Technical Description for the Hotel/Motel Model

12/11/2001

Data Source

Energy consumption and building characteristics data for the analysis of the Hotel/Motel, hereafter referred to as hotel, model was obtained 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 fully account for the variation due to amenities strongly associated within the hospitality business sector.

Data Set

The HRG data contained basic energy consumption and building characteristics data on 2,915 buildings, however of this, 729 records contained the detailed information required to analyze the data. For each hotel, the following fields of data were known for 729 records:

- Bear Stearns' classification
- Energy consumption by fuel type (Electricity, natural gas, other)
- Three-digit Zip Code
    - Heating Degree Days
    - Cooling Degree Days
    - Total Degree Days
- Number of rooms
- Range of percent occupancy in 10% increments
- Food and beverage service (yes/no)
- Parking garage (yes/no)
- Banquet facilities (yes/no)
- Health club facilities (yes/no)

Specifically excluded from the HRG database was exact figures on building size. Instead, an estimate of building size for each record was provided. These estimates were not used in the analysis.

Bear Stearns' Classification

Each of the 729 records 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. Midscale w/F&B (D): Holiday Inn, Ramada, Best Western, Sheraton Inn
5. Midscale w/o F&B (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): Residence Inn, Hawthorn Suites, Woodfin Suites
9. Extended Stay Lo (I): Extended Stay America, TownePlace Suites, Crossland

Upon investigating the variations and drivers of performance of records in each of these Bear Stearns categories, analysis proceeded along five categories. Due to a lack of records (24) and uniqueness of performance, the Extended Stay Upper Tier and Lower Tier categories were discarded from the analysis leaving seven categories. Combining categories with like

performance and building characteristics then reduced the seven remaining categories to five. Records in the Deluxe category were limited, but were nonetheless simply folded into the Luxury category. Similarly, records in the Economy category were combined with records in the Budget category to form Economy & Budget. Thus, from the original list of nine Bear Stearns categories, analysis proceeded on the following five revised categories: 1) Upper Upscale (formerly Luxury & Deluxe); 2) Upscale; 3) Midscale with Food & Beverage; 4) Midscale without Food & Beverage; and 5) Economy (formerly Economy and Budget).

Removing the records associated with the Extended Stay categories left 705 of the original 729 records. The representation by the revised categories was as follows:

Category	**# of Records**
Upper Upscale	102
Upscale	275
Midscale with Food and Beverage	83
Midscale without Food and Beverage	159
Economy	86
Total	705

Model Format

The option to combine the five categories into one statistical model was investigated. It was found that statistically combining all five yielded technically sound results, as did treating all five statistically independent. Therefore it was decided to create five separate statistical models primarily because it allows hotels to compare themselves to their true industry peers.

Dependent Variable

The basis of the regression, that is, the dependent variable chosen for the regression was the natural logarithm of annual source energy consumption (LnSource) where annual source energy consumption is measured in kBtu/year. Since energy intensity is a commonly used and understood term to characterize and compare building energy performance amongst groups of buildings, it was determined that user results would be provided in these terms by simply requiring the user to enter building size, then modifying the output presentation accordingly. A more detailed description of this is provided in the section on Assessing Performance near the end of this document.

Independent Variables

The following independent variables were examined for their significance and correlation with the dependent variable as well as with the other independent variables.

$LnHDD_{65}$	natural log of heating degree-days base 65
$LnCDD_{65}$	natural log of cooling degree-days base 65
$LnDD_{65}$	natural log of total heating and cooling degree-days base 65
LnRooms	natural log of number of hotel rooms
FoodFac	dummy variable where a value of 1 indicates the presence of revenue-generating food and beverage and/or Banquet facility and a zero value indicates the non-presence of such facilities
Health	dummy variable where a value of 1 indicates the presence of revenue-generating health club facility and a zero value indicates the non-presence of such a facility
BSDum2	Dummy variable where a value of 1 indicates that the hotel is defined as a Deluxe or Luxury hotel by Bear Stearns and a zero value otherwise (used in pooled analysis only)
BSDum3	Dummy variable where a value of 1 indicates that the hotel is defined as an Upscale hotel by Bear Stearns and a zero value otherwise (used in pooled analysis only)

