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New England's Rate Design Disconnect: Analyzing the Region's Wide Variation in Electricity Bills

A Look at New England Rate Design: Issue Brief #1

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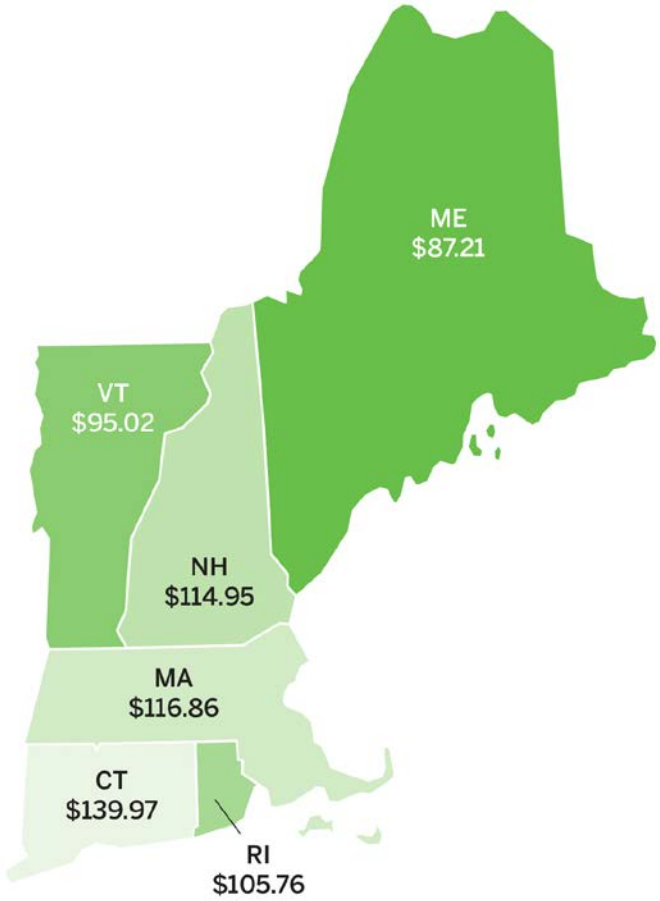
Household electricity bills vary significantly across the United States, but in no region do they vary as much as in New England. The average household in Massachusetts pays 34 percent more for electricity each month than the average Maine household; the average household in Connecticut pays 60 percent more. In this paper, we explore some reasons for this variation, but ultimately, we find these explanations unsatisfying: In short, there is no good reason why these bills and rates differ across state lines in the country's geographically smallest region. Effective rate design is crucial to achieving regulatory and public policy goals such as the grid modernization of the power sector, yet the variation in household bills reveals a systemic shortcoming. To design more robust rates at prices customers can afford, regulators need better information, including about what other jurisdictions and utilities are doing. One way to obtain it could be through establishing benchmarks and collecting comparable data on utility performance that cross utility and state lines.

Introduction

The average electric bill in New England states varies from $87 per household in Maine to $117 in Massachusetts and $140 in Connecticut. This means that the average household in Massachusetts pays 34 percent more for electricity each month than an average Maine household. The average Massachusetts household pays $1,400 for electricity annually compared to an average household in Maine, which pays $1,044 annually . For Connecticut the comparison is even steeper, with 60 percent higher bills.

Southern New England tends to have higher household bills, except for Rhode Island, where National Grid's average bills are in the middle of the pack. New Hampshire's average bill is also closer to that of Massachusetts, rather than Maine or Vermont.

Figure 1. Average Residential Household Monthly Bills in New England[1]



This variation in electricity bills is greater than in any other U.S. region.[2] Yet New England is among the smallest regions in terms of land mass.[3] This variation does not make sense.

These observations lead us to an obvious question: *Why are electricity bills so much more expensive in Massachusetts and Connecticut than in Maine and Vermont?* It's frankly difficult to fully explain. We look at the cost factors below.

