6.0 eQUEST SIMULATION AND ANALYSIS

Lots of parameters need to be put in the eQuest screens, but some of them could not be exactly found;

Therefore, assumptions based on the provided project PDF file, building code, and other online sources, are applied in the following eQuest simulation and analysis.

6.1 Baseline Single-run Reports

1 apartment:

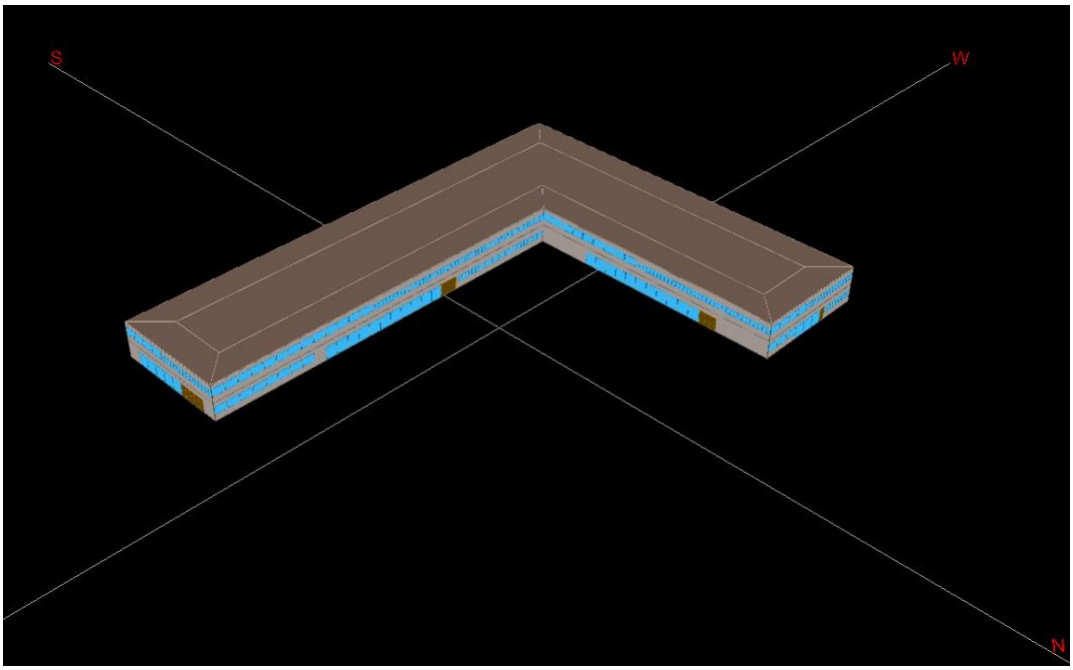


Figure 6.1 building shell of 1 apartment

Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	-	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	1,085.1	-	-
HP Supp.	-	-	-	-
Hot Water	-	620.3	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	5,914	-	-	-
Ext. Usage	7,729	-	-	-
Misc. Equip.	44,606	-	-	-
Task Lights	-	-	-	-
Area Lights	8,239	-	-	-
Total	66,488	1,705.4	-	-

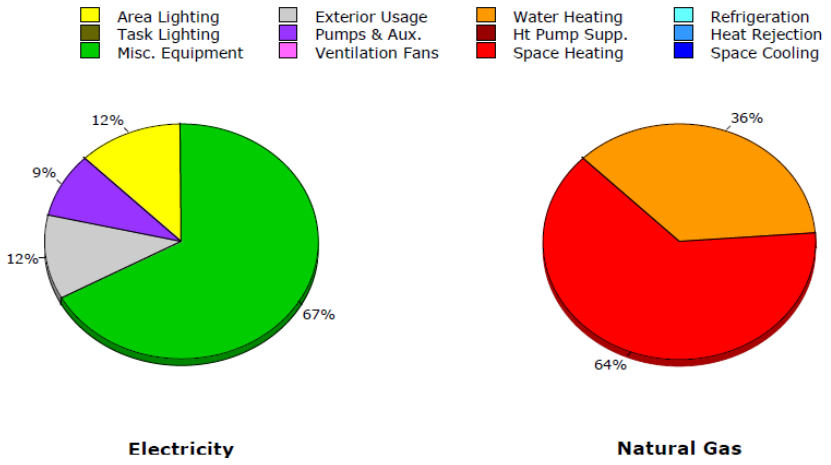


Figure 6.2 Annual Energy Consumption by Enduse

Annual energy consumption by Enduse for 2 apartments:

Table 6.1 Annual energy consumption by Enduse for 2 apartments

	Electricity (kWh)	Natural gas (MBtu)
Total	66488*2=132,976	1705.4*2=3410.8

Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h (x000)	Steam Btu/h	Chilled Water Btu/h
Space Cool	-	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	454.74	-	-
HP Supp.	-	-	-	-
Hot Water	-	124.51	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	0.70	-	-	-
Ext. Usage	2.04	-	-	-
Misc. Equip.	16.71	-	-	-
Task Lights	-	-	-	-
Area Lights	1.86	-	-	-
Total	21.30	579.25	-	-

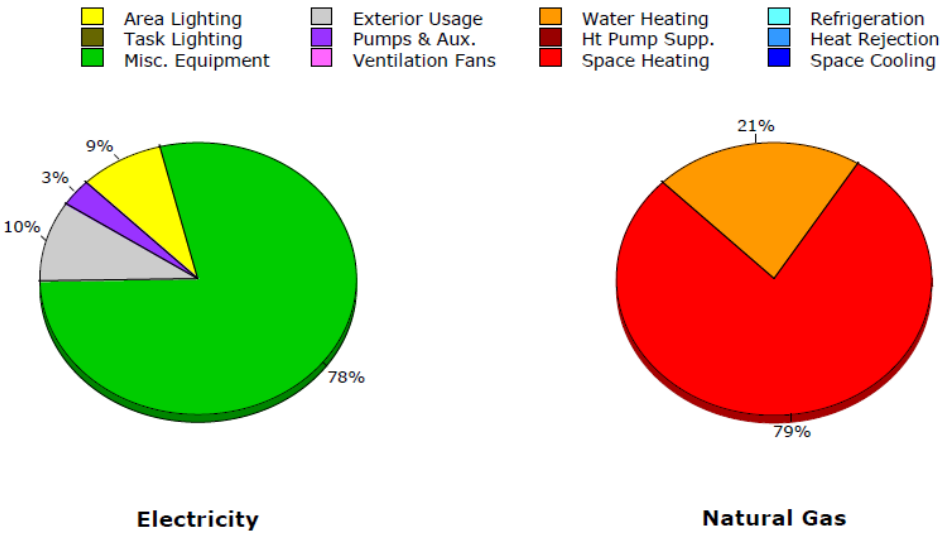


Figure 6.3 Annual Peak Demand by Enduse (1 apartment)

Annual peak demand by Enduse for 2 apartments:

