natural gas heat is shown in Figure 19.

<sup>31</sup>According to National Oceanic and Atmospheric Administration data, over a 30-year period, heating degree days in New England in June, July, August and September averaged less than 1 percent of total annual heating degree days.

**Figure 19: Aggregate consumption of natural gas for heating purposes, 1989-2007 (in million cubic feet)**

Source: Energy Information Administration, historical consumption information derived from databases supporting the *Natural Gas Monthly*, DOE/EIA-0130, and UMass Donahue Institute estimates

The long-term trend in natural gas consumption is slightly upward, but not as much as would be expected given the large increase in the number of households using natural gas. In 1990, 38 percent of Massachusetts households reported using natural gas for heating purposes. By 2006, the percentage of homes that heat with gas grew to more than 46 percent, representing a total increase of more than 280,000 gas-heated households.<sup>32</sup>

**Figure 20: Number of Massachusetts households using natural gas heat, 1960-2006**

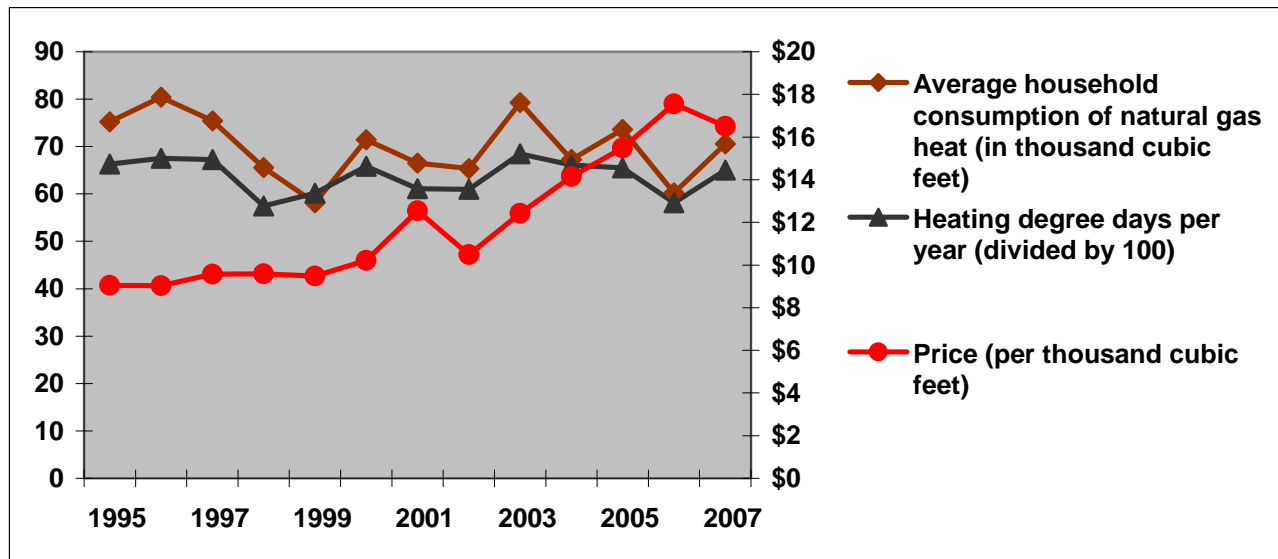
Source: U.S. Census Bureau, Historical Census of Housing and American Community Survey, 2006

Relatively small increases in aggregate gas heat consumption combined with a large increase in the number of households that heat with gas (see Figure 20) implies either significant increases in efficiency and a corresponding reduction in average consumption, some problem with the EIA data on gas consumption, or both.

<sup>32</sup> U.S. Census Bureau, Historical Census of Housing and American Community Survey, 2006.

Figure 21 shows trends in average gas heat consumption, prices and weather. There was a downward trend in gas heat consumption between 2003 and 2006 while prices rose, but it is difficult to determine the relative impact of warmer weather and higher prices on consumption during this period. Similarly, an increase in consumption in 2007 was correlated with both colder temperatures and lower prices, making it difficult to predict the impact of continued price increases in 2008 and 2009 and weather conditions similar to 2007.