One factor explaining this disparity is simply that average usage is greater in the higher-bill states. Although households in New England use, on average, about 600 kilowatt hours (kWhs) each month, households in Maine use 546 kWh, in Massachusetts 583 kWh and in Connecticut 690 kWh.[4] So households in Massachusetts use roughly 6.8 percent more electricity than those in

[1] Data from U.S. EIA. (2018a, October 12). Table 5A: Residential average monthly bill by census division, and state. Retrieved from https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf

[2] U.S. EIA, 2018a. The average monthly bill in Maine ($87.21) is $52.77 cheaper than the average bill in Connecticut ($139.97). The Mountain region comes in at a close second to New England with a regional disparity of $49.24, and the South Atlantic region in third with $44.28, although that disparity decreases to only $26.82 if one excludes the outlier, the District of Columbia. No other region has a disparity exceeding $30.

[3] For a graphic view of the different regions, see U.S. EIA. *Regional maps*. Appendix F, Figure F1: United States census divisions. Retrieved from https://www.eia.gov/outlooks/aeo/pdf/f1.pdf

[4] U.S. EIA, 2018a.

Maine, and households in Connecticut use roughly 26.4 percent more. Higher usage does explain some of the differential, but it does not fully explain why bills in Massachusetts are 34 percent higher and bills in Connecticut 60 percent higher than those in Maine.

Table 1. Average Residential Prices in New England

New England State	Average Price (Cents/kWh)
Maine	15.97
Vermont	17.68
Rhode Island	18.32
New Hampshire	19.20
Massachusetts	20.06
Connecticut	20.29
All of New England	**19.41**

Another factor is that the per-kilowatt-hour price of electricity differs among these states. Residential consumers pay, on average, 15.97 cents per kWh in Maine, 20.29 cents per kWh in Connecticut, and 20.06 cents per kWh in Massachusetts, as noted in Table 1 above. So, the price of electricity is 25.6 percent higher in Massachusetts than in Maine and 27.1 percent higher in Connecticut than in Maine.

So, two factors are at play making some bills higher and others lower. Households in Massachusetts and Connecticut use more electricity than Maine households on average. Using more of any product will cost more. The second factor is that Massachusetts and Connecticut households pay more for each kWh of electricity than Maine households. The higher usage and prices of course both lead to higher bills, and they explain the highest portion of the difference.

When homes are larger, more electricity is needed to light, heat and cool the household. Consistent with higher usage, the median dwelling in Massachusetts or Connecticut is larger than the median dwelling in Maine.[5] Moreover, the households generally enjoy higher incomes in Southern New England, so they may be able to afford a bit more and therefore choose to use more energy. (Energy efficiency can, of course, save energy in any house of any size and income level.[6]) So the factors driving higher usage are fairly easy to identify.

The reasons for higher prices per kWh are less obvious, and a variety of factors partially explain the cost differences.

[5] For example, the median size of a house for sale is larger in Massachusetts and Connecticut than Maine. See Inman. (2011, October 27). *10 states with the biggest houses.* Retrieved from https://www.inman.com/2011/10/27/10-states-with-biggest-houses

[6] Urbanek, L. (2017, July 27). *Efficiency Standards Benefit All Income Levels. Here's How* [Blog post]. Natural Resources Defense Council. Retrieved from https://www.nrdc.org/experts/lauren-urbanek/efficiency-standards-benefit-all-income-levels-heres-how

What Is the Price of Electricity?

The price of electricity is the retail rate for all electricity services, sometimes called bundled transmission, distribution, and supply rates. It is expressed in cents per kilowatt-hour or ¢/kWh. A kilowatt-hour (kWh) is simply a single kilowatt (1,000 watts) used for an entire hour.

How much electricity does the standard cents per kWh get you? An older incandescent 60-watt lightbulb uses 60 watts each hour. At a price of electricity of, say, 20 cents per kWh, 20 cents will keep an old lightbulb lit about 16 hours (60 watts multiplied by 16 hours equals 960 watts, just short of 1,000 watts or one kWh). A newer 60-watt equivalent LED lightbulb only uses nine watts per hour, so the same 20 cents would keep that LED lightbulb lit for more than 100 hours, demonstrating the value of energy efficiency to consumers.

Explaining the Cost Disparity

Geographic disparity is a major cost driver. Maine is the largest state by land area in New England, with a geographically dispersed population. Maine's geography compared to other New England states is illustrated in the map on the following page. The purple lines show bulk-system transmission lines, and the census tracts are colored to indicate population density (lighter areas being less densely populated, darker areas being more densely populated).