Table 6.2 Annual peak demand by Enduse for 2 apartments

	Electricity (kW)	Natural gas (Btu / h) (*000)
Total	21.3*2=42.6	579.25*2=1158.5

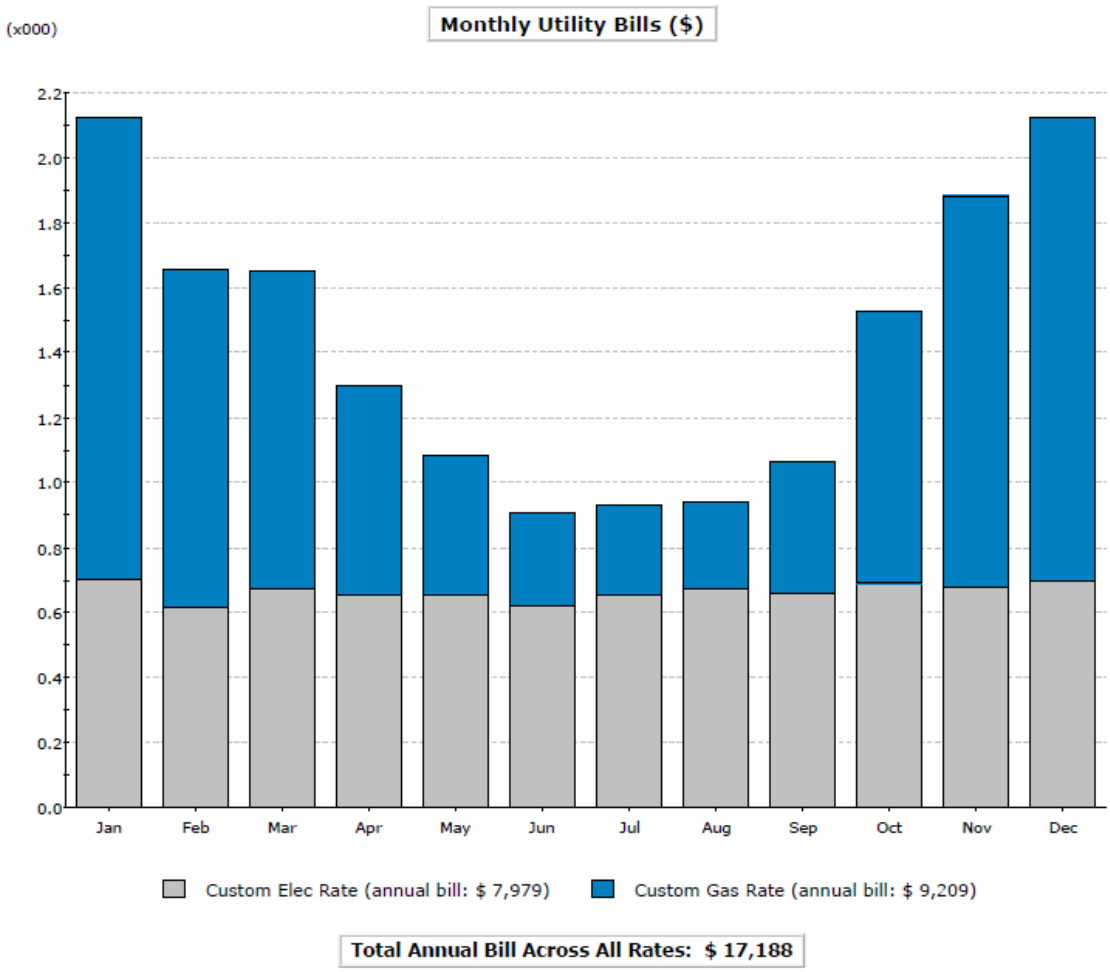
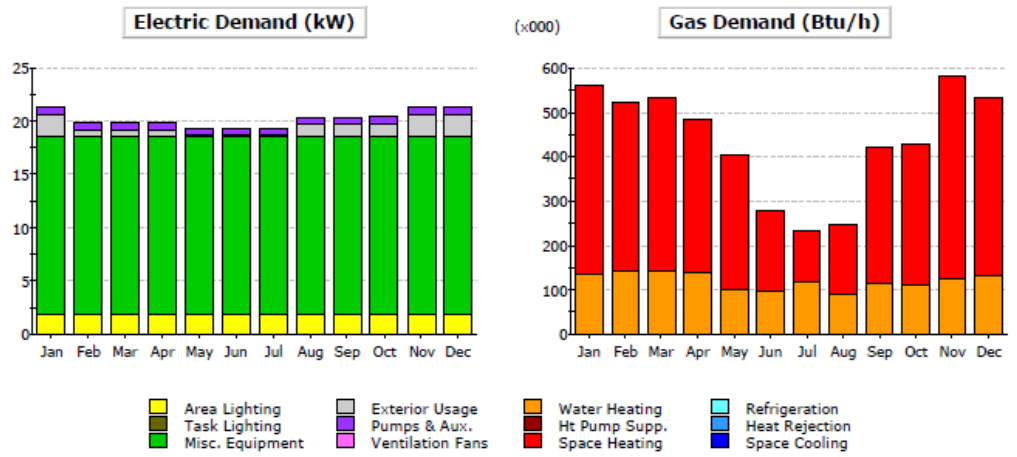


Figure 6.4 Monthly Utility Bills

For 2 apartments: total annual bill across all rates = $ 17,188 * 2 = $ 34,376



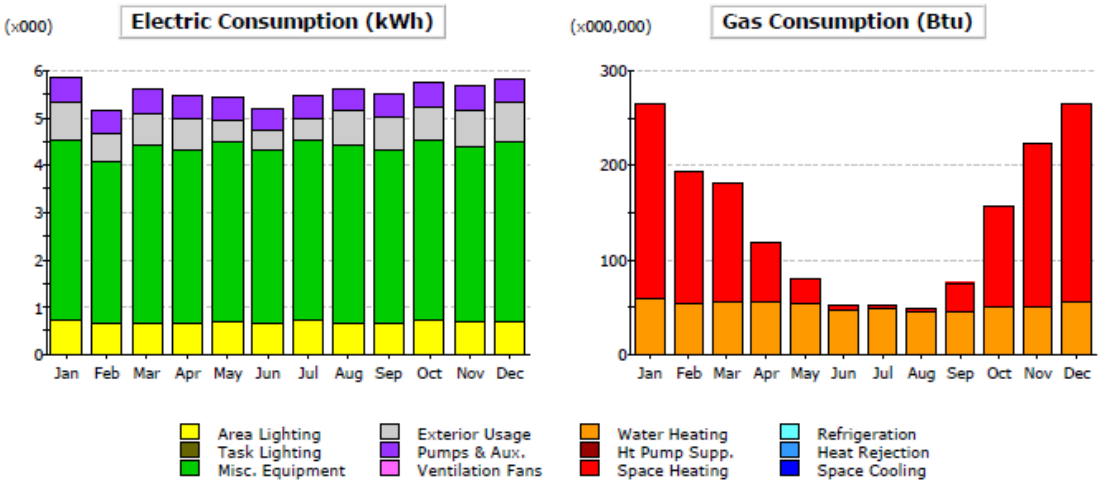
Electric Demand (kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	0.70	0.70	0.70	0.70	0.64	0.64	0.64	0.64	0.64	0.70	0.70	0.70	8.07
Ext. Usage	2.04	0.57	0.57	0.57	0.11	0.11	0.11	1.13	1.13	1.13	2.04	2.04	11.57
Misc. Equip.	16.71	16.71	16.71	16.71	16.71	16.71	16.71	16.71	16.71	16.71	16.71	16.71	200.50
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	22.29
Total	21.30	19.83	19.83	19.83	19.32	19.32	19.32	20.34	20.34	20.40	21.30	21.30	242.43