**Figure 21: Natural gas prices, gas heat consumption and heating degree days, 1995-2007**



Sources: Energy Information Administration, U.S. Census Bureau, Historical Census of Housing and American Community Survey, 2006 and UMass Donahue Institute estimates

To calculate aggregate consumption and expenditures on natural gas heat in 2008 and 2009, we used the same method as for heating oil, but used reported consumption of utility gas in 2007 as the base year, instead of 2006. Therefore, gas heat expenditure projections start from a higher base of consumption than projections for oil heat. Also, because gas heat consumption did not show the same declining trend as oil heat consumption, we did not include a decreasing consumption scenario for gas heat.

The process for estimating the number of gas heat households in 2008 and 2009 was the same as for heating oil:

**Table 7: Calculate number of Massachusetts gas heat households, step 1**

Year	Total Massachusetts Households	% of households that heat with gas	Massachusetts households that heat with gas
2000	2,443,580	43.90%	1,072,732
2006	2,446,485	46.43%	1,135,903

**Table 8: Calculate rate of change in number of Massachusetts gas heat households, step 2**

Calculating CAGR for gas heat households, 2000-2006:	
Gas households, 2000	1,072,732
Gas households, 2006	1,135,903
Number of years	6
CAGR=(Gas households 2006/Gas households 2000)^(1/number of years)-1	0.9582%

**Table 9: Project number of Massachusetts gas heat households, step 3**

Year	Gas heat households in previous year	Adjustment for fuel switching (1+ CAGR)	Gas heat households in current year
2007	1,135,903	100.96%	1,146,787
2008	1,146,787	100.96%	1,157,776
2009	1,157,776	100.96%	1,168,870

In the first gas heat scenario, we assume that 2007 consumption of 70.54 thousand cubic feet of gas per household will remain constant despite predicted warmer temperatures in 2008 and colder weather in 2009. In the second scenario, we adjust average consumption per household to account for the projected change in degree days.

**Table 10: Calculating projected gas heat expenditures in 2008 and 2009, two scenarios**

Scenario 1: average consumption per household remains at 2007 levels						
Calendar year	Number of gas-heated households	Average consumption (thousand cubic feet)	Total consumption (thousand cubic feet)	Retail price of gas per thousand cubic feet	Aggregate expenditure estimate	
2007	1,146,787	70.54	80,894,000	\$16.50	\$1,334,751,000	
2008	1,157,776	70.54	81,669,142	\$18.35	\$1,498,628,765	
2009	1,168,870	70.54	82,451,713	\$21.11	\$1,740,555,652	
Scenario 2: average consumption per household adjusted based on percentage change in degree days relative to 2007						
2007	1,146,787	70.54	80,894,000	\$16.50	\$1,334,751,000	
2008	1,157,776	68.75	79,596,316	\$18.35	\$1,460,592,401	
2009	1,168,870	72.93	85,249,202	\$21.11	\$1,799,610,662	

Table 11 shows the impact of a 2.5 percent increase in the price of gas over the most recent EIA STEO projections used in developing the projections in Table 10.

**Table 11: Impact of 2.5 percent price increase on aggregate gas heat expenditure estimates, 2008 and 2009**

Scenario 1: average consumption per household remains at 2007 levels						
Calendar year	Number of gas-heated households	Average consumption (thousand cubic feet)	Total consumption (thousand cubic feet)	Retail price increase per thousand cubic feet	Aggregate expenditure increase estimate	
2008	1,157,776	70.54	81,669,142	\$0.46	\$37,465,719	
2009	1,168,870	70.54	82,451,713	\$0.53	\$43,513,891	
<b>Two year total impact</b>					<b>\$80,979,610</b>	
Scenario 2: average consumption per household adjusted based on percentage change in degree days relative to 2007						
2008	1,157,776	68.75	79,596,316	\$0.46	\$36,514,810	
2009	1,168,870	72.93	85,249,202	\$0.53	\$44,990,267	
<b>Two year total impact</b>					<b>\$81,505,077</b>	



Table 12 shows the impact of a 1 percent decrease in average gas heat consumption on the aggregate expenditures estimates shown in Table 10.

