SCIENCE, TECHNOLOGY, AND PUBLIC POLICY PROGRAM &
HARVARD UNIVERSITY CENTER FOR THE ENVIRONMENT

Opportunities for Cost-Effective Residential Heat Pump Adoption in Massachusetts

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Daniel P. Schrag

HARVARD Kennedy School
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50 YEARS
OF RESEARCH, POLICY, AND LEADERSHIP

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PAPER
JUNE 2024

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A heat pump is installed at a house in Frankfurt, Germany, Thursday, Sept. 7, 2023. (AP Photo/Michael Probst)

Executive Summary

Background: Electrification through heat pumps is a primary strategy for decarbonizing residential heating in Massachusetts. The state has announced ambitions for 65% of residential-scale heating to be heat pump equipment by 2030 and 90% by 2040, earmarking nearly 4 billion dollars in incentives between 2022 and 2024 to promote uptake. Yet high electricity prices across the state (among the highest in the country) mean that heat pump adoption will increase household heating bills and energy burdens, preventing widespread uptake. Here, we undertake a comprehensive spatial analysis of the effect of heat pump adoption on residential household heating costs in Massachusetts across a range of heating types and fuel costs. Our aim is to identify where heat pump adoption should be prioritized and where policy, financial, or other measures will be necessary to promote uptake.

Analysis: We calculate the annual change in residential heating costs incurred by the average Massachusetts household (1,800 sq ft) converting from natural gas, oil, or electric resistance heating to an air- or ground-source (geothermal) heat pump. We conduct our analysis on a town-by-town basis, using location-specific fuel and electricity costs and heat pump coefficient of performance (COP) values.

Results: In approximately 50% of households in the state, predominately those heated with natural gas, air-source heat pump adoption would increase annual household heating costs, in most cases, by $300–$500 per year. The exception is in regions where electricity prices are substantially lower than the state average. In these households, along with households heated with oil (around 25% of all households), air-source heat pump adoption would reduce annual heating bills, but these savings are small relative to installation costs. In households currently using electric resistance heating, air-source heat pump adoption will decrease annual heating costs, in some cases up to $2,900 per year (for the average-sized MA household). The high annual savings for households with electric resistance heating mean that upfront heat pump purchase and installation costs can typically be recovered in much less than ten years, even without subsidies.

Conclusions: We recommend that state policies to promote heat pump adoption initially focus on the 16% of Massachusetts households with electric resistance heating, where the cost of heat pump installation can be recovered quickly. Obstacles in these households will likely be associated with financing as many of these are rental households where landlords have little incentive to upgrade heating systems. For households with oil heating, savings are marginal and therefore not enough to make heat pump adoption cost-effective. These households could be a secondary target for subsidies, particularly those households with central air conditioning that will, at some point, require replacement. Decarbonizing residential heating across all households will require a substantial decrease in the residential price of electricity relative to natural gas or oil to make heat pump adoption more widely cost-effective.

Background

Residential heating accounts for approximately 16% of Massachusetts' direct greenhouse gas emissions (12.2 million metric tons/year)[1], primarily from natural gas and oil, the dominant heating sources of households in the state (Figure 1). The state's Clean Energy Climate Plan outlines goals to decarbonize residential heating through electrical efficiency updates and electrification (i.e., heat pumps) with ambitions to install heat pumps in 2.2 million households by 2050.[2] To help reach these goals, the state has dedicated approximately $4 billion through its MassSave program, primarily as subsidies to help cover the upfront costs of heat pump purchase and installation. This is in addition to federal tax credits made available through the 2022 Inflation Reduction Act. The transition to heat pumps has been further bolstered by the Massachusetts Department of Public Utilities' (DPU) recent order, which stated that gas utilities are required to consider non-gas alternatives and will no longer be able to recover costs associated with programs that promote the use of natural gas through ratepayers.[3] The DPU indicated that there must be a significant increase in the adoption of heat pumps but that customer costs must be minimized.

The high electricity prices in Massachusetts, the third most expensive in the country,[4] may present a barrier to widespread heat pump uptake if adoption causes heating bills to increase. Whether annual heating bills increase with heat pump adoption depends on factors such as the incumbent heating type (natural gas, oil, or electricity), the price of heating fuels and electricity, and heat pump efficiency. In some cases, for instance in homes with electric resistance heating, heat pump adoption may substantially reduce annual energy bills due to the increased efficiency of heat pumps relative to electric resistance space heating. In this study, we aim to identify the households and regions where heat pump adoption may increase heating bills and where there may be opportunities for cost savings.

Here we undertake a spatial analysis of the annual change in residential heating costs for Massachusetts households that convert from natural gas, oil, or electric resistance heating to air- or ground-source heat pumps. Our analyses are based on the average-sized Massachusetts household, which is 1,800 sq ft[5] and consumes approximately 13,000–15,000 kWh of energy annually for heating.[6] We conduct our analyses on a town-by-town basis, using current natural gas, heating oil, and

electricity costs (as of April 2024) and average monthly temperature records (2010–2022)[7] to determine heat pump efficiency (the coefficient of performance) over the heating season (September–May). We estimate heat pump purchase and installation costs to be approximately $20,000 for air-source heat pumps for an average-sized household, with an additional $20,000 for ground-source heat pump installation.[8,9] We present our results by incumbent heating technology and discuss findings in the context of cost-effective heat pump uptake, natural gas demand, greenhouse gas emissions, and climate adaptation.

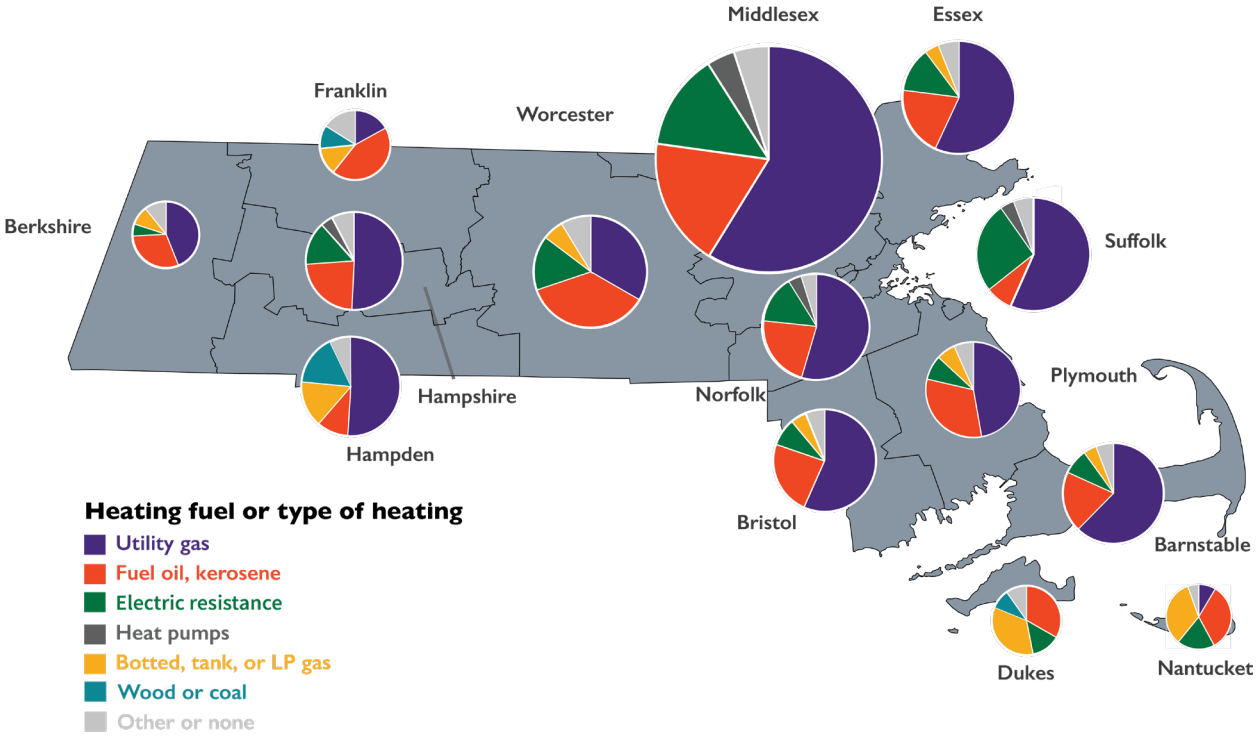

Figure 1. Household heating types by county. The size of the chart is proportional to the population size. Data source: U.S. Census Bureau, 2022 American Community Survey 1-Year Estimates.

Results

Natural gas

Natural gas is the primary residential heat source in Massachusetts, used in approximately half of all households in the state (~1.4 million households: Figure 1). Over the heating season, which runs from September to May (inclusive), an average-sized household unit in Massachusetts (~1,800 sq ft) pays approximately $910–$1,190 for natural gas heating, based on natural gas costs between 6.7¢ and 9.1¢/kWh (Table S1) and an annual heating energy consumption of 13,000 kWh.[6]

By adopting an air-source heat pump system in place of a natural gas furnace, approximately 156,000 households (6% of all households) incur a reduction in annual heating bills, saving up to $700 per year in some cases (Figure 2). These greater saving opportunities are restricted to towns or cities where municipalities provide electricity at lower prices than the state average electricity costs of 33¢/kWh (e.g., Ashburnham, Berkley, Boylston). There are marginal cost savings in other regions covered by investor-owned utilities, but only if customers seek a competitive power supply lower than the average utility rate. In all other areas with utility gas (approximately 1.25 million households), adopting air-source heat pumps would significantly increase heating costs—in some cases, up to $1,000 per year (Table A1).

The opportunities for annual cost savings are wider with ground-source heat pumps (~975,000 households), given their superior efficiency compared with air-source heat pumps (coefficient of performance ~4, compared with 2-3 for air-source heat pumps, Table A1). Further, provided they are installed at sufficient depth (~9m), ground-source heat pump efficiency does not fluctuate over air temperature variations, meaning that cost savings would be distributed across the year, unlike air-source heat pumps in which savings, on a per unit energy basis, would be greater in warmer months. Nonetheless, annual savings are still marginal (less than $100 annually) in most regions (Figure 2 and Table A1) and only benefit these additional regions if large utility customers choose their power supply at a lower cost than the average price of electricity provided by the utility.

