Understanding Your Customers: The Effects of Seasonality on Energy Savings on Cape Cod and Martha's Vineyard

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ABSTRACT

The potential for energy efficiency varies considerably by state, but differences also exist within regions of a state and even within individual service territories. Programs that do not fully understand or plan around the unique characteristics of their customers may miss opportunities for savings or set inappropriate goals. Certain types of differences tend to be well understood and are often considered in study designs. These include differences between various business segments, between single family and multifamily homes, and between low income and non-low income customers. However, there are a multitude of other characteristics, often specific to service territories, which can profoundly affect program outcomes. These unique customer characteristics, even if well understood, are rarely quantified and explicitly embedded in program planning and goal setting.

This paper discusses how a baseline and potential study, commissioned by Massachusetts program administrator Cape Light Compact (CLC), addresses the unique customer characteristics and the effect these have on key drivers of savings potential. Using the example of seasonality, this paper shows how customers' defining characteristics can affect their ability to save energy. The paper also shows how, once tested, previously held assumptions about the market may need to be updated. Understanding these factors can help program administrators better meet their customers' needs and set more accurate goals for future program achievements.

Cape Light Compact's Service Territory

Cape Light Compact (CLC) is an energy services organization operated by the 21 towns and 2 counties on Cape Cod and Martha's Vineyard. In addition to administering energy efficiency programs on Cape Cod and Martha's Vineyard, CLC's also serves its 200,000 customers through consumer advocacy, competitive electricity supply, and green power options. Cape Cod is a large peninsula that juts out from the east coast of Massachusetts, and Martha's Vineyard is an island off of the coast of Cape Cod. With numerous beaches and a historic feel, Cape Cod and Martha's Vineyard are major summer tourist areas in New England. The population of the region increases dramatically in the summer, more than doubling the number of year-round residents, as people flock to their second homes or rental properties. Utility customers with seasonal usage make up approximately 30% of residential customers and 20% of commercial customers.[1]

Given the emphasis on tourism, CLC's service territory differs considerably from the rest of Massachusetts, with the territory's economy dominated by small businesses in service-oriented segments. CLC's residential sector accounts for more than half of total annual MWh sales (56%),[2] compared to 33% for the state of Massachusetts.[3] Businesses on Cape Cod and Martha's Vineyard are predominantly low

[1] For purposes of this study, we defined seasonal customers as those whose electric usage from June 1 to September 30 is greater than for the other eight months of the year. This is the same definition NSTAR uses to establish seasonal billing rates. We also considered those businesses that shut down for any period of time in the non-summer months to be seasonal.
[2] Based on 2013 CLC customer usage data
[3] Massachusetts Energy Efficiency Advisory Council Consultant Team. 2015. 2016-2018 Energy Efficiency Plan, Draft Memo, April 23.

users of electricity, and there are very few businesses in industrial segments. Approximately 60% of the lowest energy-using businesses in the territory account for only 5% of total usage.[4]

