Maine Public Service Company
Settlement and Load Profiling Methodology
Chapter 321 Report #2

The following report will describe in outline the methodology and the software that Maine Public Service Company (MPS) plans to use for settlement and load profiling under Retail Access. Central to this methodology is the method used to calculate multiple independent competitive energy supplier loads, on a daily/hourly basis, which are dispersed across a single transmission and distribution system. The Northern Maine Independent System Administrator (NMISA) will use this information to settle, i.e. balance or match, each independent competitive supplier's energy supply against their assigned load responsibility and to allocate supplier load responsibility for shared resources. Chapter_321 of the Maine Public Utilities Commission (MPUC) Rules establishes the daily and monthly reporting requirements for reporting hourly and monthly load obligations of competitive electricity providers operating in Maine to the NMISA as well as to ISO-NE. Chapter_321 of the MPUC Rules also governs telemetering, load profiling, information access, and data transfer. Section 9 requires the Maine utilities to file two methodology reports: a report on sampling and data validation, and a report on profiling and load estimation methodology. The first MPS report on load research methodology was filed on December 1, 1998. This report is the second in the series. Since the other two investor owned utilities in Maine, Bangor Hydro Electric Company (BHE) and Central Maine Power Company (CMP) have essentially the same requirements, the many of the elements of this report borrow heavily from software vendor documentation and the CMP methodology report published previously.

Load Profiling

The method of identifying a customer's distinctive hourly load curve over a twenty-four hour period is referred to as "load profiling." MPS uses three approaches to collecting load data for customer classes. Most smaller customers do not have meters that are capable of sending hourly usage data back to the utilities, it is necessary to use a representative sample to establish the typical load shape of the customer. For these customers, since only the total monthly individual customer energy usage is known, it is necessary to estimate the hourly usage of the individual customer. These customers are sometimes referred to as "profiled customers." Most individual large customers, on the other hand, have meters that record actual hourly customer usage and send this data back to the utilities by telephone. For these customers, hourly usage is normally known exactly. These customers are often referred to as "telemetered customers." On occasion telemetered customer loads need to be estimated when actual hourly meter data is not available. In this case the profile will be based on available usage history for the customer, usually a "static profile" as described below. Certain other customer loads are not metered at all, lighting customers for example, and are based on estimates of hours of use because they are entirely predictable These are referred to as "deemed profiles."

The method of load profiling can affect the hourly load estimate associated with the customer, and as a result affect the resulting financial settlements between independent

competitive suppliers at the NMISA. There are six general profiling methods in use to estimate hourly loads that are not known precisely:

Dynamic metering is done by installing telemetering on a sample of customers from each profile group. The meters are interrogated daily, providing a profile for the day that represents actual load.

Dynamic modeling is a relationship between load and weather. Typically this would be a regression of the historical load of customers in a sample against the weather that occurred during the time of the load. The regression could be either a daily regression or an hourly regression for any season and day type combination.

Proxy day profiling is accomplished by selecting a day in history that most closely matches the day being estimated. The proxy day can be chosen based on either system load or weather. Actual data from the sample for the selected proxy day is then used to create the profile.

Static profiles are typical day representations for any season and day type combination. Static profiles do not reflect operating conditions of the day being estimated.

Calendar rotation is simply rotating a calendar of historical interval data to reflect the calendar of the time being estimated. Calendar rotation also does not reflect operating conditions of the day being estimated.

Deemed profile (see above)

Each of these methods of estimating class or segment hourly energy usage varies in terms of accuracy and the degree of predictability for an individual energy supplier. A higher level of accuracy implies that there is less "unaccounted-for energy" (UFE) between the sum of all estimates and the actual system energy load. A higher level of accuracy is more costly to implement because more elaborate equipment is required as well as more detailed calculations to handle more variables. Dynamic metering is most accurate but also most costly. As you move down the list above, cost decreases but the amount of UFE remaining after the estimate is larger. The optimum method for profiling should strike a balance between cost, accuracy, and predictability.

Concerns of Standard Offer Bidders

Competitive electricity providers, interested in bidding on the Standard Offer, expressed a concern that if the method used to derive load profiles was not decided upon until after bids were submitted, then they might be at a competitive disadvantage if their bid was based on a method different from the method they used as the basis for their bid. An additional concern expressed was that each utility might choose a different methodology and thereby increase the complexity to a supplier operating in multiple service territories.

In response to the concerns of standard offer bidders, the three Maine investor utilities MPS, BHE and CMP in conjunction with the MPUC agreed to use "Typical Day" (static profile) methodology in the beginning to simplify the methodology. It was agreed that these profiles would consist of different week-day and weekend-day profiles for each of twelve months for each profiled segment, i.e. residential, commercial, small industrial. Holidays will be modeled using the weekendday profile.