BSDum4 Dummy variable where a value of 1 indicates that the hotel is defined as a Limited Service (Midscale without Food & Beverage) hotel by Bear Stearns and a zero value otherwise (used in pooled analysis only)

BSDum5 Dummy variable where a value of 1 indicates that the hotel is defined as an Economy or Budget hotel by Bear Stearns and a zero value otherwise (used in pooled analysis only)

Source Energy

The analysis relied upon converting site energy consumption from the HRG database to source energy consumption using the conversion factors below. A one-page discussion about source energy may be viewed and downloaded from www.energystar.gov. The following table lists the conversion factors applied.

Fuel Type	Site (kBtu)	Source (kBtu)
Electricity	1	3.013
Natural Gas	1	1.024
Fuel Oil	1	1
Steam	1	1.38
Hot Water	1	1

Regression Results

Tables 1 – 5 present the results of the regression analysis for each of the five hotel categories. In general the explanatory power of the models was good with R-squared values ranging from 0.60 to 0.88. Each model used the natural log of annual source energy consumption (kBtu/year) as the dependent variable and contained two or more of the following independent variables: LNDD, LNROOMS, FOODFAC, and HEALTH.

For the Upper Upscale model (Table-1), LNROOMS, FOODFAC, and HEALTH were found to be significant by the standard statistical definition where the T-statistic is greater than +/- 2.0. Unlike the other four hotel models, LNDD was excluded from the Upper Upscale model because it was not statistically significant and the associated coefficient estimate had a counterintuitive (negative) sign.

Each of the four independent variables listed above was incorporated into the Upscale model (Table-2). Of these, only the HEALTH variable failed to have a T-statistic less than +/- 2.0, however it was included in the model since our knowledge of the hotel industry indicated that it should be considered. Furthermore, its inclusion was determined to not adversely affect the model.

The Midscale with Food & Beverage model (Table-3) contained LNDD, LNROOMS, and HEALTH as independent variables. The FOODFAC variable was not utilized for this model since every record in this particular data set contained a food facility by definition. Though not found to be statistically significant the HEALTH variable was left in the model since its inclusion did not adversely affect the model and it was believed to further explain the variations in energy use for these types of hotel buildings.

The Midscale without Food & Beverage model (Table-4) contained just LNDD and LNROOMS as independent variables. The amenity level of these types of hotel buildings was measurably less than the Midscale with Food & Beverage class. Thus, the exclusion of HEALTH variable – which was found to not be statistically significant – was deemed appropriate. Similar to the Midscale with Food & Beverage analysis, the FOODFAC variable was not utilized since, by definition, every record in the data set did not contain a food facility.

LNDD, LNROOMS, and FOODFAC were each found to be statistically significant independent variables for the Economy model (Table-5). As expected for this amenity class, the HEALTH variable was not found to be statistically significant.

Table-1 Upper Upscale Regression Results

Dependent Variable: LnSource
Method: Least Squares
Date: 10/16/01 Time: 14:45
Sample(adjusted): 15 703 IF BSDUM2=1
Included observations: 102 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	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

R-squared	0.842159	Mean dependent var	17.97169
Adjusted R-squared	0.838970	S.D. dependent var	0.951701
S.E. of regression	0.381903	Akaike info criterion	0.941672
Sum squared resid	14.43916	Schwarz criterion	1.018877
Log likelihood	-45.02527	F-statistic	264.1070
Durbin-Watson stat	1.989212	Prob(F-statistic)	0.000000

