

# **The Dayton Power and Light Company Load Profiling Methodology for the Retail Electric Choice Program**

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## **Overview of Methodology**

Dayton Power and Light (DP&L) load profiles will be used to estimate hourly loads for customers without interval metering for use in retail energy imbalance calculations. In addition, these same load profiles will be made available to Alternate Generation Suppliers in order to assist in scheduling hourly loads for retail load aggregations of customers they may serve within the DP&L distribution service territory.

In developing load profiles for various customer classes, DP&L has utilized a *dynamic modeling* methodology based on Company load research data. Each of DP&L's retail electric distribution customers without interval metering has been assigned to one of seventeen load profile categories developed by the Company. Load profile categories were developed in order to group customers with homogeneous load patterns and usage characteristics. Rate class and voltage level load research data was examined to determine the appropriate profile segments based on rate classification, usage and demand level characteristics.

Each of the DP&L profile segments was used to develop a dynamic profile model that will be used to produce daily profiles based on day of the week, season and actual weather conditions where applicable. The *dynamic modeling* approach entails developing hourly class load models that relate hourly demand with day of the week, season, and weather conditions. *Dynamic modeling* is one method of reflecting a temperature response mechanism in a mathematically modeled form. This method builds on DP&L's available load research data and incorporates calendar and weather information that will be secured from external sources. DP&L also uses 12 monthly base load profiles as a means of reflecting the impact of weather conditions.

Each day, DP&L will post the following load profile information to its supplier web site (<http://cres.dpandl.com> OR [www.electricchoicesuppliersite.com](http://www.electricchoicesuppliersite.com)):

- 1) Up to 17 load profiles for the previous day, based on day of week and where applicable actual weather.

This daily load profile information will be used to inform suppliers of the profiles that will be used in developing hourly load allocations for retail energy imbalance settlements, and to assist suppliers in developing their own retail load forecasts and energy schedules.

## **Definition**

Load profiling is an estimation and allocation process. Customers with hourly interval metering will use their actual demands in order to determine their load responsibility on the system. For customers without interval demand meters, load research data is used to build profiles that provide a mechanism to assign their daily or monthly energy use to an hourly responsibility.

Load profiling is defined as: 1) the application of generic industry load shapes as a proxy for local customer usage patterns; or 2) the use of a load shape generated from load research samples to be used as a proxy for customer usage patterns.

The use of generic industry load shapes is the least complex approach to gathering load research data, but it includes error due to both sampling and the differences between generic and utility specific customer usage patterns. DP&L has utilized load research samples to develop its load profiles.

## **DP&L Load Profile Classes**

DP&L has developed seventeen (17) load profile classifications for its non-interval metered retail electric distribution customers. Customers are classified according to rate classification, usage and demand level characteristics. Customers will be reassigned to profile classes based on these characteristics on an annual basis, during the month of October.

- The residential electric heat rate class represents its own profile class (1 profile).
- The residential non-electric heat rate class customers are grouped into two strata based on annual usage levels. The load research samples demonstrated that customers within this rate class have different load patterns depending on whether they are high or low usage customers. A class average default profile will be assigned to any customers within this rate class with insufficient usage data for profile classification, i.e. new service points (3 profiles).
- The commercial and industrial profiled tariffs employed a more defined segmentation where the segments are based on a combination of rate class, usage and kW load. Secondary rate class customers are grouped by usage level. A class average default profile will be assigned to any customers within this rate class with insufficient usage data for profile classification (7 profiles).
- Most commercial and industrial customers are interval metered; those that aren't interval metered are assigned the primary load profile (3 profiles).
- The street lighting/outdoor lighting segment represents its own profile class. Because no load research data was available, the street lighting/outdoor lighting profile was developed as a "deemed" profile that recognizes the changes in sunset and sunrise, and daylight savings time (1 profile).
- The school rate class represents its own profile class for those accounts that do not have interval metering (1 profile).

- The traffic signal rate class represents its own profile class. Because no load research data was available, the traffic signal profile was developed as a “deemed” profile based on the assumption that traffic signals exhibit no hourly variation (1 profile).

A table containing each DP&L load profile class, the associated load profile code, and a description of each class, is provided below.

