

Appendix 1 Information for selected variables for predictors and responses.

Variable name	Variable type	Label	Values/Format codes
Building Characteristics			
SQFT	Num	Square footage	1,001 – 2,100,000
NFLOOR	Num	Number of floors	1 – 9 12=10 to 14
BASEMNT	Num	Number of underground floors	0 – 4 5=5 or more
ATTIC	Cate	Attic	1=Yes 2=No
FLCEILHT	Num	Floor to ceiling height	7 – 50
YRCONC	Cate	Year of construction category	2=Before 1946 3=1946 to 1959 4=1960 to 1969 5=1970 to 1979 6=1980 to 1989 7=1990 to 1999 8=2000 to 2012 9=2013 to 2018
RFTILT	Cate	Roof tilt	1=Flat 2=Shallow pitch 3=Steeper pitch
DAYLTP	Num	Percent daylight	0 – 100
WLCNS	Cate	Wall construction material	1=Brick, stone, or stucco 2=Pre-cast concrete panels 3=Concrete block or poured concrete (above grade) 4=Aluminum, asbestos, plastic, or wood materials (siding, shingles, tiles,5=Sheet metal panels 6=Window or vision glass (glass that can be seen through) 7=Decorative or construction glass (glass that cannot be seen through) 8=Other
RFCNS	Cate	Roof construction material	1=Built-up (tar, felts, or fiberglass and a ballast, such as stone) 2=Slate or tile shingles 3=Wood shingles, shakes, or other wooden materials 4=Asphalt, fiberglass, or other shingles 5=Metal surfacing 6=Plastic, rubber, or synthetic sheeting (single or multiple ply) 7=Concrete 8=Other
SKYLT	Cate	Skylights or atriums designed to provide light	1=Yes 2=No
GLSSPC	Cate	Percent exterior glass	1=1% or less 2=2 to 10% 3=11 to 25% 4=26 to 50% 5=51 to 75% 6=76 to 100%
WINTYP	Cate	Window glass type	1=Single-layer glass 2=Multi-layer glass 3=Combination of both 4=No windows
TINT	Cate	Tinted window glass	1=Yes 2=No
REFL	Cate	Reflective window glass	1=Yes 2=No
Occupancy			

PBA	Cate	Principal building activity	1=Vacant 2=Office 4=Laboratory 6=Food sales 7=Public order and safety 8=Outpatient health care 12=Religious worship 13=Public assembly 14=Education 15=Food service 16=Inpatient health care 17=Nursing 18=Lodging 23=Strip shopping center 24=Enclosed mall 25=Retail other than mall 26=Service 91=Other
OWNOCC	Cate	Derived variable: Owner occupied or leased to tenant(s)	1=Yes 2=No 3=Not applicable
OWNOPR	Cate	Owner operates	1=Yes 2=No
WKHRS	Num	Total hours open per week	0 – 168
NWKER	Num	Number of employees	0 – 7,500
Climate			
PUBCLIM	Cate	Third-party data: ASHRAE climate zone	1=Cold or very cold 2=Cool 3=Mixed mild 4=Warm 5=Hot or very hot 7=Withheld for confidentiality
HDD65	Num	Third-party data: Heating degree days (base 65)	402 – 10,790
CDD65	Num	Third-party data: Cooling degree days (base 65)	10 – 5,643
Renovations (Note that, here "No" is represented by 0, and these are numeric variables.)			