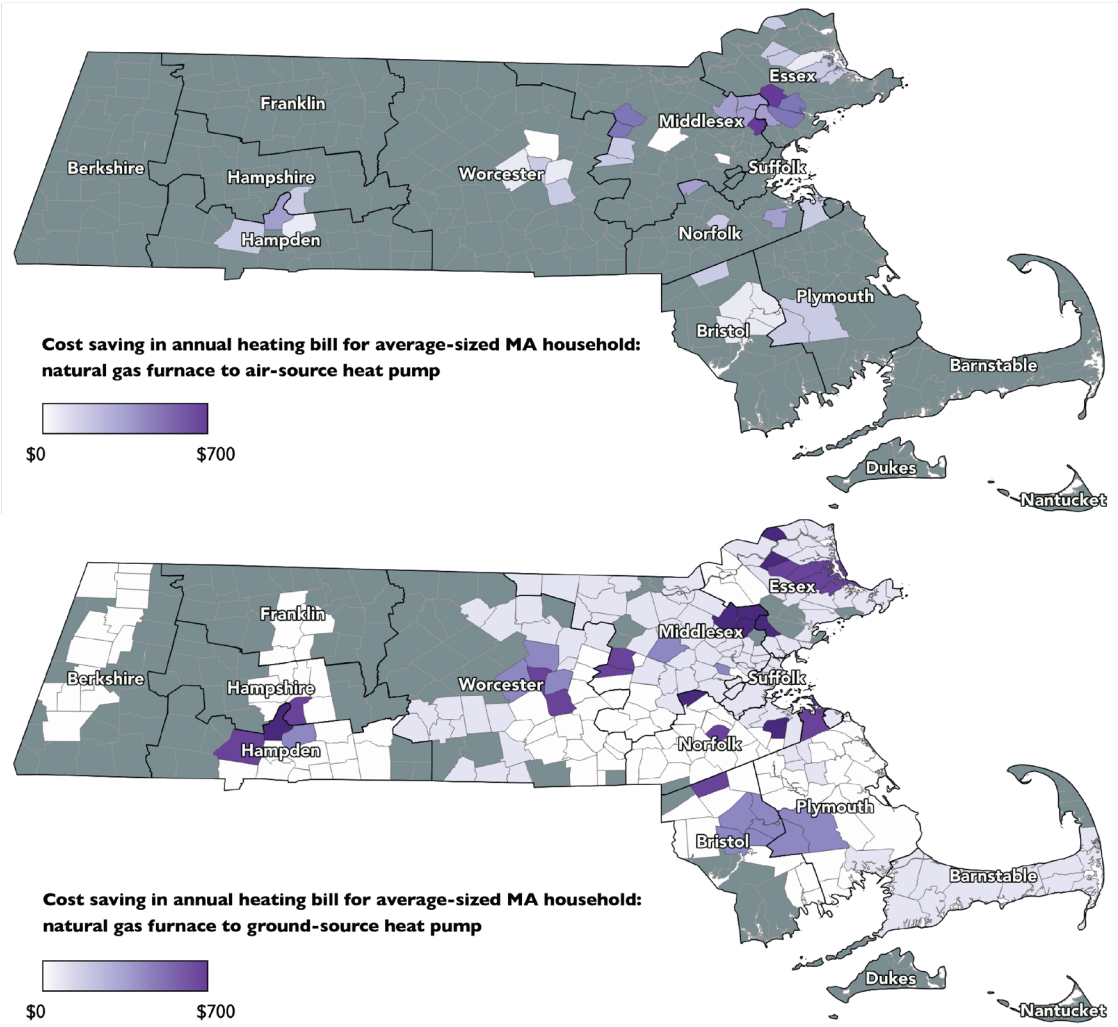

Figure 2. Annual heating cost savings through heat pump adoption in the average-sized MA household, which currently uses natural gas furnace heating. Only towns where a saving is incurred are shown; all towns/cities where heating costs would increase or where utility gas is unavailable are shown in grey. Complete data are displayed in Table A1.

Heating oil

Following natural gas, heating oil is the leading fuel source for residential heating in MA, particularly in counties where the gas grid does not provide full coverage, such as Worcester and Franklin (Figure 1). Depending on the county, heating oil costs approximately 8.8¢ – 9.2¢ per kWh, totaling $1,370–$1,435 over the heating season. The greater costs are also partly due to the lower average efficiencies (~80%) of oil furnace heating.[10]

Given the greater cost of heating oil relative to natural gas (~9¢/kWh versus ~6.7¢/kWh), opportunities for cost savings with air-source heat pump adoption are more widespread compared with natural gas heating systems—although these savings are still marginal, averaging ~$100 per year (Figure 2). With air-source heat pumps, approximately 655,000 households would incur a reduction in heating bills, representing a quarter of all households in the state. As with natural gas, the greatest savings (up to $1,100 per year) are in towns or cities with lower electricity costs than the prevailing state average (Table A1). Again, in regions served by large utilities, these savings are only possible if consumers purchase power from a different competitive supplier and not at the base rate provided by the utility (although the utility still provides delivery, which can represent more than half the total cost per kWh). With ground-source heat pumps, which are more efficient, approximately 680,000 households would incur a saving in annual heating costs (Figure 3), but again these are mostly marginal savings.

Electric resistance heating

Approximately 16% of households in Massachusetts use some form of electrical resistance heating, typically as in-built baseboard or space heating, with the greatest use in Middlesex (22.5%), Suffolk (22%), and Worcester (13.4%) counties (Figure 1).[11] Electric heating systems dominate in low-income, multi-unit housing due to the low upfront capital costs relative to other heating systems, averaging ~$250–500 for installation[12] (not including labor costs). Yet operating costs are much higher: an average-sized household unit (1,800 sq ft) with electric resistance heating pays approximately $4,290 annually at the prevailing average electricity costs across the state (33¢/kWh), although costs will be less in smaller households.

Given heat pumps' superior efficiency in converting electrical energy to thermal energy, all Massachusetts households that currently use electric resistance heating as their primary heating source (~420,000) incur cost savings by converting to an air- or ground-source heat pump, with greater annual savings in towns or cities that have higher heat pump coefficient of performance values (Table A1) or more expensive electricity. In some ways, the situation is reversed from heating oil or natural gas heat; households in towns with more expensive electricity and with electric resistance heating systems will save more switching to heat pumps than those in towns with less expensive electricity. Annual savings range from $66–$2,484 for an air-source heat pump, increasing to ~$2,787 per year for

ground-source heat pumps (Figure 4). Additional research is needed to provide detail on the households that use electric resistance heat, but many are likely to be low-income households and, in particular, rental households, as landlords may choose the lowest capital cost for heating systems if they are not directly benefitting from lower operational costs. So even though the large cost savings for switching to heat pumps should have already driven a change, the large number of households that still use electric resistance heat suggests that a major challenge exists in financing the upfront capital costs, as the savings may not accrue to the property owners.

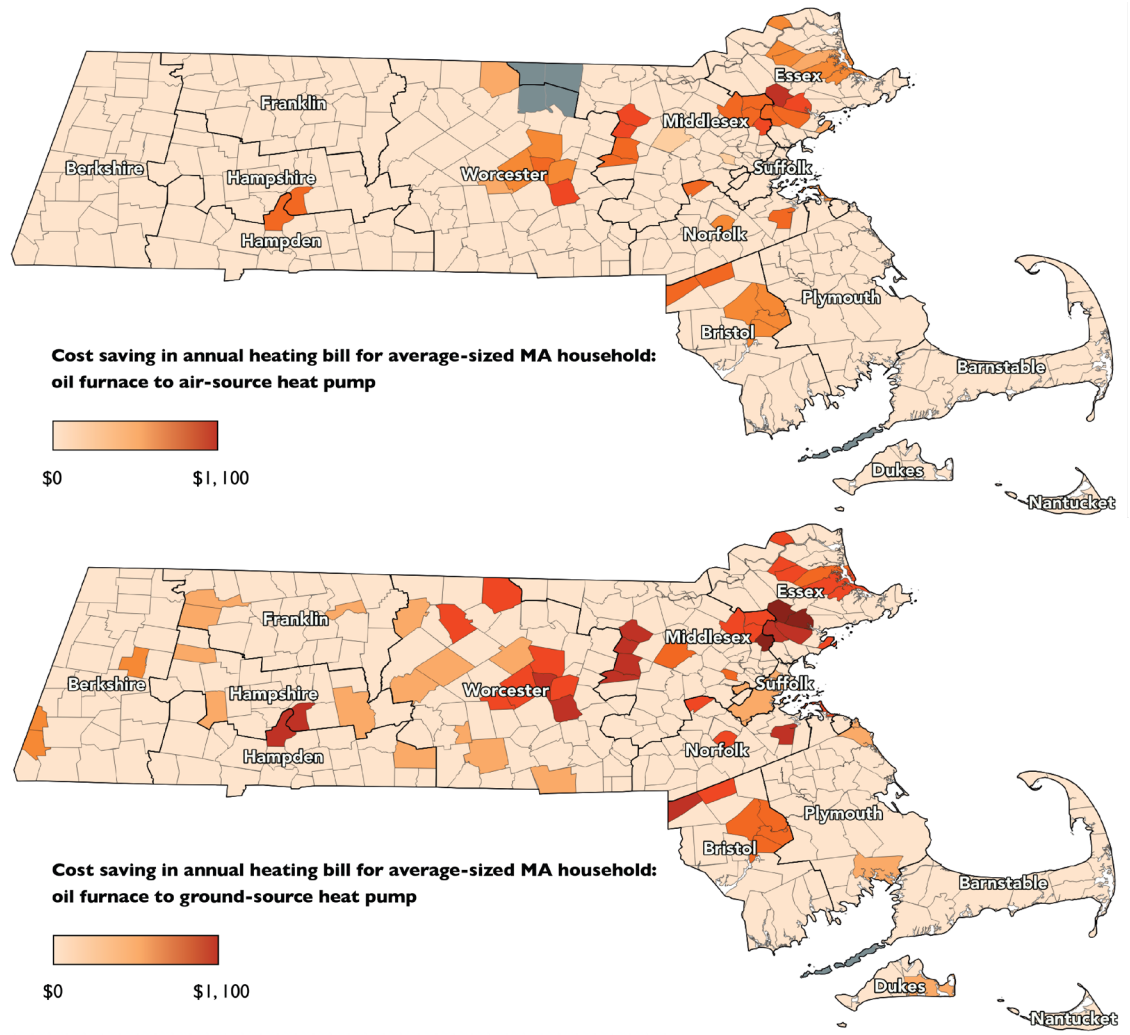

Figure 3. Annual heating cost savings through heat pump adoption in the average-sized MA household, where incumbent heating is an oil furnace. Only towns where a saving is incurred are shown; all towns/cities where heating costs would increase are shown in grey. Complete data are displayed in Table A1.