<b><u>Load Profile Class</u></b>	<b><u>Code</u></b>	<b><u>Description</u></b>
Residential No Heat Default	RS00	Residential No Heat Default
Residential No Heat Low kWh	RS01	Residential No Heat $\leq$ 7200 annual kWh
Residential No Heat High kWh	RS02	Residential No Heat $>$ 7200 annual kWh
Residential Heat	RH01	Residential Heat
Secondary Default	SS00	Secondary Default
Secondary Low kW	SS01	Secondary Low kW
Secondary Low kW	SS02	Equivalent to SS01
Secondary Med kW Low LF	SS03	Secondary Medium kW $\leq$ 50% Summer Load Factor
Secondary Med kW High LF	SS04	Secondary Medium kW $>$ 50% Summer Load Factor
Secondary High kW	SS05	Secondary High kW
Secondary High kW	SS06	Equivalent to SS05
Primary	PR01	Primary
Primary Substation	PS01	Primary Substation
High Voltage	HV01	High Voltage
Street Lighting	SL01	Street Lighting
Schools	SC01	Schools
Traffic Signals	TS01	Traffic Signals

**Secondary Low/Medium/High kW Breakdown:**

<b>Low</b>	<b>Medium</b>	<b>High</b>
$< 5$ kW	$\geq 5$ kW $< 150$ kW	$\geq 150$ kW

## Profile Class Models

Historic load research data was used to develop the profile segments. The historic data was then expanded to the current population to generate current population profiles. Seventeen profile models were developed from these average customer profiles. The profile models are executed on a daily basis to estimate the previous day profile (based on actual calendar and weather data). DP&L's daily profiling process is composed of two steps:

1. Prior day and forecasted information is extracted (i.e. weather data) and imported into the profiling system.
2. The profiling models read weather and calendar information and generate a use-per-customer hourly profile for each profile class.

## Model Format

The profile models use the modeling approaches described below:

- ***Hourly Weather Sensitive Model (RH01/RS00)***. In this modeling approach, a linear regression of historical weather data is run against the generic profiled loads from the load research study. It consists of a series of regression equations expressing the relationship between temperature and load for a 12 season, 3 day type combination. The relationship is a piece-wise linear regression whose parameters are estimated using a search algorithm. The algorithm identifies the optimal breakpoints for the regression lines in order to ensure the best possible statistical fit to the historical load data. For each hour of the season/day type combination, the model generates load profiles forecasted according to that hour's actual temperature.
  - Variables used in the weather sensitive model:
    - Seasons (Month)
    - Days of the Week
      - Weekday
      - Saturday
      - Sunday/Holiday
    - Temperature (Degrees Fahrenheit)
    - Holidays
      - New Year's Day (January 1)
      - Memorial Day (Last Monday in May)
      - Independence Day (July 4)
      - Labor Day (1<sup>st</sup> Monday in September)
      - Thanksgiving Day (4<sup>th</sup> Thursday in November)
      - Christmas Day (December 25)
- ***12 Season / 3 Day Type Model (No Weather Sensitivity)***. Most of the profiles (other than RH01, RS00, SL01 and TS01) use the 12 Season / 3 Day Type modeling approach. This model does not use the temperature variable since these types of customers are not as weather-sensitive. The model instead uses 36 regression models to forecast the hourly kW consumption by month and day type.

- **SL01 Model.** The SL01 model profiles street light and outdoor lighting customers. Because these types of customers are not weather sensitive, the models are day type models using month and day type variables. For each month, the model uses 12 regression models to forecast the hourly kW consumption.
- **TS01 Model.** The TS01 model profiles traffic signals. The data for this class consists of a constant kW value in each hour.

The table below lists each profile class model and the format used to generate the profiles.

**Profile Class Model Formats**

<b>Model</b>	<b>Model Format</b>
RH01	Hourly Weather Sensitive Model
RS00	Hourly Weather Sensitive Model
RS01	12 Season / 3 Day Type Model
RS02	12 Season / 3 Day Type Model
SS00	12 Season / 3 Day Type Model
SS01	12 Season / 3 Day Type Model
SS02	12 Season / 3 Day Type Model
SS03	12 Season / 3 Day Type Model
SS04	12 Season / 3 Day Type Model
SS05	12 Season / 3 Day Type Model
SS06	12 Season / 3 Day Type Model
PR01	12 Season / 3 Day Type Model
PS01	12 Season / 3 Day Type Model
HV01	12 Season / 3 Day Type Model
SC01	12 Season / 3 Day Type Model
SL01	12 Season / 1 Day Type Model
TS01	Constant Value

### Generic Interval Class Profiles

Accounts with interval meters are assigned a generic interval class profile according to its voltage level of service. However, a unique profile is established for each interval account to be used for PJM settlements. The unique profile model is generated using actual hourly usage history for each account. See below for the list of generic interval class profiles.

<u>Load Profile Class</u>	<u>Code</u>	<u>Description</u>
INT-HIGH VOLTAGE	IHV1	All interval meter high voltage class accounts
INT-PRIM LOW LD FCTR	IPR1	Interval meter primary class accounts with annual average load factors less than or equal 65%
INT-PRIM HI LD FCTR	IPR2	Interval meter primary class accounts with annual average load factors greater than 65%
INT-PRIM SUB	IPS1	All interval meter primary substation class accounts
INT-SEC LOW LD FCTR	ISS1	Interval meter secondary class accounts with annual average load factors less than or equal 65%
INT-SEC HI LD FCTR	ISS2	Interval meter secondary class accounts with annual average load factors greater than 65%