

MASSACHUSETTS RESIDENTIAL BASELINE STUDY

Prepared for:

The Electric and Gas Program Administrators of Massachusetts
Part of the Residential Evaluation Program Area



Submitted by: 1375 Walnut St, Ste100, Boulder, CO 80302
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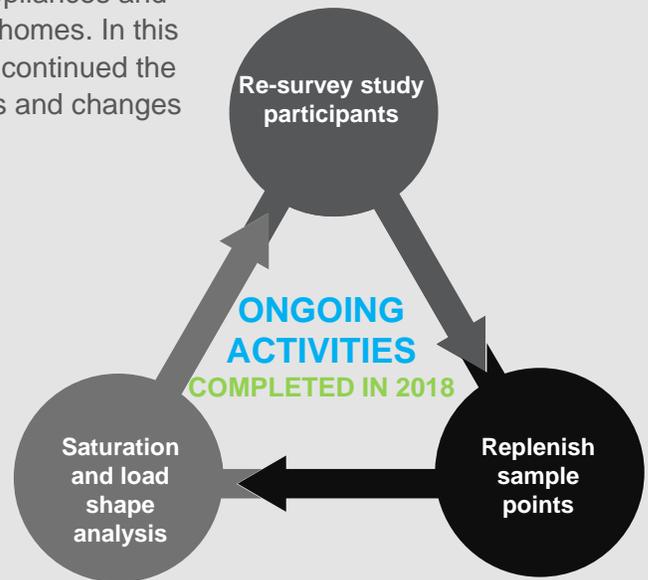
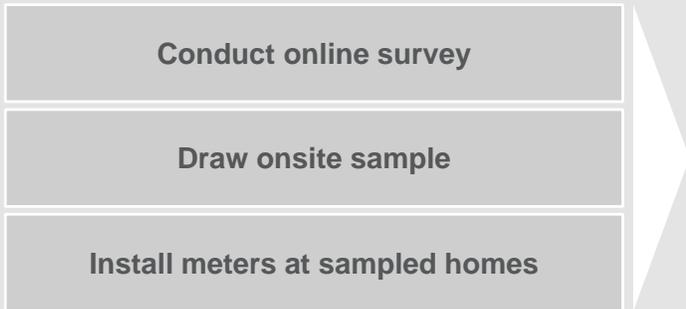
STUDY OVERVIEW

The primary goal of the Massachusetts Residential Baseline Study is to collect saturation, penetration, and usage behavior data for all major electric and gas appliances, mechanical equipment, and electronics in Massachusetts homes.

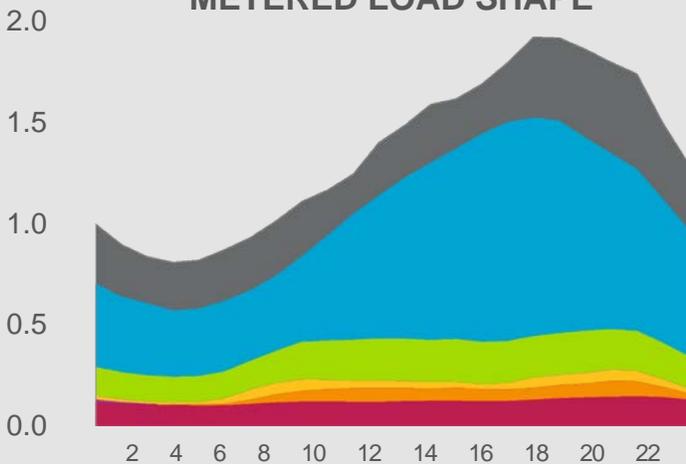
This data supports energy and peak demand savings calculations for program evaluation and design, and provides additional insight on the savings potential in the existing residential buildings market.

In the **first year** of the study, Navigant surveyed thousands of Massachusetts residents about their household appliances and energy use and metered 25 end uses at over 350 homes. In this **second year** of the study, Navigant repeated and continued the same data collection activities to calculate updates and changes in saturation and load shapes.

