

NATIONAL GRID RHODE ISLAND GAS LOAD SHAPES

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The study's purpose was to develop an end use load shape library corresponding to Natural Gas Demand-Side Management (DSM) measures for energy efficiency (EE) and demand response (DR) for Rhode Island. In this context, a load shape is defined as a usage pattern by interval, typically hourly, with end uses defined as appliances or devices that use energy (e.g., heating). Customer segments included Commercial and Industrial gas heating and non-heating end uses for major business types (Office, Retail, Grocery, Warehouse, Education, Health, Lodging, Restaurant, and Other/Industrial), with significant subsets for Office (Large/Small), Education (Secondary, High School, University) and Restaurant (Fast-food, Full-service).

The end use load shape library is sufficient to support National Grid's tracking of peak gas demand usage and savings, with contributions to defined "peaks" (e.g., coldest or design day at 8 am) by customer segments and end use measures identified for various planning applications, including studies of both potential and current DSM program usage and peak impacts.

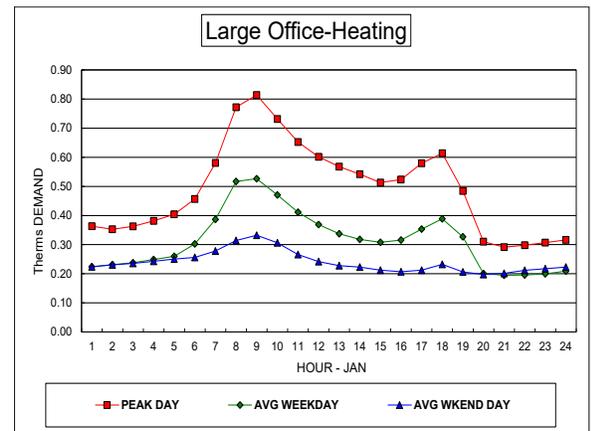
Research questions

What are the peak demand to annual usage ratios associated with the EE or DR measures?

What are the seasonal, monthly, daily, and hourly load shape savings patterns that are applicable to each customer segment end use component and measure?

METHODS

The development of load shape factors was based on an established process by DNV GL, in which we developed a description of annual load shape patterns using set of four component ratios consisting of 1) monthly usage allocation, 2) weekend/weekday ratio by month, 3) peak day to weekday ratio by month, and 4) hourly per-unit factors by day type by month. To generate the weather-related ratios (1, monthly breakdown, and 3, peak day factors) for heating load shapes specific to Rhode Island Service, daily weather data for Providence Airport was used to calculate heating degree days and peak-to-average day ratios over a 9-year history. Weekend/weekday factors by customer segment were developed from 251 identifiable sites with hourly interval data and Ratio 4 hourly per-unit factors were developed from the business type/end use-specific load shape library from metered data compiled by the Regional Technical Forum (RTF). The resulting load shape factors were then stored and linked to a delivered Excel application that generates tables, graphs, and 8,760 outputs in several formats with user-input usage level and calendar year, applicable for National Grid planning applications.



Primary Data Sources



Whole building load studies
2019 interval data for 628 customers



National Grid billing records
to identify business type and usage levels



MA DOER load study
of a college campus in Massachusetts



End use studies
from Northwest Power Council RTF



9 years
of local weather to develop weather-sensitivity factors

CONCLUSIONS

- The load shape ratio method used to build the end use load shape library provides a flexible structure for incorporating weather and load sources to facilitate development of end use load shape patterns using current and future modeled, metered, or borrowed end use load metered data.
- The load shape library provides a solid basis for National Grid - Rhode Island to use in tracking peak gas and demand savings, specifically the relationship between annual usage and various peak definitions and hourly loads overall.

Load shape ratio component data source table extract

LOAD SHAPE #	DESCRIPTION/ SEGMENT	MONTHLY BREAKDOWN	WEEKEND/ WEEKDAY RATIO	PEAK DAY FACTOR	HOURLY PROFILE
2001	Space heating: Large office	9-year average monthly HDD60	NG RI January interval data	9-year seasonal average HDD	RTF87: Large office heating
2002	Space heating: Small office	9-year average monthly HDD60	NG RI January interval data	9-year seasonal average HDD	RTF165: Small office heating