Gas Demand (Btu/h x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	422.6	381.9	389.6	344.3	301.1	184.1	117.0	159.2	306.8	317.1	454.7	402.2	3,780.5
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	137.8	141.0	141.7	139.3	101.7	96.0	117.3	88.0	114.5	110.9	124.5	131.2	1,443.9
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	560.3	522.9	531.3	483.6	402.8	280.1	234.3	247.2	421.3	428.0	579.3	533.4	5,224.4

Figure 6.5 Monthly peak demand



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	0.52	0.47	0.52	0.49	0.49	0.46	0.48	0.48	0.48	0.52	0.50	0.52	5.91
Ext. Usage	0.81	0.60	0.66	0.64	0.44	0.43	0.44	0.71	0.68	0.71	0.79	0.81	7.73
Misc. Equip.	3.80	3.43	3.77	3.66	3.79	3.65	3.80	3.77	3.66	3.80	3.67	3.79	44.61
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.72	0.64	0.67	0.67	0.70	0.65	0.72	0.67	0.67	0.72	0.69	0.71	8.24
Total	5.86	5.13	5.62	5.46	5.43	5.19	5.45	5.62	5.50	5.75	5.65	5.83	66.49

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	204.5	139.7	124.5	63.8	26.0	5.1	1.9	3.8	30.1	105.1	172.3	208.1	1,085.1
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	59.0	53.0	56.1	55.5	53.7	47.4	49.2	44.7	45.0	50.5	50.7	55.4	620.3
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	263.6	192.8	180.6	119.3	79.8	52.5	51.0	48.6	75.1	155.6	223.0	263.5	1,705.4

Figure 6.6 Monthly energy consumption

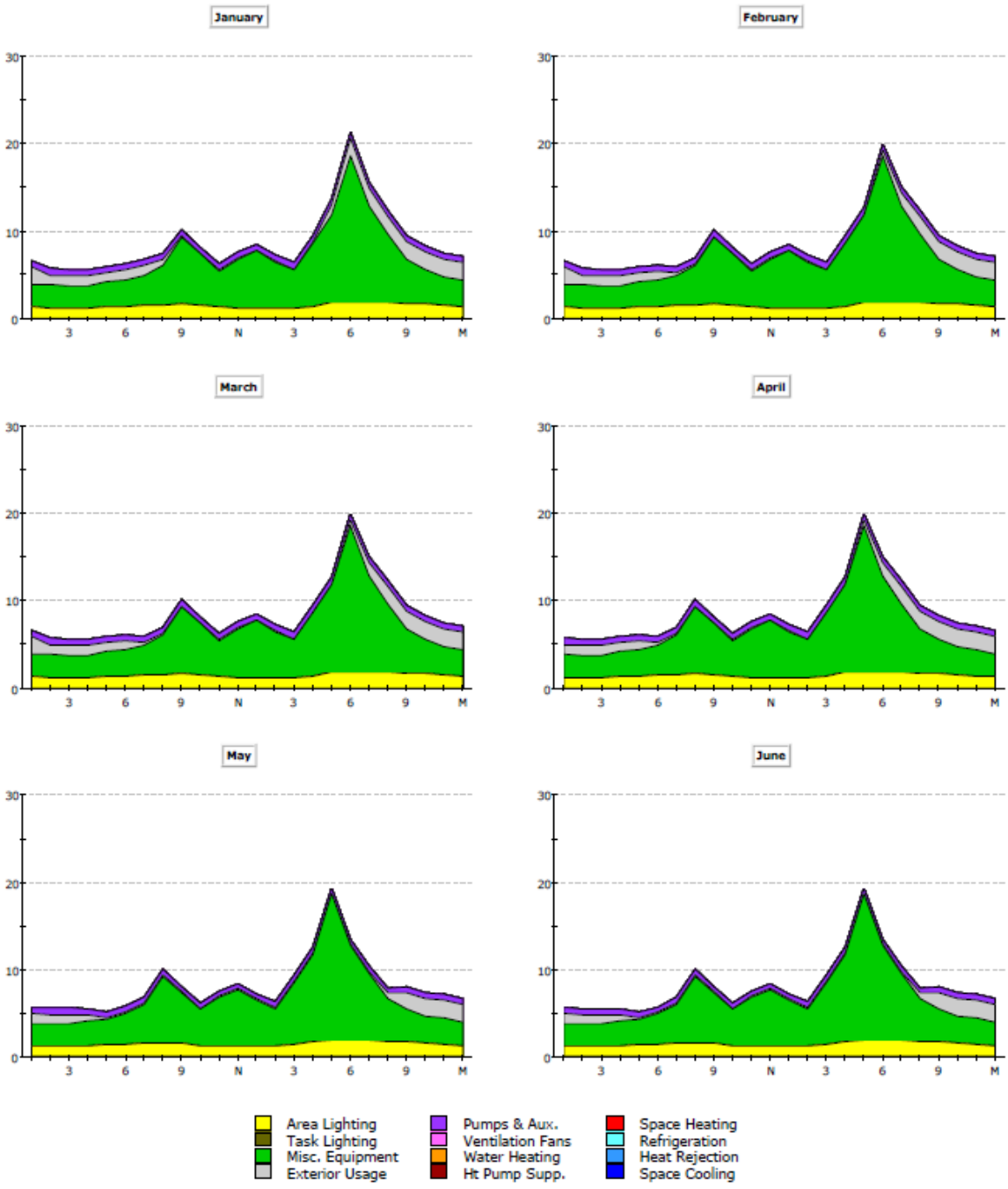


Figure 6.7 Monthly electric peak day (January - June)