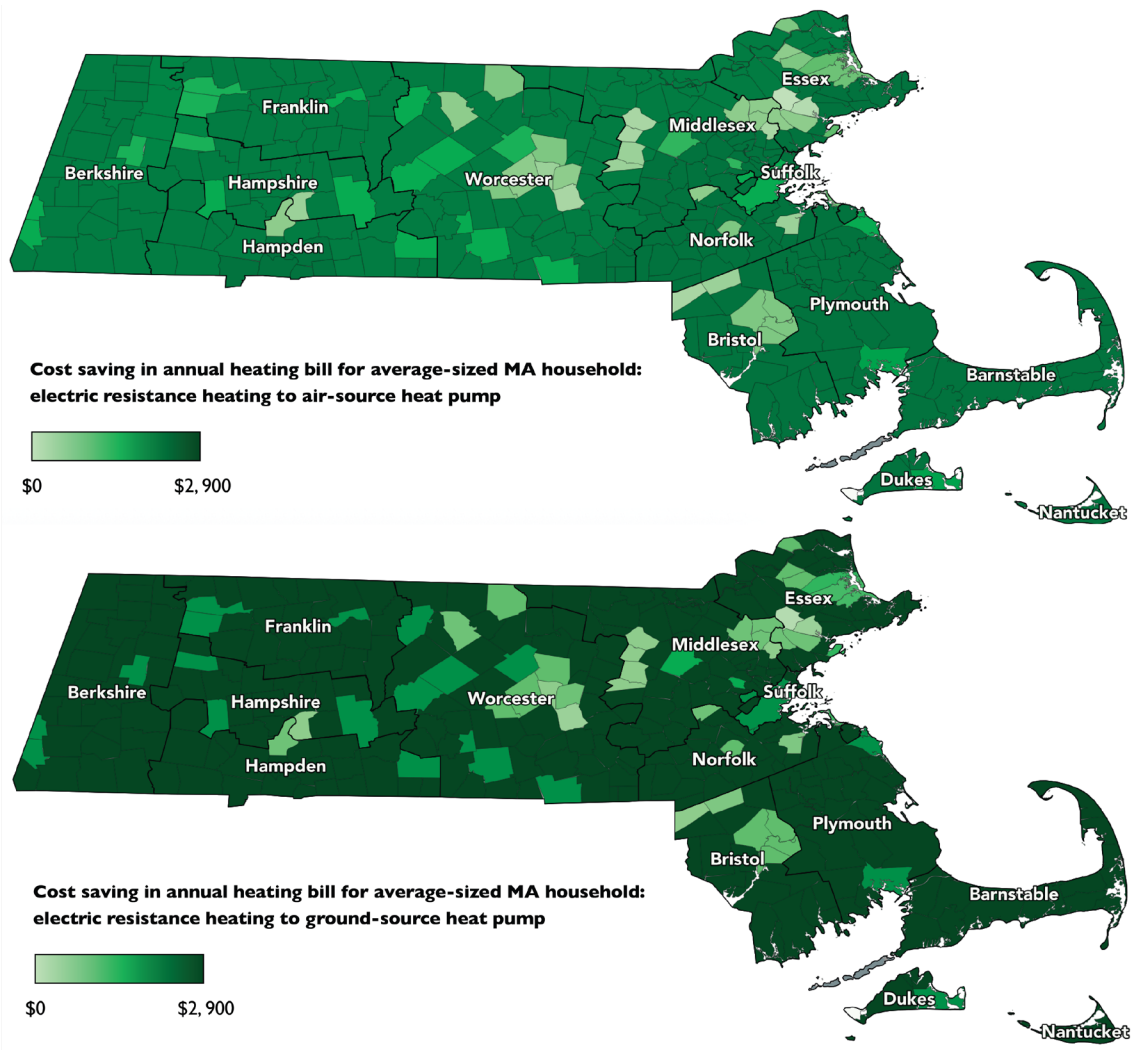

Figure 4. Annual heating cost savings through heat pump adoption in average-sized MA household, where incumbent heating is electric resistance heating. Complete data are displayed in Table A1.

Discussion

Cost-effective opportunities for heat pump adoption in Massachusetts

In this study, we conduct a spatial analysis of the impact of heat pump adoption on annual heating costs for an average-sized Massachusetts household that currently uses natural gas, oil, or electric resistance heating. Our analysis shows that at current (April 2024) electricity and fuel costs, approximately 50% of Massachusetts households, primarily those heated with natural gas, would incur an increase in annual heating bills with air-source heat pump adoption. The exceptions to this are households in towns where the cost of electricity is lower than the state average, resulting in annual cost savings with heat pump adoption. With ground-source heat pump adoption, opportunities for cost savings are more widespread; however, these are typically marginal at <$200 per year. In these cases, and in households that are currently heated with oil, the marginal annual savings through heat pump adoption will necessitate subsidies to reduce upfront capital costs for consumers since annual bill savings will be insufficient to recover high capital costs (approximately $20,000 for an air-source heat pump in Massachusetts[8,9]) in a reasonable time frame.

In contrast, high annual savings with air-source heat pump adoption (up to approximately $2,500) enable the 16% of households using electric resistance heating to recover upfront heat pump purchase and installation costs in less than ten years, even without subsidy support. Subsidies will still be necessary to cover capital costs in smaller households with lower annual cost savings and in scenarios where there may be financing issues (e.g., in low-income or rental housing).

Taken together, we suggest that policies and financial incentives should primarily focus on promoting heat pump adoption in households that would reduce or not change their heating bills by switching to a heat pump. Households with electric resistance heating should be the primary target for state policies, as the potential savings from switching to heat pumps are already high enough to justify switching without any subsidies, although subsidies may still be necessary to deal with other market failures discussed above. Subsidies should also focus on the opportunities where heat pump adoption does not increase bills, or incurs marginal savings, but

where savings are too small to recover upfront costs in a reasonable time frame. Decarbonizing the remaining households that use natural gas or oil in regions with high electricity prices will require a substantial decrease in the residential price of electricity relative to natural gas or oil to make heat pump adoption cost-effective.

Reducing demand for natural gas and greenhouse gas emissions

Maintaining a reliable natural gas supply is a critical energy concern for Massachusetts. In recent years, the state has faced high winter gas price volatility, partly due to shortages in supply, among other factors. Heat pumps are seen as a potential means of mitigating these issues by reducing the overall demand for natural gas.

If all households in the state convert to an air-source heat pump, there would be a marginal 11.49 trillion BTU increase in natural gas demand, equivalent to approximately 1% of MA's annual natural gas consumption.[13] Although overall natural gas demand would reduce if households with natural gas furnaces and electric resistance heating switched to heat pumps, the additional electricity demand from households previously heated with oil increases the overall demand as generation in the state remains dominated by natural gas. These changes in fossil fuel consumption would reduce CO_2 emissions by approximately 2 million metric tons (MMT) per year (16% of residential buildings heating emissions[14]), most of which are due to the reduction in heating oil usage. In all scenarios, natural gas and emissions savings are greater with the adoption of ground-source heat pumps due to their greater efficiencies. In addition, as the Massachusetts grid becomes decarbonized, emissions savings will increase.

The marginal reductions in natural gas demand with heat pump adoption suggest that the state should seek other strategies to reduce its total demand for natural gas, such as improvements to infrastructure to reduce losses or decarbonization of the power grid with renewables. Heat pumps remain a critical strategy for decarbonizing the residential heating sector.

Air conditioning and adaptation to extreme heat

Around one-third of households in the state currently have central air conditioning.[15] Updating these systems on a cycle of ~20 years could be a cost-effective strategy for addressing the upfront expenses of heat pumps. 53% of households in the state have room or window air conditioning, and 10% do not have any form of air conditioning. With climate change, Massachusetts is expected to experience an increase in the number of days with extreme heat (over 90°F). Therefore, heat pump adoption offers an adaptation strategy to extreme heat, particularly in lower-income households, as they can also be used for cooling.

Conclusions and recommendations

1. Heat pump adoption should be prioritized in the 16% of Massachusetts households (~420,000) with electric resistance heating, where installation costs can be recovered in 10 years or less. Subsidies should be focused on overcoming challenges with rental housing, where savings in operating costs may not accrue to owners.

2. Subsidies for heat pump installations in households heated with natural gas or oil should target communities that pay lower overall prices for residential electricity and would not incur any increase in heating bills by switching to heat pumps. Opportunities for cost-effective heat pump adoption are greater in households heated with oil than natural gas. Even in these households, savings in operating costs will rarely be sufficient to make heat pump adoption cost-effective without subsidies, although there is potential to couple heat pump installation with the replacement of air conditioning units to defray some capital costs.

3. Decarbonizing residential heating at scale will require a substantial decrease in the cost of electricity relative to natural gas or oil to make heat pump adoption cost-effective. For most households in Massachusetts that use natural gas or oil heating, heat pumps either raise annual heating bills or offer only marginal savings due to high electricity costs. Thus, complete decarbonization of building heating through electrification will require substantial changes in electricity pricing to bring down costs.

Data sources

Heat pump coefficient of performance

Air-source heat pump coefficient of performance (COP) values, the ratio of useful heating to heat pump energy requirements, were based on the empirical relationship between COP and outside air temperature.[16] Average heating season air temperatures were calculated for each town based on NOAA average monthly temperature normals between 2006 and 2020,[7] weighted to the number of heating degree days (the difference between the daily temperature mean and 18.3°C).

For ground-source heat pumps, COP values were based on the relationship between ground temperature and COP at different inlet temperatures,[17] assuming an inlet temperature of ~20°C above an inside air temperature of 20°C. For ground temperature, non-degree day weighted annual average air temperatures, calculated from the NOAA average monthly temperature normals, were used as a proxy.

Residential electricity, natural gas, and oil prices

Residential gas and electricity prices were obtained from current (April 2024) rate tariffs published by the main investor-owned utilities (Eversource, Berkshire Gas Company, Liberty Utilities, National Grid, Unitil) and municipal companies (Holyoke Gas & Electric, Middleborough Gas & Electric, Wakefield Municipal Gas & Light, Westfield Gas & Electric, among others). For utilities where residents can choose their own power supply, supply rates for independent providers were obtained from FindEnergy.com. Prices were assigned to each town based on service area information provided by the Massachusetts Department of Public Utilities.[18] Average county-level heating oil prices were obtained from NewEnglandOil.com.

