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Forecast Development with the End Use Models

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Demand Modeling Highlights

Equipment is long lived and durable

Equipment Type	Typical Age at Replacement
Residential Space Heaters	17 years
Residential Water Heaters	7 years
Residential Cooking	12 years
Residential Dryers	8 years
Residential Gas Fireplace	15 years
Commercial Space Heater	25 years
Commercial Water Heater	15 years
Industrial boiler	25 years

- When equipment decays, it is replaced.
- New customers augment the equipment inventory.
- Some customers may retire equipment early to take advantage of energy savings.

The End Use Model[1] incorporates equipment choice dynamics into the forecasting module. Energy use can be altered by changing utilization patterns of the equipment or by acquiring different equipment, holding all other considerations like weather constant.

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[1]NOTE: EU Forecaster is the end use model used. It operates using SAS software.

End Use Modeling

With the End Use Model, demand for gas over a given time interval is the sum of

- demand from new customers plus
- demand from existing customers who use the current stock of equipment plus
- Demand from current customers who replace existing equipment.

- Tracking equipment cohorts is a process is called "Vintaging".

Customers choose their end use equipment from gas or electric fuel types and their preferred efficiency level.

Factors to Consider with an End Use Model

End Use Models allow the analyst to segment the overall market into meaningful customer types.
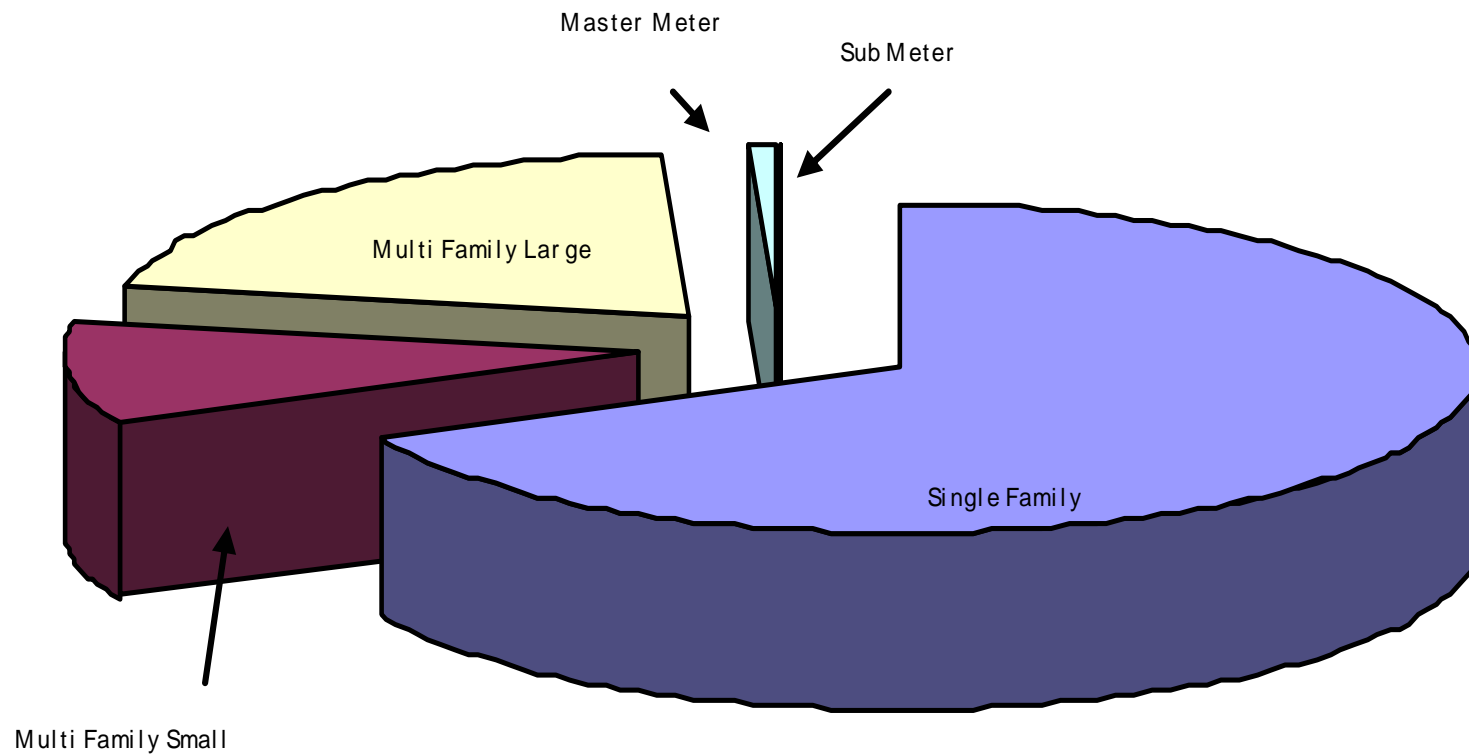
The model tracks usage by each customer's equipment characteristics, the utilization rate and the fuel efficiency.
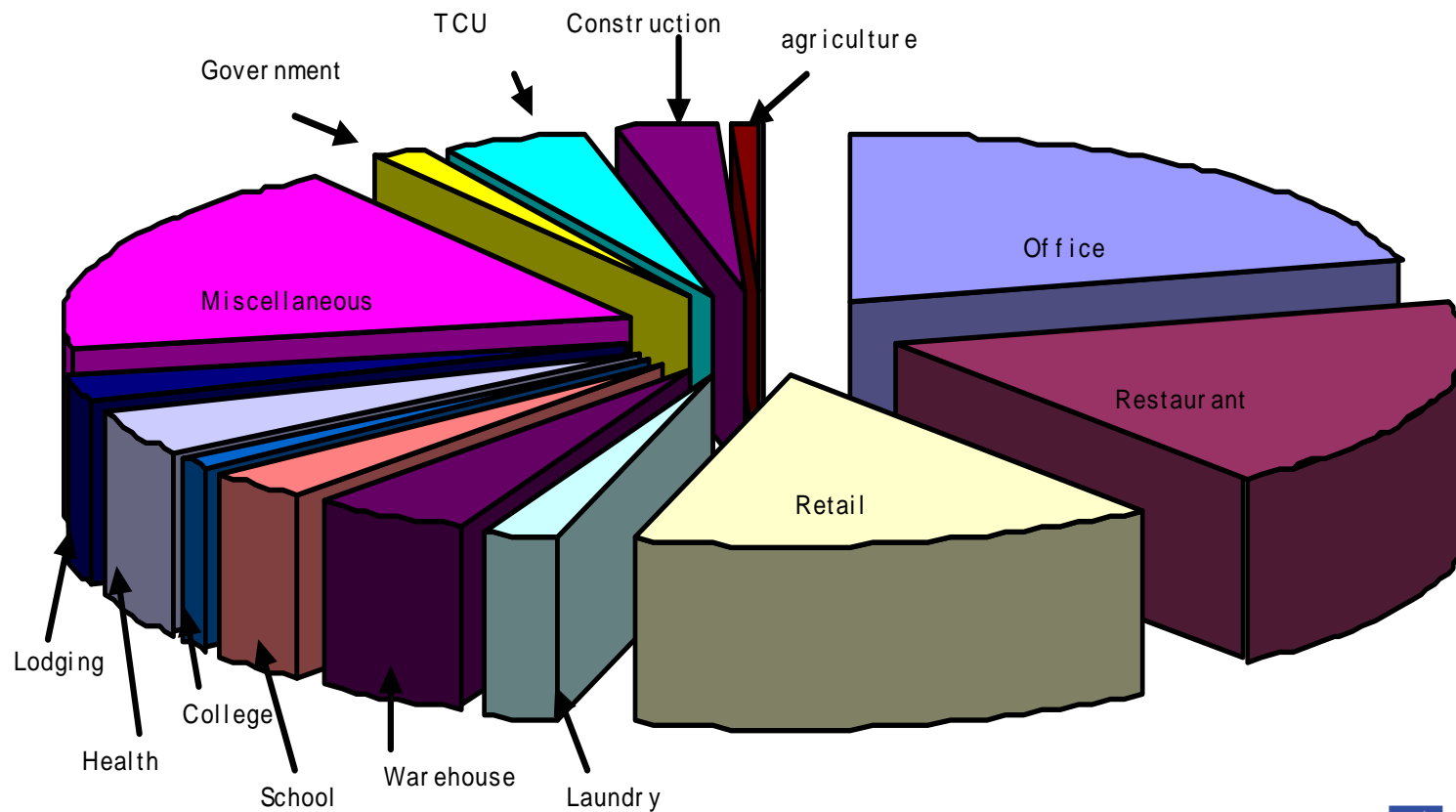
Residential Model has 5 Market Segments