**Table 12: Impact of 1 percent decrease in average gas heat consumption on aggregate expenditures, 2008 and 2009**

<b>Scenario 1: average consumption per household remains at 2007 levels</b>						
<b>Calendar year</b>	<b>Number of gas-heated households</b>	<b>Average consumption (thousand cubic feet)</b>	<b>Total consumption (thousand cubic feet)</b>	<b>Retail price of gas per thousand cubic feet</b>	<b>Aggregate expenditure estimate</b>	<b>Change from original scenario</b>
2008	1,157,776	69.83	80,852,451	\$18.35	\$1,483,642,477	-\$14,986,288
2009	1,168,870	69.83	81,627,195	\$21.11	\$1,723,150,095	-\$17,405,557
<b>Two year total impact</b>						<b>-\$32,391,844</b>
<b>Scenario 2: average consumption per household adjusted based on percentage change in degree days relative to 2007</b>						
2008	1,157,776	68.06	78,800,353	\$18.35	\$1,445,986,477	-\$14,605,924
2009	1,168,870	72.20	84,396,710	\$21.11	\$1,781,614,556	-\$17,996,107
<b>Two year total impact</b>						<b>-\$32,602,031</b>

### Projecting the burden of heating costs on households that heat with oil in 2009

The US Census American Community Survey (ACS) is an annual nationwide survey of households that is designed to collect up-to-date demographic, economic, housing and other data on communities and allow policy makers to see how households and communities are changing on a timelier basis than the decennial census.<sup>33</sup> The survey instrument includes questions on primary heating fuel and expenditures on utilities, making it a potentially useful source of information on household heating costs.

Other studies of household energy use and expenditures have used data collected by the U.S. Energy Information Administration Residential Energy Consumption Survey (RECS).<sup>34</sup> We decided to use ACS data rather than RECS for two reasons. First, while RECS data are very detailed, the survey relies on a small national sample of just 4,381 households. Regional data are available for the six New England states combined, but not at the household level for individual states. Second, the most recent complete set of RECS data is from 2001, and other sources of data specific to Massachusetts indicate substantial changes in household heating fuel and consumption since that time.

The most recent ACS data available are from calendar year 2006. The size of the 2006 sample was sufficient to allow us to make determinations about heating fuel use on a statewide level, as well as on the level of Massachusetts' major cities, but it was small enough that error became unacceptably high when we asked questions about less populous regions of the state such as Cape Cod or Berkshire County. In order to overcome this problem, we combined ACS public use microdata from 2005 and 2006 to form the dataset on which we based our household-level analysis. Because we combined two datasets that were each individually designed to reflect the entire population of the Commonwealth, we had to divide any results that represented absolute magnitudes (rather than proportions) by two to avoid double-counting the Commonwealth's residents. Our combined dataset represents a sample of 50,883 Massachusetts households.

<sup>33</sup> U.S. Census bureau website, <<http://www.census.gov/acs/www/>>

<sup>34</sup> See, for example, Bradbury, Katharine. *Regional Differences in the Impact of Energy Price Increases*. Federal Reserve Bank of Boston, 2005; Eisenberg, Joel. *The Impact of Forecasted Energy Price Increases on Low-Income Consumers*. Oak Ridge National Laboratory, 2005; Power, Meg. *Low-Income Consumers' Energy Bills and their Impact in 2006*. Economic Opportunity Studies, October 25, 2005.

We used the combined 2005-2006 ACS dataset to calculate distribution of households by heating fuel, tenure (renters and owners), and age at the statewide level. To determine the distribution of households by heating fuel at the regional level, we used ACS Data divided geographically by Public Use MicroSample Areas, or PUMAs. These PUMAs do not line up perfectly with the regions we wanted to use to divide the state geographically, so we referred to US Census data regarding town and city populations. While the PUMAs may straddle the regions identified in figures 2 and 3, all towns and cities fall entirely within one of these regions. Therefore, we were able to identify those PUMAs which did not fall entirely within a single region, look at the populations of the towns and cities in those PUMAs by region, and apply the appropriate portion of those PUMAs to each region. Once this weighting scheme was assembled, we simply tabulated the heating fuel variable in the ACS by region.