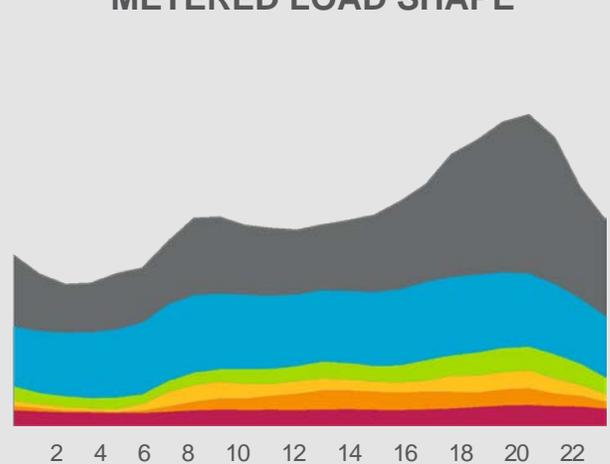
INITIAL ACTIVITIES COMPLETED IN 2017



SUMMER PEAK DAY
METERED LOAD SHAPE



WINTER PEAK DAY
METERED LOAD SHAPE



LIGHTING + OTHER

HVAC

MISC

WATER HEATING

LAUNDRY

KITCHEN

CONCLUSIONS

COOLING



Central air conditioners (AC) are the single most important end use driving summer peak demand.

Central AC should be the focus of efforts to reduce peak demands, but ductless heat pumps and room AC are also important to a comprehensive program offering.

HEATING

Hardwired electric heat, plug-in electric heat, ductless heat pumps, furnace fans, and boiler distribution systems all consume energy within the same order of magnitude, and are equally important as other prevalent non-HVAC end uses. Ductless heat pump saturation is increasing.

KITCHEN



Refrigerators are the second largest individual consumers of electricity, but peak impacts from kitchen equipment are negligible.

LIGHTING AND OTHER



Lighting is assumed to be the largest portion of the remaining load, but its energy intensity is falling quickly due to program interventions and federal standards.

WATER HEATING



Heat pump water heaters consume about half of the energy and peak demand of regular electric water heaters, providing potentially significant reductions in peak demand.

LAUNDRY



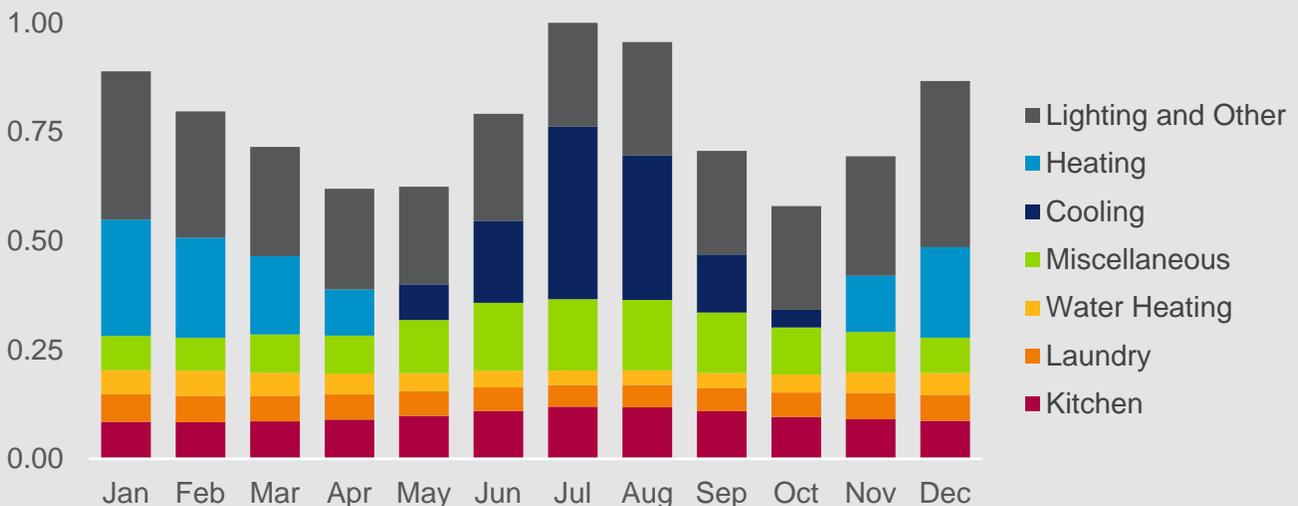
Clothes dryers are used throughout the day, including during afternoon and evening peak.