RENOV	Num	Renovations	1=Yes 0=No
RENRFF	Num	Roof replacement	1=Yes 0=No
RENWIN	Num	Window replacement	1=Yes 0=No
RENHVC	Num	HVAC equipment upgrade	1=Yes 0=No
RENLGT	Num	Lighting upgrade	1=Yes 0=No
RENPLB	Num	Plumbing system upgrade	1=Yes 0=No
RENELC	Num	Electrical upgrade	1=Yes 0=No
type_RENOV	Cate	Category for renovations	1=Non-updated aged building 2=New building 3=Updated aged building
type_RENRFF	Cate	Category for renovations in roof	1=Non-updated aged building 2=New building 3=Updated aged building
type_RENWIN	Cate	Category for renovations in window	1=Non-updated aged building 2=New building 4=Updated aged building
type_RENLGT	Cate	Category for renovations in lighting	1=Non-updated aged building 2=New building 5=Updated aged building
type_RENHVC	Cate	Category for renovations in HVAC	1=Non-updated aged building 2=New building 6=Updated aged building
type_RENPLB	Cate	Category for renovations in plumbing	1=Non-updated aged building 2=New building 7=Updated aged building
type_RENELC	Cate	Category for renovations in electric	1=Non-updated aged building 2=New building 8=Updated aged building
Response Variables (need to be divided by SQFT)			
MFBTU	Num	Derived variable: Annual major fuels consumption (thous Btu)	124 – 802,588,047

MFHTBTU	Num	Modeled variable: Major fuels heating use (thous Btu)	0 – 417,233,255
MFCLBTU	Num	Modeled variable: Major fuels cooling use (thous Btu)	0 – 121,963,882
MFVNBTU	Num	Modeled variable: Major fuels ventilation use (thous Btu)	0 – 180,731,980
MFLTBTU	Num	Modeled variable: Major fuels lighting use (thous Btu)	0 – 49,404,857
TOTEUI	Num	Annual major fuels consumption per square feet	0.013 - 1710.839
HTEUI	Num	Major fuels heating use per square feet	0 - 477.64
CLEUI	Num	Major fuels cooling use per square feet	0 - 136.58
LTEUI	Num	Major fuels lighting use per square feet	0 - 88.68
VNEUI	Num	Major fuels ventilation use per square feet	0 - 145.82

Appendix 2 Results for full multiple linear regression models

R^2	TotalEUI (TOTEUI)		CoolingEUI (CLEUI)		HeatingEUI (HTEUI)		Ventilation EUI (VNEUI)		Lighting EUI (LTEUI)	
	coef	p-value	coef	p-value	coef	p-value	coef	p-value	coef	p-value
	0.4834		0.4109		0.1899		0.4798		0.2497	
(Intercept)	(33.9315)	0.1056	(14.0860)	0.0001	(19.5783)	0.0744	(3.4513)	0.0780	(0.2298)	0.9485
PBA2	16.1568	0.0577	4.0402	0.0283	11.4186	0.0035	5.5984	0.0000	(0.7951)	0.7185
PBA4	70.4465	0.2644	17.8128	0.0075	28.1057	0.1193	(1.7324)	0.5704	(1.6485)	0.6764
PBA6	159.9339	0.0000	4.7148	0.0165	20.5584	0.0023	5.5337	0.0000	3.2426	0.1583
