ENERGY STAR® Performance Ratings
Technical Methodology for Hotel/Motel

This document presents specific details on the EPA's analytical result and rating methodology for Hotel/Motel. For background on the technical approach to development of the Energy Performance Ratings, refer to *Energy Performance Ratings – Technical Methodology* (http://www.energystar.gov/ia/business/evaluate_performance/General_Overview_tech_methodology.pdf). Please note the general technical methodology listed above reflects changes made to the methodology in 2007. The Hotel/Motel model has not yet been revised in light of these changes; therefore some of the information in this description differs slightly.

Model Release Date
April 2002

Portfolio Manager Hotel/Motel Definition
Hotel/Motel applies to buildings that rent overnight accommodations on a room/suite basis, with a bath/shower and other facilities in most guest rooms. The total gross floor area should include all supporting functions such as food preparation and restaurant space, laundry facilities, exercise rooms, health club/spas, lobbies, atria, elevator shafts, stairways, storage areas, etc.

Amenities including meeting and conference facilities, recreational space, and retail establishments should be used to place a Hotel into the appropriate amenity category; these spaces should be included in the total floor area. Hotel/Motel categories currently eligible for benchmarking include: economy, midscale, upscale, and upper upscale. Resort and extended stay categories are not eligible for a rating at this time. These categories are described further in the following section.

Reference Data
The Hotel/Motel regression model is based on data from The Hospitality Research Group's (HRG) Trends in the Hotel Industry® database. This database contains 1999 energy expenditure, energy consumption, and building characteristics data for 2,915 Hotels located throughout the United States. Through careful examination, it was determined that, for the Hotel building type, the 1995 CBECS (Commercial Buildings Expenditures and Consumption Survey 1995, EIA) data was not sufficiently robust to account for the variation associated with the hospitality sector. The HRG data set was determined to be the most robust, representative data set for development of an energy rating model.

Data Filters
Four types of filters are applied to define the peer group for comparison and to overcome any technical limitations in the data: Building Type Filters, EPA Program Filters, Data Limitation Filters, and Analytical Filters. A complete description of each of these categories is provided in Section V of the general technical description document: *Energy Performance Ratings –*

Technical Methodology. **Table 1** presents a summary of each filter applied in the development of the Hotel/Motel model.

The filters applied to distinguish among hotel amenity categories are worthy of some additional discussion. The HRG data contained 2,915 records, each of which was identified as being in one of nine different amenities categories as compiled by Bear Stearns & Company, Incorporated (Bear Stearns). The nine categories were as follows:

1. Deluxe (A): Four Seasons, Ritz-Carlton, Select Independents
2. Luxury (B): Westin, Sheraton, Omni, Hyatt, Hilton
3. Upscale (C): Radisson, Doubletree, Crowne Plaza, Embassy Suites
4. Mid-scale with Food and Beverage (D): Holiday Inn, Ramada, Best Western, Sheraton Inn
5. Mid-scale without Food and Beverage (E): Comfort Inn, Hampton Inn, Holiday Inn Express, La Quinta
6. Economy (F): Days Inn, Fairfield Inn, Red Roof Inn, Travelodge
7. Budget (G): Microtel, Motel 6, Econo Lodge, Sleep Inn
8. Extended Stay Hi (H): Hawthorn Suites, Woodfin Suites
9. Extended Stay Lo (I): Extended Stay America, Crossland

Based on the number of records present for each category, and the types of amenities and operating characteristics affiliated with these categories, EPA redefined these nine categories into six amenity categories. The Deluxe and Luxury Categories were combined into one category, *Upper Upscale*; the Economy and Budget Categories were combined into one category, *Economy*; and the Extended Stay Hi and Extended Stay Lo categories were combined into one category, *Extended Stay*. The purpose of these combinations was to increase the number of observations in each category, while still having Hotels grouped according to the level of amenities offered. Based on a review of the data, the EPA categories provided appropriate groupings of Hotels based on their services. The final EPA categories are:

1. Upper Upscale (equivalent to Bear Stearns A and B)
2. Upscale (equivalent to Bear Stearns C)
3. Mid-scale with Food and Beverage (equivalent to Bear Stearns D)
4. Mid-scale without Food and Beverage (equivalent to Bear Stearns E)
5. Economy (equivalent to Bear Stearns F and G)
6. Extended Stay (equivalent to Bear Stearns H and I)

Ultimately, it was determined that there were not enough observations in the Extended Stay category to generate a statistically meaningful model. Hence, an analytical filter is applied to remove the Extended Stay Hotels from the analysis. Once all filters are applied, there are 705 observations remaining in the analysis.