After looking at the general distribution of heating fuels, we originally intended to use ACS data to calculate household heating expenditures as a percentage of household income in 2006. However, due to limitations in the way ACS collects data on energy usage, it was not possible to conduct this analysis for all fuels. While the process of calculating expenditures on oil heat as a percentage of household income for households that depending on heating oil was relatively straightforward, it proved to be impracticable for those who heat with natural gas or electricity.

The ACS survey asks households to report or estimate the cost of heating oil used to heat their homes over a 12-month period.<sup>35</sup> However, with respect to gas and electricity, the questionnaire asks “LAST MONTH, what was the cost of [electricity or gas] for this house, apartment, or mobile home?”<sup>36</sup> At the time of writing, we have been unable to find a way to determine the month in which a given respondent completed the ACS survey. As such, there is no reliable way to differentiate between those respondents who answered this question based on a summer month versus a month during the heating season. For this reason, we could not use the ACS data to calculate household expenditures on gas or electricity for heating purposes.

Having limited our ACS data analysis to households that identified oil as their primary heating fuel, we calculated the reported 12-month cost of heating oil and expressed this cost as a percentage of the annual household incomes reported by those respondents. This allowed us to generate a variable that showed the cost of oil heat as a percentage of household income for those respondents.

It should be noted that while 9,835 respondents (representing 884,927 households) identified oil as their primary heating fuel, only 8,258 of the respondents (representing 680,399 households) also provided the fuel cost and income information necessary to calculate heating oil cost as a percentage of household income. Of those who did not provide all of the necessary information, 763 respondents (representing 79,415 households) reported that their heating costs were included in their rent. The remaining 814 respondents (representing 125,113 households) either didn't provide income information, or reported that oil was not used to heat their home in the past 12 months, despite having also reported oil as their primary heating fuel. A large portion of these responses must be assumed to be in error, suggesting that our results likely err on the side of undercounting burdened households.

Once we had generated the variable expressing heating oil costs as a proportion of household income, we consulted relevant literature for guidance on establishing thresholds by which to identify households that we believed would be burdened by the cost of heating oil. A 2005 national evaluation of the Low Income Home Energy Assistance Program (LIHEAP) identified “high home energy burden” as heating and cooling costs that exceed 4.3 percent of household income for low-income households, and “moderate home energy burden” as

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<sup>35</sup>2005-2006 ACS Questionnaire, Question 14 d., <<http://www.census.gov/acs/www/Downloads/SQuest05.pdf>>

<sup>36</sup> 2005-2006 ACS Questionnaire, Question 14 a. and b., <<http://www.census.gov/acs/www/Downloads/SQuest05.pdf>>

heating and cooling costs exceeding 2.6 percent of household income for low-income households.<sup>37</sup> The methodology used to calculate these thresholds was designed in the context of LIHEAP-eligible households, and did not take regional differences in home energy use into account.

A “home energy affordability gap” model developed by Fisher, Sheehan and Colton estimates the gap between affordable home energy bills and actual home energy bills on a county-by-county basis. The model sets 2 percent of household income as a threshold for affordable home heating and cooling bills. FSC then uses this threshold to calculate the gap between actual and affordable home energy bills for LIHEAP-eligible households.<sup>38</sup>

In setting a threshold to identify Massachusetts households that would be burdened by high oil heat bills in 2009, we wanted to be conservative. We also wanted to apply our analysis to all low and moderate-income households, not just those eligible for LIHEAP. Toward these ends, we reasoned that moderate-income households could allocate a higher percentage of their income to heating costs than the lowest-income households, whose budgets are fully absorbed by other necessities such as food and shelter. We thus established separate thresholds for “moderate burden” and “severe burden” for households in the bottom income quintile (“low-income households”) and the second income quintile (“low-to-moderate-income households”). The highest income for our “low-income households” is equivalent to 38.21 percent of the statewide median household income in 2009 and the upper end of our “low-to-moderate-income” category is 78.57 percent of statewide median.