CUSTOMER SEGMENTATION
Portions Represent Customer Counts

Master Meter

Sub Meter

Multi Family Large

Single Family

Multi Family Small

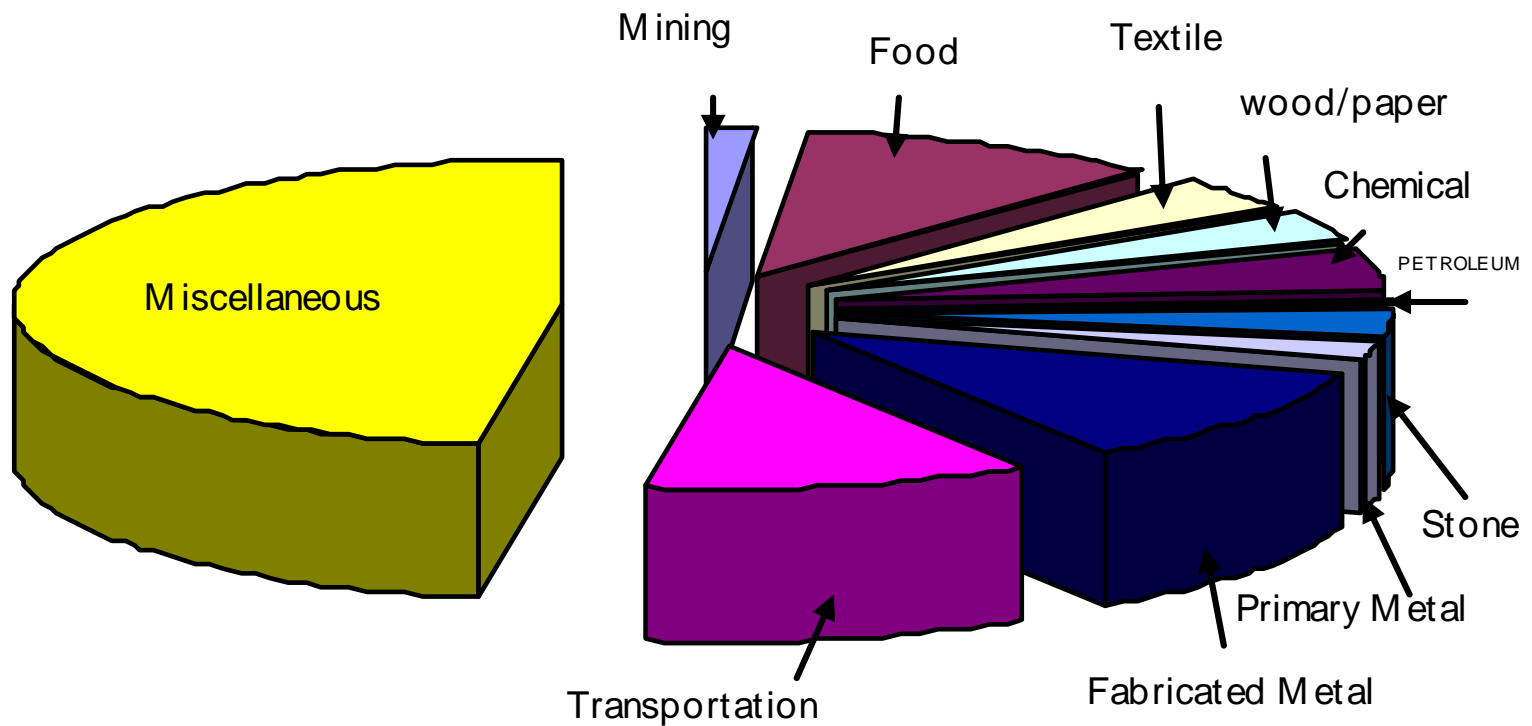# The Core Commercial Market has 14 Segments

CUSTOMER SEGMENTATION
Portions Represent Customer Counts

The Core Industrial Market has 11 Segments

CUSTOMER SEGMENTATION
Portions Represent Customer Counts

End Use Model's Analyst Provides Inputs

- For each end use, fuel type and efficiency level, the analyst inputs the saturation of the equipment type in the population, the intensity[2] of the equipment used, and the usage per unit.

