



# ENERGY STAR® Smart Home Energy Management Systems (SHEMS)

## Draft 2 Method to Determine Field Performance

### 1) OVERVIEW

This method shall be used to determine the performance of SHEMS in the field. Performance in this case is the ability to identify and react to hours that the home is vacant in order to reduce home energy use. In addition to laying out data elements required to assess performance, this method addresses optional data fields that support the Environmental Protection Agency's efforts to determine key variables relevant to establishing an energy savings metric for SHEMS, as well as information important to monitoring the evolution of the SHEMS market.

**Note:** This document serves a similar purpose to that served by a test method for typical ENERGY STAR products. In Version 1.0, EPA is proposing that certification be based on a demonstration of the system's occupancy-based optimization performance, as a step towards building a metric that differentiates SHEMS packages based on energy savings.

This draft, and the associated data reporting template, continue the conversation with stakeholders about what data is available to be reported and what might be important to know. We look forward to a robust and detailed conversation as we continue to refine the Method.

### 2) APPLICABILITY

This ENERGY STAR Method is applicable to SHEMS Products as defined in the ENERGY STAR Eligibility Criteria for Smart Home Energy Management Systems.

### 3) DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the ENERGY STAR Eligibility Criteria for Smart Home Energy Management Systems.

**Population for Analysis:** The population to be analyzed shall include all installations using an ENERGY STAR certified SHEMS package from a given service provider during the Period of Analysis in the United States. While each brand owner partner is ultimately responsible for demonstrating compliance with ENERGY STAR performance requirements, data may be submitted on behalf of a brand owner by their service provider. Ideally, all installations using the same original service provider's service algorithms, under any service brand name, would be analyzed together. That means that if a service provider markets their package directly to consumers under their own brand name, and also provides energy management packages on behalf of other consumer service brands, all of the installations should be analyzed together, if possible.

**Period of Analysis:** The time period analyzed to produce the data in the reporting template.

**Mean:** The arithmetic average of all values calculated per Equation 1 as the sum of all values divided by the number of values.

**Equation 1:** Calculation of the mean ( $\mu$ )

$$\mu = \frac{1}{n} \sum_{i=1}^n x_i \text{ where } n \text{ is the number of values } (x_i)$$

**Standard Error of the Mean:** Assuming that the values are distributed normally, the standard error calculated per Equation 2 expresses the range that the mean is 63% likely to fall within, given the variations of data in the data set.

43

**Equation 2:** Calculation of the standard error of the mean ( $s_x$ )

44

$$s_x = \frac{s}{\sqrt{n}} = \sqrt{\frac{\sum_{i=1}^n (x_i - \mu)^2}{n(n-1)}}$$

where s is the sample standard deviation.

45

**Quartiles:** Expressing the distribution of values within the data set. The first quartile (Q1 or 25<sup>th</sup> percentile) is the value such that one quarter of values in the data set are at or below the value. The second quartile (Q2, median, or 50<sup>th</sup> percentile) is the value such that half of the values in the data set are at or below the value. The third quartile (Q3 or 75<sup>th</sup> percentile) is the value such that three quarters of the values in the data set are at or below the value.

46

47

48

49

50

#### 4) DEMONSTRATING FIELD PERFORMANCE

51

Field performance of SHEMS package shall be assessed for initial certification as well as for periodic reporting as detailed in the Partner Commitments section of the ENERGY STAR Program Requirements for SHEMS.

52

53

54

1. The population for analysis shall include at least 50 installations, at least 30 of which meet requirement 4) 4.c.ii below.

55

56

2. For the population, calculate the required statistics and enter them into the SHEMS Data Reporting Template. The current version of the template is [available](#) as a protected Excel workbook. Appendix A explains each data element in the template in detail.

57

58

59

3. Appendix A, Section 2) is required; Sections 3) and 4) are optional.

60

*Note: The data elements included in optional Sections 3) and 4) of Appendix A, while not required, are central to EPA's long term efforts to support and recognize the development of SHEMS capable of seamlessly integrating energy savings and grid services while delivering additional user convenience and benefits. The data elements in Section 4) are of particular interest to stakeholders eager to see progress towards the vision of SHEMS that provide comprehensive, integrated energy management. EPA would greatly appreciate partners' cooperation in submitting these data.*

61

62

63

64

65

66

67

4. Period of Analysis and Data Submission Guidelines

68

a. The statistics calculated and submitted in the SHEMS Data Reporting Template will be derived from analysis of a six-month period.

69

70

b. The end of the period of analysis shall be no more than three months before the submission date.

71

72

c. To be included in the sample for analysis, installations must

73

i. Have been connected to the service at the beginning and end of the period of analysis, and

74

75

ii. Have been connected to the service and collecting subject data for at least 90% of days in the reporting period.