MISCELLANEOUS



Pool pumps have the largest non-cooling summer peak demand of any metered end use.

Program administrators should consider targeting dehumidifiers and pool pumps for peak demand savings with low customer impacts.

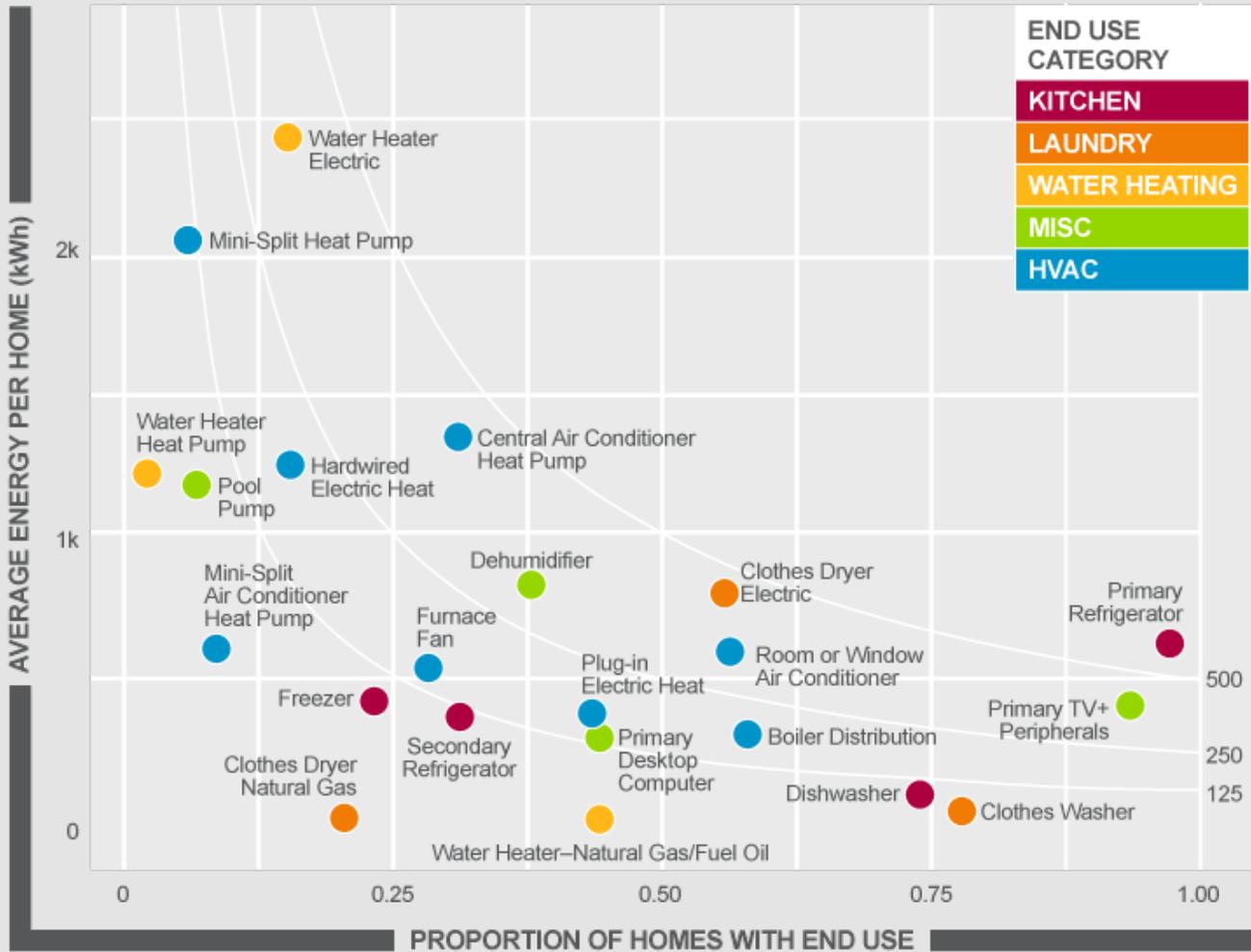




ANNUAL ENERGY CONSUMPTION

Electric heating and hot water (including heat pumps) are anticipated to increase in saturation. As saturations of these end uses go up, statewide electricity consumption will increase.