Table-2 Upscale Regression Results

Dependent Variable: LnSource
Method: Least Squares
Date: 10/16/01 Time: 14:48
Sample(adjusted): 36 705 IF BSDUM3=1
Included observations: 275 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.034322	0.524355	15.32229	0.0000
LNROOMS	1.217668	0.032832	37.08838	0.0000
LNDD	0.307686	0.056955	5.402245	0.0000
FOODFAC	0.156245	0.052644	2.967961	0.0033

R-squared	0.869213	Mean dependent var	17.59018
Adjusted R-squared	0.867765	S.D. dependent var	0.825240
S.E. of regression	0.300091	Akaike info criterion	0.444979
Sum squared resid	24.40486	Schwarz criterion	0.497587
Log likelihood	-57.18464	F-statistic	600.3553
Durbin-Watson stat	1.934596	Prob(F-statistic)	0.000000

Table-3 Midscale with Food and Beverage Regression Results

Dependent Variable: LnSource
Method: Least Squares
Date: 10/16/01 Time: 15:05
Sample(adjusted): 39 639 IF BSDUM2=0 AND BSDUM3=0 AND BSDUM4=0 AND BSDUM5=0
Included observations: 83 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	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

R-squared	0.688972	Mean dependent var	17.12447
Adjusted R-squared	0.681196	S.D. dependent var	0.630010
S.E. of regression	0.355721	Akaike info criterion	0.806136
Sum squared resid	10.12300	Schwarz criterion	0.893564
Log likelihood	-30.45464	F-statistic	88.60564
Durbin-Watson stat	1.029150	Prob(F-statistic)	0.000000

Table-4 Midscale without Food and Beverage Regression Results

Dependent Variable: LnSource
Method: Least Squares
Date: 03/02/01 Time: 11:45
Sample(adjusted): 45 534 IF BSDUM4=1
Included observations: 159 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	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

R-squared	0.601693	Mean dependent var	16.22686
Adjusted R-squared	0.596587	S.D. dependent var	0.395653
S.E. of regression	0.251298	Akaike info criterion	0.094333
Sum squared resid	9.851502	Schwarz criterion	0.152236
Log likelihood	-4.499442	F-statistic	117.8291
Durbin-Watson stat	1.101705	Prob(F-statistic)	0.000000

Table-5 Economy Regression Results

Dependent Variable: LnSource
Method: Least Squares
Date: 03/02/01 Time: 11:53
Sample(adjusted): 1 612 IF BSDUM5=1
Included observations: 86 after adjusting endpoints
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.728508	1.178948	6.555430	0.0000
LNROOMS	0.933250	0.057038	16.36197	0.0000
LNDD	0.448884	0.133234	3.369141	0.0012
FOODFAC	0.466603	0.119286	3.911619	0.0002

R-squared	0.879315	Mean dependent var	15.65626
Adjusted R-squared	0.874900	S.D. dependent var	0.722224
S.E. of regression	0.255447	Akaike info criterion	0.153791
Sum squared resid	5.350756	Schwarz criterion	0.267947
Log likelihood	-2.613006	F-statistic	199.1520
Durbin-Watson stat	0.898759	Prob(F-statistic)	0.000000

Tables 6 – 10 present the basic statistics of the independent variables for each hotel model. This includes the number of data records (observations) used to construct the model, the minimum, maximum, mean, and median values for each independent variable considered.

Table-6 Limited Descriptive Statistics for Upper Upscale Model and Its Dependent and Independent Variables

Variable	# of Obs	Min	Mean	Median	Max
LnSource	102	15.03	17.97	18.00	19.89
LnDD	102	7.69	8.51	8.56	9.07
DD	102	2185	5187	5200	8663
CDD	102	65	1566	1096	4798
HDD	102	0	3621	4047	7981
LnRooms	102	3.14	5.83	5.90	7.79
FoodFac	102	0	0.94	1.00	1.00

Table-7 Limited Descriptive Statistics for Upscale Model and Its Dependent and Independent Variables