Table 1 Summary of Hotel/Motel Model Filters	
Condition for Including an Observation in the Analysis	**Rationale**
HRG Hotel Survey Respondent	Building Filter – In the HRG data set, all buildings are Hotels, therefore the typical Building Filter is not required.
Must have valid, non-zero, values for energy consumption	Data Limitation Filter – Must have supplied complete energy data in the survey in order to model with regression analysis.
Must have valid values for all operating characteristics reviewed	Data Limitation Filter – Must have supplied complete operational data in the survey in order to model with regression analysis.
Cannot be an extended stay Hotel	Analytical Limitation Filter – Due to the limited number of records present, the analysis was not able to model behavior for these facilities.

Dependent Variable

The dependent variable in the Hotel/Motel analysis is the natural log of annual source energy use (LN(Source Energy)). By setting LN(Source Energy) as the dependent variable, the regressions analyze the key drivers of LN(Source Energy) – those factors that explain the variation in the natural log of source energy consumption in Hotel/Motels.

Independent Variables

The HRG data contain numerous building operation variables that EPA identified as potentially important for Hotel/Motel facilities. These include characteristics such as the total number of hotel rooms, the presence of revenue generating food and beverage, the presence of a health club facility, the Bear Sterns category, and the number of heating and cooling degree days. Specifically excluded from the HRG database are exact figures on building size. Instead, an estimate of building size for each record is provided. These estimates were not used in the analysis.

EPA performed extensive review on all of these operational characteristics. In addition to reviewing each characteristic individually, characteristics were reviewed in combination with each other. As part of the analysis, some variables were reformatted to reflect the physical relationships of building components. Based on analytical results and residual plots, variables were also examined using different transformations (such as the natural logarithm). The analyses consisted of multiple regression formulations. These analyses were structured to find the combination of statistically significant operating characteristics that explained the greatest amount of variance in the dependent variable: LN(Source Energy).

In addition to reviewing various combinations of operating characteristics, EPA also explored the available hotel amenity categories. This included an evaluation of all 705 observations in the filtered data set together, with dummy variables to identify each amenity category, as well as separate regressions for each amenity category. Ultimately, it was determined that separate statistical models for each amenity category offered superior results. EPA was able to develop statistically significant models for each amenity category except for the Extended Stay category.

Across all of the models evaluated and developed, some or all of the following three characteristics were identified as the key explanatory variables that can be used to estimated the expected LN(Source Energy) in a Hotel or Motel:

- Natural log of number of hotel rooms
- Presence of a revenue-generating food and beverage and/or banquet facility
- Natural log of total heating and cooling degree-days

Regression Modeling Results

The final regressions are ordinary least squares regressions performed across each hotel amenity group. There are five final regression models, one for each of the EPA amenity categories, with the exception of Extended Stay. The dependent variable in each of these regression analyses is LN(Source Energy). Basic statistics for the final sets of independent variables in the models are provided in **Table 2**. The final models are presented in **Tables 3 through 7**.

In general the models have strong explanatory powers, with R-squared values ranging from 0.60 to 0.88. These values mean that the models explain 60% to 88% of the variation in the natural log of source energy use within each hotel amenity category. Moreover, in each of the five regressions the independent variables used in the analysis are significant with 90% confidence or better (a p-level of less than 0.10 indicates 90% confidence). Overall, these are excellent results for statistically based energy models.

Detailed information on the ordinary least squares regression approach and the methodology for performing weather adjustments is available in the technical document: *Energy Performance Ratings – Technical Methodology*.