Annual savings to heating costs

Annual heating costs were based on an average-sized Massachusetts household of 1,800 sq ft,[15] taking the state average annual energy consumption of 13 MWh for heating.[6] A fuel efficiency of 90% was assumed for natural gas heating and a lower efficiency of 80% for oil-based heating, as these systems are typically older and therefore less efficient.[10] Data on primary household heating type by county were obtained from the American Community Survey undertaken in 2022.[11] In the absence of empirical data, the number of households with each heating type by town was estimated using the total number of households per town19 and the percentage of heating types by county.[9]

Natural gas demand and CO_2 emissions

The potential change in natural gas demand with air-source heat pump adoption was calculated based on state-level data on consumption of natural gas, oil and electricity for space heating collected in the 2020 Energy Information Administration Residential Energy Consumption Survey.[20–22] Our calculation assumes that all additional electricity demand with heat pump adoption is met using natural gas, since electricity production is dominated by natural gas in Massachusetts.[23]

In this calculation, we used an average natural gas power plant efficiency of 46%, calculated using Massachusetts' 2023 annual natural gas consumption for electric power generation (109,583 MMcf)[13] and 2023 state-level total electric power generation (14,850,080 MWh).[24] To calculate CO_2 emissions reductions, we used a natural gas emissions intensity of 52.91 kg/mmbtu and 74.14 kg/mmbtu for residential heating oil.[25]

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Table A1. Change in annual heating costs through air- and ground-source heat pump adoption in Massachusetts by town, based on incumbent heating type. Additional information included relating to the coefficient of performance value (COP) for both air- and ground-source heat pumps and the current (April 2024) residential price of heating fuel (natural gas, oil) and electricity, in ¢/kWh. In towns served by the large investor-owned utilities Eversource and National Grid, electricity costs represent average costs across all potential independent energy supply companies that consumers may choose (with delivery provided by the utility). Electricity costs can vary depending on whether consumers opt for a competitive energy supply, and therefore, some consumers may incur cost savings while other consumers incur additional costs through heat pump adoption. To account for this, [1] represents the average of consumers receiving cost savings, and [2] represents the overall average of all consumers served in each town.

				Price of heating fuel/type (¢/kWh)			**Air-source heat pumps: change in annual heating bill** (USD)				**Ground-source heat pumps: change in annual heating bill** (USD)			
County	**Town**	**COP air-source**	**COP ground-source**	**Oil**	Natural gas	Electricity	Natural gas	Oil[1]	Oil[2]	Electric resistance	Natural gas[1]	Natural gas[2]	Oil	Electric resistance
Plymouth	Abington	2.98	4.25	9.1	7.9	33.0	414	**-175**	17	**-2419**	**-118**	**-19**	**-416**	-2851
Middlesex	Acton	2.90	4.20	9.2	7.9	33.0	440	**-128**	41	**-2379**	**-118**	**-19**	**-419**	**-2850**
Bristol	Acushnet	3.02	4.28	8.8	6.7	33.0	538	**-110**	52	**-2439**	**-53**	155	**-365**	**-2849**
Berkshire	Adams	2.77	4.05	9.3	7.1	33.0	605	**-75**	89	**-2313**	**-85**	80	**-399**	**-2855**
Middlesex	Agawam	2.93	4.24	9.2	6.7	33.0	578	**-145**	23	**-2398**	**-23**	193	**-427**	**-2858**
Berkshire	Alford	2.83	4.11	9.3	-	33.0	-	**-294**	**-294**	**-1805**	-	-	**-656**	**-2851**
Essex	Amesbury	2.88	4.16	9.2	7.9	33.0	448	**-99**	47	**-2372**	**-114**	**-14**	**-411**	**-2851**
Hampshire	Amherst	2.87	4.19	9.1	7.1	33.0	552	**-97**	73	**-2368**	**-87**	107	**-395**	**-2852**
Essex	Andover	2.89	4.19	9.2	6.7	33.0	600	**-114**	44	**-2375**	**-51**	158	**-417**	**-2850**
Dukes	Aquinnah	3.09	4.29	9.0	-	25.4	-	**-157**	**-10**	**-66**	-	-	**-398**	**-2859**
Middlesex	Arlington	2.95	4.23	9.2	7.9	33.0	412	**-130**	13	**-2408**	**-120**	**-3**	**-426**	-2851
Worcester	Ashburnham	2.78	4.08	9.0	-	17.3	-	**-605**	**-605**	**-1214**	-	-	**-861**	**-2857**
Middlesex	Ashby	2.81	4.10	9.2	9.1	33.0	341	84	84	**-2332**	**-171**	**-171**	**-395**	**-2850**
Franklin	Ashfield	2.74	4.06	9.0	-	33.0	-	**-20**	159	**-2296**	-	-	**-349**	**-2855**
Middlesex	Ashland	2.92	4.21	9.2	6.7	33.0	586	**-114**	31	**-2390**	**-33**	180	**-422**	**-2854**
Worcester	Athol	2.82	4.12	9.0	-	33.0	-	**-239**	**-239**	**-1798**	-	-	**-609**	**-2152**
Bristol	Attleboro	2.98	4.25	8.8	6.7	33.0	556	**-181**	72	**-2420**	**-56**	152	**-360**	**-2789**
Worcester	Auburn	2.88	4.17	9.0	6.7	33.0	606	**-136**	81	**-2369**	**-63**	143	**-382**	**-2808**
Norfolk	Avon	2.97	4.25	9.1	6.7	33.0	562	**-191**	19	**-2414**	**-47**	163	**-416**	**-2797**
Middlesex	Ayer	2.88	4.19	9.2	7.9	33.0	447	**-168**	49	**-2372**	**-116**	-17	-415	-2798
Barnstable	Barnstable	3.08	4.27	9.0	7.9	33.0	353	**-237**	**-8**	**-2469**	**-104**	**-3**	**-394**	-2784
Worcester	Barre	2.81	4.11	9.0	-	33.0	-	**-235**	**-235**	**-1794**	-	-	**-608**	**-2801**
Berkshire	Becket	2.75	4.03	9.3	-	33.0	-	**-157**	100	**-2303**	-	-	**-395**	**-2787**
Norfolk	Bedford	2.92	4.21	9.1	7.9	33.0	428	**-172**	42	**-2392**	**-121**	**-22**	**-408**	**-2813**

Hampshire	Belchertown	2.86	4.17	9.1	-	33.0	-	-266	-266	-1816	-	-	-628	-2806
Norfolk	Bellingham	2.94	4.23	9.1	6.7	33.0	573	-225	31	-2403	-55	153	-412	-2781
Norfolk	Bellingham	2.94	4.23	9.1	6.7	33.0	573	-181	31	-2403	-55	153	-412	-2803
Middlesex	Belmont	2.95	4.23	9.2	7.9	21.9	-60	-473	-473	-1600	-352	-352	-766	-2790
Bristol	Berkley	3.00	4.26	8.8	6.7	17.2	-119	-622	-622	-1268	-337	-337	-843	-2783
Worcester	Berlin	2.89	4.19	9.0	6.7	33.0	601	-141	76	-2374	-65	141	-387	-2801
Franklin	Bernardston	2.82	4.14	9.0	-	33.0	-	-107	114	-2341	-	-	-370	-2799
Essex	Beverly	2.96	4.21	9.2	7.9	33.0	409	-203	8	-2411	-121	-4	-423	-2800
Middlesex	Billerica	2.90	4.20	9.2	7.9	33.0	437	-177	38	-2382	-109	-9	-418	-2809
Worcester	Blackstone	2.95	4.22	9.0	3.0	33.0	1025	-169	43	-2407	0	626	-395	-2811
Hampden	Blandford	2.79	4.09	9.2	-	33.0	-	-116	108	-2324	-	-	-379	-2810
Worcester	Bolton	2.89	4.19	9.0	6.7	33.0	601	-94	76	-2374	-57	150	-388	-2167
Suffolk	Boston	2.99	4.25	9.2	7.9	33.0	393	-335	-335	-1868	-153	-4	-660	-2172
Barnstable	Bourne	3.06	4.28	9.0	7.9	33.0	363	-158	2	-2459	-116	-17	-397	-2152
Middlesex	Boxborough	2.89	4.20	9.2	7.9	13.6	-417	-829	-829	-978	-615	-615	-1019	-2801
Essex	Boxford	2.90	4.19	9.2	7.9	33.0	438	-178	38	-2381	-122	-5	-417	-2810
Worcester	Boylston	2.88	4.18	9.0	6.7	16.2	-136	-681	-681	-1160	-364	-364	-908	-2824
Norfolk	Braintree	2.98	4.26	9.1	7.9	14.7	-384	-783	-783	-1081	-568	-568	-977	-2801
Barnstable	Brewster	3.08	4.25	9.0	7.9	33.0	353	-210	-8	-2469	-120	-21	-389	-2801
Plymouth	Bridgewater	2.99	4.25	9.1	6.7	33.0	553	-197	12	-2424	-62	144	-416	-2793
Hampden	Brimfield	2.86	4.15	9.2	-	33.0	-	-273	-273	-1814	-	-	-634	-2817
Plymouth	Brockton	2.97	4.25	9.1	6.7	33.0	560	-191	19	-2417	-63	143	-415	-2811
Worcester	Brookfield	2.86	4.15	9.0	7.9	33.0	459	-129	89	-2360	-117	-18	-377	-2798
Norfolk	Brookline	2.96	4.25	9.1	7.9	33.0	407	-190	21	-2413	-112	7	-416	-2818
Franklin	Buckland	2.81	4.10	9.0	-	33.0	-	-100	122	-2333	-	-	-360	-2817
Middlesex	Burlington	2.92	4.21	9.2	7.9	33.0	429	-184	30	-2391	-116	-17	-421	-2802
Middlesex	Cambridge	2.98	4.24	9.2	6.7	33.0	555	-210	-1	-2422	-55	153	-428	-2857
Norfolk	Canton	2.96	4.24	9.1	6.7	33.0	563	-190	21	-2413	-61	146	-416	-2858
Middlesex	Carlisle	2.90	4.20	9.2	7.9	33.0	438	-176	39	-2382	-116	-16	-418	-2860
Plymouth	Carver	3.00	4.26	9.1	6.7	33.0	545	-204	4	-2432	-53	155	-417	-2854
Franklin	Charlemont	2.77	4.07	9.0	-	33.0	-	-213	-213	-1777	-	-	-594	-2860
Worcester	Charlton	2.86	4.15	9.0	-	33.0	-	-255	-255	-1814	-	-	-616	-2857
Barnstable	Chatham	3.09	4.25	9.0	7.9	33.0	351	-212	-10	-2472	-119	-19	-390	-2852
Middlesex	Chelmsford	2.89	4.19	9.2	7.9	33.0	442	-172	43	-2377	-117	-18	-416	-2853
Suffolk	Chelsea	2.98	4.25	9.2	7.9	33.0	399	-331	-331	-1863	-121	-3	-660	-2849
Berkshire	Cheshire	2.77	4.05	9.3	7.1	33.0	605	-135	90	-2312	-79	87	-399	-2854
Berkshire	Cheshire	2.77	4.05	9.3	7.1	33.0	605	-135	90	-2312	-79	87	-399	-2851
Hampden	Chester	2.80	4.09	9.2	-	23.7	-	-326	-326	-1675	-	-	-674	-2857
Hampden	Chester	2.80	4.09	9.2	-	33.0	-	-120	103	-2328	-	-	-379	-2855
Hampshire	Chesterfield	2.79	4.08	9.1	-	33.0	-	-103	121	-2321	-	-	-369	-2857
Hampden	Chicopee	2.91	4.22	9.2	6.7	17.9	-147	-630	-630	-1292	-349	-349	-878	-2857
Hampden	Chicopee	2.91	4.22	9.2	6.7	33.0	-147	-168	46	-2385	-349	-349	-412	-2858
Dukes	Chilmark	3.10	4.29	9.0	-	33.0	-	-172	-14	-2475	-	-	-398	-1489
Berkshire	Clarksburg	2.74	4.02	9.3	7.1	33.0	620	-74	105	-2298	-85	94	-391	-1489