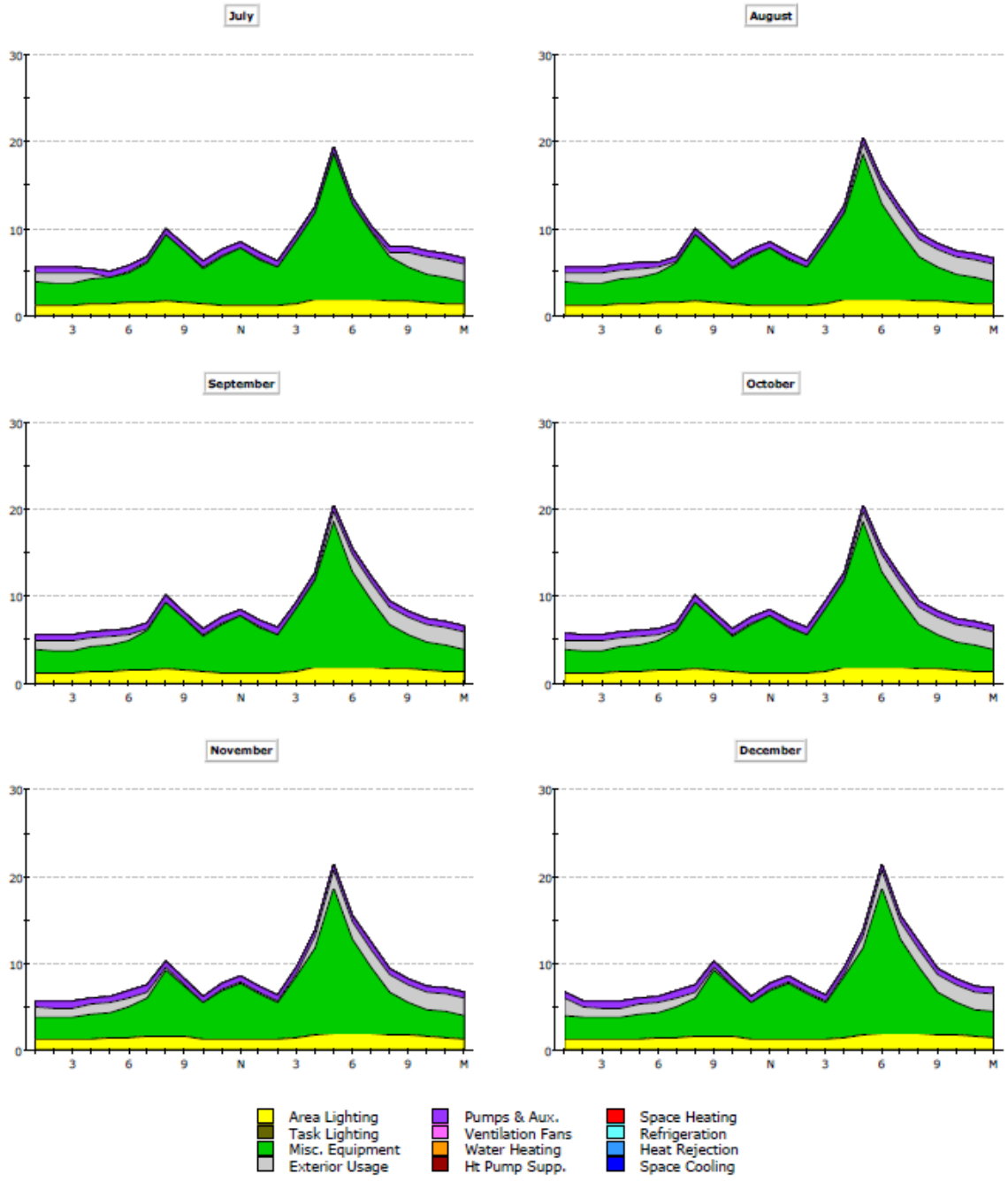


Figure 6.8 Monthly electric peak day (July - December)

Note:

Due to there are 2 apartments, so all of the data mentioned above should multiple 2 times.

1 townhouse:

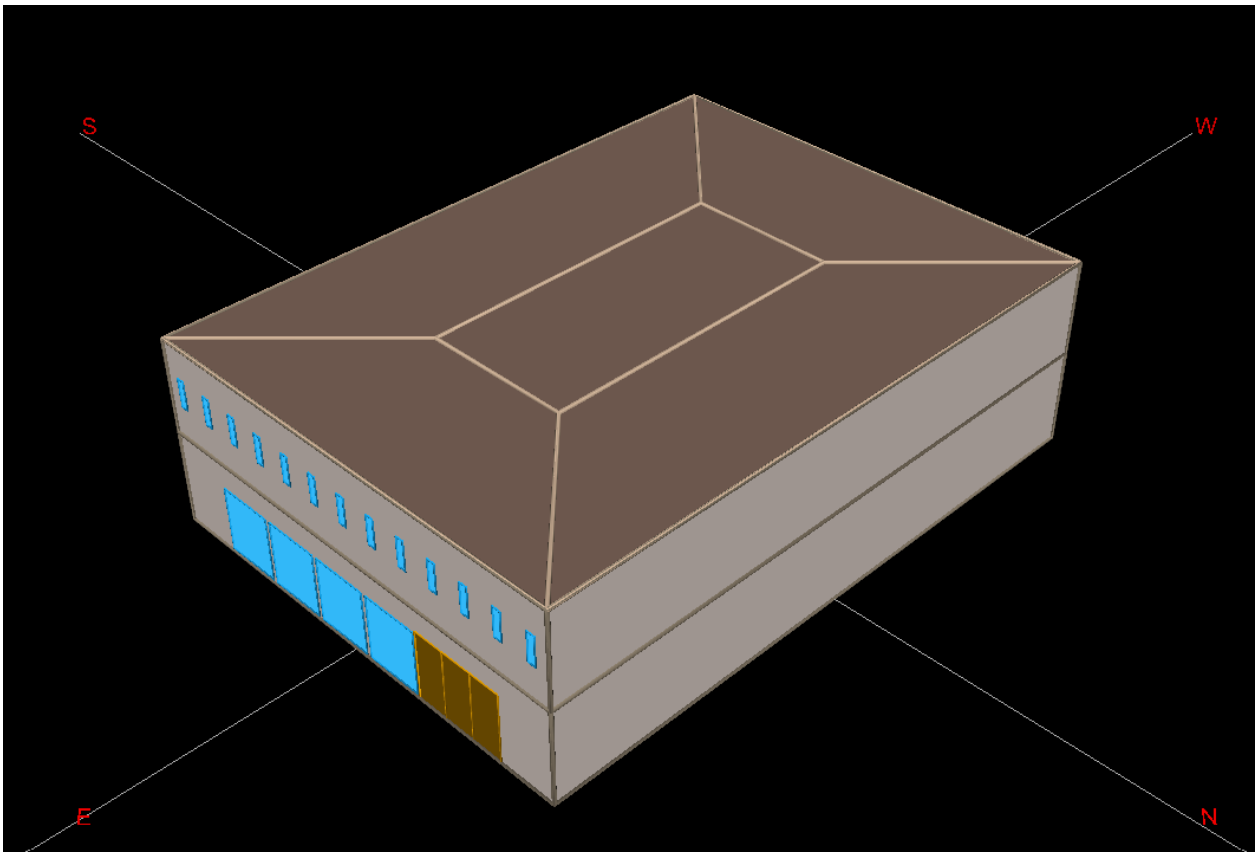


Figure 6.9 Building shell of 1 townhouse

Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas Btu (x000)	Steam Btu	Chilled Water Btu
Space Cool	-	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	93,595	-	-
HP Supp.	-	-	-	-
Hot Water	13,489	-	-	-
Vent. Fans	68	-	-	-
Pumps & Aux.	197	-	-	-
Ext. Usage	900	-	-	-
Misc. Equip.	3,311	-	-	-
Task Lights	-	-	-	-
Area Lights	1,054	-	-	-
Total	19,018	93,595	-	-

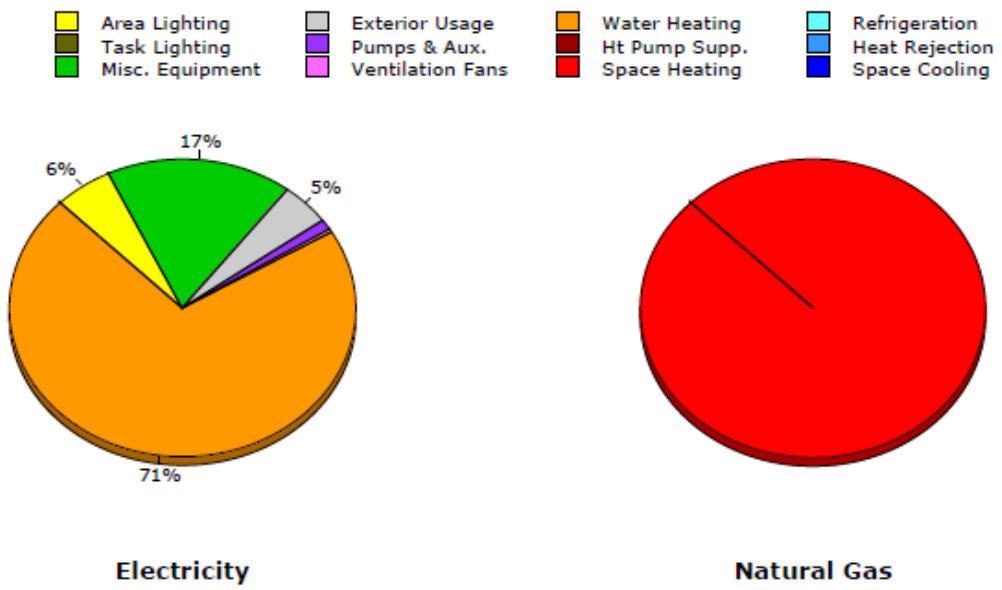


Figure 6.10 Annual Energy Consumption by Enduse

Annual energy consumption by Enduse for 33 townhouses:

Table 6.3 Annual energy consumption by Enduse for 33 townhouses

	Electricity (kWh)	Natural gas Btu (*000)
Total	19,018*33=627,594	93,595*33=3088,635

Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h	Steam Btu/h	Chilled Water Btu/h
Space Cool	-	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	66,382	-	-
HP Supp.	-	-	-	-
Hot Water	3.22	-	-	-
Vent. Fans	0.02	-	-	-
Pumps & Aux.	0.02	-	-	-
Ext. Usage	0.24	-	-	-
Misc. Equip.	1.33	-	-	-
Task Lights	-	-	-	-
Area Lights	0.24	-	-	-
Total	5.07	66,382	-	-

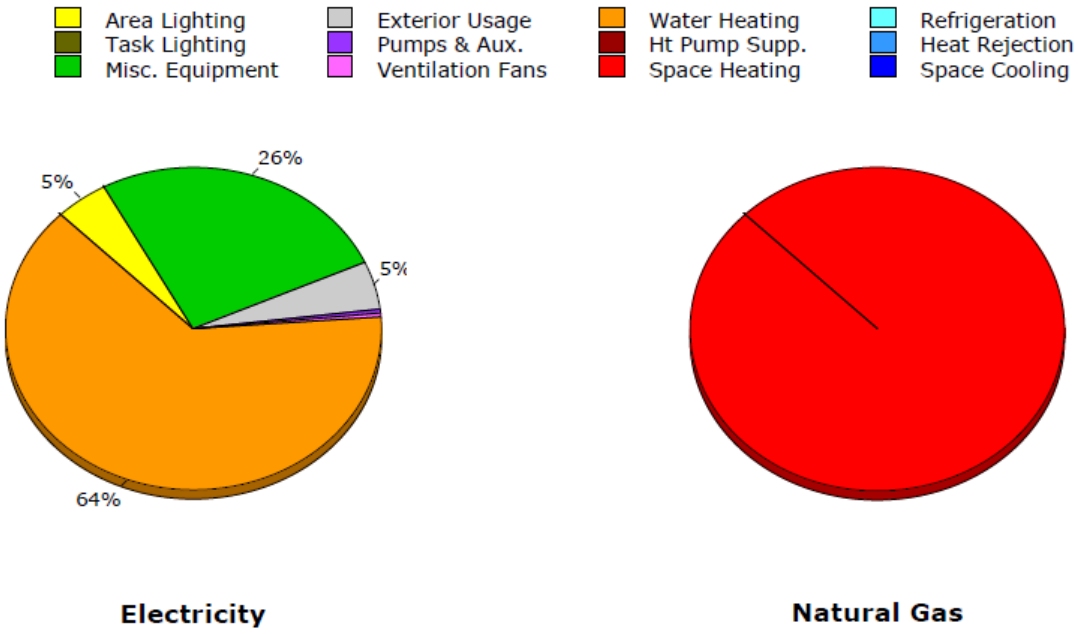


Figure 6.11 Annual Peak Demand by Enduse

Annual peak demand by Enduse for 33 townhouses:

Table 6.4 Annual peak demand by Enduse for 33 townhouses

	Electricity (kW)	Natural gas (Btu / h)
Total	5.07*33=167.31	66,382*33=2190,606

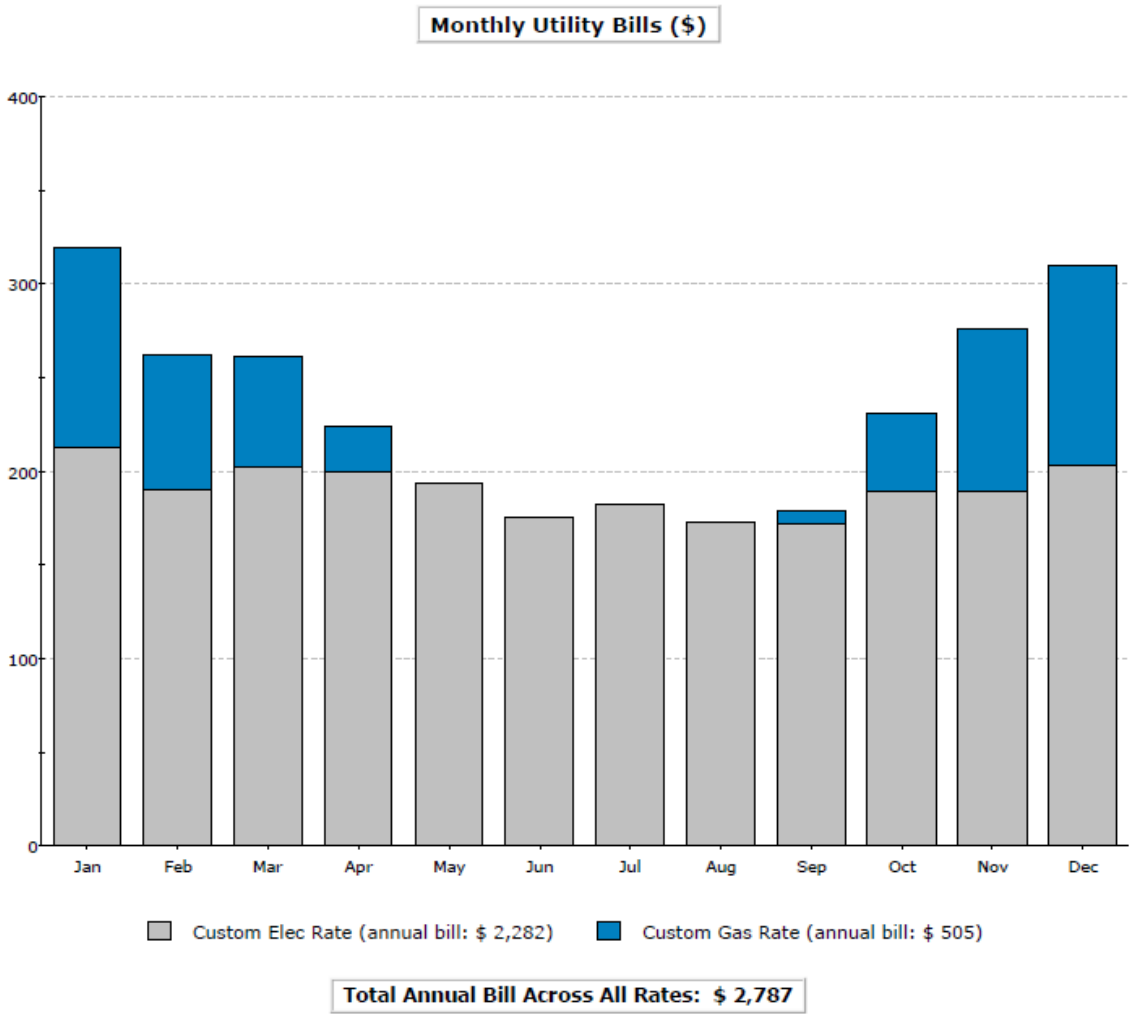
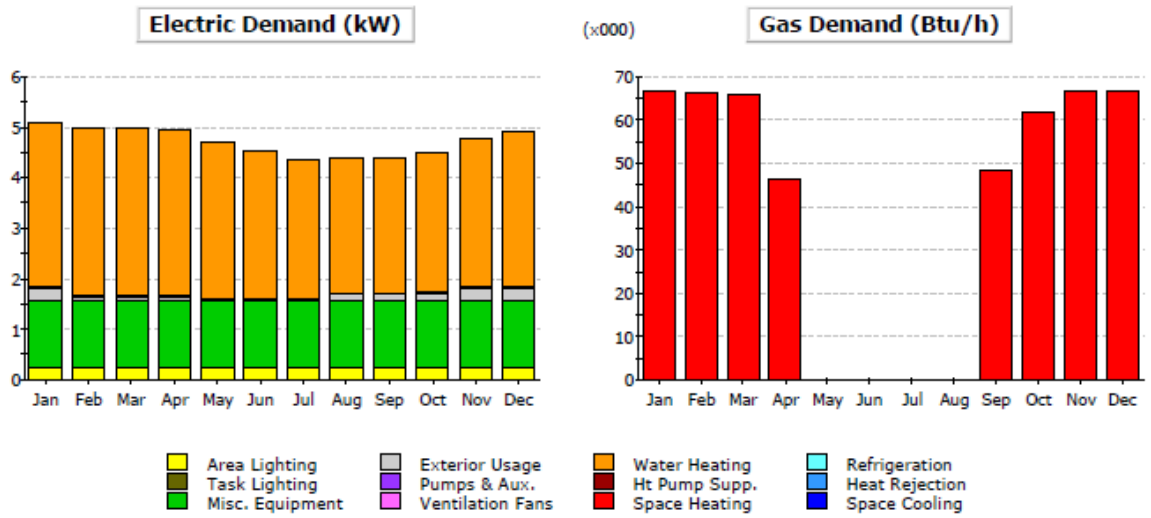