In Maine, where customer density is lower and geography greater, more wires are needed per customer. Maine's largest utility, Central Maine Power (CMP), serves approximately 624,000 customers using 23,500 miles of distribution lines, whereas Connecticut's United Illuminating (UI) uses only 3,500 miles of distribution to serve its 335,000 customers.[7] On average, then, to serve 100 customers, CMP has to build almost four miles of distribution line (3.77), whereas UI needs to build only one mile (1.04). CMP has about 3.6 times as much distribution line as UI per customer. This is not surprising: Serving a more compact urban and suburban customer base should be more efficient, due to shared infrastructure and lower per capita utility costs.

However, this geographic cost disparity may be offset by differing construction practices. The more urban states have more underground wires,[8] which are much more expensive than overhead lines.[9] The U.S. Department of Energy estimates that building underground distribution lines can cost three to four times as much as building overhead lines. Thus, while Maine customers need more wires, Massachusetts and Connecticut urban areas have more expensive underground wires. More

[7] Both CMP and UI are subsidiaries of Avangrid.

Avangrid. About Avangrid. Retrieved from https://www.avangrid.com/wps/portal/avangrid/aboutus/companyprofile

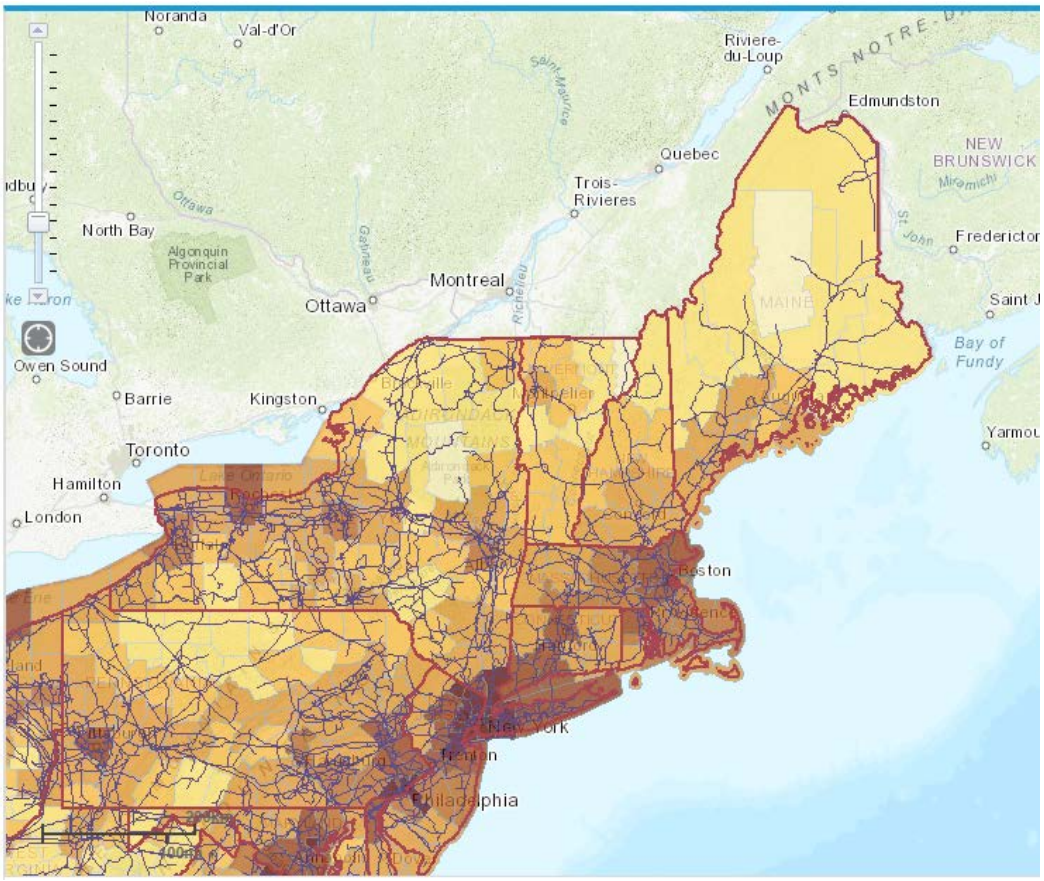
[8] See, e.g., Macmillan, T. (2014, February 7). *Clear Trees? Or Bury Power Lines?* New Haven Independent. Retrieved from https://www.newhavenindependent.org/index.php/archives/entry/burying_power_lines/