Table 2 Descriptive Statistics for Variables Used in Regression Models				
Variable	**Full Variable Name**	**Mean**	**Minimum**	**Maximum**
Upper Upscale regression variables				
LnSource	Natural Log of Source Energy Use	17.97	15.03	19.89
LnRooms	Natural Log of the Number of Rooms	5.83	3.14	7.79
FoodFac	Presence of an on-site cooking facility	0.94	0	1.00
Upscale regression variables				
LnSource	Natural Log of Source Energy Use	17.59	15.35	20.10
LnRooms	Natural Log of the Number of Rooms	5.59	3.93	7.55
FoodFac	Presence of an on-site cooking facility	0.86	0	1.00
LnDD	Natural Log of the Sum of Heating Degree Days and Cooling Degree Days	8.54	7.69	9.55
Mid-scale with Food and Beverage regression variables				
LnSource	Natural Log of Source Energy Use	17.12	15.41	18.46
LnRooms	Natural Log of the Number of Rooms	5.36	4.17	6.48
LnDD	Natural Log of the Sum of Heating Degree Days and Cooling Degree Days	8.61	7.69	9.27
Mid-scale without Food and Beverage regression variables				
LnSource	Natural Log of Source Energy Use	16.23	15.49	17.85
LnRooms	Natural Log of the Number of Rooms	4.81	3.83	5.74
LnDD	Natural Log of the Sum of Heating Degree Days and Cooling Degree Days	8.61	7.69	9.07
Economy regression variables				
LnSource	Natural Log of Source Energy Use	15.66	13.77	18.25
FoodFac	Presence of an on-site cooking facility	0.08	0	1.00
LnRooms	Natural Log of the Number of Rooms	4.44	3.22	6.52
LnDD	Natural Log of the Sum of Heating Degree Days and Cooling Degree Days	8.46	7.69	9.28

Table 3 Upper Upscale Regression Modeling Results				
Dependent Variable	LN(Source Energy)			
Number of Observations in Analysis	102			
Model R^2 value	0.8422			
Model F Statistic	264.100			
Model Significance (p-level)	0.000			
	Unstandardized Coefficients	**Standard Error**	**T value**	**Significance (p-level)**
(Constant)	11.87840	0.271379	43.77046	0.0000
LNROOMS	0.942549	0.054610	17.25965	0.0000
FOODFAC	0.633806	0.206259	3.072871	0.0027

Table 4 Upscale Regression Modeling Results				
Dependent Variable		LN(Source Energy)		
Number of Observations in Analysis		275		
Model R^2 value		0.8692		
Model F Statistic		600.3553		
Model Significance (p-level)		0.000		
	Unstandardized Coefficients	**Standard Error**	**T value**	**Significance (p-level)**
(Constant)	8.034322	0.524355	15.32229	0.0000
LNROOMS	1.217668	0.032832	37.08838	0.0000
FOODFAC	0.156245	0.052644	2.967961	0.0033
LNDD	0.307686	0.056955	5.402245	0.0000

Table 5 Mid-scale with Food and Beverage Regression Modeling Results				
Dependent Variable		LN(Source Energy)		
Number of Observations in Analysis		83		
Model R^2 value		0.6889		
Model F Statistic		88.6056		
Model Significance (p-level)		0.000		
	Unstandardized Coefficients	**Standard Error**	**T value**	**Significance (p-level)**
(Constant)	8.598854	1.214071	7.082660	0.0000
LNROOMS	1.024112	0.063556	16.11366	0.0000
LNDD	0.357193	0.125492	2.846332	0.0056

Table 6 Mid-scale without Food and Beverage Regression Modeling Results				
Dependent Variable		LN(Source Energy)		
Number of Observations in Analysis		159		
Model R^2 value		0.6017		
Model F Statistic		117.8291		
Model Significance (p-level)		0.000		
	Unstandardized Coefficients	**Standard Error**	**T value**	**Significance (p-level)**
(Constant)	9.497230	0.893935	10.62408	0.0000
LNROOMS	1.121501	0.091615	12.24144	0.0000
LNDD	0.155445	0.093088	1.669869	0.0970