PBA7	(0.0833)	0.9952	5.5279	0.0053	15.9253	0.0424	(5.0800)	0.0001	(3.4409)	0.1770
PBA8	24.0357	0.0192	2.5049	0.2120	11.0858	0.0121	11.0233	0.0000	1.7364	0.4413
PBA12	11.4673	0.1507	3.4572	0.0935	11.3553	0.0043	1.2895	0.0728	(3.0028)	0.2126
PBA13	26.8664	0.0024	11.9683	0.0000	20.4714	0.0000	(0.5492)	0.4242	(3.5878)	0.1032
PBA14	18.1935	0.0427	6.3257	0.0011	14.0095	0.0027	0.8845	0.1934	(3.2320)	0.1619
PBA15	217.6336	0.0000	15.5067	0.0000	19.4199	0.0001	11.5851	0.0000	0.9338	0.6925
PBA16	92.6095	0.0000	14.7684	0.0001	46.1136	0.0003	11.4748	0.0000	(3.8684)	0.1097
PBA17	24.2926	0.1461	6.2388	0.0094	10.3404	0.1641	4.9479	0.0875	(1.3147)	0.6790
PBA18	(10.9351)	0.5000	2.4236	0.2713	(0.7265)	0.9311	(1.3745)	0.4496	(8.5711)	0.0006
PBA23	49.8397	0.0000	2.1469	0.2911	20.1695	0.0000	3.4286	0.0001	1.9046	0.4333
PBA24	48.3890	0.0154	12.4012	0.0009	4.7716	0.6014	1.2676	0.5726	4.4911	0.2540
PBA25	(0.1406)	0.9880	2.5896	0.1307	2.6685	0.5348	1.4396	0.0758	1.1454	0.6316
PBA26	14.5840	0.0524	3.9148	0.0311	12.3145	0.0007	(0.6533)	0.3446	0.0370	0.9874
PBA91	25.8966	0.1728	5.9830	0.0280	6.4952	0.4786	(3.2349)	0.0091	(0.8083)	0.7448
SQFT	(0.0001)	0.0000	(0.0000)	0.0000	(0.0000)	0.2893	(0.0000)	0.0265	(0.0000)	0.1024
NFLOOR2	(8.0344)	0.0299	(0.8779)	0.0938	(1.2079)	0.4939	0.2315	0.5812	0.1080	0.8018
NFLOOR3	(12.8995)	0.0190	(1.4072)	0.0537	(1.8399)	0.5619	(0.8602)	0.1327	0.0091	0.9869
NFLOOR4	(12.9959)	0.0629	(3.6820)	0.0000	2.9598	0.4697	(0.7880)	0.2777	(0.8705)	0.2607
NFLOOR5	(0.0382)	0.9957	(2.4372)	0.1199	4.3733	0.3235	0.3633	0.7214	(0.7613)	0.1716
NFLOOR6	(16.0872)	0.0660	(2.4670)	0.0276	(3.7231)	0.4501	1.0539	0.5021	3.7544	0.1394
NFLOOR7	(3.7090)	0.6570	(0.1086)	0.9345	(2.0618)	0.6316	0.4017	0.8077	0.1227	0.9213
NFLOOR8	0.5114	0.9678	(2.1526)	0.2622	5.3353	0.4176	0.6062	0.7036	0.4815	0.7017
NFLOOR9	(1.0372)	0.9226	(5.1599)	0.0005	3.8636	0.4076	(1.8500)	0.2393	0.7262	0.6834
NFLOOR12	(1.6296)	0.8941	(1.1564)	0.4196	(2.5514)	0.6142	2.1097	0.0614	(0.3533)	0.7236
BASEMNT	(0.6039)	0.8626	(0.0536)	0.9221	(0.7234)	0.7759	0.1226	0.8026	(0.5978)	0.1041
ATTIC2	0.0932	0.9820	0.3332	0.4616	(0.4706)	0.7042	0.5112	0.1294	(0.4924)	0.1197
FLCEILHT	0.3444	0.1515	0.0291	0.3383	0.3796	0.0046	(0.0124)	0.4940	(0.0383)	0.4656
RFTILT2	(9.1020)	0.0635	(0.9160)	0.1257	(1.0688)	0.4941	(0.9594)	0.0119	(0.1100)	0.8463
RFTILT3	(10.9885)	0.0709	(0.8536)	0.1992	(0.3637)	0.8551	(0.8473)	0.0423	(0.2548)	0.6232
DAYLTP	0.0124	0.8514	0.0011	0.9058	(0.0202)	0.4917	(0.0016)	0.7476	(0.0030)	0.6549
WLCNS2	0.8620	0.9120	(1.3857)	0.2468	(0.0283)	0.9947	0.3152	0.6115	0.6916	0.4119