Variable	# of Obs	Min	Mean	Median	Max
LnSource	275	15.35	17.59	17.59	20.10
LnDD	275	7.69	8.54	8.54	9.55
DD	275	2185	5354	5118	14024
CDD	275	0	1471	1201	4798
HDD	275	0	3883	3865	13940
LnRooms	275	3.93	5.59	5.62	7.55
FoodFac	275	0	0.86	1.00	1.00

Table-8 Limited Descriptive Statistics for Midscale with Food and Beverage Model and Its Dependent and Independent Variables

Variable	# of Obs	Min	Mean	Median	Max
LnSource	83	15.41	17.12	17.15	18.46
LnDD	83	7.69	8.61	8.64	9.27
DD	83	2185	5649	5669	10570
CDD	83	0	1510	1201	4798
HDD	83	0	4140	4514	10570
LnRooms	83	4.17	5.36	5.32	6.48
FoodFac	83	1.00	1.00	1.00	1.00

Table-9 Limited Descriptive Statistics for Midscale without Food and Beverage Model and Its Dependent and Independent Variables

Variable	# of Obs	Min	Mean	Median	Max
LnSource	159	15.49	16.23	16.20	17.85
LnDD	159	7.69	8.61	8.58	9.07
DD	159	2185	5636	5345	8663
CDD	159	65	1610	1348	4798
HDD	159	100	4026	3865	8284
LnRooms	159	3.83	4.81	4.83	5.74
FoodFac	159	0	0	0	0

Table-10 Limited Descriptive Statistics for Economy Model and Its Dependent and Independent Variables

Variable	# of Obs	Min	Mean	Median	Max
LnSource	86	13.77	15.66	15.57	18.25
LnDD	86	7.69	8.46	8.46	9.28
DD	86	2185	4916	4715	10736
CDD	86	65	1607	1473	4798
HDD	86	0	3309	2991	10487
LnRooms	86	3.22	4.44	4.49	6.52
FoodFac	86	0	0.08	0	1.00

Look-Up Table

Tables 11-15 are used compute the Energy Performance Rating (EPR) on a 1 to 100 scale seen by the user. Generating a histogram of energy consumption for each of the five categories created these tables. The column Actual LnSource is the natural logarithm of source energy consumption of the buildings in the PKF data set after normalizing for the level of business activity by applying the regression models in Tables 1 through 5 above. The column of Fitted LnSource is the same data, only smoothed out by fitting column Actual LnSource to a gamma distribution. In fitting the Actual LnSource the value corresponding to an EPR of 75—the minimum threshold for ENERGY STAR—is held constant. Users see EPRs from 1 to 100 based on the column Fitted LnSource.

Table-11 Energy Performance Rating, Adjusted LnSource, and Fitted LnSource for Upper Upscale Model

EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)		EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)
100	16.95	16.96		50	17.98	17.98
99	17.17	17.10		49	17.99	17.99
98	17.22	17.18		48	18.01	18.00
97	17.27	17.24		47	18.01	18.01
96	17.33	17.29		46	18.02	18.02
95	17.40	17.33		45	18.03	18.03
94	17.42	17.37		44	18.04	18.04
93	17.44	17.40		43	18.04	18.05
92	17.46	17.43		42	18.05	18.06
91	17.46	17.46		41	18.05	18.07
90	17.46	17.48		40	18.05	18.08
89	17.49	17.50		39	18.06	18.09
88	17.49	17.52		38	18.08	18.10
87	17.54	17.54		37	18.11	18.11
86	17.55	17.56		36	18.12	18.11
85	17.57	17.58		35	18.12	18.12
84	17.63	17.60		34	18.12	18.13
83	17.63	17.61		33	18.13	18.14
82	17.65	17.63		32	18.14	18.15
81	17.65	17.64		31	18.15	18.16
80	17.69	17.66		30	18.16	18.17
79	17.70	17.67		29	18.16	18.18
78	17.70	17.69		28	18.18	18.19
77	17.71	17.70		27	18.19	18.21
76	17.72	17.71		26	18.21	18.22
75	**17.73**	**17.73**		25	18.21	18.23
74	17.74	17.74		24	18.25	18.24
73	17.75	17.75		23	18.25	18.25
72	17.75	17.76		22	18.26	18.26
71	17.77	17.77		21	18.28	18.27
70	17.78	17.78		20	18.29	18.29
69	17.80	17.80		19	18.29	18.30
68	17.82	17.81		18	18.30	18.31
67	17.83	17.82		17	18.32	18.32
66	17.83	17.83		16	18.33	18.34
65	17.85	17.84		15	18.36	18.35
64	17.86	17.85		14	18.37	18.37
63	17.86	17.86		13	18.39	18.38
62	17.87	17.87		12	18.40	18.40
61	17.88	17.88		11	18.42	18.42
60	17.88	17.89		10	18.51	18.44
59	17.89	17.90		9	18.53	18.46
58	17.89	17.91		8	18.58	18.48
57	17.91	17.92		7	18.59	18.50
56	17.92	17.93		6	18.60	18.53
55	17.93	17.94		5	18.64	18.56
54	17.95	17.95		4	18.65	18.60
53	17.95	17.96		3	18.75	18.65
52	17.95	17.97		2	18.79	18.73
51	17.97	17.97		1	19.00	18.94

Table-12 Energy Performance Rating, Adjusted LnSource, and Fitted LnSource for Upscale Model

EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)		EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)
100	16.91	16.86		50	17.59	17.60
99	16.97	16.95		49	17.60	17.61
98	16.98	17.01		48	17.61	17.62
97	17.05	17.06		47	17.62	17.62
96	17.07	17.09		46	17.63	17.63
95	17.09	17.12		45	17.64	17.64
94	17.11	17.15		44	17.65	17.64
93	17.16	17.17		43	17.65	17.65
92	17.18	17.19		42	17.65	17.66
91	17.19	17.21		41	17.66	17.67
90	17.20	17.23		40	17.67	17.67
89	17.22	17.24		39	17.68	17.68
88	17.24	17.26		38	17.68	17.69
87	17.24	17.27		37	17.69	17.69
86	17.26	17.29		36	17.70	17.70
85	17.29	17.30		35	17.71	17.71
84	17.29	17.31		34	17.71	17.72
83	17.31	17.33		33	17.72	17.72
82	17.31	17.34		32	17.74	17.73
81	17.32	17.35		31	17.75	17.74
80	17.34	17.36		30	17.75	17.75
79	17.35	17.37		29	17.76	17.76
78	17.35	17.38		28	17.78	17.76
77	17.39	17.39		27	17.80	17.77
76	17.40	17.40		26	17.80	17.78
75	**17.41**	**17.41**		25	17.81	17.79
74	17.41	17.42		24	17.82	17.80
73	17.42	17.43		23	17.82	17.81
72	17.44	17.43		22	17.83	17.81
71	17.45	17.44		21	17.84	17.82
70	17.46	17.45		20	17.85	17.83
69	17.46	17.46		19	17.86	17.84
68	17.47	17.47		18	17.86	17.85
67	17.48	17.48		17	17.87	17.86
66	17.49	17.48		16	17.89	17.87
65	17.50	17.49		15	17.90	17.89
64	17.51	17.50		14	17.90	17.90
63	17.51	17.51		13	17.92	17.91
62	17.52	17.52		12	17.94	17.92
61	17.53	17.52		11	17.95	17.94
60	17.54	17.53		10	17.96	17.95
59	17.54	17.54		9	17.97	17.97
58	17.55	17.54		8	18.03	17.98
57	17.56	17.55		7	18.05	18.00
56	17.56	17.56		6	18.06	18.03
55	17.57	17.57		5	18.09	18.05
54	17.57	17.57		4	18.18	18.08
53	17.58	17.58		3	18.27	18.12
52	17.59	17.59		2	18.32	18.19
51	17.59	17.60		1	18.44	18.36