Table 7 Economy Regression Modeling Results				
Dependent Variable		LN(Source Energy)		
Number of Observations in Analysis		86		
Model R^2 value		0.8793		
Model F Statistic		199.1520		
Model Significance (p-level)		0.000		
	Unstandardized Coefficients	**Standard Error**	**T value**	**Significance (p-level)**
(Constant)	7.728508	1.178948	6.555430	0.0000
LNROOMS	0.933250	0.057038	16.36197	0.0000
FOODFAC	0.466603	0.119286	3.911619	0.0002
LNDD	0.448884	0.133234	3.369141	0.0012

Hotel/Motel Lookup Table

The final regression models (presented in **Tables 3 through 7**) yield predictions of LN(Source Energy) based on a building's operating constraints. Some buildings in the HRG data sample use more energy than predicted by the regression equation, while others use less. The *actual* value of LN(Source Energy) for each HRG observation is divided by its *predicted v*alue for LN(Source Energy) to calculate an energy efficiency ratio:

Energy Efficiency Ratio = Actual LN(Source Energy) / Predicted LN(Source Energy)

A lower efficiency ratio indicates that a building uses less energy than predicted, and consequently is more efficient. A higher efficiency ratio indicates the opposite. For each building, the ratio is expressed in terms of a normalized LN(Source Energy) to represent the value for LN(Source Energy) that the building would have if it were average. This *normalized energy use* is obtained by multiplying the efficiency ratio by the mean value of LN(Source Energy) [1]:

Normalized LN(Source Energy) = Energy Efficiency Ratio * mean LN(Source Energy)

For each hotel amenity category (i.e. for each regression data sample), the normalized LN(Source Energy) values are sorted from smallest to largest and the cumulative percent of the population at each energy value is computed. A smooth curve is fitted to the data using a two parameter gamma distribution. The fit is performed in order to minimize the sum of squared differences between each building's actual percent rank in the population and each building's percent rank with the gamma solution. The fit is performed with the constraint that the gamma value of LN(Source Energy) at a rating of 75 must equal the actual value of LN(Source Energy) at 75. These fits yield five gamma curves: one to describe the distribution of energy efficiency for each of the five hotel amenity categories.

[1] The mean value of LN(Source) is evaluated separately for each regression, across the corresponding hotel amenity category. These values are presented in Table 2.

For each hotel amenity category, the final gamma shape and scale parameters are used to calculate the normalized LN(Source Energy) value at each percentile (1 to 100) along the curve. For example, the normalized LN(Source Energy) value on the gamma curve at 1% corresponds to a rating of 99; only 1% of the population has a value this small or smaller. The normalized LN(Source Energy) value on the gamma curve at the value of 25% will correspond to the normalized LN(Source Energy) value for a rating of 75; only 25% of the population has normalized LN(Source Energy) values this small or smaller. Complete lookup tables for each hotel amenity category are presented at the end of the document. In order to read these tables, note that for an Upper Upscale Hotel (see **Table 9**) if the normalized LN(Source Energy) value is less than 17.044 the rating for that building should be 100. If the normalized LN(Source Energy) value is greater than or equal to 17.184 and less than 17.044, the rating for the building should be 99, etc.

Example Calculation

Below are the five steps to compute a rating for a hypothetical Hotel/Motel, using the Upscale Hotel Model. Note that these steps are slightly different than those outlined in the document *Energy Performance Ratings – Technical Methodology*, which reflects changes made to the methodology in 2007. The Hotel/Motel models have not yet been revised in light of these changes (departures from the current methodology are described in footnotes).

Step 1 – User enters building data into Portfolio Manager

For the purpose of this example, sample data is provided.

- Energy data
  - Total annual electricity = 3,010,000 kWh
  - Total annual natural gas = 65,000 therms
  - Note that this data is actually entered in monthly meter entries
- Operational data
  - Hotel amenity category = Upscale Hotel
  - Gross floor area (ft^2) = 400,000
  - Number of rooms = 360
  - Presence of on-site cooking and food preparation = yes (1)
  - HDD (provided by Portfolio Manager, based on zip code) = 1000
  - CDD (provided by Portfolio Manager, based on zip code) = 2070

Step 2 – Portfolio Manager computes the actual value for the natural log of Source Energy Use[2]

In order to compute actual Source Energy Use, Portfolio Manager must convert each fuel from the specified units (e.g. kWh) into Site kBtu, and must convert from Site kBtu to Source kBtu.