Figure 6.12 Monthly Utility Bills

For 33 townhouses:

Total annual bill across all rates = $2,787 * 33 = $ 91,971.



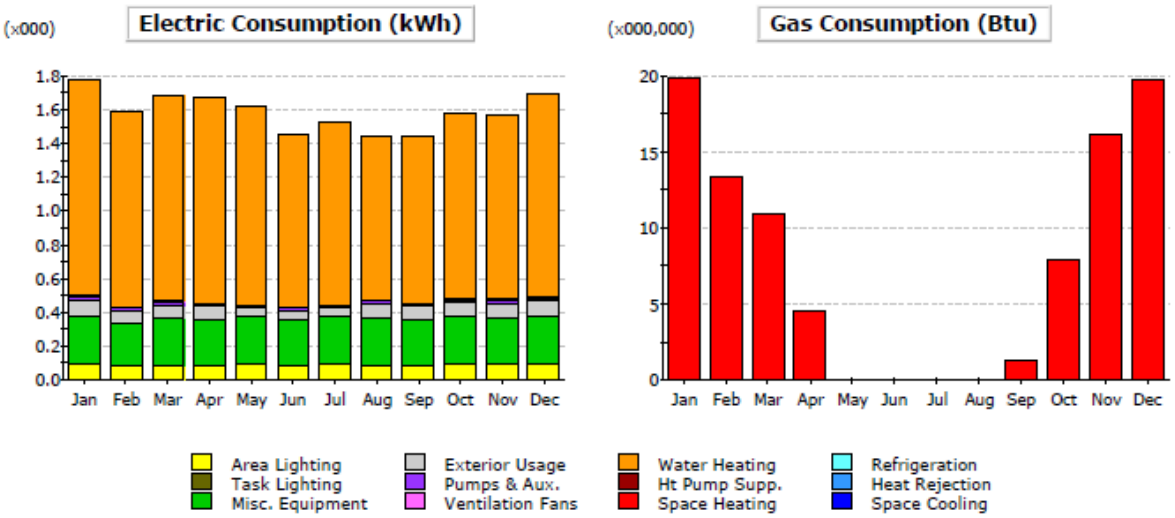
Electric Demand (kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	3.22	3.31	3.32	3.27	3.10	2.91	2.75	2.67	2.68	2.76	2.90	3.07	35.95
Vent. Fans	0.02	0.01	0.01	0.01	-	-	-	-	-	0.00	0.02	0.02	0.10
Pumps & Aux.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.27
Ext. Usage	0.24	0.07	0.07	0.07	0.01	0.01	0.01	0.13	0.13	0.13	0.24	0.24	1.35
Misc. Equip.	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	15.95
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	2.85
Total	5.07	4.98	4.98	4.93	4.70	4.51	4.35	4.39	4.40	4.48	4.75	4.92	56.46

Gas Demand (Btu/h x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	66.38	66.09	65.88	46.30	-	-	-	-	48.12	61.64	66.38	66.38	487.17
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	66.38	66.09	65.88	46.30	-	-	-	-	48.12	61.64	66.38	66.38	487.17

Figure 6.13 Monthly peak demand



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	1.27	1.15	1.22	1.21	1.18	1.04	1.08	0.98	0.98	1.10	1.09	1.19	13.49
Vent. Fans	0.01	0.01	0.01	0.00	-	-	-	-	0.00	0.01	0.01	0.01	0.07
Pumps & Aux.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.20
Ext. Usage	0.09	0.07	0.08	0.07	0.05	0.05	0.05	0.08	0.08	0.08	0.09	0.09	0.90
Misc. Equip.	0.28	0.25	0.28	0.27	0.28	0.27	0.28	0.28	0.27	0.28	0.27	0.28	3.31
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.09	0.08	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09	0.09	1.05
Total	1.77	1.58	1.69	1.66	1.62	1.46	1.52	1.44	1.44	1.58	1.57	1.69	19.02

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	19.86	13.27	10.97	4.53	-	-	-	-	1.26	7.84	16.13	19.73	93.60
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	19.86	13.27	10.97	4.53	-	-	-	-	1.26	7.84	16.13	19.73	93.60