[9] In a 2012 feasibility study on undergrounding more distribution lines in the state, the MDER assumed a "conservative" cost estimate of 3 million dollars per mile to underground the distribution system. See MDER (2012), 18.

refined data is necessary to determine whether these two factors are a wash or whether they provide a cost advantage to an urban system or a rural geographically spread-out customer base.

Could the cost disparity be due to differences among utility companies? Prices between regulated utilities vary, just as they do between states. Residential customers of CMP pay 15.08 cents per kWh on average whereas residential customers of Massachusetts NSTAR pay 21.03 cents per kWh. Similarly, customers of Connecticut's United Illuminating Company (UI) pay 23.68 cents per kWh, and those of Connecticut Light & Power (also owned by Eversource) pay 19.47 cents per kWh.

Figure 2. Transmission Lines and Population Density[10]

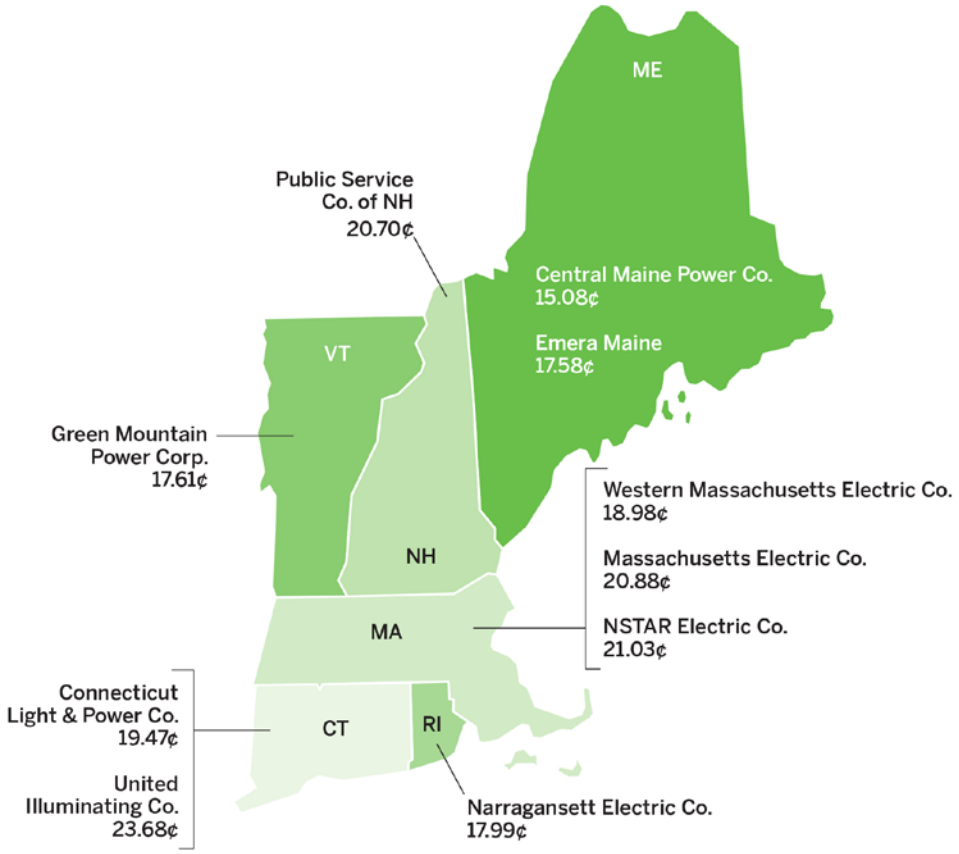


Maine's CMP customers pay about 4.4 cents per kWh less than Connecticut Light & Power customers, about 6 cents per kWh less than Massachusetts NSTAR customers and about 8.6 cents per kWh less than UI customers. These differentials are 29 to 57 percent between Maine CMP electricity costs and Massachusetts NSTAR, Connecticut Light & Power and Connecticut's UI customer costs for a single kWh of delivered electricity.

