



# Pay for Performance - EB Technical Tip

## Alternative Approach to Establishing In-unit Electricity Usage for Multifamily Projects

### Executive Summary

1. This alternative calculation is meant to help partners who face difficulty collecting the 10% required sample of in-unit electricity bills
2. During ERP stage, the in-unit consumption generated by this method must be documented in the ERP and combined with collected common area bills to obtain the total electricity consumption for each bill period. This total consumption must then be entered into the Model Calibration Tool and used to calibrate the model.
3. For projects with in-unit ECMs, their savings should be based on stipulated values in the current NJ Protocols and P4P Program Guidelines.
4. During the Savings Verification phase of the project, in-unit electric consumption should not be entered in the Savings Verification Tool (SVT) so that only common area electricity consumption is weather-normalized. For projects with in-unit ECMs, stipulated savings allowed at the ERP stage must be submitted to the Program Manager to determine the final savings and incentive amounts.

### 1. Background

Section 3.2.1 of P4P EB Program Guidelines v4.1 requires collecting a 10% sample of both pre- and post-construction tenant utility bills for direct-metered multifamily projects regardless of whether improvements are planned within the units. Apartment electricity bills may be collected directly from the tenants. Alternatively, fuel release forms from the required sample size (10%) may be collected from tenants and submitted to the utility. If neither of these options yields desired results, Section 3.2.1 describes alternative approaches that may be used to establish in-unit consumption. This Technical Topic replaces these alternative approaches.

### 2. Establishing baseline in-unit electricity consumption

If the required sample of in-unit utility bills was not collected, the total daily baseline in-unit electricity consumption must be calculated using Eq.1 and values in Tables 1 & 2.

$$E_i = (LTG + PLG) * A + (ES * N_s) + (DW * N_{DW}) + (CW * N_{CW}) + (CD * N_{CD}) + (WAC_i * A_{WAC}) + (FCU_i * A_{FCU}) \quad (\text{Eq. 1})$$

- $E_i$  [kWh/day] – in-unit electricity usage during month  $i$
- $A_{WAC}$  [SF] – square foot area of in-unit spaces with room air-conditioners
- $A_{FCU}$  [SF] – square foot area of in-unit spaces served by fan-coil units

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**Table 1: Electricity Consumption of In-unit Lighting, Appliances, and Plug loads**

	Units	Value	Definition
LTG	kWh/day/SF	0.00444 [1]	daily lighting kWh per SF of apartment area
PLG	kWh/day/SF	0.00646 [1]	daily kWh of miscellaneous appliances and plug loads per SF of apartment area
A	SF		total area of apartments
ES	kWh/day/unit	1.7 [3]	daily kWh of electric stoves per unit
N <sub>S</sub>	each		total number of in-unit electric stoves in the building
DW	kWh/day/unit	0.6 [4]	daily kWh of dishwashers per unit
N <sub>DW</sub>	each		total number of in-unit dishwashers in the building
CW	kWh/day/unit	0.2 [4]	daily kWh per <i>in-unit</i> clothes washer
N <sub>CW</sub>	each		total number of <i>in-unit</i> clothes washers in the building
CD	kWh/day/unit	2 [3]	daily kWh per <i>in-unit electric</i> clothes dryer
N <sub>CD</sub>	each		Total number of <i>in-unit electric</i> clothes dryer in the building

**Table 2: Seasonal in-unit HVAC electricity consumption**

Month	In-unit Window AC [2] WAC <sub>i</sub> [kWh/day/SF]	In-unit fan-coil unit fans (heating & cooling, cycling) [2] FCU <sub>i</sub> [kWh/day/SF]
January	0	0.00009
February	0	0.00007
March	0	0.00005
April	0	0.00004
May	0.0082	0.00011
June	0.0218	0.00017
July	0.0270	0.00002
August	0.0275	0.00021
September	0.0114	0.00015
October	0	0.00008
November	0	0.00002
December	0	0.00007

[1] U.S. Department of Energy Commercial Reference Building Models of the National Building Stock; National Renewable Energy Laboratory; February 2011; Deru, Michael, et al; Appendix A Reference Building Internal Load; Page 54

[2] Sample models developed with eQuest 3.65 using parameters outlined in U.S. Department of Energy Commercial Reference Building Models of the National Building Stock; National Renewable Energy Laboratory, February 2011, as well as software defaults

[3] Building America Research Benchmark Definition, Updated December 29, 2004; US Department of Energy; February 2005; Hendron, Robert; Page 23

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[4] Energy consumption of refrigerator, dishwashers and clothes washers is based on information posted at [www.energystar.gov](http://www.energystar.gov), including the *Product Lists* and *Savings Calculators*, and as provided in the ENERGY STAR® Multifamily High Rise Program Simulation Guidelines, version 1.0, revision 03, issued January 2015, Section 3.10.2, pages 23-25