- Convert the meter data entries into site kBtu
  - Electricity: (3,010,000 kWh)*(3.412 kBtu/kWh) = 10,270,120 kBtu Site
  - Natural gas: (65,000 therms)*(100 kBtu/therm) = 6,500,000 kBtu Site
- Apply the site-to-source conversion factors to compute the source energy
  - Electricity:

[2] Note that for models revised in 2007 or later, this step computes the actual source energy use intensity.

10,270,120 Site kBtu*(3.34 Source kBtu/ Site kBtu) = 34,302,201 kBtu Source
    - Natural gas:
      6,500,000 Site kBtu*(1.047 Source kBtu/Site kBtu) = 6,805,500 kBtu Source
- Combine source kBtu across all fuels
    - 34,302,201 kBtu + 6,805,500 kBtu = 41,107,701 kBtu
- Take the natural log of total source energy consumption
    - LN (41,107,701 kBtu) = 17.532

Step 3 – Portfolio Manager computes the predicted natural log of Source Energy Use[3]
Portfolio Manager uses the building data entered in Step 1 to compute the predicted energy consumption of the building with the given operational constraints.

- Compute each variable in the model
    - Use the operating characteristic values to compute each variable in the model.
      e.g. LN(Rooms) = LN(360) = 5.886104
- Multiply each variable by the corresponding coefficient in the model
    - e.g. Coefficient * LN(Rooms) = 1.217668*5.886104 = 7.167
- Sum each product (i.e. coefficient*variable) from the preceding step and add to the constant
    - This yields a predicted LN(Source Energy) of 17.828
- This calculation is summarized in **Table 8**

Step 4 – Portfolio Manager computes the normalized LN(Source Energy) value[4]
The actual and predicted values for LN(Source Energy) are used to compute the energy efficiency ratio, which is converted into a normalized LN(Source Energy).

- Compute the energy efficiency ratio
    - Energy efficiency ratio =
      Actual LN(Source Energy) / Predicted LN(Source Energy)
    - 17.532 / 17.828 = 0.9834
- Compute the normalized LN(Source Energy)
    - Normalized LN(Source Energy) =
      Energy Efficiency Ratio * Mean LN(Source Energy)
    - Mean LN(Source Energy) for Upscale Hotels is provided in **Table 2** = 17.59
    - 0.9834* 17.59 = 17.298

[3] Note that for models revised in 2007 or later, this step computes the predicted source energy use intensity.
[4] Note that for models revised in 2007 or later, this step compute the energy efficiency ratio.

Step 5 – Portfolio Manager looks up the Normalized LN(Source Energy) in the Lookup Table[5]
Starting at 100 and working down, Portfolio Manager searches the lookup table for Upscale Hotels (**Table 10**) for the first normalized LN(Source Energy) value that is larger than the computed normalized LN(Source Energy) for the building.

- An adjusted value of 17.298 is less than 17.314 (requirement for 90) and greater than 17.294 (requirement for 91).
- ***The rating is a 90***

Table 8
Example Calculation – Computing predicted LN(Source Energy)

Operating Characteristic	Variable Value	Coefficient	Coefficient * Variable
(Constant)	N/A	8.034322	8.034
LnRooms	5.886104	1.217668	7.167
LnDD	8.029433	0.307686	2.471
FoodFac	1	0.156245	0.156
Predicted LN(Source Energy) (LN(kBtu))			***17.828***

[5] Note that for models revised in 2007 or later, this step looks up the energy efficiency ratio in the lookup table.

Attachment

Tables 9 through 13 list the normalized LN(Source Energy) cut-off point for each rating for each category, from 1 to 100.