76

77

5. The SHEMS Data Reporting Template shall be filled in (consistent with 2. above) and submitted:

78

a. to the Certification Body for initial certification, or

79

b. to EPA (via [SmartHomeSystems@energystar.gov](mailto:SmartHomeSystems@energystar.gov)) for ongoing reporting.

80

*Note: For initial certification, the population for analysis may be a pre-market test group, as long as the group meets all requirements of the population for analysis, and the service and devices used by the test group are functionally equivalent to those of the certified package.*

81

82

83 **Note:** In this draft, EPA proposes a minimum size of the population to be analyzed and specifies that at  
84 least 30 of these installations must have complete enough data records to be included in the analysis.  
85 This suggestion arose from a discussion in the Draft 1 stakeholder meeting. In that meeting (and in  
86 subsequent comments) stakeholders also pointed out that most service providers interested in offering  
87 platforms to the US market do not already have a substantial user base. To account for this, EPA  
88 proposes clarifying that for initial certification the Population for Analysis may be a pre-market test group,  
89 as long as the package used is functionally equivalent to the eventual certified product. EPA welcomes  
90 feedback on these proposals and how they might be more clearly stated.

91 **Appendix A: Detailed description of data elements in the reporting template**

92 **1) INTERPRETATION OF STATISTICAL INFORMATION:**

93 The definitions below contain descriptions of each data element. In cases where we ask for statistical  
94 results (mean, standard error of the mean, quantiles) the data element will describe the data for each  
95 installation, which would then be averaged over the population in question. For instance, to calculate  
96 values for “Change in number of connected devices per installation,” start with the change in number  
97 of devices visible to the platform in each installation, then calculate statistics describing the  
98 distribution of that number across installations in the population.

99 **2) PROGRAM PERFORMANCE**

- 100 a) Total installations served by the platform: The total number of installations the platform is  
101 serving, both with and without the energy management package. Do not include installations  
102 signed up only for limited time trials. This data element characterizes a population other than  
103 that defined in Section 3.
- 104 b) Total installations in the Population: the total number of installations in the population for  
105 analysis (see Section 3) Definitions above).
- 106 c) Installations with insufficient data: the total number of installations in the populations for  
107 analysis that meet requirement 4)4.c.i but do not meet 4)4.c.ii.
- 108 d) New installations registered during the reporting period: the percentage of installations in the  
109 population which first configured and registered a SHEMS in the data reporting period. Do not  
110 include installations that were first registered in a previous reporting period but experienced a  
111 lapse in service and have re-registered.
- 112 e) Number of ENERGY STAR Certified thermostats per installation: the number of ENERGY  
113 STAR certified thermostats connected to the SHEMS in each installation in the population.  
114 EPA’s API for certified thermostats may be leveraged for verifying certification of models.
- 115 f) Number of controllable lighting devices per installation: the number of controllable lighting  
116 devices in each installation in the population,
- 117 g) Number of controllable lighting devices that are ENERGY STAR certified per installation: the  
118 number of controllable lighting devices that are ENERGY STAR certified in each installation  
119 in the population.
- 120 h) Number of smart outlets per installation: the number of smart outlets in each installation in the  
121 population.
- 122 i) Number of smart power strips per installation: the number of smart power strips in each  
123 installation in the population.
- 124 j) Average scheduled away hours per week per installation: the number of scheduled away  
125 hours per week for each installation in the population, averaged over the current reporting  
126 period, i.e. total scheduled away hours in the reporting period divided by number of weeks in  
127 the reporting period.
- 128 k) Average non-scheduled explicitly generated away hours per week per installation: the non-  
129 scheduled hard trigger away hours per week for each installation in the population, averaged  
130 over the current reporting period.
- 131 l) Average implicitly generated away hours per week per installation: the number of away hours  
132 generated implicitly by the system per week for each installation in the population, averaged  
133 over the current reporting period.
- 134 m) Average suggested away hours per week per installation: the number of away hours per  
135 week initiated by the system after the user confirms a suggested action for each installation in  
136 the population, averaged over the current reporting period.
- 137 n) Average on time per light fixture: the average time light fixtures or control devices are on per  
138 day, averaged across all controlled lighting in each installation in the population. If providers

- 139 have data, they may weight on time by estimated relative energy consumption, e.g. a light on  
140 at 50% power for 10 minutes would count as five minutes.
- 141 o) Average lighting load in vacation or night time safety mode per installation: the average  
142 lighting load (kWh/day) in each installation during the times the installation is in the vacation  
143 and/or night time safety mode, as required in the specification section 4.1G. Calculate by  
144 summing lighting energy used while in these modes, as reported by the lighting device(s) in  
145 use and dividing by the number of days in this mode. Number of days need not be a whole  
146 number.
- 147 p) Installations in each of 5 climate zones: the percentage of total installations in the population  
148 located in each climate zone according to [this mapping of zip codes](#) to the Energy  
149 Information Administration (EIA) climate zones.
- 150 q) Average weekly away hours per installation for each month in the reporting period: the  
151 average away hours of all types per installation averaged individually for each month in the  
152 reporting period, normalized to weekly hours. i.e. for a 28-day month it would be total away  
153 hours (sum of 6a – 6d) divided by 4; for a 31-day month, the sum of 6a – 6d times 7 over 31.