WLCNS3	(5.8688)	0.1320	0.4623	0.4391	0.0107	0.9940	(0.2523)	0.5333	0.2083	0.5552
WLCNS4	(1.4604)	0.8021	0.4528	0.3787	(2.2312)	0.3375	(0.7797)	0.1202	0.7053	0.3746
WLCNS5	(9.6931)	0.0490	(0.8683)	0.3207	(3.7525)	0.1420	(0.6643)	0.1954	(0.2400)	0.7896
WLCNS6	20.8695	0.4315	(2.8204)	0.3390	0.2111	0.9641	(0.4551)	0.6855	0.6197	0.7009
WLCNS7	42.6991	0.5763	0.0946	0.9766	(10.7532)	0.0002	17.2958	0.3868	(1.5867)	0.1504
WLCNS8	2.1764	0.8332	(0.9146)	0.4546	(0.7243)	0.7769	(0.1593)	0.8974	0.3097	0.7490
RFCNS2	7.5776	0.2571	0.2374	0.8201	1.6048	0.4920	(0.0174)	0.9812	(0.3547)	0.5445
RFCNS3	0.4425	0.9683	(0.6080)	0.6650	1.5742	0.7517	(0.0156)	0.9869	(0.2005)	0.8154
RFCNS4	8.0319	0.2232	0.1386	0.8722	2.1580	0.3848	0.0744	0.9077	(0.1550)	0.7930
RFCNS5	1.4926	0.7583	0.1066	0.9197	(0.8311)	0.7149	0.2847	0.6571	(0.0199)	0.9701
RFCNS6	11.0458	0.0206	(0.6047)	0.3523	4.0009	0.0475	0.2950	0.5497	0.7758	0.3049
RFCNS7	0.5440	0.9491	4.3293	0.1378	(10.4906)	0.0541	1.0115	0.4779	0.0419	0.9677
RFCNS8	(1.6168)	0.8916	(1.2634)	0.3528	(3.0541)	0.2651	(0.8005)	0.3825	2.3832	0.0397
SKYLT2	6.9245	0.1135	0.9075	0.2386	3.9358	0.0192	0.2622	0.5871	0.3515	0.4798
GLSSPC2	4.0165	0.3033	1.6378	0.0053	1.6883	0.4604	0.2240	0.6502	0.6791	0.1082
GLSSPC3	8.9734	0.0596	2.2162	0.0005	3.2531	0.1153	(0.2918)	0.5073	0.8668	0.0452
GLSSPC4	19.5271	0.0031	5.2466	0.0000	5.1789	0.0397	0.8011	0.1263	1.5978	0.0084
GLSSPC5	25.1348	0.0106	9.5941	0.0003	7.3453	0.2148	0.3381	0.7271	3.0399	0.1277
GLSSPC6	(20.2020)	0.1886	8.0949	0.0001	0.3984	0.9527	(2.0074)	0.1452	(2.9807)	0.0529
WINTYP2	(3.7334)	0.4170	0.8133	0.1257	(5.1673)	0.0125	0.8703	0.0254	(0.0587)	0.8817
WINTYP3	4.7970	0.2997	2.5208	0.0058	(3.2062)	0.0954	1.1675	0.0021	1.1588	0.0963
WINTYP4	(11.7962)	0.0665	(0.8987)	0.3479	(13.3203)	0.0001	(0.1351)	0.7895	1.3644	0.4836
REFL2	5.0493	0.2834	1.5974	0.0193	3.8536	0.0129	0.3683	0.5050	0.5659	0.3366
TINT2	(3.5498)	0.3835	0.2432	0.6391	(0.8369)	0.5213	0.0548	0.8732	0.3367	0.2991
OWNOCC2	(0.4763)	0.9037	(0.6981)	0.2189	(1.5277)	0.3535	(0.0311)	0.9328	1.1682	0.1559
OWNOCC3	8.4721	0.3516	4.2950	0.0334	3.7310	0.4388	1.5124	0.0385	(2.3967)	0.3638
OWNOPR2	7.3167	0.2054	0.9043	0.1212	0.8119	0.7450	0.1584	0.7751	0.4599	0.6058
WKHRS	0.5162	0.0000	0.0328	0.0001	0.0895	0.0078	0.0859	0.0000	0.0552	0.0000
NWKER	0.0499	0.0001	0.0011	0.4217	0.0030	0.4754	0.0065	0.0000	0.0034	0.0023
PUBCLIM2	8.2469	0.1502	0.5581	0.2426	2.6818	0.5492	0.4677	0.3805	1.4694	0.1178
PUBCLIM3	12.4024	0.0931	2.3770	0.0040	4.5721	0.3632	0.4615	0.4784	1.7481	0.0507
PUBCLIM4	8.0702	0.4560	4.2997	0.0003	(0.9940)	0.8764	0.5171	0.5643	2.0726	0.0988