Table 9
Lookup Table for Hotel/Motel Upper Upscale Rating

Rating	Cumulative Percent	Normalized LN(Source Energy)		Rating	Cumulative Percent	Normalized LN(Source Energy)
100	0%	17.044		50	50%	18.064
99	1%	17.184		49	51%	18.074
98	2%	17.264		48	52%	18.084
97	3%	17.324		47	53%	18.094
96	4%	17.374		46	54%	18.104
95	5%	17.414		45	55%	18.114
94	6%	17.454		44	56%	18.124
93	7%	17.484		43	57%	18.134
92	8%	17.514		42	58%	18.144
91	9%	17.544		41	59%	18.154
90	10%	17.564		40	60%	18.164
89	11%	17.584		39	61%	18.174
88	12%	17.604		38	62%	18.184
87	13%	17.624		37	63%	18.189
86	14%	17.644		36	64%	18.198
85	15%	17.664		35	65%	18.204
84	16%	17.684		34	66%	18.214
83	17%	17.694		33	67%	18.224
82	18%	17.714		32	68%	18.234
81	19%	17.724		31	69%	18.244
80	20%	17.744		30	70%	18.254
79	21%	17.754		29	71%	18.264
78	22%	17.774		28	72%	18.274
77	23%	17.784		27	73%	18.294
76	24%	17.794		26	74%	18.304
75	25%	17.814		25	75%	18.314
74	26%	17.824		24	76%	18.324
73	27%	17.834		23	77%	18.334
72	28%	17.844		22	78%	18.344
71	29%	17.854		21	79%	18.354
70	30%	17.864		20	80%	18.374
69	31%	17.884		19	81%	18.384
68	32%	17.894		18	82%	18.394
67	33%	17.904		17	83%	18.404
66	34%	17.914		16	84%	18.424
65	35%	17.924		15	85%	18.434
64	36%	17.934		14	86%	18.454
63	37%	17.944		13	87%	18.464
62	38%	17.954		12	88%	18.484
61	39%	17.964		11	89%	18.504
60	40%	17.974		10	90%	18.524
59	41%	17.984		9	91%	18.544
58	42%	17.994		8	92%	18.564
57	43%	18.004		7	93%	18.584
56	44%	18.014		6	94%	18.614
55	45%	18.024		5	95%	18.644
54	46%	18.034		4	96%	18.684
53	47%	18.044		3	97%	18.734
52	48%	18.054		2	98%	18.814
51	49%	18.054		1	99%	19.024

Table 10 Lookup Table for Hotel/Motel Upscale Rating						
Rating	**Cumulative Percent**	**Normalized LN(Source Energy)**		**Rating**	**Cumulative Percent**	**Normalized LN(Source Energy)**
100	0%	16.944		50	50%	17.688
99	1%	17.034		49	51%	17.694
98	2%	17.094		48	52%	17.699
97	3%	17.144		47	53%	17.708
96	4%	17.174		46	54%	17.714
95	5%	17.204		45	55%	17.719
94	6%	17.234		44	56%	17.728
93	7%	17.254		43	57%	17.734
92	8%	17.274		42	58%	17.744
91	9%	17.294		41	59%	17.749
90	10%	17.314		40	60%	17.758
89	11%	17.324		39	61%	17.764
88	12%	17.344		38	62%	17.769
87	13%	17.354		37	63%	17.778
86	14%	17.374		36	64%	17.784
85	15%	17.384		35	65%	17.794
84	16%	17.394		34	66%	17.799
83	17%	17.414		33	67%	17.808
82	18%	17.424		32	68%	17.814
81	19%	17.434		31	69%	17.824
80	20%	17.444		30	70%	17.834
79	21%	17.454		29	71%	17.839
78	22%	17.464		28	72%	17.848
77	23%	17.474		27	73%	17.854
76	24%	17.484		26	74%	17.864
75	25%	17.494		25	75%	17.874
74	26%	17.504		24	76%	17.884
73	27%	17.509		23	77%	17.889
72	28%	17.518		22	78%	17.898
71	29%	17.524		21	79%	17.904
70	30%	17.534		20	80%	17.914
69	31%	17.544		19	81%	17.924
68	32%	17.554		18	82%	17.934
67	33%	17.559		17	83%	17.944
66	34%	17.568		16	84%	17.954
65	35%	17.574		15	85%	17.974
64	36%	17.584		14	86%	17.984
63	37%	17.594		13	87%	17.994
62	38%	17.599		12	88%	18.004
61	39%	17.608		11	89%	18.024
60	40%	17.614		10	90%	18.034
59	41%	17.619		9	91%	18.054
58	42%	17.628		8	92%	18.064
57	43%	17.634		7	93%	18.084
56	44%	17.644		6	94%	18.114
55	45%	17.649		5	95%	18.134
54	46%	17.658		4	96%	18.164
53	47%	17.664		3	97%	18.204
52	48%	17.674		2	98%	18.274
51	49%	17.679		1	99%	18.444

