Case Study 2: One Montgomery Plaza
This subtask adopted ASHRAE Guideline in measuring the accuracy of RMT baseline energy simulations, due to the widespread use of this guideline in the energy modeling community. However, there is no well-defined approach to determine model complexity and time required for inputs. The RMT team used existing publications to propose a new approach that segregates the human factor from determination of the model complexity and time required for inputs. The RMT team proposes using two weighting factors to exclude the human factor from the analyses of the model complexity and time required for inputs. These two weighting factors are functions of (1) computational time required to perform the energy model for the selected variable and (2) time required to collect the inputs. In this report, the time required for collecting inputs on model variables is presented. This study uses the results of a survey conducted by Pacific Northwest National Laboratory (PNNL) to determine ease of data collection [1]. Three categories are used to describe a variable's input: (1) easy, (2) medium, and (3) difficult. Table provides the times required in each of these three categories to collect onsite data as defined by PNNL.

Table 1 Time required for the data collection of a single input variable/system for application in a building energy model as defined by PNNL [1]

	Easy	**Medium**	**Difficult**
Time Required	2 Minutes	5 to 10 Minutes	10 to 30 Minutes

The time required for inputs for both Building 101 and One Montgomery Plaza is less than 5 hours with the initial set of data already available to an experienced user, and the
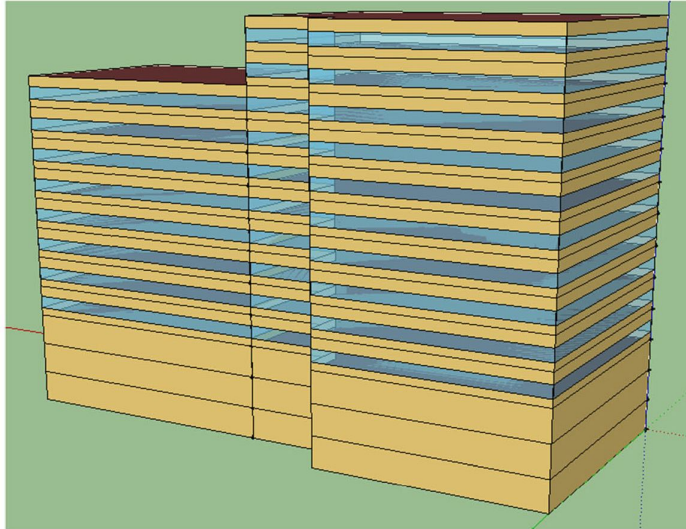accuracies meet ASHRAE Guideline 14 requirements.

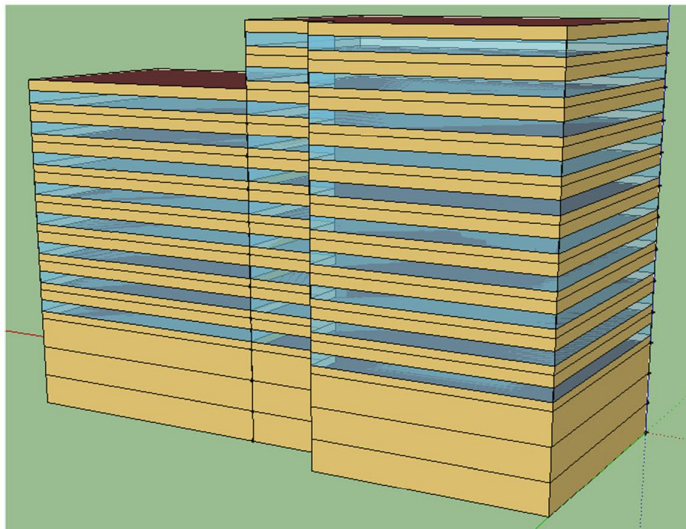Figure shows the One Montgomery Plaza building modeled in the RMT and visualized in the OpenStudio API.

Figure 4 Representation of One Montgomery Plaza building modeled in RMT

First, the RMT team used information from the building drawings, including geometry, fenestration, and HVAC systems. Default values for load densities and associated schedules are used to model the building. In order to achieve more accurate results, sub-metered information were used to derive the internal loads

