**Forecast Model Variable Construction**

**Residential SAE Monthly (m) Variables**

1.  **XHeatm** = HeatUsem \* HeatEIm

HeatUsem = HHSizem0.3 \* HHIncm0.1 \* Pricem-0.1 \* HDDm

2. **XOtherm** = OtherUsem \* OtherEIm

* OtherUsem = HHSizem0.6 \* HHIncm0.1 \* Pricem-0.1 \* BillingDaysm
* OtherEIm = WaterHeatEIm + DryerEIm + CookingEIm

**XHeatm**: Initial estimate of monthly heat (therms per household)

HeatUsem: Factors that drives monthly residential heating utilization.

HeatEIm: Average residential heating intensity (therms per household)

HHSizem: Average number of persons per household

HHIncm: Average household income

Pricem: Average gas price ($ per therm)

HDDm: Cycle-weighted HDD

**XOtherm**: Initial estimate of non-weather sensitive gas use (therms per household)

OtherUsem: Factors that drive monthly residential non-weather sensitive use

BillingDaysm: Number of billing days

OtherEIm: Nonweather sensitive end-uses (Water Heating, Dryers, and Cooking)

**Notes:**

* + Model variables other than HeatEI (Heating Energy Intensity) and OtherEI (Non-weather sensitive Energy Intensities) are indexed to a base year (2015). This allows the resulting XHeat and XOther variables to be interpreted as initial heating therms per customer estimate.
  + The numbers shown in exponentials are effectively elasticities with respect to utilization. The elasticity shows the percent change in utilization given a percent change in the drivers. Utilization is inelastic (elasticities less than one) in average use consumption models. Elasticities are from the Census Division models that Itron has developed from EIA Annual Energy Outlook (AEO).

**Commercial SAE Variables**

1. **XHeatm** = HeatUsem \* HeatEIm

* HeatUsem = EconVarm0.1 \* Pricem-0.1 \* HDDm
* EconVarm = GDPm^.2 \* Emplm^.8

1. **XOtherm** = OtherUsem \* OtherEIm
   * OtherUsem= EconVarm0.1 \* Pricem-0.1 \* BillingDays
   * OtherEIm = WaterHeatEIm + CookEIm + MiscEIm

**XHeatm**: Initial estimate of monthly heating (therms per square foot)

HeatUsem: Factors that drives monthly commercial heating utilization.

HeatEIm: Average commercial heating intensity (therms per square foot)

EconVarm: Commercial economic driver

Pricem: Average commercial gas price ($ per therm)

HDDm: Cycle-weighted HDD

**XOtherm**: Initial estimate of non-weather sensitive gas use (terms per square foot)

OtherUsem: Factors that drive monthly residential non-weather sensitive use

BillingDaysm: Number of billing days

OtherEIm: Nonweather sensitive end-uses (Water Heating, Cooking, and Miscellaneous)

Miscellaneous includes laundry, pools, and other process heat requirements.

**Notes:**

* + Model variables other than heating intensity (HeatEI) and non-weather intensities (OtherEI) are indexed to a base year (2015). This allows the resulting XHeat and XOther variables to be interpreted as initial heating therms per customer estimate.
  + The numbers shown in exponentials are effectively elasticities with respect to utilization. The elasticity shows the percent change in utilization given a percent change in the drivers. Changes in economic activity and price have a small impact on average use. The economic elasticity was evaluated by examining in-sample and out of sample statistics with small variations.
  + The economic variable combines employment and output with more weight given to employment. The weights again were base on overall assessment as to how changes in weighting impacted model fit and consistency of projected trends with historical trends.