We defined *moderately burdened* households as low-income households that would spend more than 2.5 percent of income on oil bills, and low-to-moderate-income households that would spend more than 5 percent of income on oil heat. *Severely burdened* households are low-income households that would spend more than 5 percent of income on oil heat, and low-to-moderate-income households with oil bills exceeding 10 percent of income. The income groups and thresholds are summarized in Table 13.

*It is important to note that these thresholds are very conservative, and thus do not represent all households that may actually be burdened by high oil heat bills.* There will likely be households with annual incomes of less than \$46,315 with oil bills below these thresholds that are nevertheless unaffordable. There may also be moderate-income households earning more than \$46,315 with oil bills approaching or exceeding 10 percent of income that are also unaffordable.

**Table 13: Summary of thresholds for households burdened by high oil heat costs**

	Min. household income	Max. household income	Median household income	Oil cost "moderate burden" as % of income	Moderate oil cost burden threshold for median income household	Oil cost "severe burden" as % of income	Severe oil cost burden threshold for median income household
Low income households	\$0	\$22,526	\$12,526	2.5%	\$313	5.0%	\$626
Low to moderate income households	\$22,527	\$46,315	\$34,420	5.0%	\$1,721	10.0%	\$3,442

<sup>37</sup> Applied Public Policy Research Institute for Study and Evaluation (APPRISE, Inc). *LIHEAP Energy Burden Evaluation Study*, prepared for the Division of Energy Assistance, Office of Community Services, Administration for Children and Families, U.S. Department of Health and Human Services, July 2005.

<sup>38</sup> Fisher, Sheehan and Colton website, <<http://www.homeenergyaffordabilitygap.com/>>

Using the thresholds shown in Table 13, we calculated the number of moderately burdened and severely burdened households in the Commonwealth in 2006, and summarized demographic characteristics of these households.

To project the number of moderately burdened and severely burdened households in 2009, we made a number of assumptions. First, we assumed that the incomes of low and low-to-moderate-income households would remain level between 2006 and 2009. Given long-term trends documenting declining household income for low and low-to-moderate-income households in the Commonwealth,<sup>39</sup> we feel that this is a conservative assumption. Current data suggest the incomes of these households may in fact be declining, and are certainly unlikely to grow substantially by 2009.

Next, we needed to project increases in the price of heating oil between 2006 and 2009. To do this, we used the Energy Information Administration Short-Term Energy Outlook (STEO) from July 8, 2008. This dataset gave us annual price estimates and projections for the Northeast Census region for 2007, 2008, and 2009. Because we used ACS household data on oil costs from 2005 and 2006 as our starting point, our first step with the STEO data was to average the annual prices from 2005 and 2006 (\$2.15 and \$2.49 respectively) to form a baseline price (\$2.32). We then compared the 2007 actual prices and 2008 and 2009 projected prices to the 2005-2006 baseline price in order to determine the magnitude of the modification necessary to adjust 2005/2006 costs to reflect subsequent increases in price. For example, STEO reported the average cost of a gallon of heating oil in the Northeast region in 2007 was \$2.73. We compared this to our baseline by dividing the new price by the baseline price ( $\$2.73/\$2.32$ ), yielding an adjustment factor of 1.18. Similarly, average prices of \$4.00 and \$4.43 for 2008 and 2009 yielded adjustment factors of 1.72 and 1.91 respectively.

In applying price adjustment factors to ACS data on 2005-2006 oil heat bills, we assumed that consumption would remain constant. That is, we projected what it would cost (based upon the assumptions noted above) for the individuals we had identified to use the same amount of oil in 2009 that they used in 2005-2006. So, if a given household spent \$1,000 on oil in 2006, and the adjustment factor for 2009 was 1.91, we projected that household would spend  $\$1,000 \times 1.91$ , or \$1,910 on heating oil in 2009. This assumption may overestimate household expenditures in 2009, as it does not take fuel switching, weatherization or reduced usage into account. On the other hand, it might underestimate these expenditures, as 2006 was an unusually warm year and the STEO projections are considered to be conservative.