Worcester	Clinton	2.88	4.19	9.0	7.9	33.0	448	-92	78	-2371	-116	40	-386	-1488
Norfolk	Cohasset	3.00	4.26	9.1	7.9	33.0	389	-162	2	-2432	-119	-2	-420	-1489
Franklin	Colrain	2.79	4.09	9.0	-	33.0	-	-42	134	-2320	-	-	-356	-1272
Middlesex	Concord	2.91	4.21	9.2	7.9	22.1	-41	-453	-453	-1597	-354	-354	-758	-1154
Franklin	Conway	2.83	4.13	9.0	-	33.0	-	-62	111	-2343	-	-	-366	-2199
Hampshire	Cummington	2.76	4.06	9.1	-	33.0	-	-225	-225	-1775	-	-	-606	-76
Berkshire	Dalton	2.76	4.04	9.3	7.1	33.0	609	-59	94	-2309	-83	95	-397	-2859
Essex	Danvers	2.96	4.21	9.2	7.9	12.0	-499	-913	-913	-876	-641	-641	-1070	-2859
Bristol	Dartmouth	3.05	4.28	8.8	4.6	33.0	780	-100	38	-2454	0	419	-366	-2859
Norfolk	Dedham	2.96	4.25	9.1	6.7	33.0	566	-143	23	-2410	-68	137	-416	-2859
Franklin	Deerfield	2.87	4.18	9.0	7.1	33.0	555	-81	90	-2365	-90	87	-379	-2840
Barnstable	Dennis	3.08	4.25	9.0	7.9	33.0	355	-209	-6	-2468	-118	0	-390	-2832
Bristol	Dighton	2.99	4.26	8.8	6.7	17.2	-117	-620	-620	-1266	-340	-340	-843	-2836
Bristol	Dighton	2.99	4.26	8.8	6.7	33.0	-117	-143	66	-2426	-340	-340	-361	-2830
Worcester	Douglas	2.89	4.18	9.0	-	33.0	-	-270	-270	-1828	-	-	-622	-2842
Norfolk	Dover	2.94	4.23	9.1	6.7	33.0	574	-181	31	-2402	-64	141	-412	-2836
Middlesex	Dracut	2.89	4.18	9.2	7.9	33.0	443	-154	44	-2376	-112	-12	-414	-2837
Worcester	Dudley	2.88	4.17	9.0	7.9	33.0	450	-119	80	-2369	-119	-2	-382	-2838
Middlesex	Dunstable	2.87	4.18	9.2	7.9	33.0	451	-164	53	-2368	-116	2	-414	-2837
Plymouth	Duxbury	3.02	4.27	9.1	6.7	33.0	537	-211	-4	-2440	-49	160	-419	-2833
Plymouth	East Bridgewater	2.98	4.25	9.1	6.7	33.0	554	-196	13	-2423	-66	139	-416	-2836
Worcester	East Brookfield	2.86	4.15	9.0	7.9	33.0	459	-257	-257	-1815	-118	-19	-615	-2846
Hampden	East Longmeadow	2.92	4.23	9.2	6.7	33.0	584	-174	40	-2392	-42	168	-413	-2835
Barnstable	Eastham	3.08	4.24	9.0	7.9	33.0	354	-167	-7	-2469	-112	-12	-388	-2849
Hampshire	Easthampton	2.89	4.21	9.1	6.7	33.0	598	-152	64	-2377	-61	145	-399	-2833
Bristol	Easton	2.97	4.24	8.8	6.7	33.0	562	-133	77	-2415	-54	154	-357	-2833
Dukes	Edgartown	3.10	4.28	9.0	-	33.0	-	-335	-335	-1906	-	-	-628	-2836
Berkshire	Egremont	2.84	4.14	9.3	-	33.0	-	-297	-297	-1808	-	-	-660	-2837
Franklin	Erving	2.82	4.14	9.0	-	33.0	-	-235	-235	-1799	-	-	-609	-2842
Franklin	Erving	2.82	4.14	9.0	-	33.0	-	-106	116	-2339	-	-	-370	-2830
Essex	Essex	2.94	4.19	9.2	7.9	33.0	417	-151	15	-2404	-116	-16	-418	-2845
Middlesex	Everett	2.98	4.25	9.2	7.9	33.0	400	-165	0	-2421	-121	-4	-430	-2846
Bristol	Fairhaven	3.06	4.29	8.8	6.7	33.0	519	-171	33	-2459	-62	144	-368	-2837
Bristol	Fall River	3.01	4.26	8.8	4.6	33.0	801	-150	57	-2435	0	402	-362	-2839
Barnstable	Falmouth	3.09	4.28	9.0	7.9	33.0	352	-168	-9	-2471	-120	-21	-397	-1694
Worcester	Fitchburg	2.83	4.13	9.0	9.1	33.0	330	102	102	-2342	-183	-183	-375	-1638
Berkshire	Florida	2.67	4.01	9.3	-	33.0	-	-37	147	-2255	-	-	-387	-1583
Norfolk	Foxborough	2.95	4.23	9.1	6.7	33.0	570	-139	27	-2406	-40	172	-413	-1496
Middlesex	Framingham	2.92	4.22	9.2	6.7	33.0	585	-138	30	-2390	-59	148	-423	-1422
Norfolk	Franklin	2.94	4.23	9.1	6.7	33.0	574	-135	32	-2402	-57	151	-412	-1414
Bristol	Freetown	3.00	4.26	8.8	6.7	33.0	547	-101	63	-2429	-58	149	-362	-1389
Worcester	Gardner	2.79	4.09	9.0	9.1	33.0	346	-48	128	-2321	-192	-176	-362	-1033

