Instructions for Using Profile Equations

The methodology for calculating class hourly profile kW values was developed by running regression models on class historical demand data as a function of hourly temperature values. The models produce temperature breakpoint ranges, along with equations and its associated coefficients and constants that are applied in the calculation of the class profile kW. Each model is calculated to best fit the last two years of actual usage and temperature data.

The models represent the temperature to usage relationship of an average customer within a specific rate group. To more accurately forecast the usage of any individual customer utilizing the profile equations, the Company recommends utilizing a usage factor, which should be calculated to represent the temperature response of the individual customer with respect to its rate group profile. To forecast the usage of an individual customer, the calculated usage factor should be applied to the usage indicated by the model for the forecasted temperature. PPL Electric utilizes calculated proportional usage factors using each hour and each day type based on the average proportion of the individual's usage to the model usage over the last 30 days. Suppliers may utilize any method deemed fit, per their terms and conditions, including usage factors, or applying the profile equations and any other scaling tool to achieve desired results.

Regarding breakpoint ranges, the Load Profile Process detects changes in inflection points in the hourly data (based on confidence band, coefficient of correlation, t-statistic), prompting a breakpoint at certain data points where necessary. The write up below provides an explanation of how the regression models are used in the profile calculations along with some examples. The profile values are calculated at the sales level. Profile values at generations level = Sales Level Profile Value*loss factor.

The profile equations are generated using a 4 season, 2 day-type model. The following defined seasons correspond to the following stated time periods:

Winter:	December 1st to February 29th
Spring:	March 1st to May 31st
Summer:	June 1st to August 31st
Fall:	September 1st to November 30th

The equations in general form:

Let $m_1 \ldots m_n$ = coefficients associated with temperature ranges 1 through n.

C = Regression constant.

X = Temperature value for given hour (ending).

Y = Calculated profile value at sales level.

$L_1 \ldots L_n$ = upper limit for each temperature range

$$Y = m_1(X) + C$$ → If temp falls in 1st range.

$$Y = m_1(L_1) + (m_2)(X - L_1) + C$$ → If temp falls in 2nd range.

$$Y = m_1(L_1) + (m_2)(L_2 - L_1) + (m_3)(X - L_2) + C$$ → If temp falls in 3rd range.

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$$Y = m_1(L_1) + \ldots\ldots + (m_{n-1})(L_{n-1} - L_{n-2}) + (m_n)(X - L_{n-1}) + C$$ → If temp falls in nth range.

Ex 1: GS1, SPRING WEEKDAY HOUR 14, TEMP=50 DEGREES F:

HIGH_1	HIGH_2	HIGH_3	HIGH_4	COEFF_1	COEFF_2	COEFF_3	COEFF_4	CONSTANT
50.4741	64.5280	77.3043	99999	-0.0204	-0.0028	0.0055	0.0297	2.5810

Temp is **50** degrees FAHR which is in range 1 (0-50.4741). Use equation:

$Y = m_1(X) + C$

Y = **Profile Value for range 1**

m_1 = **COEFF_1** = -0.0204

X = **TEMP** = **50**

C = **CONSTANT** = 2.581

$Y = m_1(X) + C$

= -0.02037 (**50**) + 2.581

=1.5625

Ex 2: GS1, SPRING WEEKDAY HOUR 14, TEMP=60 DEGREES F:

HIGH_1	HIGH_2	HIGH_3	HIGH_4	COEFF_1	COEFF_2	COEFF_3	COEFF_4	CONSTANT
50.4741	64.5280	77.3043	99999	-0.0204	-0.0028	0.0055	0.0297	2.5810

Temp is **60** degrees FAHR which is in range 2 (50.4741-64.5280). Use equation:

$Y = m_1(L_1) + (m_2)(X - L_1) + C$

Y = **Profile Value for range 2**

m_1 = **COEFF_1** = -0.0204

m_2 = **COEFF_2** = -0.0028

X = **TEMP** = **60**

C = **CONSTANT** = 2.581

L_1 = **HIGH_1** = 50.4741

$Y = m_1(L_1) + (m_2)(X - L_1) + C$

= -0.0204(50.4741) + -0.0028(**60**-50.4741) + 2.5810

=**1.5343**

Ex 3: GS1, SPRING WEEKDAY HOUR 14, TEMP=70 DEGREES F:

HIGH_1	HIGH_2	HIGH_3	HIGH_4	COEFF_1	COEFF_2	COEFF_3	COEFF_4	CONSTANT
50.4741	64.5280	77.3043	99999	-0.0204	-0.0028	0.0055	0.0297	2.5810

Temp is **70** degrees FAHR which is in range 3 (64.5280-77.3043). Use equation:

$$Y = m_1(L_1) + (m_2)(L_2 - L_1) + (m_3)(X - L_2) + C$$

Y = **Profile Value for range 3**

m_1 = **COEFF_1** = -0.0204

m_2 = **COEFF_2** = -0.0028

m_3 = **COEFF_3** = 0.0055

X = **TEMP** = **70**

C = **CONSTANT** = 2.581

L_1 = **HIGH_1** = 50.4741

L_2 = **HIGH_2** = 64.528

$$Y = m_1(L_1) + (m_2)(L_2 - L_1) + (m_3)(X - L_2) + C$$

= -0.0204(50.4741) + -0.0028(64.528-50.4741) + 0.0055(**70**-64.528) + 2.581

=**1.5419**

Ex 4: GS1, SPRING WEEKDAY HOUR 14, TEMP=80 DEGREES F:

HIGH_1	HIGH_2	HIGH_3	HIGH_4	COEFF_1	COEFF_2	COEFF_3	COEFF_4	CONSTANT
50.4741	64.5280	77.3043	99999	-0.0204	-0.0028	0.0055	0.0297	2.5810

Temp is **80** degrees FAHR which is in range 4 (77.3043-99999). Use equation:

$$Y = m_1(L_1) + (m_2)(L_2 - L_1) + (m_3)(L_3 - L_2) + (m_4)(X - L_3) + C$$

Y = **Profile Value for range 4**

m_1 = **COEFF_1** = -0.0204

m_2 = **COEFF_2** = -0.0028

m_3 = **COEFF_3** = 0.0055

m_4 = **COEFF_4** = 0.0297

X = **TEMP** = **80**

C = **CONSTANT** = 2.581

L_1 = **HIGH_1** = 50.4741

L_2 = **HIGH_2** = 64.528

L_3 = **HIGH_3** = 77.3043

$$Y = m_1(L_1) + (m_2)(L_2 - L_1) + (m_3)(L_3 - L_2) + (m_4)(X - L_3) + C$$

= -0.0204(50.474) + -0.0028(64.528-50.4741) + 0.0055(77.3043-64.528) + 0.0297(**80**-77.3043) + 2.581

=**1.6622**