Refrigerators consume more electricity in Massachusetts than any other appliance.



Dryers and dehumidifiers are both medium energy consumers and present in many but not all homes.

High saturation end uses such as refrigerators and TVs are ripe for broad-based behavior or upstream/midstream programs to save energy.

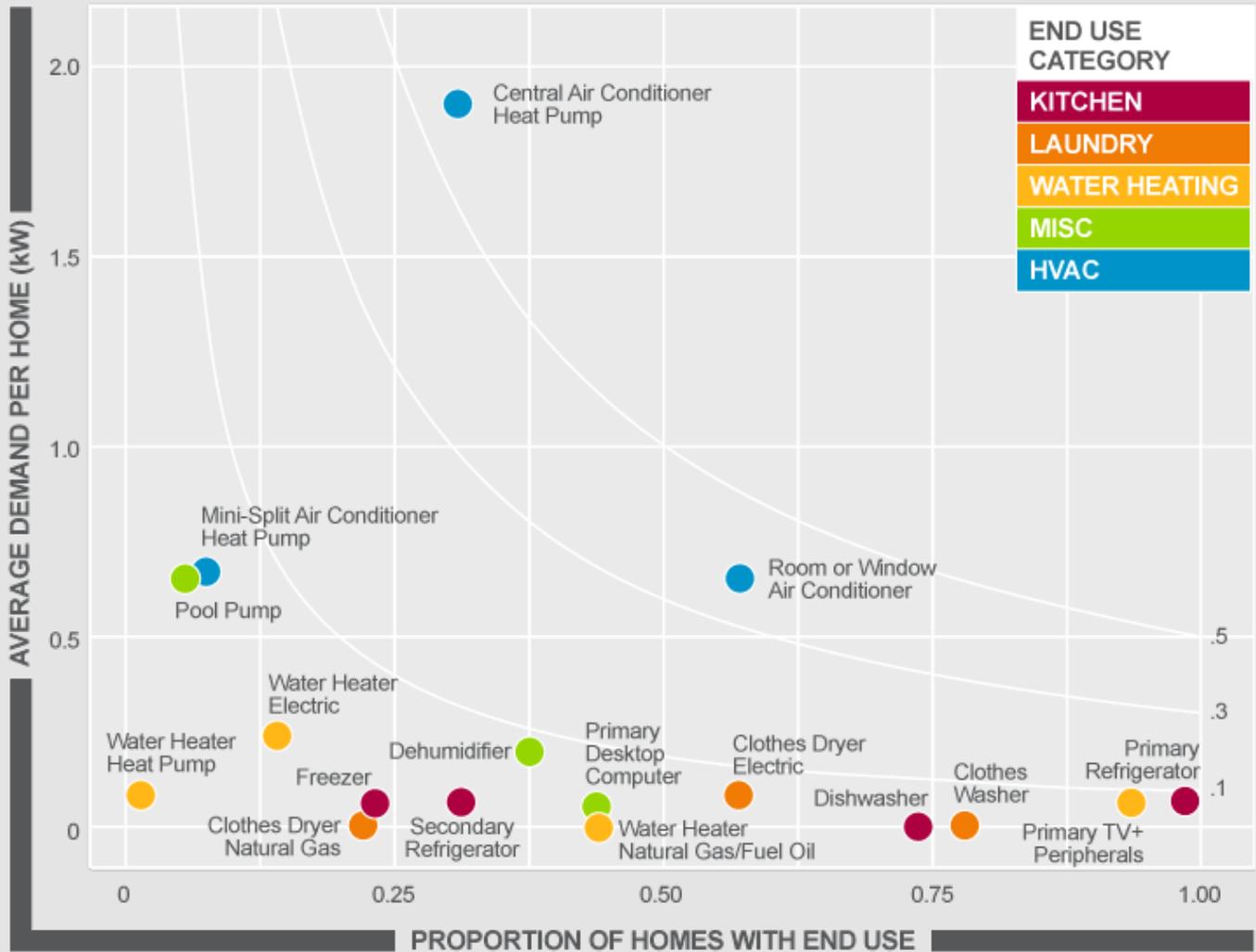
Each point in this plot shows the household consumption and the fraction of households with a given end use. As you move up and to the right, the aggregate consumption per Massachusetts household goes up, as shown by the lines of constant aggregate Massachusetts consumption. For example, primary refrigerators are found in 99% of homes and have an annual consumption of 557 kWh per home with a refrigerator, so the statewide average is 547 kWh per Massachusetts household, while Central AC is found in 31% of homes and has an annual consumption of 1390 kWh per home with a Central AC. This yields 431 kWh per Massachusetts household.