154 **Note:** EPA proposes adding two data elements in the program performance group of elements. First, a  
155 stakeholder pointed out an opportunity to get a sense of data quality and connection reliability by  
156 reporting what proportion of the installations were eliminated from analysis due to insufficient data.  
157 Second, reporting energy used in the vacation/night time safety mode provides insight into compliance  
158 with the specification. In addition, EPA proposes moving two data elements from the optional group to the  
159 required group, based on the concern that it may be difficult to interpret the away hours without a sense  
160 of the effects of climate and seasonality. In addition, EPA has moved Whole installation standby power  
161 into the optional section 3) and has clarified our expectations about how it would be calculated and  
162 encourages stakeholder feedback on the proposed method.

### 163 3) SAVINGS METRIC DEVELOPMENT (optional)

- 164 a) Length of time subscribed: the length of time each installation in the population was  
165 continuously subscribed to the SHEMS service as of the last day of the reporting period.  
166 Statistics regarding the length of time subscribed shall be reported in days. As noted in the  
167 definition of the test population, any installation which is inactive for more than 18 days (10%  
168 of the period of analysis) is considered unsubscribed and shall not be included in the test  
169 population.
- 170 b) Change in number of devices connected to the system in the past calendar year: for each  
171 installation in the population, calculate the net change in the number of devices connected to  
172 the system over the past calendar year as an integer (may be positive or negative). Report  
173 the quartiles, mean, and standard error of that distribution of integer values.
- 174 c) Percent of controllable lighting devices which are scheduled or automated per installation: the  
175 percentage of controllable lighting devices which are scheduled or automated in each  
176 installation in the test population.
- 177 d) Installations with insight into whole home energy use: the percentage of total installations in  
178 the population with the capability of estimating and reporting the energy use of the entire  
179 home, by any means. For instance, some installations may include connection to a smart  
180 meter, an optical meter reader, or a home energy submetering system, and some platforms  
181 may be able to access [Green Button](#) data for those homes that have it available.
- 182 e) Number of thermostats per installation: the number of thermostats connected to the SHEMS  
183 platform in each installation in the population, whether they are ENERGY STAR certified or  
184 not. This is not intended to include other thermostats in the home (smart or not) that the  
185 SHEMS is unable to control or get data from.
- 186 f) Whole installation standby power: the total standby or idle power of all devices in each  
187 installation in the population, reported in watts. The idle power of each device may be  
188 reported by the device, determined by analyzing reported device power, or assigned based

189 on data reported for the device by the manufacturer, for instance in product literature. If no  
190 such data are available for a device, service providers may use a conservative assumed  
191 value.

192 **4) SHEMS MARKET EVOLUTION (optional)**

- 193 a) Percent of controllable lighting devices reporting energy or power per installation: the  
194 percentage of controllable lighting devices that report energy or power data in each  
195 installation in the population.
- 196 b) Percent of smart outlets or strips reporting energy or power per installation: the percentage of  
197 outlets and power strips reporting power or energy data in each installation in the population.
- 198 c) Percent of installations enrolled in DR programs using SHEMS service: the percent of total  
199 installations in the test population enrolled in a load control program with a utility via the  
200 SHEMS.
- 201 d) Installations leveraging time of use pricing: the percent of total installations in which the  
202 SHEMS algorithm optimizes energy use based on a time of use pricing structure.
- 203 e) Percent of DR events opted-out or overridden per installation: the percentage of utility DR  
204 events which were opted-out or overridden in the data reporting period for each installation in  
205 the test population.
- 206 f) Installations including a connected water heater or water heater controller: the percentage of  
207 total installations in which either a connected water heater or water heater controller is in  
208 communication with the SHEMS.
- 209 g) Installations including connected PV: the percentage of total installations in which the home is  
210 equipped with solar photovoltaic panels and the solar meter output is communicated with the  
211 SHEMS.
- 212 h) Installations including connected battery storage: the percentage of total installations in which  
213 the home is equipped with battery storage equipment connected to the SHEMS.
- 214 i) Installations including a connected EV charger: the percentage of total installations in which  
215 the home is equipped with an electric vehicle charger connected to the SHEMS.
- 216 j) Installations including at least one connected room air conditioner: the percentage of total  
217 installations in which the SHEMS is connected to a room air conditioner.
- 218 k) Installations with leak detection for water heater: the percentage of total installations in which  
219 the SHEMS is capable of detecting and reporting water heater leakage.