Electricity rates are traditionally supposed to be cost-based. So are the costs for delivered electricity and all its components much higher in Massachusetts and Connecticut than Maine? Perhaps so, but

[10] U.S. EIA. U.S. energy mapping system. Retrieved from https://www.eia.gov/state/maps.php?src=home-f3

Figure 3. Average Residential Price (cents per kWh) for Investor-Owned Utilities[11] in New England[12]



the price difference still seems quite high. We examined several electricity cost components with this question in mind.

Wholesale price of electricity supply

Maine is a net power exporter, and as the transmission map in Figure 2 implies, transmission constraints between Maine and the Boston region can bottle up generation supply in Maine. Those constraints can sometimes reduce wholesale pricing in Maine when transmission constraints through New Hampshire and into the Boston area trap power in Maine. Overall, this Maine zone export constraint historically accounts for 5 to 8 percent lower wholesale supply costs in Maine. The 2018 average wholesale price (locational marginal price) for the Maine locations was $40.9575/MWh, compared with $43.0525/MWh for Connecticut, and $43.6/MWh for

[11] The entities included here are limited to those investor-owned utilities with at least 100,000 residential customers.

[12] Data from U.S. EIA. (2018b, October 12). Table 6: 2017 utility bundled retail sales- residential. Retrieved from: https://www.eia.gov/electricity/sales_revenue_price/pdf/table6.pdf.

Massachusetts (with Massachusetts' multiple nodal location averaged across the state). The difference amounts to 0.21 cents per kWh for Connecticut and 0.27 cents per kWh for Massachusetts, reflecting a small portion of the 4 cents per kWh difference in observed prices for the various states (see Table 1).[13]

Labor costs

Almost certainly, labor rates and corresponding contractor costs are higher in more urban and suburban areas, as a result of labor market differentials within the New England region. But utilities are a capital-intensive industry, not labor-intensive. Higher labor and contracting costs may account for part of the difference but not for the 29 to 57 percent higher prices per kWh between utilities. For example, Rhode Island, which has similar labor market pricing to Massachusetts and Connecticut but middle-of-the-pack rates, illustrates that labor costs cannot fully account for the price differential.

Table 2. Residential Sales Volume among New England Investor-Owned Utilities, 2018[14]

Entity	State	Sales (megawatt-hours)
Central Maine Power Co.	ME	3,018,478
Emera Maine	ME	752,473
Green Mountain Power Corp.	VT	1,466,486
Western Massachusetts Electric Co.	MA	997,932
Connecticut Light & Power Co.	CT	6,742,630
The Narragansett Electric Co.	RI	2,631,619
Public Service Co. of New Hampshire	NH	2,312,312
Massachusetts Electric Co.	MA	4,635,858
NSTAR Electric Co.	MA	3,515,566
United Illuminating Co.	CT	1,272,798

Sales volume

Table 2 illustrates the sales volume by utility. If higher sales volume explained the price disparity, Massachusetts's NSTAR should have lower rates than Narragansett Power & Light (owned by National Grid) in Rhode Island and Public Service Company of New Hampshire (owned by Eversource), but the opposite is the case. Further, Connecticut Light & Power has the highest sales volume by far but does not have the lowest rates; instead, that utility is in the middle of the pack. And if low sales volume drives higher rates, one would expect to see Vermont's Green Mountain

[13] See ISO New England. *Pricing reports*. Monthly LMP (locational marginal price) indices. Retrieved from: https://www.iso-ne.com/isoexpress/web/reports/pricing

[14] Like Figure 3, Table 3 is limited to those investor-owned utilities with at least 100,000 residential customers. Data from U.S. EIA, 2018b.

Power (GMP), which has the lowest sales volume, with the highest rates — yet it has one of the lowest.