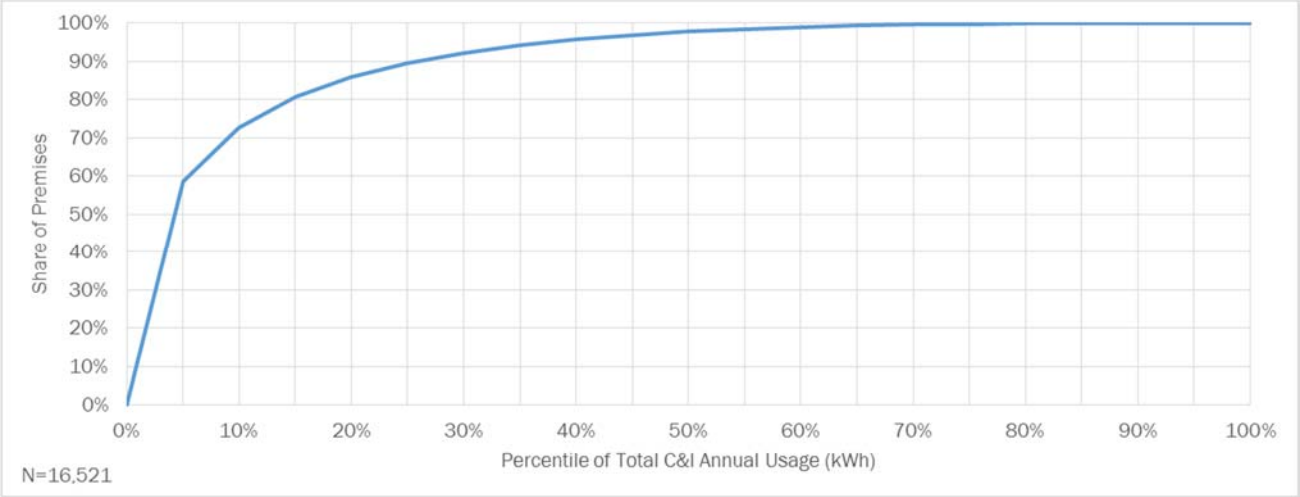

Figure 1. Breakout of C&I Premises by Share of Total C&I Annual Usage

Additionally, Cape Cod and Martha's Vineyard are somewhat isolated from the rest of Massachusetts. Cape Cod is connected to the mainland by two bridges that are often heavily congested with traffic during peak summer months while Martha's Vineyard is only accessible via ferries. The effect of this isolation is that there is little crossover between contractors serving CLC's territory and those serving the rest of Massachusetts.

The Study

In compliance with regulatory requirements, CLC staff contracted with Opinion Dynamics and Dunsky Energy Consulting to conduct a baseline and potential study. To fully understand the impacts of their unique service territory on the potential for energy savings, CLC decided to conduct a study that was firmly grounded in primary data. The goal of the effort was to develop estimates of penetration and saturation of energy-using equipment for CLC's residential and commercial customer base, estimate the potential for electric savings in CLC's territory, and – in a second phase - provide program design support. In 2014, the study team conducted extensive primary and secondary research to develop CLC-specific assumptions with respect to customer characteristics, equipment penetration and saturation, and measure adoption, and embedded these into the potential model.

In particular, the study team used the primary research to create custom assumptions about the effect of seasonality on savings and residential and commercial customers' adoption of energy efficiency. These included the effect of seasonality on the hours of use and, by extension, the electric savings of measures, as well as the barriers faced by CLC customers when implementing energy efficiency projects. While overall the study found the effect of seasonality to be lower savings and higher barriers, in some cases the study found the effect of seasonality to be minimal or even opposite to generally accepted hypotheses. This paper provides findings from the study specific to seasonality as examples of how primary research is crucial to develop accurate estimates of achievable energy savings potential.

[4] Total usage in this calculation excludes street lighting, premises in the utility segment (e.g., cell phone towers and electric substations), and premises with missing or zero annual usage.

Seasonality's Effect on Hours of Use and Savings

The primary effect of seasonal occupancy on energy efficiency potential is the reduction of the annual hours of use of some equipment types, such as lighting and heating equipment. Lower hours of use lead to reduced energy savings and bill savings, resulting in lowered cost effectiveness and increased payback period. Additionally, where seasonality is common in certain segments (e.g., restaurants and hospitality), the overall energy efficiency potential for end uses specific to those segments is reduced.

To understand the effect of seasonality on energy savings, consider the hours of operation of three Cape Cod restaurants:

- Company A operates year-round and is occupied 12 hours per day 7 days per week, resulting in a total of 4,380 hours per year.
- Company B operates year-round and is occupied 12 hours per day 7 days per week from May through September. It reduces its operation from 7 days per week to 5 days per week from October to April due to lower customer demand. This schedule results in a total of 3,653 hours per year.
- Company C has a schedule similar to Company B but also shuts down completely in December, January, and February. This schedule results in 2,882 hours per year.