PUBCLIM5	(9.1500)	0.4971	6.8587	0.0009	(11.3895)	0.1212	(0.8531)	0.4766	2.2937	0.1224
PUBCLIM7	2.9447	0.7736	0.9615	0.3662	(3.0335)	0.6425	0.0424	0.9711	2.6879	0.0719
HDD65	0.0043	0.0422	0.0002	0.3250	0.0034	0.0008	0.0000	0.8168	0.0002	0.2769
CDD65	0.0076	0.0099	0.0036	0.0000	0.0006	0.5179	0.0005	0.0566	0.0004	0.1984
type_RENWIN3	5.7029	0.1482	0.9716	0.0855	0.7136	0.6912	0.5630	0.1239	1.6508	0.0480
type_RENWIN4	(2.8823)	0.6390	(0.0660)	0.9317	3.3575	0.3400	(0.3289)	0.4987	0.7731	0.1237
RENRF5	1.7664	0.7946	0.6388	0.3407	(3.2811)	0.1502	0.4473	0.4549	(0.0230)	0.9640
RENLT6	2.9176	0.5049	(0.5663)	0.3165	3.5972	0.0867	(0.5122)	0.2983	(0.8181)	0.0885
RENHVC	0.8544	0.8955	(0.5927)	0.3547	1.6313	0.6351	0.7289	0.1476	0.9549	0.0648
RENPLB	(13.7239)	0.0286	(0.0821)	0.9039	(6.0849)	0.0533	(0.4954)	0.3755	(0.6321)	0.2561
RENELC	0.5120	0.9390	0.2786	0.7156	0.1160	0.9716	(0.2652)	0.6251	(0.0277)	0.9658

Appendix 3 Results for reduced multiple linear regression models

R^2	TotalEUI (TOTEUI)		CoolingEUI (CLEUI)		HeatingEUI (HTEUI)		Ventilation EUI (VNEUI)		Lighting EUI (LTEUI)	
	coef	p-value	coef	p-value	coef	p-value	coef	p-value	coef	p-value
	0.4758		0.4032		0.1744		0.4691		0.2361	
(Intercept)	0.2204	0.9828	(10.8464)	0.0000	(22.6610)	0.0000	(1.1745)	0.0909	0.8623	0.5240
PBA2	10.2949	0.0803	3.4190	0.0380	9.1759	0.0204	5.7377	0.0000	1.3447	0.2867
PBA4	58.5027	0.3665	17.0227	0.0122	29.4642	0.0961	(2.1997)	0.5488	0.1947	0.9529
PBA6	154.1631	0.0000	3.9070	0.0297	19.6960	0.0040	5.4548	0.0000	5.2143	0.0007
PBA7	(8.7900)	0.4707	4.4249	0.0173	14.8702	0.0530	(5.1307)	0.0000	(1.5688)	0.3930
PBA8	17.4051	0.0191	1.9721	0.2576	9.4044	0.0388	11.2475	0.0000	4.0815	0.0022
PBA12	8.4870	0.1118	2.9806	0.1131	9.3307	0.0361	1.6353	0.0107	(1.4365)	0.2479
PBA13	20.7233	0.0013	11.3451	0.0000	18.6961	0.0002	(0.4624)	0.4630	(1.8378)	0.1184
PBA14	9.6780	0.1210	5.6941	0.0015	11.8380	0.0064	0.9191	0.1099	(1.4314)	0.2411
PBA15	213.7424	0.0000	14.9978	0.0000	17.8818	0.0011	11.9506	0.0000	2.9752	0.0325
PBA16	79.5956	0.0000	13.7535	0.0001	42.7114	0.0000	11.0881	0.0000	(1.8347)	0.2681
PBA17	17.3216	0.2624	5.0900	0.0227	8.3440	0.2590	4.6099	0.1158	1.1671	0.6336
PBA18	(17.6551)	0.2120	1.6571	0.4171	(3.3594)	0.6614	(1.3786)	0.3791	(6.2523)	0.0005
PBA23	53.3621	0.0000	1.8437	0.3203	18.4000	0.0001	3.5905	0.0000	4.5952	0.0018
PBA24	35.8032	0.0488	11.2216	0.0021	(3.3127)	0.5836	0.8247	0.6511	7.3283	0.0409
PBA25	(3.6566)	0.5913	2.1238	0.1692	0.8620	0.8495	1.5699	0.0314	3.4017	0.0110
PBA26	6.6080	0.1896	3.2626	0.0481	10.1366	0.0083	(0.6789)	0.2655	1.8648	0.1607