Figure 6.14 Monthly energy consumption

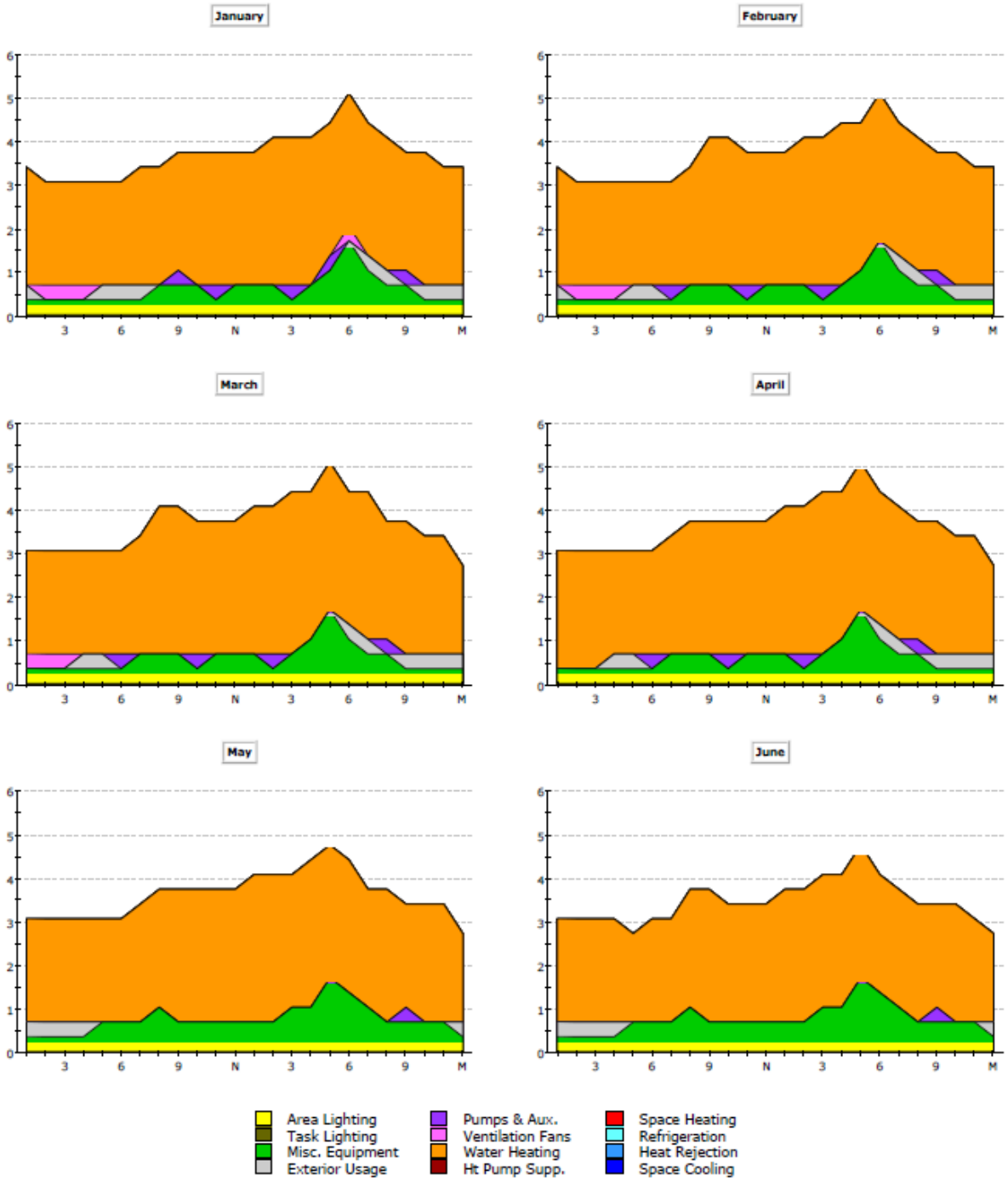


Figure 6.15 Monthly electric peak day (January - June)

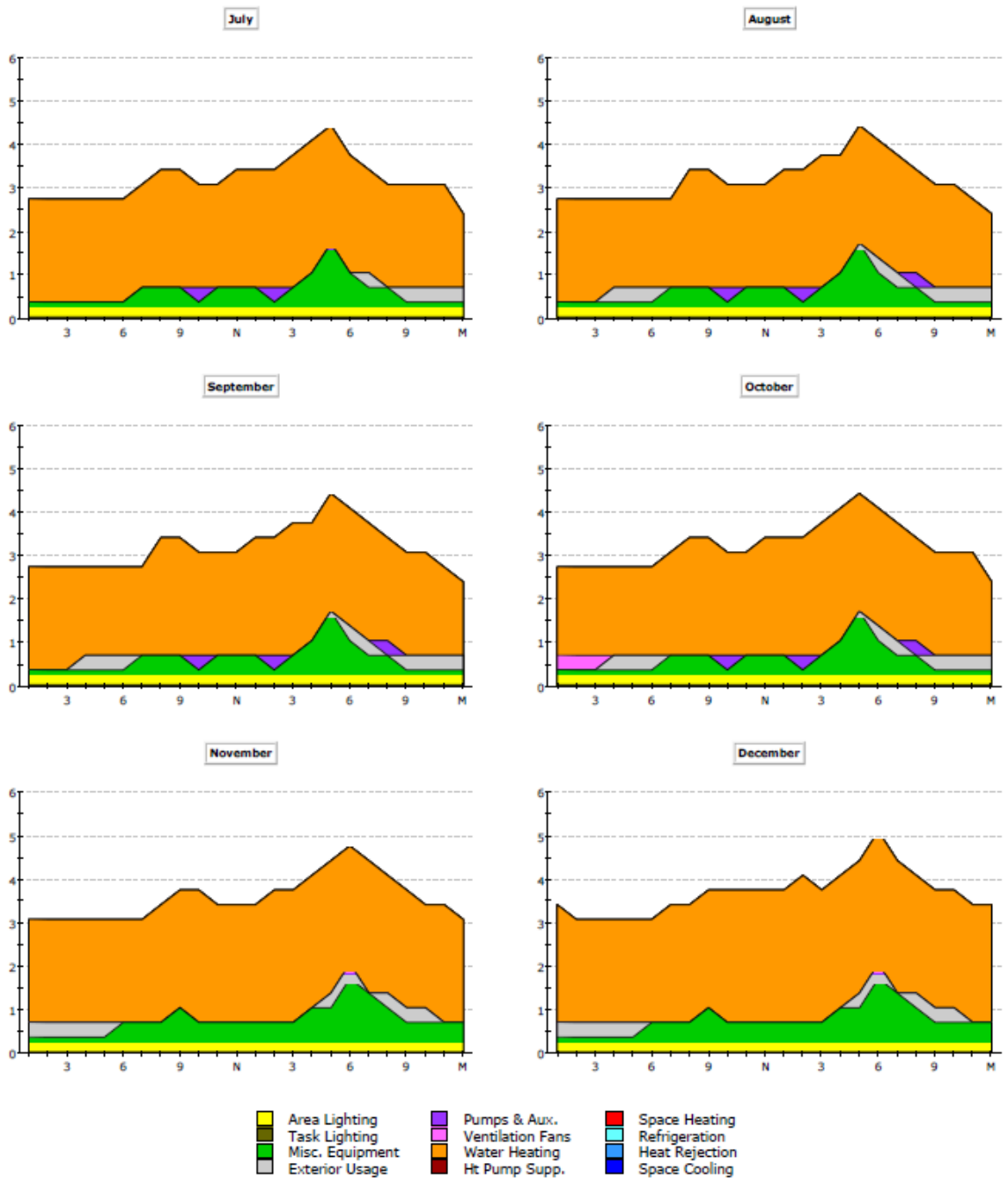


Figure 6.16 Monthly electric peak day (July - December)

Note:

Due to there are 33 townhouses, so all of the data mentioned above should multiple 33 times.