Assuming the three companies are identical except for their schedule, the variation in hours of operation can result in significant differences in the energy savings from installing energy efficient equipment.[5] The table below presents the annual savings from retrofitting a 19W CFL bulb with a 12W LED bulb for the three scenarios. In this example, the seasonal schedule of Company C results in 66% of the annual hours of use and savings of a non-seasonal company. For this retrofit, this reduction in hours results in the simple payback period increasing from 2.0 years to 3.0 years. Depending on a company's investment criteria, this increase in payback period may deter some seasonal companies from investing in the same measures that a company operating year-round would make or may require the company to include the project in capital expenditure budget rather than annual maintenance costs.

	Company A	Company B	Company C
Annual Hours of Use	4,380	3,653	2,882
Annual Savings (kWh)	30.7	25.6	20.2
Incremental Measure Cost	$6	$6	$6
Electricity Rate	$0.10	$0.10	$0.10
Annual Savings in Dollars (kWh x Electricity Rate)	$3.07	$2.56	$2.02
Simple Payback in Years (IMC/Annual Savings in Dollars)	2.0	2.3	3.0

Table 1. Effects of Changes in Hours of Use on CFL to LED Replacement Savings

[5] In this example, we assume that the equipment runs for the entirety of the company's hours of operation but beyond the hours of operation, such as lighting.

The effect of seasonality also results in significant differences in energy saving for residential customers. For example, our analysis found that swapping a 60W incandescent bulb to a 12W LED resulted in annual savings of 32 kWh for year-round residential customers but only 15 kWh for seasonal customers.

In addition to a customer's internal investment criteria, a reduction in average hours of operation and related savings may change a utility's program planning assumptions. Estimates of CLC's achievable potential include only measures that are cost effective and the changes to hours of operation and savings may push some measures to a benefit/cost ratio of less than 1.0.[6] For example, in the residential sector, several measures are cost effective for year-round customers but are not for seasonal customers, including heat pump water heaters and SEER 16 heat pumps.

Aggregating the hours of individual businesses in CLC's territory to the segment level, we found that seasonality reduces segments' maximum overall hours of use by 1% to 11%, as shown in Table 2. As expected, traditionally seasonal segments have the largest adjustment to hours of use, while there is minimal effect for the health services and office segments.

C&I Segment	Seasonality Adjustment to Annual HOU (% of Max HOU)
Health Services	99%
Office	98%
Automotive, Warehouse/ Distribution or Industrial	98%
Grocery, Convenience or Large Retail	98%
Government or Education	97%
Small Retail	95%
Multi-family	94%
Other Commercial	94%
Restaurant	91%
Lodging/ Hospitality	89%

Table 2. Annual Seasonal Hours of Use Adjustment Factor

Upon initial review, the effect of seasonality on the hours of use for the lodging/hospitality and restaurant segments appears smaller than expected. However, even in these highly seasonal segments approximately two-thirds of businesses remain open year-round. Moreover, for those businesses that do reduce their hours of operation, the change is typically neither substantial (e.g., a total shutdown) nor long lasting.

Regardless of any effects from seasonality, all CLC customers (including both seasonal and non-seasonal) may have hours of use different than in other jurisdictions. Our primary research found that, for some measures, the hours of use of CLC's commercial and residential customers differed substantially from the assumptions made in the Massachusetts TRM. As a result, the estimated savings per measure may be lower than originally assumed. Additionally, the cost effectiveness of some measures (both at a program level and a customer level) may be lower and could be screened out of the achievable potential estimate.

[6] Based on survey results about the decision making of CLC customers, we screened measures for cost effectiveness as part of the achievable potential using the Participant Cost Test for C&I customers and Simple Payback Period for residential customers.