End Uses by Market Segment

Residential: **Space Heat, Water Heat, Cooking, Drying Pool, Spa, Fireplace, Barbecue, Other**

Commercial: **Space Heat, Water Heat, Cooktop, Fryer, Griddle, Other   Cooking, Drying, Engine, AC Compressor, Other**

Industrial: **Space Heat, Water Heat, Fire Tube Boiler, Water Tube Boiler,   Dryer, Furnace/Oven/Kiln, AC, Engine, Other**

Fuel Types: **Gas or Electric**
Efficiency Levels: **Stock, Standard, High, or Premium**

[2]Note: Intensity = unit energy consumption * saturation

Usage Module:

The total gas usage in the base year for each market segment is equivalent to the total energy usage across all the range of end uses for a particular market segment.

End Use Energy = **(usage per unit)*(end use saturation)*(fuel share)*(# Customers)**

More energy efficient appliances have lower saturations and lower usage per unit values which dampen the demand forecast over time as households or firms make the decision that the more energy efficient appliance becomes economic.

Provider Choice Module:

The provider choice module analyzes customer choice decisions among competitors and product options

Customers will choose their end use equipment from various fuel types and efficiency levels based on what is economic

Factors considered are

- (1) Operating Costs   (gas vs. electric prices)

    What is the present value of operating equipment over time?

- (2) Capital Costs (ie, what does it cost to replace and install a new piece of equipment?)

    Cost Difference for Standard vs. High Efficiency vs. Premium Efficiency becomes Important

Forecast Module:

This module merges all the input data:

Existing accounts and the distribution of accounts across vintages

New construction forecast

Decay rates and saturations

Product Usage and Provider Choice Forecast

The module solves for output arrays that contain information on a number of market segments, units per year that are indexed by specified dimensions such as building vintage, equipment age and fuel efficiency

The module multiplies all of the units by the respective consumption estimate per unit and summarizes results.

Where do the data inputs come from?

Conditional Demand Analysis provides the data inputs for the various models.

The Data are derived from survey instruments: RASS, CEUS, IEUS.

✓ Complete analysis of usage characteristics was performed on survey results.

✓ Analysts merged survey and billing records to estimate demand equations

Conditional Demand Analysis yields:
- Appliance saturations [3] by building vintage
- Appliance replacement information
- Home size by building vintage
- Estimated consumption for gas appliances by building vintage
- Analysis provides annual use predictions of usage by building age under normal weather conditions for each appliance

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[3] Note: Saturation refers to the percent of customers that have a given end use.

RECAP: Steps taken to obtain a forecast:

(1) Input the required data by designated market segment
(2) Populate the data into the EuForecaster Tool
(3) Merge all input data by market segment
(4) Solve for output arrays
(5) Store results of datasets
(6) Multiply the number of units by the unit consumption
(7) Summarize the results in a standard report format

BENEFIT OF USING END USE MODEL

1. Equipment is not assumed to be homogeneous (usage per unit varies by age of equipment and efficiency type)

2. Holding all other factors constant such as weather, demand will be based on an economic decision based on capital costs and operating cost for each end use piece of equipment replaced

3. Equipment Decay Rates, New Meter Growth and Employment Drive Growth In Demand

4. Forecast is calibrated to base year inputs.

How do SoCalGas and SDG&E Use the CEC Demand Forecasts?

- Reconciliation Efforts

- Internal Consistency Checks

- Outlooks

What Additional Information or Analysis is Desired?

The Utilities would like to see:

- Data Source References

- Summaries of Trends and Important Industry Changes

- Data Inputs

EE Savings Process

- End Use Model's emphasis is on economic decision-making based on current capital, O&M costs and commodity costs.

- The utility's EE programs buy down the cost difference

  of high vs. standard efficiency end use equipment.

- The utilities subtract out 100% of the State-Mandated Targets from the Demand Forecast.

Conclusion

Unlike an econometric model, the End Use Model allows the analyst to disaggregate behavior into specific user-defined segments and allows the analyst to simulate each segment's behavior regarding product demands and the set of choices they face.