Once we inflated 2006 oil consumption by expected prices in 2009, we could estimate the cost of oil as a percent of household income for 2009. These data were then subjected to the same analysis described above for the 2006 data, as we identified those households that were **moderately burdened** and **severely burdened** and examined their demographic characteristics.

Our goal was to identify low- and low-to-moderate-income households that would be burdened by high heating oil bills regardless of whether they met the Massachusetts eligibility threshold for LIHEAP, currently set at 200 percent of federal poverty level (FPL). The American Community Survey includes a variable that indicates household income as a percentage of federal poverty level. This is a very useful variable, because the poverty threshold varies depending upon the size of the household, so that an income that puts a family of 3 at 200 percent of the poverty threshold might put a family of 8 at 50 percent of the threshold. So, for the purposes of our analysis, this variable allowed us to determine poverty status for those households that we identified as moderately burdened and severely burdened by high oil heat bills.

To conduct our poverty level analysis for burdened households, we used ACS data to generate a variable that split poverty status into three categories: below 100 percent of the threshold, between 100 percent and 200 percent of

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<sup>39</sup> Loveland, Rebecca, Robert Nakosteen, Raija Vaisanen and Roy Williams. "Income Inequality in Massachusetts, 1980 – 2006." Forthcoming in *MassBenchmarks*, volume ten, issue two, 2008.

the threshold, and over 200 percent of the threshold. Again, calculating the number of moderately burdened and severely burdened households that fell into these categories in 2006 was a relatively simple matter. For 2009, however, we needed to adjust the poverty threshold variable. While it may be the case that households in the bottom two income quintiles are unlikely to see income gains through 2009, it is also certainly the case that poverty thresholds have increased substantially over recent years. Our analysis of poverty thresholds for families of between one and eight people from 2006 to 2008 showed that, while the rate of increase was not perfectly constant, all thresholds had increased by approximately 6 percent over the two year period. We calculated that this two year growth rate of 6 percent translated to an annual growth rate of 2.956 percent. If thresholds were increasing at a rate of 2.956 percent annually, we could assume that they would increase by 9.1327 percent over the three year period between 2006 (our baseline data point) and 2009. So, if the poverty threshold for a family of two was \$13,200 in 2006, we projected that in 2009 it would be  $\$13,200 \times 1.091327$ , or \$14,405.52. If a family's income remained constant at \$26,400, they would have moved from 200 percent of the poverty threshold in 2006 to  $\$26,400/\$14,405.52$ , or 183 percent of the poverty threshold in 2009. Using these adjusted poverty data, we were able to replicate the analysis of the 2006 data discussed above, substituting the 2009 data. This allowed us to look for differences in the populations that were burdened in 2006 and those that would become burdened between 2006 and 2009.