Seasonality's Effect on Market Barriers

In addition to potential changes to a measure's cost effectiveness, seasonal customers may face other barriers to installing energy efficient equipment. Market barriers play a significant role in the estimation of the achievable potential for energy efficiency program savings, as they drive the rate of installation of measures. We asked CLC residential and commercial customers to provide a rating of the degree to which common barriers to installing energy efficient equipment affected them. Potential barriers included:

- The higher cost of energy efficient equipment
- Access to financing or capital for energy improvements
- Difficulty finding information on how to improve energy efficiency
- Uncertainty about the savings from energy efficiency improvements
- Limited availability of energy efficient equipment
- Limited upside to investment as a renter
- Seasonality
- Difficulty finding contractors

Given the seasonal nature of Cape Cod and Martha's Vineyard, we analyzed the results of these questions to identify any difference between seasonal and non-seasonal customers in terms of their barrier levels. Interestingly, our analysis found that the effect of seasonality on barriers is not clear. Figure 2 and Figure 3 show the mean level of barriers to installing energy efficient equipment for CLC commercial and residential customers, respectively.

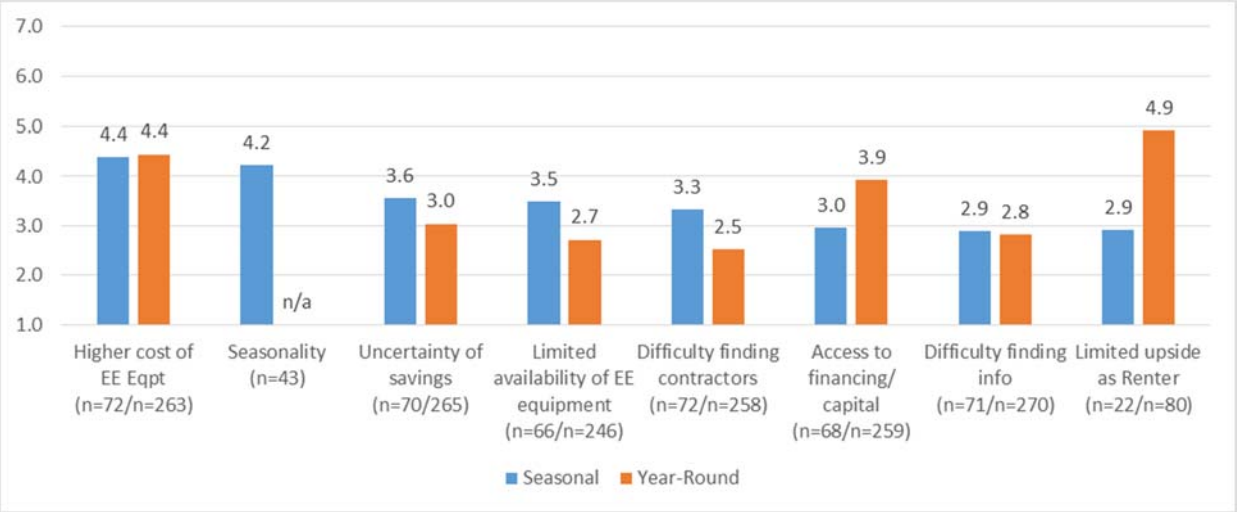

Figure 2. Mean Level of Barriers to Installing Energy Efficient Equipment for CLC Commercial Customers (1=Not a Barrier at All, 7=A Major Barrier)