**Example:** A 110-unit multifamily building has a total floor area of 100,000 SF including 80,000 SF apartments and 20,000 SF of common spaces. Gas is master metered for the entire building, and apartments are directly metered for electricity. Units have gas stoves and there are no in-unit clothes washers/dryers. Ten (10) three-bedroom apartments have in-unit dishwashers. Most units have room air conditioners in the bedrooms, with an estimated cooled area of 30,000 SF. Common area electricity bills are available, but the in-unit bill sample could not be obtained. The baseline period includes a 16,000 kWh electricity bill for common spaces for July 17 – August 10. How can the total electricity consumption,  $E_{total}$ , be calculated for the July 17 – August 10 period?

The bill includes 15 days in July and 10 days in August. Eq. 1 is applied to the periods in July and August, and then the total consumption is calculated as shown below.

$$E_{July} = ((0.00444 + 0.00646) * 80,000 + (0.6 * 10) + (0.0270 * 30,000)) * 15 \text{ days} = 25,320 \text{ kWh}$$

$$E_{August} = ((0.00444 + 0.00646) * 80,000 + 0.6 * 10 + 0.0275 * 30,000) * 10 \text{ days} = 17,030 \text{ kWh}$$

$$E_{Total \text{ for July 17 – Aug 10 period}} = 25,320 + 17,030 + 16,000 = 58,350 \text{ kWh}$$

$E_{Total}$  is entered into P4P Model Calibration Tool, Actual Electric Bills table for July 17 – Aug 10 period. The same procedure must be followed for the other months in the baseline period.

### 3. Documentation for ERP

A calculation spreadsheet will be added to the ERP tables shortly. In the interim, the monthly in-unit electricity consumption should be calculated using a supplemental spreadsheet. The calculated monthly values should be entered into the *ERP Tables, Apt-Elec* as a single unit as shown in the image below. The ERP Tables will add this consumption to the common area usage to come up with the total ( $E_{total}$ ).  $E_{total}$  should be entered into P4P Model Calibration Tool and ENERGY STAR Portfolio Manager benchmark. Actual descriptive apartment information should still be entered in the *ERP Tables, Area Identification* and remaining applicable tabs.

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**Figure 1**

**Electric Utility Data - Apartment Meters** Return to Electric 1

**Instructions**

- 1) Enter data for pre-construction apartment-level energy use. First cell must not be blank. For months with zero consumption
- 2) Unhide columns (OD-PI) if there are more than 10 units sampled for a given unit type. You may hide columns that are not
- 3) Post-Construction data will be filled in one year after construction has been completed.
- 4) Please use the "Notes" field below the data entry section of this tab to explain unusual circumstances, any anomalies in made. Also, please follow *Program Guidelines v4.1, Section 3.2.2* for irregular delivers, outliers, and estimated bills.

Pre-Construction In-Unit Billing Dates			Unit Type 1 -						
Billing Period Start Date	Read Date	Days in Billing Period	Unit #:	Unit #:	Unit #:	Unit #:	Unit #:	Unit #:	
			Account #:	Account #:	Account #:	Account #:	Account #:	Account #:	
			kWh	Actual/Estimated	kWh	Actual/Estimated	kWh	Actual/Estimated	kWh
1/1/00		0							
1/1/00		0							
1/1/00		0							
1/1/00		0							
1/1/00		0							
1/1/00		0							

Navigation: Utility Info | Electric Totals | **Apt-Elec** | Gas Totals | Apt-Gas | Utility Use Summary

## 4. Measures that affect in-unit electricity consumption

To qualify for incentives, a project’s Energy Reduction Plan (ERP) must include energy efficiency measures (EEMs) that identify at least 15% source energy savings compared to the entire building baseline consumption, including common area and apartments.

**Scenario A:** If the proposed scope of work does *not* include EEMs that address in-unit electricity consumption, the 15% target must be met by EEMs reducing consumption only on common meters, such as improved stairwell lighting, VFD on pumps serving the central boiler loop, central HVAC, etc.

**Scenario B:** If proposed scope includes improvements to systems inside apartments that contribute to in-unit electricity consumption, such as in-unit hardwired lighting or refrigerators, then savings from such ECMs may not exceed stipulated savings based on the current NJCEP protocols<sup>1</sup> and P4P Program Guidelines. For such projects, the 15% target may be met by combined savings from in-unit and common space ECMs.