Energy efficiency and renewables program costs

Massachusetts's and Connecticut's utilities have some of the most robust energy efficiency (EE) programs in the United States and undertake more extensive EE investments than Maine does. As one might expect, they have higher programmatic charges. In 2018, the American Council for an Energy-Efficient Economy ranked these states and utility efficiency programs in its annual *State*

Table 3. Comparison of Energy Efficiency Charges and Prices of Select New England Utilities[15]

Entity	EE Charge (¢/kWh)	Differential to CMP's Charge (¢/kWh)	Overall Price Differential to CMP's Charge (¢/kWh)	Overall Price Differential Explained by EE Charge Differential (%)
Central Maine Power Co.	0.2458			
Connecticut Light & Power Co (Eversource, Connecticut)	0.6	0.3542	4.39	8.06
United Illuminating Co.	0.6	0.3542	8.6	4.12
NSTAR Electric Co. (Eversource, Massachusetts)	1.652–2.278	1.4062–2.0322	5.95	23.63–34.15

[15] These numbers are primarily drawn from each utility's residential tariff documents effective as of January 14, 2019. CMP's tariff documents note that the residential rate includes the Efficiency Maine Trust assessment charges. CMP. Rate A, Residential Service. Retrieved from https://www.cmpco.com/wps/wcm/connect/617e3b4e-59da-4a67-96b7-9a9eca8eba16/a.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-617e3b4e-59da-4a67-96b7-9a9eca8eba16-mn3hhlc. The current Efficiency Maine Trust assessment charge is 0.002458 cents per kWh for the basic service tariff. CMP. Terms & Conditions, Section 49, Efficiency Maine Trust Assessment. Retrieved from https://www.cmpco.com/wps/wcm/connect/d2a9b628-b98a-4231-a26e-d1212b685367/sect49.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-d2a9b628-b98a-4231-a26e-d1212b685367-mn3gkfR. Connecticut Light and Power dba Eversource Energy. Residential electric service (nonheating): Rate 1. Retrieved from https://www.eversource.com/content/docs/default-source/rates-tariffs/rate-1-ct.pdf. United Illuminating. (2019, January 1). Schedule of rates & riders. Residential Rate R, 56–58. Both Connecticut utilities note these charges as "conservation" charges, which means they may fund more than energy efficiency (EE) alone. Also, both Connecticut utilities have "systems benefits" charges that fund numerous activities. Although these may include EE activities, we have excluded those charges here. For example, see Connecticut Light and Power dba Eversource Energy. System benefits cost adjustment. Retrieved from https://www.eversource.com/content/docs/default-source/rates-tariffs/sbca.pdf. Massachusetts lists its system benefits charge as a component of its EE charge; we consider the total energy efficiency charges in all service territories under both rates R-1 and R-3. See NSTAR Electric Company d/b/a Eversource Energy. Summary of electric service delivery rates [western]. Retrieved from https://www.eversource.com/content/docs/default-source/rates-tariffs/2-tariff-ma.pdf. NSTAR Electric Company d/b/a Eversource Energy. Summary of electric service delivery rates [eastern]. Retrieved from https://www.eversource.com/content/docs/default-source/rates-tariffs/1-tariff-ma.pdf

Energy Efficiency Scorecard: Massachusetts ranked first in the nation with a 20 out of 20 score for its utility efficiency programs, Connecticut ranked fifth with a 15 out of 20 score for its utility programs and Maine ranked 14th with a 9.5 out of 20 score for its utility programs.[16]

Unsurprisingly, utilities in Massachusetts and Connecticut have somewhat higher charges in their basic residential tariffs than CMP does, as detailed in Table 3 on the previous page. So these efficiency charges account for some of the pricing difference. That said, they explain between 4 percent and 34 percent of the observed difference in average residential prices (that is, 4 percent of the 8.6 cents per kWh difference observed for UI, for example). Spending more on EE in rates should result in overall net savings over the long term, reducing household electric bills. But in the short run it is a portion of the cost differential.