Essex	Georgetown	2.90	4.18	9.2	7.9	17.4	-246	-660	-660	-1257	-473	-473	-900	-860
Franklin	Gill	2.85	4.17	9.0	-	33.0	-	-72	101	-2354	-	-	-378	-1377
Essex	Gloucester	2.94	4.20	9.2	7.9	33.0	417	-151	15	-2404	-119	-1	-419	-1378
Hampshire	Goshen	2.76	4.07	9.1	-	33.0	-	-42	136	-2305	-	-	-364	-2173
Worcester	Grafton	2.90	4.19	9.0	6.7	33.0	596	-174	70	-2380	-52	157	-387	-2817
Hampshire	Granby	2.88	4.20	9.1	6.7	33.0	602	-176	68	-2373	-51	158	-397	-2825
Hampden	Granville	2.83	4.13	9.2	-	33.0	-	-197	89	-2343	-	-	-389	-2794
Berkshire	Great Barrington	2.84	4.11	9.3	7.1	33.0	571	-254	55	-2347	-80	99	-415	-2775
Franklin	Greenfield	2.86	4.17	9.0	7.1	33.0	559	-188	94	-2360	-93	120	-378	-2804
Middlesex	Groton	2.88	4.19	9.2	7.9	33.0	450	-193	52	-2369	-117	1	-415	-2824
Essex	Groveland	2.89	4.18	9.2	7.9	16.5	-286	-700	-700	-1185	-516	-516	-929	-2815
Hampshire	Hadley	2.88	4.20	9.1	7.1	33.0	550	-190	72	-2369	-90	104	-397	-2810
Plymouth	Halifax	2.99	4.26	9.1	6.7	33.0	551	-226	10	-2426	-52	156	-417	-2821
Essex	Hamilton	2.93	4.19	9.2	7.9	33.0	425	-189	24	-2395	-119	-20	-419	-2832
Hampden	Hampden	2.90	4.20	9.2	6.7	33.0	596	-191	52	-2380	-52	157	-407	-2829
Berkshire	Hancock	2.74	4.04	9.3	-	33.0	-	-149	108	-2294	-	-	-396	-2825
Berkshire	Hancock	2.74	4.04	9.3	-	33.0	-	-253	-253	-1765	-	-	-641	-2820
Plymouth	Hanover	2.99	4.26	9.1	6.7	33.0	552	-198	11	-2425	-53	155	-416	-2833
Plymouth	Hanson	2.99	4.26	9.1	7.9	33.0	396	-198	11	-2425	-118	-19	-416	-2833
Worcester	Hardwick	2.84	4.13	9.0	-	33.0	-	-248	-248	-1806	-	-	-613	-2831
Worcester	Harvard	2.88	4.19	9.0	7.9	33.0	447	-139	78	-2372	-118	-19	-387	-2836
Barnstable	Harwich	3.09	4.25	9.0	7.9	33.0	351	-212	-10	-2472	-120	-3	-390	-2831
Hampshire	Hatfield	2.88	4.20	9.1	7.1	33.0	550	-99	72	-2369	-80	86	-397	-2158
Essex	Haverhill	2.89	4.18	9.2	7.9	33.0	445	-125	45	-2374	-122	-5	-414	-2152
Franklin	Hawley	2.78	4.04	9.0	-	33.0	-	-217	-217	-1781	-	-	-588	-2824
Franklin	Heath	2.73	4.02	9.0	-	33.0	-	-94	165	-2290	-	-	-339	-2821
Plymouth	Hingham	3.00	4.26	9.1	7.9	19.0	-205	-602	-602	-1400	-436	-436	-845	-2819
Plymouth	Hingham	3.00	4.26	9.1	7.9	33.0	-205	-265	4	-2432	-436	-436	-418	-2792
Berkshire	Hinsdale	2.75	4.03	9.3	-	33.0	-	-260	-260	-1771	-	-	-640	-2817
Norfolk	Holbrook	2.97	4.25	9.1	6.7	33.0	558	-221	16	-2418	-65	140	-417	-2818
Worcester	Holden	2.85	4.14	9.0	6.7	16.5	-113	-658	-658	-1178	-361	-361	-892	-2823
Hampden	Holland	2.87	4.15	9.2	-	33.0	-	-151	67	-2365	-	-	-395	-2827
Middlesex	Holliston	2.93	4.22	9.2	6.7	33.0	579	-201	24	-2397	-40	171	-422	-2811
Hampden	Holyoke	2.89	4.20	9.2	8.0	15.7	-335	-723	-723	-1127	-558	-558	-944	-2811
Worcester	Hopedale	2.94	4.21	9.0	6.7	33.0	576	-163	49	-2400	-53	155	-393	-2821
Middlesex	Hopkinton	2.91	4.21	9.2	6.7	33.0	591	-178	36	-2385	-55	152	-420	-2826
Worcester	Hubbardston	2.81	4.10	9.0	-	33.0	-	-134	117	-2332	-	-	-365	-2809
Middlesex	Hudson	2.90	4.20	9.2	6.7	14.0	-237	-811	-811	-1010	-433	-433	-1006	-2844
Plymouth	Hull	3.08	4.27	9.0	7.9	33.0	353	-237	-8	-2469	-104	-3	-394	-2784
Hampshire	Huntington	2.83	4.12	9.1	-	33.0	-	-253	-253	-1804	-	-	-617	-2838
Essex	Ipswich	2.94	4.19	9.2	7.9	18.4	-214	-628	-628	-1341	-466	-466	-870	-2843
Plymouth	Kingston	3.02	4.27	9.1	6.7	33.0	537	-211	-4	-2440	-51	158	-419	-2845
Plymouth	Lakeville	3.00	4.26	9.1	6.7	15.2	-206	-765	-765	-1119	-403	-403	-960	-2842

Plymouth	Lakeville	3.00	4.26	9.1	6.7	33.0	-206	-201	7	-2428	-403	-403	-417	-2845
Worcester	Lancaster	2.88	4.19	9.0	7.9	33.0	450	-91	80	-2369	-119	-19	-387	-2175
Berkshire	Lanesborough	2.78	4.05	9.3	7.1	33.0	602	-138	87	-2315	-92	101	-398	-2825
Essex	Lawrence	2.89	4.19	9.2	6.7	33.0	597	-175	41	-2378	-22	194	-417	-2845
Berkshire	Lee	2.80	4.08	9.3	7.1	33.0	589	-150	73	-2329	-91	102	-407	-2839
Worcester	Leicester	2.85	4.13	9.0	7.9	33.0	462	-126	93	-2356	-129	24	-372	-2831
Berkshire	Lenox	2.80	4.09	9.3	7.1	33.0	589	-150	73	-2329	-96	116	-409	-2832
Berkshire	Lenox	2.80	4.09	9.3	7.1	33.0	589	-150	73	-2329	-96	116	-409	-2839
Worcester	Leominster	2.86	4.16	9.0	7.9	33.0	458	-83	89	-2360	-131	22	-380	-2023
Franklin	Leverett	2.83	4.16	9.0	-	33.0	-	-65	108	-2346	-	-	-375	-1628
Middlesex	Lexington	2.93	4.22	9.2	7.9	33.0	422	-145	23	-2398	-114	4	-422	-1540
Franklin	Leyden	2.81	4.11	9.0	-	33.0	-	-55	120	-2335	-	-	-363	-1348
Middlesex	Lincoln	2.92	4.22	9.2	7.9	33.0	428	-139	29	-2392	-110	-10	-423	-1206
Middlesex	Littleton	2.89	4.19	9.2	7.9	13.6	-416	-828	-828	-977	-609	-609	-1019	-2157
Hampden	Longmeadow	2.94	4.24	9.2	6.7	33.0	576	-135	32	-2400	-52	157	-417	-2168
Middlesex	Lowell	2.89	4.19	9.2	7.9	33.0	443	-216	44	-2377	-115	-15	-416	-2801
Hampden	Ludlow	2.89	4.20	9.2	6.7	33.0	599	-205	56	-2376	-51	158	-406	-2805
Worcester	Lunenburg	2.85	4.17	9.0	7.9	33.0	474	90	90	-2354	-6	-6	-382	-2810
Essex	Lynn	2.98	4.23	9.2	7.9	33.0	401	-238	-1	-2420	-115	3	-427	-2823
Essex	Lynnfield	2.93	4.21	9.2	7.9	16.0	-318	-732	-732	-1163	-535	-535	-947	-2837
Essex	Lynnfield	2.93	4.21	9.2	7.9	16.1	-318	-727	-727	-1173	-535	-535	-943	-2793
Middlesex	Malden	2.97	4.24	9.2	7.9	33.0	404	-206	4	-2417	-115	-7	-428	-2820
Essex	Manchester	2.96	4.21	9.2	-	33.0	-	-231	7	-2412	-	-	-422	-2805
Bristol	Mansfield	2.96	4.24	8.8	6.7	14.7	-219	-721	-721	-1077	-414	-414	-917	-2837
Essex	Marblehead	2.97	4.23	9.2	-	19.0	-	-610	-610	-1391	-	-	-857	-2841
Plymouth	Marion	3.05	4.29	9.1	6.7	33.0	522	-224	-20	-2456	-61	145	-424	-2838
Middlesex	Marlborough	2.90	4.20	9.2	6.7	33.0	595	-175	41	-2380	-70	134	-418	-2838
Plymouth	Marshfield	3.02	4.27	9.1	6.7	33.0	537	-167	-4	-2440	-53	155	-419	-2179
Barnstable	Mashpee	3.09	4.27	9.0	7.9	33.0	349	-213	-12	-2473	-121	-22	-395	-2829
Plymouth	Mattapoisett	3.05	4.28	9.1	6.7	33.0	523	-223	-19	-2455	-67	138	-423	-2820
Middlesex	Maynard	2.90	4.21	9.2	6.7	33.0	592	-177	38	-2383	-69	136	-420	-2838
Norfolk	Medfield	2.94	4.23	9.1	6.7	33.0	572	-182	30	-2404	-54	153	-413	-2836
Middlesex	Medford	2.98	4.23	9.2	7.9	33.0	400	-165	0	-2421	-113	-13	-426	-1205
Norfolk	Medway	2.94	4.23	9.1	6.7	33.0	577		35	-2399	-59	147	-411	-2811
Middlesex	Melrose	2.97	4.23	9.2	7.9	33.0	404		4	-2417	-112	-12	-426	-2824
Worcester	Mendon	2.93	4.21	9.0	6.7	33.0	581	-159	55	-2395	-59	148	-393	-2842
Essex	Merrimac	2.87	4.17	9.2	7.9	16.6	-276	-690	-690	-1189	-515	-515	-924	-2839
Essex	Methuen	2.89	4.18	9.2	6.7	33.0	600	-172	44	-2375	-46	164	-416	-2847
Plymouth	Middleborough	2.99	4.26	9.1	6.7	15.2	-204	-762	-762	-1117	-393	-393	-960	-2841
Plymouth	Middleborough	2.99	4.26	9.1	6.7	33.0	-204	-152	12	-2424	-393	-393	-417	-2846
Hampshire	Middlefield	2.75	4.05	9.1	-	33.0	-	-36	143	-2298	-	-	-360	-2849
Essex	Middleton	2.91	4.20	9.2	7.9	10.0	-581	-995	-995	-724	-722	-722	-1132	-2839
Worcester	Milford	2.93	4.21	9.0	6.7	33.0	581	-159	55	-2395	-52	156	-393	-2844
Worcester	Millbury	2.89	4.17	9.0	6.7	33.0	601	-141	75	-2374	-55	152	-383	-2843