SUMMER PEAK DEMAND

Pool pumps are uncommon, but they offer a high quality peak saving opportunity. Dehumidifiers offer a more common medium-sized opportunity.

Central air conditioners are the single most important end use driving summer peak demand, and their saturation is increasing. Room ACs are the next largest contributor. These two end uses are the best opportunity for near-term peak demand savings.



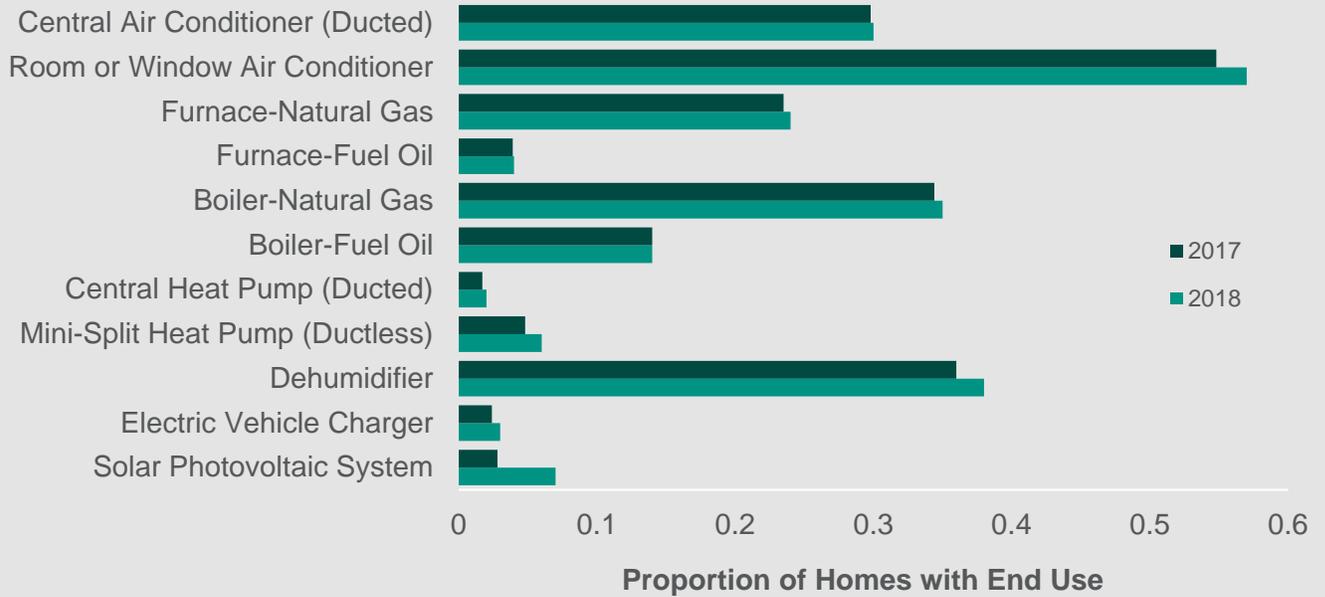
While typical electric water heaters and electric clothes dryers do not offer significant demand savings, a small portion offer high quality peak savings opportunities.

Ubiquitous end uses like TVs, refrigerators and lighting are candidates for behavior-based DR, or upstream/midstream programs.

Each point in this plot shows the household demand and the fraction of households with a given end use. As you move up and to the right, the aggregate demand per Massachusetts household goes up, as shown by the lines of constant demand. For example, primary refrigerators are found in 99% of homes and accounts for 0.088 kW per home, so the statewide average is 0.087 kW per household. Central AC is found in 31% of homes and has an average demand of 1.93 kW per home with a central AC. This yields 0.6 kW per Massachusetts household.