Utilities in all three states — Maine, Massachusetts and Connecticut — list some renewable energy (RE) charges in their distribution rates. Maine's retail rates include charges for contracts for renewable (and other) resources called energy resource obligations.[17] Connecticut is the lowest, with both Eversource and UI noting a RE charge of 0.1 cents per kWh. Maine identified an energy resource component of 0.21 cents per kWh in 2016, the most recent year available. Massachusetts's Eversource notes in its tariff documents various charges — a distributed solar charge, RE charge, long-term renewable contract adjustment, solar program cost adjustment factor and solar expansion cost recovery factor — which together amount to either 0.391 cents per kWh or 0.359 cents per kWh for the basic nonheating and heating tariffs, respectively.[18] So renewable charges account for a portion of rates, with Connecticut's portions the lowest of these charges. The higher

Table 4. Comparison of Renewable Energy Charges and Prices of Select New England Utilities[19]

Entity	RE Charge (¢/kWh)	Differential to CMP's Charge (¢/kWh)	Overall Price Differential to CMP's Charge (¢/kWh)	Overall Price Differential Explained by RE Charge Differential (%)
Central Maine Power Co.	0.21			
Connecticut Light & Power Co (Eversource, Connecticut)	0.1	-0.11	4.39	-2.51
United Illuminating Co.	0.1	-0.11	8.6	-1.28
NSTAR Electric Co. (Eversource, Massachusetts)	0.391 0.359	0.181 0.149	5.95	3.04–2.5

[16] American Council for an Energy-Efficient Economy. (2018, October). *The 2018 state energy efficiency scorecard*, xii. Retrieved from https://aceee.org/research-report/u1808

[17] Maine Public Utility Commission. *2016 average prices by component - Central Maine Power Company customers*. Retrieved from https://www.maine.gov/mpuc/electricity/price_transparency/cmpgraph.shtml

[18] See NSTAR Electric Company d/b/a Eversource Energy. *Summary of electric service delivery rates* [western]; *Summary of electric service delivery rates* [eastern].

[19] See footnote 15.

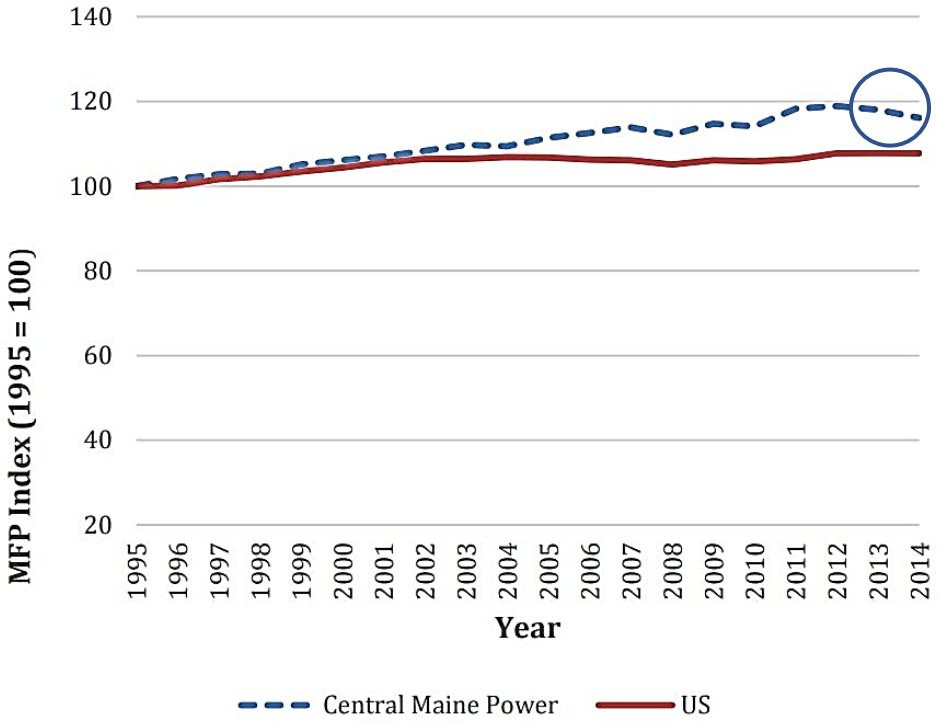
renewable charges in Massachusetts explain about 3 percent of the differential in rates (that is, 3 percent of the 5.95 cents per kWh difference) so charges for state-acquired resources, typically energy efficiency and power purchase agreements, explains some but not most of the retail rate differential.[20]