Norfolk	Millis	2.94	4.23	9.1	6.7	33.0	574	-180	32	-2402	-48	162	-412	-2840
Worcester	Millville	2.94	4.22	9.0	6.7	33.0	573	-166	46	-2403	-59	148	-394	-2843
Norfolk	Milton	2.99	4.25	9.1	7.9	33.0	393	-203	6	-2428	-110	-10	-417	-2843
Franklin	Monroe	2.66	3.95	9.0	-	33.0	-	-28	206	-2248	-	-	-320	-2841
Hampden	Monson	2.88	4.17	9.2	6.7	33.0	604	-156	61	-2371	-62	143	-399	-2846
Franklin	Montague	2.86	4.17	9.0	7.1	33.0	559	-77	94	-2360	-88	106	-376	-2848
Berkshire	Monterey	2.79	4.08	9.3	-	33.0	-	-143	81	-2321	-	-	-406	-2845
Hampden	Montgomery	2.82	4.14	9.2	-	33.0	-	-83	91	-2340	-	-	-392	-2848
Berkshire	Mount Washington	2.76	4.05	9.3	-	33.0	-	-114	94	-2309	-	-	-399	-2844
Essex	Nahant	2.98	4.24	9.2	7.9	33.0	399	-212	-3	-2421	-116	2	-430	-2843
Nantucket	Nantucket	3.11	4.26	9.0	-	33.0	-	-205	-22	-2483	-	-	-391	-2845
Middlesex	Natick	2.93	4.23	9.2	7.9	33.0	422	-145	22	-2398	-115	-16	-425	-2848
Norfolk	Needham	2.95	4.24	9.1	6.7	33.0	570	-184	27	-2406	-58	148	-414	-2845
Berkshire	New Ashford	2.73	3.99	9.3	-	33.0	-	-115	114	-2289	-	-	-382	-2845
Bristol	New Bedford	3.04	4.29	8.8	6.7	33.0	529	-118	43	-2449	-60	147	-368	-2845
Worcester	New Braintree	2.84	4.12	9.0	-	33.0	-	-120	100	-2349	-	-	-370	-2843
Berkshire	New Marlborough	2.79	4.08	9.3	-	33.0	-	-146	77	-2325	-	-	-408	-2835
Franklin	New Salem	2.84	4.14	9.0	-	33.0	-	-116	104	-2351	-	-	-369	-2836
Essex	Newbury	2.91	4.18	9.2	7.9	33.0	434	-181	33	-2386	-125	-27	-414	-2839
Essex	Newburyport	2.91	4.17	9.2	7.9	33.0	436	-180	35	-2384	-117	0	-414	-2837
Middlesex	Newton	2.96	4.24	9.2	7.9	33.0	412	-199	12	-2409	-117	1	-427	-2835
Norfolk	Norfolk	2.95	4.23	9.1	6.7	33.0	572	-182	30	-2404	-60	146	-413	-2835
Berkshire	North Adams	2.77	4.04	9.3	7.1	33.0	604	-89	88	-2314	-87	91	-396	-2850
Essex	North Andover	2.89	4.19	9.2	6.7	33.0	598	-174	42	-2377	-26	196	-417	-2835
Bristol	North Attleborough	2.96	4.25	8.8	4.6	13.4	823	-782	-782	-977	0	427	-959	-2837
Worcester	North Brookfield	2.84	4.13	9.0	7.9	33.0	467	-75	98	-2351	-117	-18	-373	-2849
Middlesex	North Reading	2.92	4.20	9.2	7.9	16.1	-309	-721	-721	-1169	-520	-520	-940	-2839
Hampshire	Northampton	2.88	4.19	9.1	7.1	33.0	550	-99	72	-2369	-81	98	-394	-2847
Worcester	Northborough	2.89	4.20	9.0	6.7	33.0	597	-98	71	-2378	-50	159	-389	-2847
Worcester	Northbridge	2.91	4.20	9.0	6.7	33.0	590	-150	64	-2385	-53	156	-385	-2835
Franklin	Northfield	2.84	4.14	9.0	-	33.0	-	-113	107	-2348	-	-	-370	-2835
Bristol	Norton	2.97	4.25	8.8	6.7	33.0	561	-134	76	-2416	-53	155	-359	-2836
Plymouth	Norwell	3.01	4.26	9.1	6.7	33.0	543	-205	2	-2434	-63	143	-416	-2837
Norfolk	Norwood	2.96	4.24	9.1	7.9	17.3	-269	-668	-668	-1260	-500	-500	-897	-1902
Dukes	Oak Bluffs	3.10	4.28	9.0	-	33.0	-	-174	-16	-2477	-	-	-397	-1893
Worcester	Oakham	2.82	4.12	9.0	-	33.0	-	-64	110	-2339	-	-	-370	-1388
Franklin	Orange	2.82	4.13	9.0	-	33.0	-	-60	114	-2341	-	-	-367	-1389
Barnstable	Orleans	3.09	4.24	9.0	7.9	33.0	352	-168	-9	-2471	-114	-15	-388	-1388
Berkshire	Otis	2.77	4.05	9.3	-	33.0	-	-87	91	-2312	-	-	-399	-1205
Worcester	Oxford	2.88	4.17	9.0	7.9	33.0	450	-91	80	-2370	-116	-16	-381	-1205
Hampden	Palmer	2.87	4.17	9.2	6.7	33.0	608	-106	65	-2367	-46	164	-400	-1167
Worcester	Paxton	2.82	4.11	9.0	-	17.3	-	-614	-614	-1229	-	-	-864	-1167

Essex	Peabody	2.94	4.21	9.2	7.9	16.0	-470	-734	-734	-1165	-635	-635	-947	-1120
Hampshire	Pelham	2.81	4.13	9.1	-	33.0	-	-42	108	-2333	-	-	-381	-2852
Plymouth	Pembroke	2.99	4.26	9.1	6.7	33.0	549	-200	8	-2428	-55	153	-417	-2841
Plymouth	Pembroke	2.99	4.26	9.1	6.7	33.0	549	-200	8	-2428	-55	153	-417	-2845
Middlesex	Pepperell	2.87	4.18	9.2	7.9	33.0	454	-162	56	-2365	-119	-20	-412	-2850
Berkshire	Peru	2.70	4.00	9.3	-	33.0	-	-102	129	-2273	-	-	-384	-2849
Worcester	Petersham	2.82	4.13	9.0	-	33.0	-	-112	110	-2340	-	-	-372	-2850
Worcester	Phillipston	2.79	4.09	9.0	-	33.0	-	-96	128	-2321	-	-	-362	-2845
Berkshire	Pittsfield	2.79	4.08	9.3	7.1	33.0	593	-147	77	-2325	-89	104	-408	-2846
Hampshire	Plainfield	2.72	4.02	9.1	-	33.0	-	-72	157	-2284	-	-	-352	-2845
Norfolk	Plainville	2.95	4.23	9.1	4.6	33.0	828	-185	27	-2407	0	452	-413	-2846
Plymouth	Plymouth	3.04	4.27	9.1	6.7	33.0	530	-173	-12	-2448	-59	147	-419	-2851
Plymouth	Plympton	3.00	4.26	9.1	6.7	33.0	546	-203	5	-2431	-65	140	-417	-2847
Worcester	Princeton	2.82	4.12	9.0	-	24.8	-	-270	-270	-1755	-	-	-629	-2846
Barnstable	Provincetown	3.07	4.25	9.0	-	33.0	-	-204	-1	-2462	-	-	-389	-2847
Norfolk	Quincy	3.00	4.26	9.1	7.9	33.0	392	-204	4	-2429	-119	-20	-420	-2846
Norfolk	Randolph	2.97	4.25	9.1	6.7	33.0	561	-192	18	-2415	-65	140	-417	-2848
Bristol	Raynham	2.99	4.25	8.8	6.7	17.2	-116	-618	-618	-1265	-339	-339	-842	-2850
Middlesex	Reading	2.93	4.21	9.2	7.9	16.1	-312	-724	-724	-1172	-534	-534	-941	-2845
Bristol	Rehoboth	3.04	4.27	8.8	6.7	33.0	529	-118	44	-2448	-54	153	-363	-2854
Suffolk	Revere	2.97	4.24	9.2	7.9	33.0	403	-204	6	-2417	-121	-22	-425	-2847
Berkshire	Richmond	2.80	4.10	9.3	-	33.0	-	-148	75	-2327	-	-	-411	-2845
Plymouth	Rochester	3.01	4.27	9.1	6.7	33.0	542	-189	1	-2435	-60	146	-419	-2851
Plymouth	Rockland	2.98	4.26	9.1	7.9	33.0	398	-196	13	-2423	-121	-22	-416	-2847
Essex	Rockport	2.95	4.19	9.2	7.9	33.0	412	-155	11	-2408	-118	-19	-419	-2854
Franklin	Rowe	2.73	4.02	9.0	-	33.0	-	-45	165	-2290	-	-	-338	-2851
Essex	Rowley	2.92	4.18	9.2	7.9	19.7	-148	-563	-563	-1427	-416	-416	-829	-2849
Worcester	Royalston	2.78	4.10	9.0	-	33.0	-	-46	131	-2318	-	-	-363	-2854
Hampden	Russell	2.85	4.15	9.2	-	19.0	-	-560	-560	-1355	-	-	-833	-1489
Hampden	Russell	2.85	4.15	9.2	-	33.0	-	-141	79	-2353	-	-	-394	-2846
Worcester	Rutland	2.82	4.11	9.0	-	33.0	-	-63	111	-2338	-	-	-368	-1377
Essex	Salem	2.97	4.21	9.2	7.9	33.0	406	-161	4	-2414	-119	-2	-423	-1275
Essex	Salisbury	2.91	4.16	9.2	7.9	33.0	436	-134	35	-2384	-109	-9	-411	-2853
Berkshire	Sandisfield	2.80	4.07	9.3	-	33.0	-	-100	76	-2326	-	-	-404	-2855
Barnstable	Sandwich	3.07	4.27	9.0	7.9	33.0	360	-161	-1	-2463	-115	3	-393	-2855
Essex	Saugus	2.96	4.23	9.2	7.9	33.0	408	-159	7	-2412	-121	-22	-426	-2853
Berkshire	Savoy	2.68	3.98	9.3	-	33.0	-	-14	144	-2258	-	-	-379	-2860
Plymouth	Scituate	3.00	4.26	9.1	6.7	33.0	547	-324	-324	-1869	-58	149	-650	-2855
Plymouth	Scituate	3.00	4.26	9.1	6.7	33.0	547	-135	6	-2430	-58	149	-418	-2859
Bristol	Seekonk	3.01	4.28	8.8	6.7	33.0	543	-105	58	-2434	-65	141	-365	-2853
Norfolk	Sharon	2.95	4.23	9.1	6.7	33.0	570	-139	27	-2406	-68	137	-413	-2853
Berkshire	Sheffield	2.85	4.14	9.3	-	33.0	-	-99	49	-2353	-	-	-422	-2855
Franklin	Shelburne	2.80	4.13	9.0	-	33.0	-	-50	125	-2330	-	-	-366	-2853
Middlesex	Sherborn	2.93	4.23	9.2	6.7	33.0	578	-144	23	-2398	-59	148	-425	-2855