Table 11 Lookup Table for Hotel/Motel Midscale w/ Food and Beverage Rating						
Rating	**Cumulative Percent**	**Normalized LN(Source Energy)**		**Rating**	**Cumulative Percent**	**Normalized LN(Source Energy)**
100	0%	16.574		50	50%	17.248
99	1%	16.654		49	51%	17.254
98	2%	16.714		48	52%	17.258
97	3%	16.754		47	53%	17.264
96	4%	16.784		46	54%	17.269
95	5%	16.804		45	55%	17.278
94	6%	16.834		44	56%	17.284
93	7%	16.854		43	57%	17.289
92	8%	16.874		42	58%	17.298
91	9%	16.884		41	59%	17.304
90	10%	16.904		40	60%	17.309
89	11%	16.914		39	61%	17.318
88	12%	16.934		38	62%	17.324
87	13%	16.944		37	63%	17.329
86	14%	16.954		36	64%	17.338
85	15%	16.974		35	65%	17.344
84	16%	16.984		34	66%	17.349
83	17%	16.994		33	67%	17.358
82	18%	17.004		32	68%	17.364
81	19%	17.014		31	69%	17.374
80	20%	17.024		30	70%	17.379
79	21%	17.034		29	71%	17.388
78	22%	17.044		28	72%	17.394
77	23%	17.054		27	73%	17.404
76	24%	17.059		26	74%	17.409
75	25%	17.068		25	75%	17.418
74	26%	17.074		24	76%	17.424
73	27%	17.084		23	77%	17.434
72	28%	17.094		22	78%	17.444
71	29%	17.099		21	79%	17.449
70	30%	17.108		20	80%	17.458
69	31%	17.114		19	81%	17.464
68	32%	17.124		18	82%	17.474
67	33%	17.129		17	83%	17.484
66	34%	17.138		16	84%	17.494
65	35%	17.144		15	85%	17.504
64	36%	17.154		14	86%	17.514
63	37%	17.159		13	87%	17.534
62	38%	17.168		12	88%	17.544
61	39%	17.174		11	89%	17.554
60	40%	17.179		10	90%	17.564
59	41%	17.188		9	91%	17.584
58	42%	17.194		8	92%	17.594
57	43%	17.199		7	93%	17.614
56	44%	17.208		6	94%	17.634
55	45%	17.214		5	95%	17.664
54	46%	17.219		4	96%	17.694
53	47%	17.228		3	97%	17.724
52	48%	17.234		2	98%	17.784
51	49%	17.239		1	99%	17.944