and associated schedules as well as the temperature setpoints [2]. Actual Meteorological Year (AMY) data were then used to compare the building energy use with the utility bills. Figure 55 shows the comparison between the modeled and measured monthly gas consumptions. Based on ASHRAE Guideline 14, the Coefficient of Variation (CV) is 13.8%, and Normalized Mean Bias Error (NMBE) is 1.6%. They both meet the ASHRAE Guideline 14 requirements. It is important to note that temperature profiles show the building is overheated in May. Monthly measured indoor air temperature is used to develop detailed setpoint temperatures in the RMT; otherwise, it is not possible to explain overheating of the building space in some of these months. Figure 6 presents modeled and actual monthly electricity consumption. CVRSME and NMBE are 14.4% and 2.9% in 2013.
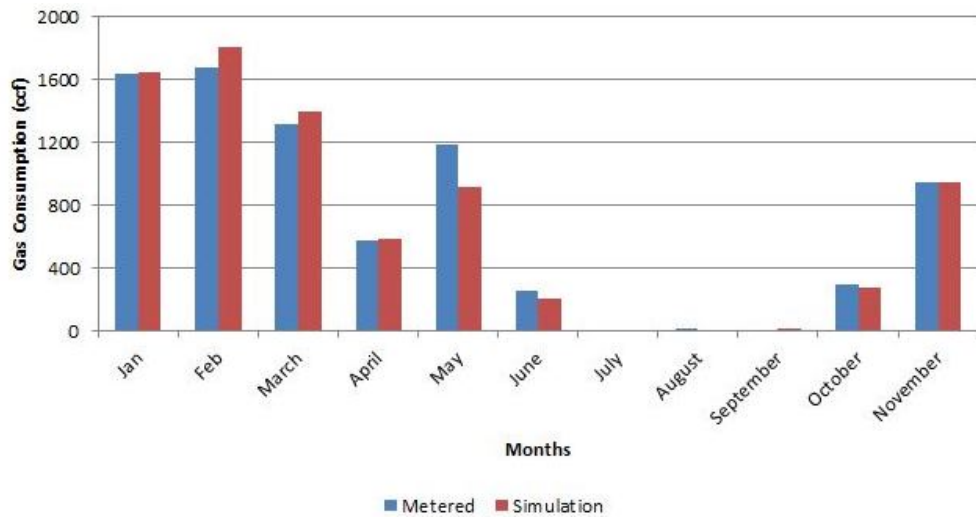

Figure 5 Utility bills and simulation monthly gas consumptions for One Montgomery Plaza in 2013
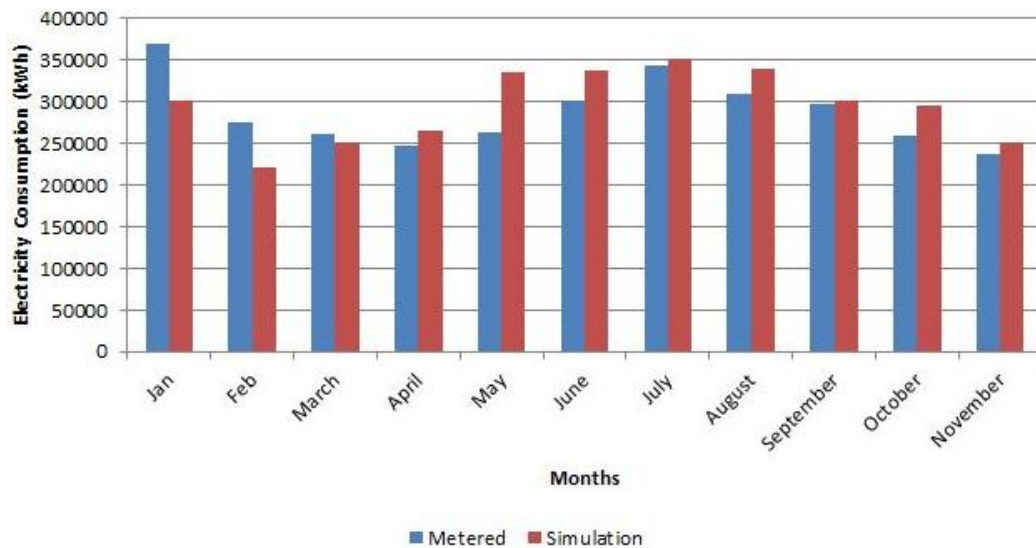

Figure 6 Utility bills and simulation monthly electricity consumptions for One Montgomery Plaza in 2013

In order to estimate the time required for inputs, this study uses Table 2.3.1 results to determine the time required for inputs. Table 1 summarizes the input time required for One Montgomery Plaza simulations by an experienced users. Individual inputs are categorized as easy, medium, and difficult in this time assessment, while the multipliers / weighting factors are gathered from the time records for an experienced user on the task. Overall, the total time required for input collection is less than 5 hours. It is important to note this time record assumes that the person who collects these data is an expert and already has access to building drawing, measured HVAC set points, and the sub metered building energy use.

Table 1 Time required for the data collection for One Montgomery Plaza adopted from the Asset Score Technical Report

Variable	Complexity	Time Required for inputs
Lighting and equipment schedules	Difficult	$2^*\times30/60=1$ hour
Geometry and Window-to-Wall Ratio	Easy	$2^*\times2/60=1/15$ hours
Cooling and heating setpoints	Difficult	$2^*\times30/60=1$ hour
HVAC (Boiler, Chiller, Pumps) specifications	Medium	$3^*\times10/60=1/2$ hour
Service Hot Water (SHW) specifications	Medium	$1^*\times10/60=1/6$ hour
Construction materials	Medium	$1^*\times10/60=1/6$ hour
Infiltration and outdoor air specifications	Difficult	$2^*\times30/60=1$ hour
AMY weather data	Difficult	$2^*\times30/60=1$ hour

* - these weighting factors are obtained from the time records for an experienced user on the task

Similarly, Building 101 was modeled with the RMT and the accuracy achieved for the model met the ASHRAE Guideline 14 requirements. The time required for inputs is similar to that for One Montgomery Plaza.