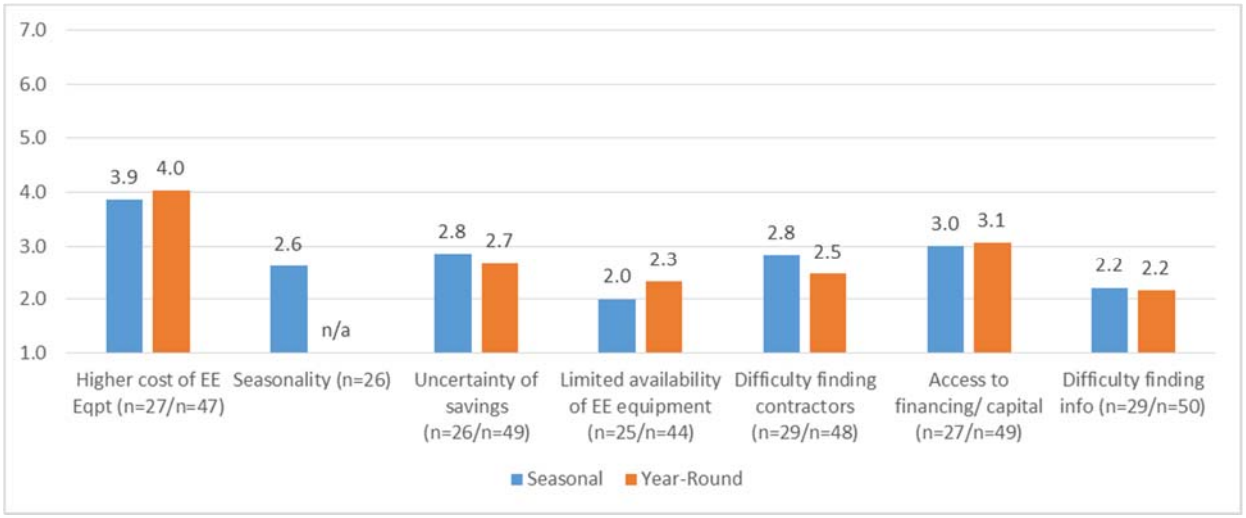

Figure 3. Mean Level of Barriers to Installing Energy Efficient Heating/Cooling Equipment for CLC Residential Customers (1=Not a Barrier at All, 7=A Major Barrier)

As shown in the above figures, both seasonal and year-round customers rate these barriers as low to moderate, with commercial customers providing slightly higher mean ratings than residential customers. On average, neither seasonal nor year-round customers in the commercial or residential sectors rated any of the barriers as substantial, with most mean ratings among commercial customers and all mean ratings among residential customers being 4.0 or lower on a scale of 1 to 7.

Notably, the results show little difference between the mean ratings of seasonal and non-seasonal customers; only the difference between seasonal and non-seasonal commercial customers for the barrier of limited upside as a renter is statistically significant at the 90/10 confidence and precision level. The lack of significant difference in barrier levels between seasonal and year-round customers opposes CLC's original assumptions. This finding suggests that other factors beyond seasonality, such as segment-specific issues or circumstances unique to Cape Cod and Martha's Vineyard, may impact customers' decision and ability to install energy efficient equipment. For example, seasonal residential customers have significantly higher income levels than year-round customers.[7]

Conclusion

All jurisdictions have a unique mix of customers with distinctive features and individual challenges limiting the installation of energy efficient equipment. Although these features and challenges may seem apparent, it is only through careful research that these effects can be verified and quantified. As described in this paper, our study confirmed many of Cape Light Compact's assumptions about its seasonal customers, but contradicted others. As expected, seasonal customers in Cape Light Compact's service territory face the hurdle of reduced savings and longer payback periods due to lower hours of use than non-seasonal customers. However, the effect of seasonality on the overall market may not be as large as originally thought. Additionally, our research also found no apparent link between the average level of barriers for seasonal customers and their year-round counterparts, for both the commercial and residential sectors.

Together, these findings support the need for a comprehensive understanding of the unique features of service territories. Using state-level assumptions may not be appropriate for some segments

[7] According to our mail survey, 43% of seasonal respondents have annual household income of $150,000 or more, compared to 9% of non-seasonal respondents. Conversely, only 9% of seasonal respondents had income below $50,000 compared to 27% of non-seasonal respondents. We observed similar trends among respondents to the barrier telephone survey.

or measures. However, using broad assumptions for these unique features may also lead to incorrect results. It is only through careful research of a service territory's market characteristics that these features can be fully understood and quantified to help program administrators better meet their customers' needs and set more accurate goals.