Software Used

MPS has purchased a license to use Load Vision developed by ICF Consulting, Inc. Load Vision is a profiling, scheduling, and settlement tool that is currently used by many utilities and energy suppliers across the U.S. to forecast and settle loads in energy markets opened up to retail competition. Load Vision provides many capabilities, perhaps the most important of which is auditability. Information flowing into Load Vision database is "time-stamped" so that prior settlement runs can be recalculated at any time. Currently the Load Vision is being used by the three investor owned utilities in Maine, Bangor Hydro Electric Company, Central Maine Power Company, and Maine Public Service Company.

How Load Vision Calculates a Static Profile

Traditionally static profiles are calculated by averaging hourly values for each season and day type combination. This results in a flattened load shape, i.e. the average load shape peak is generally too low and the average load shape trough is generally too high. Load Vision improves this calculation by using a rank average method, as described in Appendix A in the Load Vision documentation. This method results in a static profile that more accurately reflects the typical day usage pattern, including the height of the peaks and depth of the troughs.

How Load Vision Estimates the Daily Load

The daily load estimation process will consist of loading various types of data into Load Vision, customer add/drop data, customer cycle energy use data, telemetered customer data, and daily weather data as appropriate. Customer class segment profile data will be updated on a monthly basis as the data becomes available. Data loading will be a semi-automated process for the forseeable future.

1. **Profiled Customer Load Estimation with Load Vision** uses the following four process steps:

   Determination of the hourly profiled load for each customer profile class- As described above, a static profile will be used for each of the three profile classes defined in Chapter 321, and a deemed profile will be used for unmetered load.

   Scale the profiled load for each hour by the relevant Loss Factor - The loss factor is assigned to the customer depending on the season and voltage level.

Determination of each customer's Usage Factor - The Energy Usage Factor (EUF) characterizes how the customer's usage relates to the average energy usage for a particular profile class. The EUF is defined as the ratio of the metered usage to the aggregate hourly profiled loads for the customer's profile class for a billing period. If a new customer has no historic or billed usage, an hourly Usage Factor of 1.0 will be assigned to that customer.

Derive the usage-adjusted profile load for each customer. The customer usage-adjusted profile is the loss-adjusted profile multiplied by the customer Usage Factor.

2. **Telemetered Customer Load Determination -** For telemetered customers, if interval meter data is available for the day, the hourly load is the metered usage multiplied by the customer's Loss Factor. The Loss Factor assigned to the customer depends on the season and voltage level. If a telemetered customer's interval data is not available for the day and needs to be estimated, the missing data will be estimated using the customer's historical usage. The hourly loads using the day profile will be calculated using the method for profiled load detailed above.

3. **Settlement or Summation of Supplier Hourly Loads -** During this step customer class hourly loads created in the previous procedures are aggregated into total loads for each supplier.

4. **Reconciliation of Supplier Hourly Loads to System Load:**

   Determination of the Hourly Load Difference using the hourly system load as the baseline.

   Determination of the Supplier profile load by allocating the hourly load difference to profiled customers only requires that all telemetered loads for a supplier be subtracted from that supplier's total hourly load. The resulting value is the supplier's hourly profile load.

   Calculate the Load Allocation Ratio- The hourly load difference is allocated to a supplier based on the ratio of that supplier's profiled load to the aggregate profile load of all suppliers.

   Allocation of the Hourly Load Difference to the Supplier's non-telemetered customers - This reconciliation step distributes the hourly load difference back to the non-telemetered customers using the load allocation ratio. The allocated amount is the product of the hourly load difference and the load allocation ratio. This allocation amount is added to the supplier's hourly profiled load to derive the reconciled profile load.

Calculate the Supplier Hourly Load Obligation - The supplier's hourly load obligation is the sum of the supplier's hourly telemetered load and the reconciled profiled load.

MONTH-END ADJUSTMENTS

After all meter readings for each month have been obtained, MPS will re-estimate the hourly load for the month. The process will be identical to the daily process but the month-end calculation will use available data collected subsequent to the original calculation. The usage factors will be recalculated to reflect each customer's most recent billing period's usage. This usage will better reflect usage during the month being re-estimated. The calculations for the month-end adjustment are the same as described in the daily process: total profiled load with losses is added to total telemetered load with losses and compared to total system load. Any hourly differences are allocated back to suppliers based on their proportion of the total profiled load.

The total month-end energy will also be adjusted to reflect Net Energy Billing customers. Excess generation (or negative usage) cannot be reported in the daily load settlement process but it is possible to adjust the month end numbers to reflect excess generation by net energy billing customers. The adjustment would reduce the supplier's load obligation by the amount of the excess generation and would proportionately increase the load obligation of all other suppliers.