Table-13 Energy Performance Rating, Adjusted LnSource, and Fitted LnSource for Midscale with Food and Beverage Model

EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)		EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)
100	15.37	16.49		50	17.12	17.16
99	16.40	16.57		49	17.13	17.17
98	16.50	16.63		48	17.13	17.17
97	16.61	16.67		47	17.14	17.18
96	16.64	16.70		46	17.14	17.19
95	16.67	16.72		45	17.14	17.19
94	16.69	16.75		44	17.14	17.20
93	16.70	16.77		43	17.15	17.21
92	16.71	16.79		42	17.16	17.21
91	16.72	16.80		41	17.17	17.22
90	16.73	16.82		40	17.17	17.23
89	16.74	16.83		39	17.18	17.23
88	16.81	16.85		38	17.20	17.24
87	16.81	16.86		37	17.20	17.25
86	16.82	16.87		36	17.21	17.25
85	16.82	16.89		35	17.23	17.26
84	16.86	16.90		34	17.24	17.27
83	16.86	16.91		33	17.25	17.27
82	16.87	16.92		32	17.25	17.28
81	16.88	16.93		31	17.27	17.29
80	16.89	16.94		30	17.28	17.30
79	16.90	16.95		29	17.29	17.30
78	16.93	16.96		28	17.29	17.31
77	16.94	16.97		27	17.30	17.32
76	16.94	16.98		26	17.31	17.33
75	**16.98**	**16.98**		25	17.33	17.33
74	16.99	16.99		24	17.34	17.34
73	16.99	17.00		23	17.35	17.35
72	17.00	17.01		22	17.36	17.36
71	17.01	17.02		21	17.38	17.37
70	17.02	17.02		20	17.40	17.37
69	17.03	17.03		19	17.41	17.38
68	17.04	17.04		18	17.45	17.39
67	17.04	17.05		17	17.46	17.40
66	17.04	17.05		16	17.47	17.41
65	17.05	17.06		15	17.47	17.42
64	17.05	17.07		14	17.48	17.43
63	17.05	17.08		13	17.52	17.45
62	17.05	17.08		12	17.53	17.46
61	17.06	17.09		11	17.53	17.47
60	17.06	17.10		10	17.58	17.48
59	17.07	17.10		9	17.58	17.50
58	17.09	17.11		8	17.58	17.51
57	17.10	17.12		7	17.58	17.53
56	17.10	17.12		6	17.65	17.55
55	17.10	17.13		5	17.69	17.58
54	17.10	17.14		4	17.72	17.61
53	17.11	17.14		3	17.76	17.64
52	17.11	17.15		2	17.81	17.70
51	17.12	17.16		1	17.89	17.86

Table-14 Energy Performance Rating, Adjusted LnSource, and Fitted LnSource for Midscale without Food and Beverage Model

EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)		EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)
100	15.56	15.59		50	16.24	16.24
99	15.59	15.67		49	16.24	16.24
98	15.75	15.73		48	16.24	16.25
97	15.81	15.76		47	16.25	16.26
96	15.84	15.79		46	16.25	16.26
95	15.86	15.82		45	16.26	16.27
94	15.86	15.84		44	16.27	16.28
93	15.90	15.86		43	16.28	16.28
92	15.90	15.88		42	16.29	16.29
91	15.93	15.90		41	16.29	16.29
90	15.93	15.91		40	16.29	16.30
89	15.94	15.93		39	16.30	16.31
88	15.96	15.94		38	16.30	16.31
87	15.96	15.95		37	16.31	16.32
86	15.97	15.96		36	16.31	16.33
85	15.98	15.97		35	16.32	16.33
84	16.00	15.99		34	16.32	16.34
83	16.00	16.00		33	16.33	16.35
82	16.01	16.01		32	16.34	16.35
81	16.01	16.02		31	16.35	16.36
80	16.02	16.02		30	16.36	16.37
79	16.04	16.03		29	16.37	16.37
78	16.06	16.04		28	16.38	16.38
77	16.06	16.05		27	16.38	16.39
76	16.07	16.06		26	16.39	16.40
75	**16.07**	**16.07**		25	16.40	16.40
74	16.07	16.08		24	16.41	16.41
73	16.09	16.08		23	16.41	16.42
72	16.09	16.09		22	16.43	16.43
71	16.10	16.10		21	16.44	16.43
70	16.10	16.11		20	16.44	16.44
69	16.11	16.11		19	16.44	16.45
68	16.11	16.12		18	16.44	16.46
67	16.12	16.13		17	16.46	16.47
66	16.14	16.14		16	16.48	16.48
65	16.14	16.14		15	16.49	16.49
64	16.15	16.15		14	16.50	16.50
63	16.15	16.16		13	16.52	16.51
62	16.17	16.16		12	16.54	16.52
61	16.17	16.17		11	16.54	16.54
60	16.17	16.18		10	16.55	16.55
59	16.17	16.18		9	16.55	16.56
58	16.17	16.19		8	16.60	16.58
57	16.18	16.19		7	16.61	16.60
56	16.19	16.20		6	16.64	16.62
55	16.19	16.21		5	16.67	16.64
54	16.21	16.21		4	16.70	16.67
53	16.22	16.22		3	16.72	16.70
52	16.22	16.23		2	16.74	16.76
51	16.23	16.23		1	16.93	16.91

Table-15 Energy Performance Rating, Adjusted LnSource, and Fitted LnSource for Economy Mode

EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)		EPR	Actual LnSource (kBtu/year)	Fitted LnSource (kBtu/year)
100	15.02	14.99		50	15.67	15.67
99	15.06	15.07		49	15.67	15.67
98	15.21	15.13		48	15.67	15.68
97	15.24	15.17		47	15.67	15.68
96	15.26	15.20		46	15.67	15.69
95	15.26	15.23		45	15.67	15.70
94	15.32	15.25		44	15.68	15.70
93	15.33	15.27		43	15.68	15.71
92	15.34	15.29		42	15.69	15.72
91	15.35	15.31		41	15.70	15.72
90	15.35	15.32		40	15.70	15.73
89	15.35	15.34		39	15.71	15.74
88	15.36	15.35		38	15.71	15.74
87	15.37	15.36		37	15.71	15.75
86	15.40	15.38		36	15.72	15.76
85	15.41	15.39		35	15.73	15.76
84	15.43	15.40		34	15.73	15.77
83	15.43	15.41		33	15.74	15.78
82	15.43	15.42		32	15.74	15.78
81	15.44	15.43		31	15.75	15.79
80	15.44	15.44		30	15.78	15.80
79	15.46	15.45		29	15.79	15.81
78	15.46	15.46		28	15.80	15.81
77	15.48	15.47		27	15.82	15.82
76	15.48	15.48		26	15.82	15.83
75	**15.49**	**15.49**		25	15.83	15.84
74	15.49	15.50		24	15.84	15.84
73	15.49	15.50		23	15.84	15.85
72	15.49	15.51		22	15.86	15.86
71	15.49	15.52		21	15.86	15.87
70	15.52	15.53		20	15.86	15.88
69	15.56	15.53		19	15.88	15.89
68	15.56	15.54		18	15.88	15.90
67	15.56	15.55		17	15.88	15.91
66	15.58	15.56		16	15.90	15.92
65	15.59	15.56		15	15.91	15.93
64	15.59	15.57		14	15.92	15.94
63	15.60	15.58		13	15.94	15.95
62	15.61	15.59		12	15.95	15.96
61	15.61	15.59		11	15.97	15.97
60	15.61	15.60		10	16.00	15.99
59	15.61	15.61		9	16.01	16.00
58	15.62	15.61		8	16.03	16.02
57	15.62	15.62		7	16.03	16.04
56	15.63	15.63		6	16.05	16.06
55	15.63	15.63		5	16.06	16.08
54	15.64	15.64		4	16.09	16.11
53	15.65	15.65		3	16.11	16.15
52	15.65	15.65		2	16.22	16.21
51	15.66	15.66		1	16.45	16.37