## Works Consulted

- American Community Survey. *U.S. Census Bureau*. 2006. <<http://www.census.gov/acs/www/index.html>>.
- Anderson, R.; Kochanek, K., and S. Murphy. *Report of Final Mortality Statistics, 1995*. Hyattsville, MD: National Center for Health Statistics, 1997.
- Applied Public Policy Research Institute for Study and Evaluation (APPRISE, Inc). *LIHEAP Energy Burden Evaluation Study*, prepared for the Division of Energy Assistance, Office of Community Services, Administration for Children and Families, U.S. Department of Health and Human Services, July 2005.
- Bradbury, Katharine. *Regional Differences in the Impact of Energy Price Increases*. Federal Reserve Bank of Boston, 2005.
- Broncaccio, Diane. "Buckland board considers local assistance for heating." *Recorder*, July 3, 2008. <[http://www.recorder.com/story.cfm?id\\_no=5158860](http://www.recorder.com/story.cfm?id_no=5158860)>.
- Child Health Impact Working Group. *Unhealthy Consequences: Energy Costs and Child Health, A Child Health Impact Assessment of Energy Costs and the Low Income Home Energy Assistance Program*, 2006.
- Cooper, Mark. *Rising Energy Prices Strain Household Budgets and the Economy, for most Americans*. Consumer Federation of American, Consumers Union and Free Press, 2004.
- Ebbert, Stephanie. "Governor Launches Energy Task Force." *Boston Globe*, July 24, 2008.
- Eisenberg, Joel. *The Impact of Forecasted Energy Price Increases on Low-Income Consumers*. Oak Ridge National Laboratory, 2005.
- Energy Affordability Gap Model. Fisher, Sheehan and Colton website, <<http://www.homeenergyaffordabilitygap.com/>>
- "Fuel Price Information." *Massachusetts Department of Energy Resources (DOER)*. <<http://www.mass.gov/doer/fuels/pricing.htm>>.
- The Impact of Energy Costs on Seniors*. AARP Public Policy Institute, 2008.
- Historical Census of Housing. *United States Census Bureau*. <<http://www.census.gov/hhes/www/housing/census/historic/fuels.html>>
- "Hungry for gas: Gas prices threaten Meals on Wheels programs. AARP Bulletin Today, July 2, 2008. <[http://bulletin.aarp.org/states/ma/articles/hungry\\_for\\_gas\\_gas\\_prices\\_threaten\\_meals\\_on\\_wheels\\_programs.html](http://bulletin.aarp.org/states/ma/articles/hungry_for_gas_gas_prices_threaten_meals_on_wheels_programs.html)>
- U.S. Senator John Kerry, Opening Statement on Congressional hearing held June 25, 2008, titled "Examining Solutions to Cope with the Rise in Home Heating Oil Prices." <[http://www.sbc.senate.gov/press/record\\_statement.cfm?id=299673](http://www.sbc.senate.gov/press/record_statement.cfm?id=299673)>

- Klein, R., and J. Watson. "Two Boys Killed in Mattapan House Fire; Blaze is Blamed on Space Heater." *The Boston Globe*, 2000.
- LIHEAP selected data, dated June 24, 2008, unpublished provided to authors by Gerald Bell, Director of Community Services Programs, Massachusetts Department of Housing and Community Development, July 16, 2008.
- Loveland, Rebecca, Robert Nakosteen, Raija Vaisanen and Roy Williams. "Income Inequality in Massachusetts, 1980 – 2006. Forthcoming in *MassBenchmarks*, volume ten, issue two, 2008.
- Massachusetts Sales of Distillate Fuel by End Use. *Energy Information Administration*. Released 12/13/07. <[http://tonto.eia.doe.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_sma\\_a.htm](http://tonto.eia.doe.gov/dnav/pet/pet_cons_821dst_dcu_sma_a.htm)>
- National Energy Assistance Directors. *2005 National Energy Assistance Survey*, 2005.
- Nord, Mark and Kantor, Linda S. "Seasonal Variation in Food Insecurity is Associated with Heating and Cooling Costs among Low-Income Elderly Americans." *The Journal of Nutrition* (2006).
- Power, Meg. *Low-Income Consumers' Energy Bills and their Impact in 2006*. Economic Opportunity Studies. October 25, 2005.
- Running on Empty: Massachusetts Faces Record Energy Costs*. Massachusetts State Senate Committee on Post Audit and Oversight Report, July 1, 2008
- Scheible, Sue. "Tough Times for Meals on Wheels." *Quincy Patriot Ledger*, posted July 14, 2008, update July 15, 2008. <[www.patriotledger.com](http://www.patriotledger.com)>
- Short-Term Energy Outlook. *Energy Information Administration*. July 8, 2008 <<http://www.eia.doe.gov/emeu/steo/pub/contents.html>>
- State Energy Data System. *Energy Information Administration (EIA)*. February 29, 2008 <[http://www.eia.doe.gov/emeu/states/\\_seds.html](http://www.eia.doe.gov/emeu/states/_seds.html)>.
- U.S. regional weather data accessed from Energy Information Administration website, <http://www.eia.doe.gov/emeu/steo/pub/contents.html>. Historical weather data from U.S. Department of Commerce, National Oceanic and Atmospheric Association (NOAA), projections are based on forecasts by NOAA Climate Prediction Center.