Middlesex	Shirley	2.87	4.18	9.2	7.9	33.0	453	-117	54	-2366	-112	-12	-414	-2195
Worcester	Shrewsbury	2.89	4.18	9.0	6.7	12.7	-295	-840	-840	-914	-471	-471	-1016	-2199
Franklin	Shutesbury	2.80	4.12	9.0	-	33.0	-	-80	124	-2330	-	-	-364	-2852
Bristol	Somerset	3.03	4.28	8.8	4.6	33.0	791	-115	47	-2445	0	428	-365	-2852
Middlesex	Somerville	2.98	4.24	9.2	7.9	33.0	400	-209	0	-2420	-123	-24	-427	-2851
Hampshire	South Hadley	2.89	4.21	9.1	6.7	14.0	-235	-788	-788	-1008	-436	-436	-986	-2852
Hampshire	Southampton	2.89	4.19	9.1	-	33.0	-	-106	64	-2378	-	-	-396	-2853
Worcester	Southborough	2.91	4.21	9.0	6.7	33.0	591	-104	65	-2384	-54	153	-391	-2852
Worcester	Southbridge	2.88	4.17	9.0	7.9	33.0	449	-92	79	-2371	-115	-7	-381	-2852
Hampden	Southwick	2.92	4.22	9.2	6.7	33.0	586	-126	43	-2389	-46	164	-411	-2854
Worcester	Spencer	2.84	4.14	9.0	7.9	33.0	467	-75	98	-2351	-110	-9	-374	-2852
Hampden	Springfield	2.92	4.23	9.2	6.7	33.0	582	-129	39	-2393	-40	171	-413	-2853
Worcester	Sterling	2.86	4.16	9.0	6.7	16.9	-99	-644	-644	-1210	-346	-346	-883	-2852
Berkshire	Stockbridge	2.81	4.12	9.3	7.1	33.0	583	-108	67	-2336	-87	108	-416	-2854
Middlesex	Stoneham	2.94	4.22	9.2	7.9	33.0	418	-176	19	-2402	-136	15	-423	-2851
Norfolk	Stoughton	2.96	4.24	9.1	6.7	33.0	565	-171	22	-2412	-57	151	-415	-2852
Middlesex	Stow	2.90	4.21	9.2	6.7	14.0	-238	-812	-812	-1010	-437	-437	-1007	-1643
Worcester	Sturbridge	2.87	4.16	9.0	-	33.0	-	-87	84	-2366	-	-	-379	-2850
Middlesex	Sudbury	2.92	4.22	9.2	7.9	33.0	427	-140	28	-2393	-108	-7	-422	-1314
Franklin	Sunderland	2.86	4.19	9.0	7.1	33.0	558	-78	93	-2361	-84	94	-381	-1314
Worcester	Sutton	2.88	4.18	9.0	6.7	33.0	603	-93	77	-2372	-51	158	-385	-2192
Essex	Swampscott	2.98	4.23	9.2	7.9	33.0	402	-165	0	-2419	-118	-1	-428	-2193
Bristol	Swansea	3.04	4.28	8.8	4.6	33.0	788	-118	44	-2448	0	416	-366	-2848
Bristol	Taunton	2.99	4.25	8.8	6.7	17.2	-117	-619	-619	-1266	-343	-343	-842	-2850
Worcester	Templeton	2.79	4.09	9.0	-	15.9	-		-671	-1120	-	-	-906	-2819
Middlesex	Tewksbury	2.90	4.19	9.2	7.9	33.0	438		39	-2381	-118	-19	-415	-2827
Dukes	Tisbury	3.09	4.28	9.0	-	33.0	-	-171	-13	-2474	-	-	-397	-2168
Hampden	Tolland	2.77	4.08	9.2	-	33.0	-	-59	118	-2314	-	-	-377	-2166
Essex	Topsfield	2.92	4.19	9.2	7.9	33.0	430	-139	29	-2390	-120	-3	-419	-2175
Middlesex	Townsend	2.85	4.16	9.2	9.1	33.0	320	63	63	-2352	-162	-162	-409	-2180
Barnstable	Truro	3.07	4.25	9.0	-	33.0	-	-160	0	-2462	-	-	-388	-2174
Middlesex	Tyngsborough	2.88	4.18	9.2	-	33.0	-	-118	52	-2369	-	-	-414	-2171
Berkshire	Tyringham	2.78	4.06	9.3	-	33.0	-	-169	84	-2318	-	-	-401	-2814
Worcester	Upton	2.91	4.20	9.0	6.7	33.0	591	-150	65	-2384	-49	160	-390	-2820
Worcester	Uxbridge	2.92	4.21	9.0	6.7	33.0	585	-183	59	-2390	-53	155	-392	-2819
Middlesex	Wakefield	2.93	4.22	9.2	7.9	13.0	-552	-863	-863	-945	-696	-696	-1038	-2821
Hampden	Wales	2.85	4.15	9.2	-	33.0	-	-172	75	-2357	-	-	-394	-2811
Norfolk	Walpole	2.95	4.23	9.1	6.7	33.0	572	-210	30	-2404	-56	152	-413	-2813
Middlesex	Waltham	2.94	4.23	9.2	7.9	33.0	418	-221	19	-2402	-113	-13	-424	-2817
Hampshire	Ware	2.85	4.16	9.1	-	33.0	-	-134	84	-2357	-	-	-388	-2828
Plymouth	Wareham	3.07	4.29	9.1	7.9	33.0	361	-348	-348	-1893	-112	-12	-654	-2809
Worcester	Warren	2.85	4.15	9.0	7.9	33.0	464	-124	95	-2354	-125	-26	-377	-2832
Franklin	Warwick	2.80	4.11	9.0	-	33.0	-	-95	128	-2327	-	-	-362	-2837
Berkshire	Washington	2.72	4.01	9.3	-	33.0	-	-109	121	-2281	-	-	-388	-2844

Middlesex	Watertown	2.96	4.24	9.2	7.9	33.0	412	-199	12	-2409	-111	7	-427	-2837
Middlesex	Wayland	2.93	4.23	9.2	7.9	33.0	423	-189	24	-2397	-115	-15	-424	-2826
Worcester	Webster	2.89	4.18	9.0	7.9	33.0	443	-143	73	-2376	-112	-12	-384	-2835
Norfolk	Wellesley	2.94	4.23	9.1	7.9	16.0	-322	-721	-721	-1162	-530	-530	-936	-2831
Barnstable	Wellfleet	3.08	4.24	9.0	-	33.0	-	-207	-5	-2466	-	-	-388	-2811
Franklin	Wendell	2.80	4.11	9.0	-	33.0	-	-98	125	-2330	-	-	-363	-2837
Essex	Wenham	2.93	4.20	9.2	7.9	33.0	421	-193	20	-2399	-113	-13	-420	-2836
Worcester	West Boylston	2.87	4.17	9.0	6.7	14.0	-233	-778	-778	-1005	-432	-432	-974	-2842
Plymouth	West Bridgewater	2.98	4.25	9.1	6.7	33.0	556	-194	15	-2421	-47	163	-415	-2836
Worcester	West Brookfield	2.84	4.14	9.0	7.9	33.0	467	-122	97	-2352	-117	-18	-375	-2821
Essex	West Newbury	2.89	4.17	9.2	7.9	33.0	444	-172	44	-2375	-110	9	-413	-2830
Hampden	West Springfield	2.92	4.22	9.2	6.7	33.0	586	-172	42	-2389	-47	162	-413	-2842
Berkshire	West Stockbridge	2.81	4.11	9.3	7.1	33.0	583	-155	67	-2335	-86	93	-415	-2842
Dukes	West Tisbury	3.08	4.28	9.0	-	33.0	-	-208	-6	-2467	-	-	-397	-2832
Worcester	Westborough	2.90	4.20	9.0	6.7	33.0	592	-149	66	-2383	-35	177	-390	-2843
Hampden	Westfield	2.91	4.21	9.2	7.0	14.0	-289	-803	-803	-1013	-481	-481	-996	-2839
Hampden	Westfield	2.91	4.21	9.2	7.0	33.0	-289	-170	45	-2387	-481	-481	-410	-2822
Middlesex	Westford	2.88	4.19	9.2	7.9	33.0	446	-169	47	-2373	-109	-9	-416	-2839
Hampshire	Westhampton	2.84	4.12	9.1	-	33.0	-	-130	89	-2352	-	-	-379	-2830
Worcester	Westminster	2.81	4.10	9.0	9.1	33.0	334	-106	116	-2333	-175	-160	-365	-2840
Middlesex	Weston	2.93	4.23	9.2	7.9	33.0	422	-190	23	-2398	-134	19	-424	-2831
Bristol	Westport	3.06	4.28	8.8	4.6	33.0	778	-171	33	-2459	0	417	-365	-2823
Bristol	Westport	3.06	4.28	8.8	4.6	33.0	778	-171	33	-2459	0	417	-365	-2834
Norfolk	Westwood	2.95	4.24	9.1	6.7	33.0	571	-183	28	-2405	-67	137	-414	-2840
Norfolk	Weymouth	2.99	4.26	9.1	7.9	33.0	396	-200	9	-2425	-114	-14	-420	-2841
Franklin	Whately	2.86	4.17	9.0	7.1	33.0	561	-122	97	-2358	-82	84	-376	-2826
Plymouth	Whitman	2.98	4.25	9.1	7.9	33.0	400	-195	15	-2421	-116	2	-416	-2833
Hampden	Wilbraham	2.90	4.20	9.2	6.7	33.0	593	-165	50	-2382	-63	143	-407	-2824
Hampshire	Williamsburg	2.83	4.12	9.1	-	33.0	-	-126	94	-2347	-	-	-379	-2839
Berkshire	Williamstown	2.78	4.05	9.3	7.1	33.0	599	-170	83	-2319	-81	98	-400	-2815
Middlesex	Wilmington	2.92	4.20	9.2	7.9	16.1	-308	-721	-721	-1168	-510	-510	-940	-2831
Worcester	Winchendon	2.78	4.08	9.0	-	33.0	-	-43	133	-2316	-	-	-360	-2114
Middlesex	Winchester	2.95	4.23	9.2	7.9	33.0	412	-153	13	-2408	-114	-6	-424	-1479
Berkshire	Windsor	2.68	3.98	9.3	-	33.0	-	-43	140	-2262	-	-	-381	-1469
Suffolk	Winthrop	2.97	4.25	9.2	7.9	33.0	403	-159	6	-2417	-112	-12	-427	-1449
Middlesex	Woburn	2.94	4.22	9.2	7.9	33.0	419	-147	20	-2401	-117	-17	-422	-1412
Worcester	Worcester	2.88	4.17	9.0	6.7	33.0	605	-91	80	-2370	-56	152	-381	-1387
Hampshire	Worthington	2.77	4.06	9.1	-	33.0	-	-47	130	-2311	-	-	-363	-1355
Norfolk	Wrentham	2.95	4.23	9.1	6.7	33.0	571	-138	29	-2405	-46	164	-412	-1090
Barnstable	Yarmouth	3.09	4.26	9.0	7.9	33.0	349	-171	-12	-2473	-113	-13	-392	-1201

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