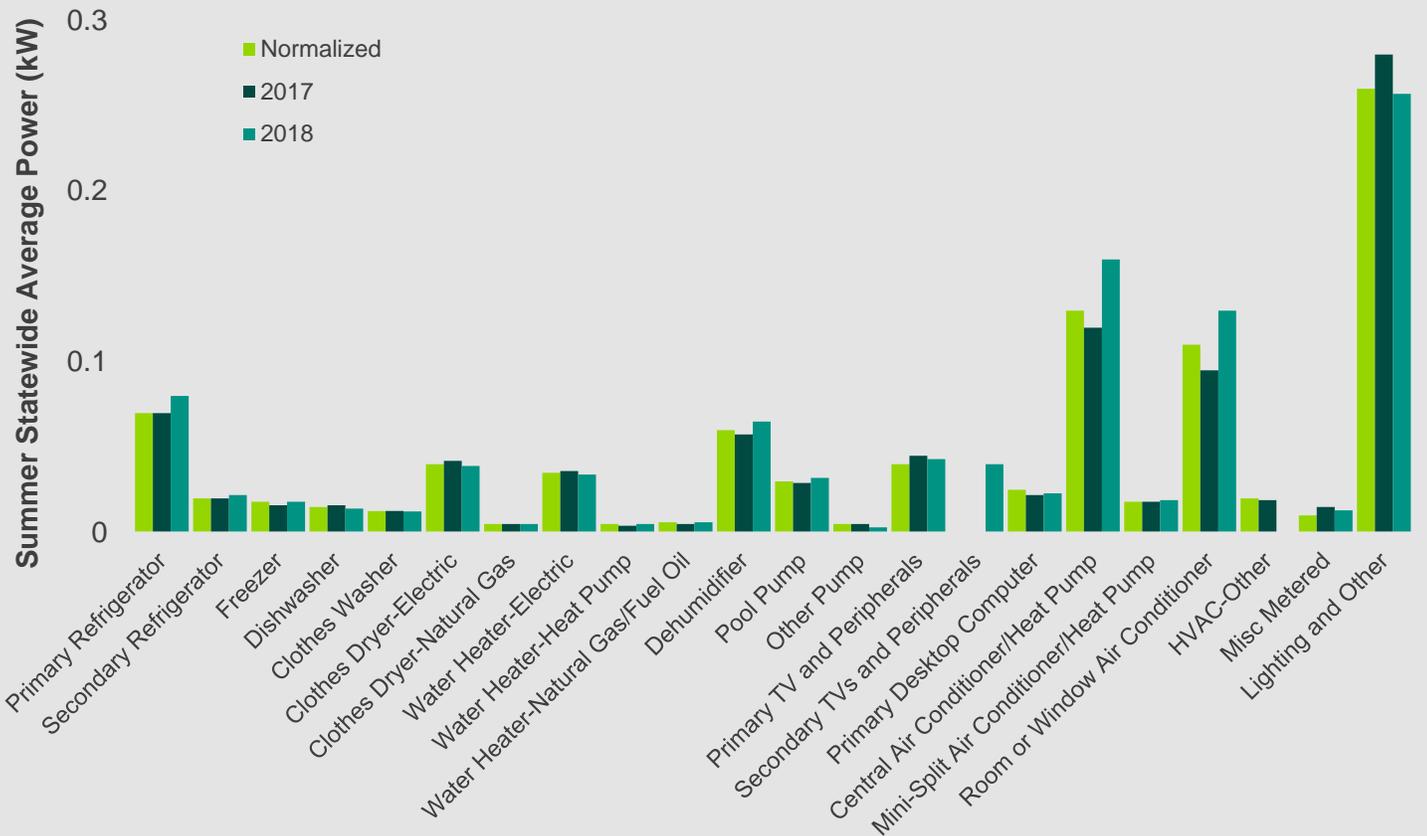


CHANGES FROM LAST YEAR



The online surveys conducted this year showed notable increases in the saturation of room ACs, dehumidifiers, and electric vehicles. The hot moist weather in summer of 2018 appeared to motivate people to purchase room ACs and dehumidifiers. Gas end uses increased in saturation in the last year, while oil end uses remained constant.

Meanwhile, the hot summer caused consumption from air conditioning measures to increase significantly in 2018, compared to 2017.



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