Utility performance

Perhaps Maine's CMP and Vermont's GMP are just much more economically efficient utilities? Some utilities are surely run better, with more efficient operations and investments, than other utilities. Some analysts have examined productivity of U.S. and Canadian utilities and concluded that CMP's performance for two decades from 1992 through 2014 indeed exceeded the U.S. norm.[21]

However, note in Figure 4 CMP's decreasing productivity (see circled area), which started in 2012. This trend culminated in a rate case filing by CMP in 2014 in which CMP claimed not only decreasing, but also *negative* productivity. The Maine Public Utilities Commission (PUC) declined

Figure 4. Productivity Growth of Central Maine Power and Other U.S. Utilities, 1992–2014[22]



[20] Arguably for Eversource in Massachusetts, both the energy efficiency and renewable resource fees constitute a larger portion of the retail bill, but even together less than 40 percent of the differential to Maine's CMP rates.

[21] M. Lowry, M., Makos, M., Deason, J., and Schwartz L. (2017, July). State PBR using multiyear rate plans for U.S. electric utilities. Retrieved from https://eta.lbl.gov/sites/default/files/publications/multiyear_rate_plan_gmlc_1.4.29_final_report071217.pdf

[22] Lowry et al, 2017.

to adopt CMP's proposed alternative rate plan with an automatic "unproductivity" rate escalator. Nonetheless, this claim has been made by other utilities. It is foreboding perhaps of a time of lower or even negative productivity growth and suggests more focus by regulators: Because productivity leads directly to lower customer costs, "unproductivity" will lead to higher costs for consumers.

Ultimately, the explanatory value of any single factor — and even all factors taken together — is unsatisfying. Our review provides no factors that can either independently or in aggregate adequately explain why rates are different among utilities operating right next to or near one another in the same or neighboring states. The answers may be historic and particular to each utility and jurisdiction, which is even more unsatisfying because these are real prices people face every day.

The question of whether higher bills and rates produce better service quality is an interesting one. Maine's CMP had historically good reliability and service quality performance until recent years, when its service quality measured by duration and frequency of outages fell substantially. CMP's rate increased marginally, as well, even as service quality fell.[23] But those rates stayed at the lowest in New England throughout, suggesting that service quality is not directly linked to rates and is certainly not correlated across states with higher rate and bill jurisdictions enjoying better service quality.[24]

But if service quality and service costs are not correlated, one is left to examine why costs and bills vary and what order can be brought to rationalizing the difference.

Here are some ideas on how to approach cost rationalizing:

- Could there be an effort to set average cost benchmarks across utilities and states?
- Can more efficient operations be rewarded with such benchmarks? Yes. Has such an effort ever been undertaken? Not directly to set a specific cost/ratepayer or price/ratepayer benchmark.
- Can and should utilities be held to standards for operational and capital efficiency?
- Should there be standards for costs across utilities in a region so customers and regulators can compare what costs are reasonable? Perhaps standards for costs would be differentiated by rural and urban, size of service territory and types of service including undergrounding in urban areas.
- Should regulators reward better service quality such as higher reliability and storm restoration performance as well as operational and capital efficiency?

[23] For an illustration of reduced service quality by Maine's Central Maine Power Company (CMP), see the recent 2019 Maine Public Utilities Commission (PUC) staff letter to CMP expressing concern over serious billing failures, failure to inform customer of mandatory information and inadequate response to customer complaints. Davidson, D. D. (2019, February 6). State of Maine PUC letter to D. Herling, president and CEO, CMP. Retrieved from https://htv-prod-media.s3.amazonaws.com/files/cmp-letter-1549471521.pdf

[24] This question of a statistical correlation between rates, bills and service quality would be an interesting academic econometric research topic, like many topics considered in this issue brief.

This paper illustrates the disparate electricity bills and pricing, even across the small New England region, the inability to fully explain this disparity and the lack of good baselines or standards to explain why there are such differences. Our conclusions are that the differences in bills are understandable given differences in usage and rates, but there is no satisfactory explanation for why retail electricity prices vary across this very compact geographic region.

Acknowledging and defining a problem is the first step toward addressing it. Addressing the problem could take many forms of jurisdictional information sharing, regulatory development and interstate cooperation. Perhaps adopting rate and efficiency benchmarks and examining utility performance for what customers pay is a good place to start.

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