REPORTING REQUIREMENTS

Daily estimates of supplier load obligation will be reported to NMISA within 36 hours after the end of the day being reported. The load obligation will be reported by Load Asset ID to the NMISA. will send suppliers their load obligation at the same time it is sent to NMISA. Month end numbers will be reported to NMISA within 45 days after the end of the month. Month-end numbers will be the revised total energy for the month, reported by Load Asset ID. MPS will send suppliers their hourly loads that comprise this new estimate within 2 days after reporting to NMISA.

SUMMARY

MPS will use a static profiling methodology for the three profile groups defined in Chapter 321. The profiles will represent 12 months and 2 day types (week-day and weekend-day). Holidays will be estimated using a weekend profile. Unmetered load will be estimated using a deemed profile that is determined by the number of daylight hours. Telemetered customers will be settled using their actual load. If the actual data is not available for telemetered customers on a given day, a historical day profile for the individual customer will be used.

APPENDIX
STATIC PROFILING METHODOLOGY

The rank average method that Load Vision uses to create typical day or static profiles improves on traditional static profiling methods by preserving the levels of the peaks and valleys in the final load shape. The rank average approach involves various steps that are detailed below.

Step 1: Group load research sample meter data based on season and day-type combination - The load data will be grouped into 12 month with 2 day types for each profile group. Holidays will be put into the included with weekends.

Example:

12 Season (month) /2 Day-Type Calendar

Season 1 (January)	Season 7 (July)
Season 2 (February)	Season 8 (August)
Season 3 (March)	Season 9 (September)
Season 4 (April)	Season 10 (October)
Season 5 (May)	Season 11 (November)
Season 6 (June)	Season 12 (December)

Day Type 1 (Weekday): Mon, Tue, Wed, Thurs, Fri
Day Type 2 (Weekend): Sat, Sun, Holiday

Step 2: Create a weighted average of all observations for the profile for each day.

Example:

Weights are assigned by the user within Load Vision:

Profile	Load Research Meter	Weight
Residential	R123	1
Residential	R456	1
Residential	R789	1

(Note: weights will reflect weights assigned to each meter in the sampling process)

Illustrative Observations from the meter:

Load Research Meter	Day	Hour1	Hour2	Hour3	Hour4	…
R123	12/1/98	30	50	40	60	…
R456	12/1/98	35	55	45	65	…
R789	12/1/98	40	60	50	70	…

Result:

Profile	Day	Hour1	Hour2	Hour3	Hour4	…
Residential	12/1/98	35	55	45	65	…
Residential	12/2/98	60	70	50	55	…
Residential	12/3/98	55	70	55	60	…
Residential	12/4/98	32	60	45	50	…

Step 3: Average the load values to create an Average Load Shape

Example:

Season (month) 12, Day-Type 1

Profile	Day	Hour1	Hour2	Hour3	Hour4	…
Residential	12/1/98	35	55	45	65	…
Residential	12/2/98	60	70	50	55	…
Residential	12/3/98	55	70	55	60	…
Residential	12/4/98	32	60	45	50	…

Result:

Profile	Day Type	Hour1	Hour2	Hour3	Hour4	…
Residential	Weekday	45.5	63.75	48.75	57.5	…

Step 4: Sort the load values in descending order to create a Load Duration Curve

Example:

Season 12, Day Type 1

Profile	Day	Hour1	Hour2	Hour3	Hour4	…
Residential	12/1/98	65	55	45	35	…
Residential	12/2/98	70	60	55	50	…
Residential	12/3/98	70	60	55	55	…
Residential	12/4/98	60	50	45	32	…

Step 5: Average the Load Duration Curve values to create an Average Load Duration Curve

Example:

Result:

Profile	Day Type	Hour1	Hour2	Hour3	Hour4	…
Residential	Weekday	66.25.	56.25	50	43	…

Step 6: Map the Average Load Duration Curve to the Average Load Shape

Example:

Average Load Shape:

Profile	Day Type	Hour1	Hour2	Hour3	Hour4	…
Residential	Weekday	45.5	63.75	48.75	57.5	…

Average Load Duration Curve:

Profile	Day Type	Hour1	Hour2	Hour3	Hour4	…
Residential	Weekday	66.25	56.25	50	43	…

Resulting Load Profile:

Profile	Day Type	Hour1	Hour2	Hour3	Hour4	…
Residential	Weekday	43	66.25	50	56.25	…

This methodology preserves the same usage pattern as a traditional static profiling approach (the average load shape shown above) but also preserves the level of peaks and troughs obtained through the average load duration curve. The result is a static profile that better represents a "typical day."