<sup>1</sup><http://www.njcleanenergy.com/main/public-reports-and-library/market-analysis-protocols/market-analysis-baseline-studies/market-an>

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### 5. Savings Verification for Incentive #3

Projects that used the alternative procedure described in this document at the ERP stage must document achieved savings as follows:

1. Pre-retrofit and post-retrofit consumption entered into P4P Savings Verification Tool (SVT) must include *only* the common area bills, and regular process to verify savings must be followed. Tenant in-unit electric consumption calculated using the alternative procedure described in this document should not be included in either pre-retrofit or post-retrofit inputs.
2. If there were *no* in-unit ECMs in the P4P scope (Scenario A), then the common bill savings will be the basis of Incentive #3. If there *were* in-unit ECMs in the P4P scope (Scenario B), then stipulated in-unit ECM savings approved in the ERP stage must be added to the realized weather-normalized source energy savings from SVT to calculate the total achieved savings.
3. Submit both the SVT with common area bills and the stipulated savings calculations to TRC and describe the used approach in the cover email. The Program Manager will reconcile the common area actual savings and the stipulated in-unit savings and inform the partner of the final incentive #3 amount to be received.

**Example:**

A multifamily building with directly-metered in-unit consumption had gas bills and common area electric bills available for pre-retrofit (baseline) period. In-unit consumption for the project was calculated using alternative procedure described in this document. The resulting baseline consumption is shown in Table 3. Savings projected in ERP are shown in Table 4.

**Table 3**

	Pre-retrofit (Baseline)	
Gas consumption based on utility bills	6,517 MMBtu	
Electricity consumption on common meters' utility bills	321,200 kWh	1,301,200
In-unit consumption calculated using alternative procedure	980,000 kWh	kWh

**Table 4**

	ERP Savings	
Modeled gas savings	2,280 MMBtu	
Modeled common area electricity savings	64,200 kWh	164,200
Stipulated in-unit savings	100,000 kWh	kWh

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Post-retrofit utility bills for gas and common area electricity were collected, with usage shown in Table 5. Since ERP savings for in-unit ECM were 100,000 kWh, post-retrofit in-unit consumption is stipulated to be 880,000 kWh.

**Table 5**

	Post-retrofit	
Gas consumption based on utility bills	4,236 MMBtu	
Electricity consumption on common meters' utility bills	257,558 kWh	1,201,200 kWh
In-unit consumption accounting for stipulated savings	880,000 kWh	

Pre- and post-retrofit gas bills, and *common area electric bills* (but not in-unit bills) are entered into SVT for both the pre-retrofit and post-retrofit periods. SVT inputs for pre/post electricity bills are shown on Figure 2.

**Figure 2**

Actual <b>Pre-Retrofit</b> Electric Bills			Actual <b>Post-Retrofit</b> Electric Bills		
Number Electric Billing Periods		12	Number Electric Billing Periods		11
Read Date (last day of period)	Billing Period Length (elapsed days)	Billed Electric (kWh)	Read Date (last day of period)	Billing Period Length (elapsed days)	Billed Electric (kWh)
5/12/2011	30	24,800	7/12/2013	30	16,600
6/13/2011	32	30,000	8/12/2013	31	11,200
7/13/2011	30	22,000	9/10/2013	29	13,400
8/11/2011	29	32,800	10/10/2013	30	24,600
9/12/2011	32	31,600	11/8/2013	29	22,000
10/11/2011	29	26,800	12/12/2013	34	25,800
11/12/2011	32	27,100	1/11/2014	30	22,600
12/12/2011	30	27,100	2/13/2014	61	25,000
1/12/2012	31	24,800	3/12/2014	29	24,679
2/10/2012	29	30,400	4/11/2014	29	24,679
3/13/2012	32	29,000	5/13/2014	32	21,800
4/12/2012	30	24,800	6/12/2014	30	25,200

Following the regular SVT steps the actual savings excluding savings from in-unit ECM are established as shown in Figure 3. The stipulated in-unit savings of 100,000 kWh will be added to the actual electricity savings by the Program Manager.

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**Figure 3**

Table-1	Annual Consumption	Projected Savings	% Savings	Actual Savings (Calculated by Tool)
Electricity (kBtu)	4,098,494	560,250	14%	238,840
Natural Gas (kBtu)	6,517,000	2,280,000	35%	2,394,000
District Steam (kBtu)	0	0	0%	0
District Hot Water (kBtu)	0	0	0%	0
Source Energy Use Intensity (kBtu/ft2)	136.7	28.4		0.0
Source Energy Use Reduction			<b>20.8%</b>	<b>16.1%</b>

With prior approval from Program Manager, a different M&V method, such as Retrofit Isolation approach, may be used for in-unit ECMs that do not have stipulated savings, or to document savings that exceed stipulated values.