Assessing Performance

To assess the performance of a building via the Energy Performance Rating on the 1 to 100 scale, two calculations are made upon the user entering the requisite data. First, as explained in the Weather Normalization file (downloadable at www.energystar.gov), the user's actual annual source energy intensity, in kBtu/ft^2-yr, is weather normalized to reflect the annual source energy intensity the building would have seen in a normal (i.e. 30-year average) weather year. In the second calculation, the weather normalized energy consumption is further adjusted so as to normalize for the level of business activity. Once the energy consumption is normalized for weather and business level activity effects, the look up Tables 11 to 15 are used to report the final EPR.

To account for level of business activity, the regression-model equations are used to calculate a predicted LnSource energy consumption value based on the operating characteristics entered by the user. This predicted LnSource energy consumption is then divided by the mean LnSource energy consumption of the regression model, which yields an adjustment factor. The adjustment factor is then multiplied to each of the Fitted LnSource energy consumption values in Tables 11 to 15 respectively, corresponding to EPRs from 1 to 100 to provide a range of Customized LnSource values. Next, the exponential of LnSource values are taken and then divided by the user's actual building area (ft^2) yielding a table of Customized Source EUI values corresponding to EPRs from 1 to 100. Finally, to calculate the EPR of the building, the building's weather-normalized Source EUI is compared to the table of Customized Source EUI values.

Table-16 is intended for use with the following example to illustrate how an EPR is determined for a given building. In this example, the actual Source EUI was weather normalized down approximately 2%; in essence meaning that over the course of the year in which the building's energy consumption was reported the building "experienced" a net 2% more severe weather year than normal.

Example Upscale Motel

Area	=	400,000 ft^2
DD	=	3070
# of Rooms	=	360
Food Facility	=	yes ("yes" = 1; "no" = 0)

Actual Source EUI = 104.9 kBtu/ft^2-yr

Weather Norm. Source EUI = 102.8 kBtu/ft^2-yr ⟵

Regression Equation

LnSource (kBtu/year) = $C_0 + C_1$ Ln(Rooms) + C_2 Ln(DD) + C_3(FoodFac)

LnSource (kBtu/year) = 8.034322472 + 1.217667723*Ln(Rooms) + 0.3076860709*Ln(DD) + 0.1562447001*(FoodFac)

Predicted LnSource	=	17.83
Mean LnSource	=	17.59
Adjustment Factor	=	(17.83/17.59)
	=	1.0135

Table-16 Determining Energy Performance Rating

EPR	Fitted LnSource	Adjustment Factor	Customized LnSource	Customized Source EUI (kBtu/ft^2-yr)
100	16.86	1.0135	17.09	66.1
99	16.95	1.0135	17.18	72.3
98	17.01	1.0135	17.24	76.8
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
85	17.30	1.0135	17.53	102.6
84	17.31	1.0135	17.54	103.6
83	17.33	1.0135	17.56	105.7
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
1	18.36	1.0135	18.61	302.1

Note that when this model is placed onto the production site with the Energy Performance Rating software tool, users can include other space types to further characterize their building. These space types include office, computer rooms, garage space, and parking lots. With the exception of parking lots, these other space types, if used to characterize the building having hotel space, are incorporated into the benchmarking targets by using weighted averages. If defined by the user, the energy impact associated with parking lots is simply added to the customized look up table.