Table 12 Lookup Table for Hotel/Motel Midscale w/o Food and Beverage Rating						
Rating	**Cumulative Percent**	**Normalized LN(Source Energy)**		**Rating**	**Cumulative Percent**	**Normalized LN(Source Energy)**
100	0%	15.674		50	50%	16.324
99	1%	15.754		49	51%	16.328
98	2%	15.814		48	52%	16.334
97	3%	15.844		47	53%	16.339
96	4%	15.874		46	54%	16.348
95	5%	15.904		45	55%	16.354
94	6%	15.924		44	56%	16.359
93	7%	15.944		43	57%	16.368
92	8%	15.964		42	58%	16.374
91	9%	15.984		41	59%	16.378
90	10%	15.994		40	60%	16.384
89	11%	16.014		39	61%	16.389
88	12%	16.024		38	62%	16.398
87	13%	16.034		37	63%	16.404
86	14%	16.044		36	64%	16.409
85	15%	16.054		35	65%	16.418
84	16%	16.074		34	66%	16.424
83	17%	16.084		33	67%	16.429
82	18%	16.094		32	68%	16.438
81	19%	16.099		31	69%	16.444
80	20%	16.108		30	70%	16.449
79	21%	16.114		29	71%	16.458
78	22%	16.124		28	72%	16.464
77	23%	16.134		27	73%	16.474
76	24%	16.144		26	74%	16.479
75	25%	16.154		25	75%	16.488
74	26%	16.159		24	76%	16.494
73	27%	16.168		23	77%	16.504
72	28%	16.174		22	78%	16.509
71	29%	16.184		21	79%	16.518
70	30%	16.189		20	80%	16.524
69	31%	16.198		19	81%	16.534
68	32%	16.204		18	82%	16.544
67	33%	16.214		17	83%	16.554
66	34%	16.219		16	84%	16.564
65	35%	16.228		15	85%	16.574
64	36%	16.234		14	86%	16.584
63	37%	16.239		13	87%	16.594
62	38%	16.248		12	88%	16.604
61	39%	16.254		11	89%	16.624
60	40%	16.259		10	90%	16.634
59	41%	16.268		9	91%	16.644
58	42%	16.272		8	92%	16.664
57	43%	16.278		7	93%	16.684
56	44%	16.284		6	94%	16.704
55	45%	16.289		5	95%	16.724
54	46%	16.298		4	96%	16.754
53	47%	16.304		3	97%	16.784
52	48%	16.309		2	98%	16.844
51	49%	16.318		1	99%	16.994

Table 13 Lookup Table for Hotel/Motel Economy and Budget Rating						
Rating	**Cumulative Percent**	**Normalized LN(Source Energy)**		**Rating**	**Cumulative Percent**	**Normalized LN(Source Energy)**
100	0%	15.074		50	50%	15.749
99	1%	15.154		49	51%	15.758
98	2%	15.214		48	52%	15.764
97	3%	15.254		47	53%	15.768
96	4%	15.284		46	54%	15.774
95	5%	15.314		45	55%	15.779
94	6%	15.334		44	56%	15.788
93	7%	15.354		43	57%	15.794
92	8%	15.374		42	58%	15.799
91	9%	15.394		41	59%	15.808
90	10%	15.404		40	60%	15.814
89	11%	15.424		39	61%	15.819
88	12%	15.434		38	62%	15.828
87	13%	15.444		37	63%	15.834
86	14%	15.464		36	64%	15.839
85	15%	15.474		35	65%	15.848
84	16%	15.484		34	66%	15.854
83	17%	15.494		33	67%	15.859
82	18%	15.504		32	68%	15.868
81	19%	15.514		31	69%	15.874
80	20%	15.524		30	70%	15.884
79	21%	15.534		29	71%	15.889
78	22%	15.544		28	72%	15.898
77	23%	15.554		27	73%	15.904
76	24%	15.564		26	74%	15.914
75	25%	15.574		25	75%	15.919
74	26%	15.579		24	76%	15.928
73	27%	15.588		23	77%	15.934
72	28%	15.594		22	78%	15.944
71	29%	15.604		21	79%	15.954
70	30%	15.609		20	80%	15.964
69	31%	15.618		19	81%	15.974
68	32%	15.624		18	82%	15.984
67	33%	15.634		17	83%	15.994
66	34%	15.639		16	84%	16.004
65	35%	15.648		15	85%	16.014
64	36%	15.654		14	86%	16.024
63	37%	15.664		13	87%	16.034
62	38%	15.669		12	88%	16.044
61	39%	15.678		11	89%	16.054
60	40%	15.684		10	90%	16.074
59	41%	15.689		9	91%	16.084
58	42%	15.698		8	92%	16.104
57	43%	15.704		7	93%	16.124
56	44%	15.709		6	94%	16.144
55	45%	15.718		5	95%	16.164
54	46%	15.724		4	96%	16.194
53	47%	15.729		3	97%	16.234
52	48%	15.738		2	98%	16.294
51	49%	15.744		1	99%	16.454