PBA91	18.9137	0.3123	5.2800	0.0530	5.2220	0.5528	(3.1170)	0.0056	0.8681	0.6243
SQFT	(0.0001)	0.0000	(0.0000)	0.0000	(0.0000)	0.5827	(0.0000)	0.0518	(0.0000)	0.0609
NFLOOR2	(7.5732)	0.0723	(0.9890)	0.0519			0.1722	0.6634	(0.1227)	0.7543
NFLOOR3	(11.1521)	0.0194	(1.5750)	0.0268			(0.8361)	0.0458	(0.4764)	0.3161
NFLOOR4	(12.0654)	0.0673	(3.9998)	0.0000			(0.6591)	0.2848	(1.3832)	0.0557
NFLOOR5	1.7089	0.7957	(2.4037)	0.0931			0.4141	0.6781	(1.3355)	0.0128
NFLOOR6	(14.3536)	0.0354	(2.5803)	0.0089			1.4258	0.2960	3.1852	0.2133
NFLOOR7	(6.2462)	0.3253	(0.2301)	0.8480			0.0477	0.9776	(0.5549)	0.6652
NFLOOR8	0.0443	0.9967	(2.1664)	0.2108			1.2025	0.1986	(0.3095)	0.8134
NFLOOR9	0.1148	0.9901	(4.7776)	0.0026			(1.6975)	0.2005	0.0949	0.9578
NFLOOR12	(2.8522)	0.7964	(1.1022)	0.3836			2.1860	0.0189	(1.0320)	0.2681
BASEMNT			0.1283	0.8085						
ATTIC2										
FLCEILHT					0.3498	0.0083				
RFTILT2	(9.8645)	0.0172					(1.2710)	0.0003		
RFTILT3	(11.7662)	0.0082					(1.3099)	0.0003		
DAYLTP										
WLCNS2					(0.8205)	0.8495				
WLCNS3					(0.0389)	0.9801				
WLCNS4					(2.5992)	0.2699				
WLCNS5					(4.3117)	0.0735				
WLCNS6					0.6164	0.8946				
WLCNS7					(11.2150)	0.0360				
WLCNS8					(1.5998)	0.5279				
RFCNS2	7.1246	0.2603			1.7271	0.4220			(0.3035)	0.5561
RFCNS3	(1.0135)	0.9268			0.2477	0.9591			0.0187	0.9837
RFCNS4	7.4008	0.2788			2.0868	0.3797			0.0679	0.8974
RFCNS5	(2.5780)	0.5651			(1.3329)	0.5171			(0.1093)	0.8314
RFCNS6	9.2768	0.0393			4.0589	0.0501			0.7484	0.3284
RFCNS7	(1.0264)	0.9022			(12.1643)	0.0239			0.1324	0.8932
RFCNS8	(0.7360)	0.9544			(2.8079)	0.2727			2.4487	0.0327
SKYLT2					3.7327	0.0191				
GLSSPC2	6.4406	0.0747	1.7218	0.0019	1.1765	0.6053			0.7777	0.0785
GLSSPC3	11.4513	0.0149	2.3301	0.0002	2.5666	0.1968			0.8690	0.0327
GLSSPC4	22.9104	0.0002	5.5107	0.0000	4.5775	0.0450			1.6042	0.0032
GLSSPC5	30.7629	0.0035	9.5117	0.0005	6.9431	0.2262			3.2036	0.1038
GLSSPC6	(9.5684)	0.4760	7.6370	0.0013	0.6690	0.9234			(2.1606)	0.0849
WINTYP2			0.5761	0.2888	(4.4564)	0.0322	0.7239	0.0513	(0.1605)	0.7129
WINTYP3			2.3454	0.0089	(2.7200)	0.1640	1.0656	0.0044	0.9337	0.1424
WINTYP4			(1.0451)	0.2504	(11.9359)	0.0004	(0.2140)	0.5922	1.3780	0.4489
REFL2			1.5804	0.0216	4.0441	0.0081				
TINT2										
OWNOCC2			(0.2584)	0.6292			0.0237	0.9524		
OWNOCC3			3.8766	0.0730			1.5266	0.0206		
OWNOPR2										
WKHRS	0.5032	0.0000	0.0354	0.0000	0.0817	0.0124	0.0856	0.0000	0.0556	0.0000
NWKER	0.0495	0.0000					0.0067	0.0000	0.0036	0.0008
PUBCLIM2			0.3138	0.4581					1.0964	0.0946
PUBCLIM3			1.7824	0.0059					1.2107	0.0150

[illegible]