1 office:

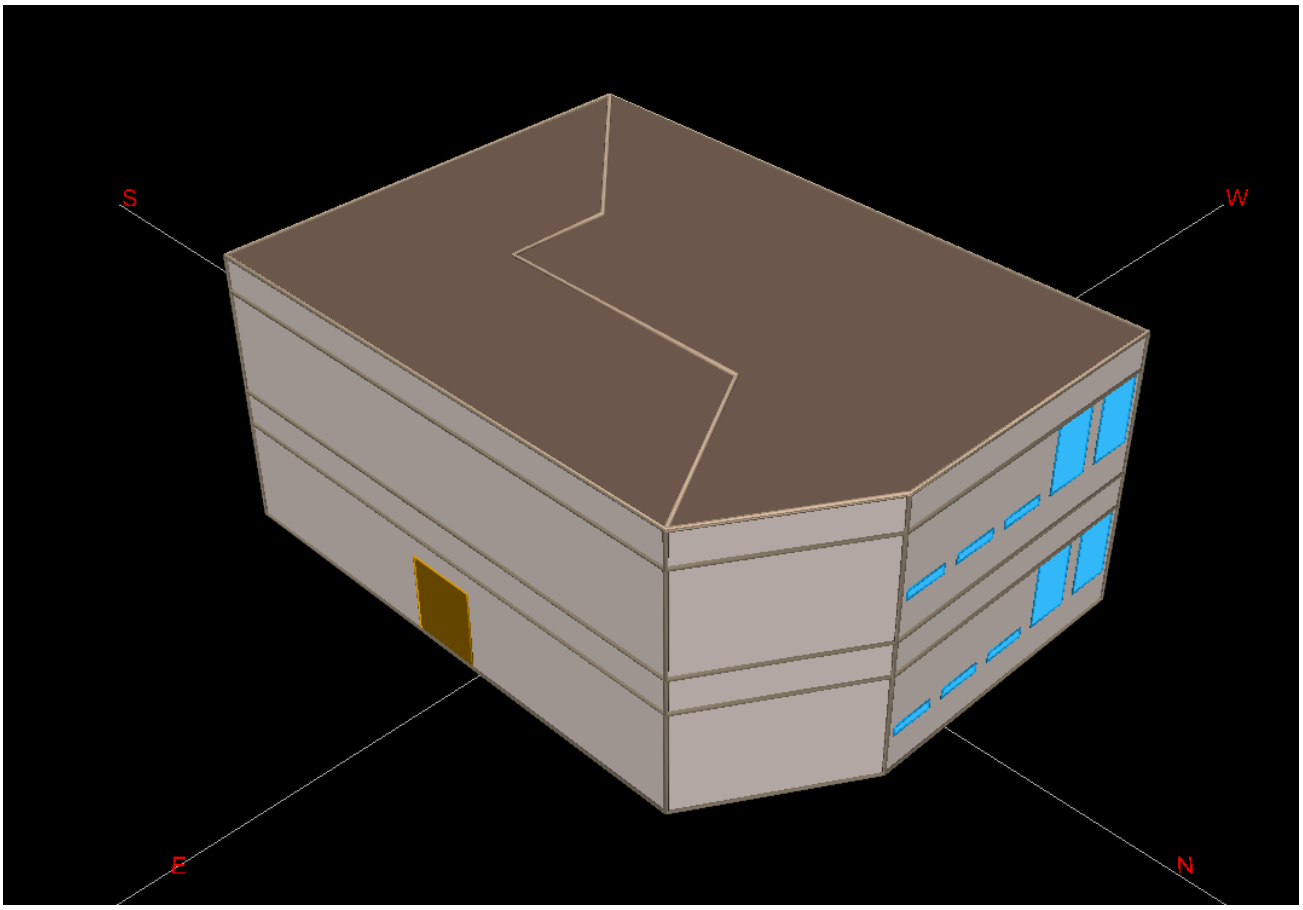


Figure 6.17 Building shell of 1 office

Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	1,340	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	139.01	-	-
HP Supp.	-	-	-	-
Hot Water	-	11.98	-	-
Vent. Fans	8,737	-	-	-
Pumps & Aux.	950	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	20,138	-	-	-
Task Lights	-	-	-	-
Area Lights	18,334	-	-	-
Total	49,499	150.99	-	-

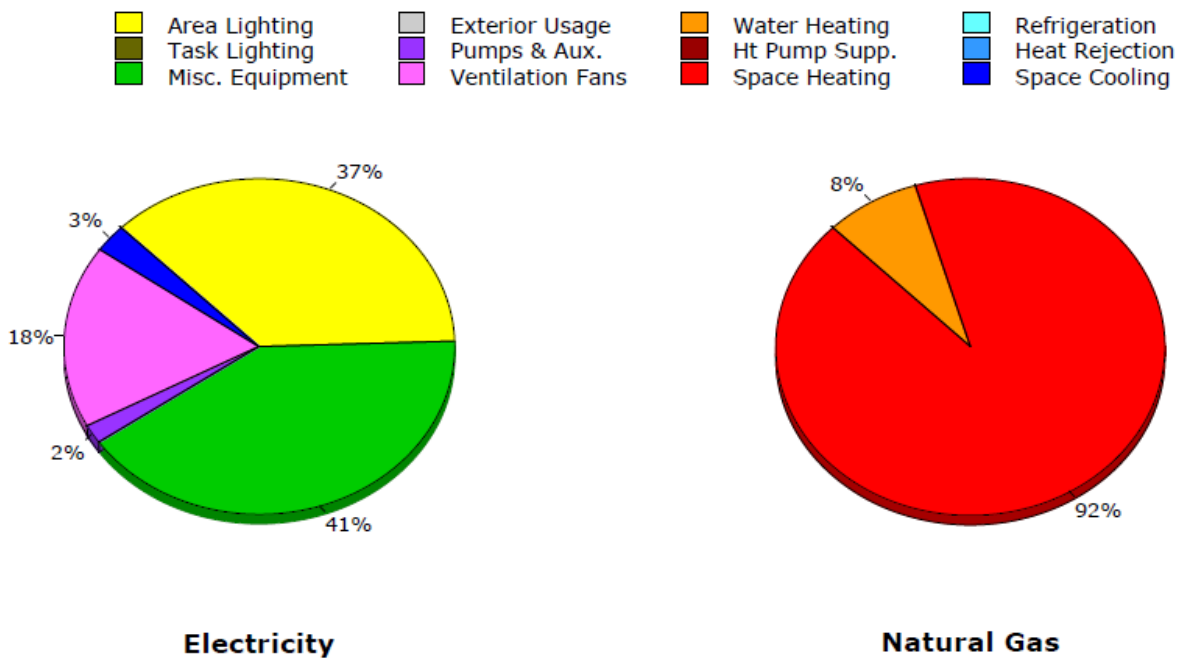


Figure 6.18 Annual Energy Consumption by Enduse

Annual energy consumption by Enduse for 1 office:

Table 6.5 Annual energy consumption by Enduse for 1 office

	Electricity (kWh)	Natural gas (MBtu)
Total	49,499	150.99

Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h (x000)	Steam Btu/h	Chilled Water Btu/h
Space Cool	3.22	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	569.42	-	-
HP Supp.	-	-	-	-
Hot Water	-	0.88	-	-
Vent. Fans	3.16	-	-	-
Pumps & Aux.	0.00	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	4.49	-	-	-
Task Lights	-	-	-	-
Area Lights	4.35	-	-	-
Total	15.22	570.30	-	-

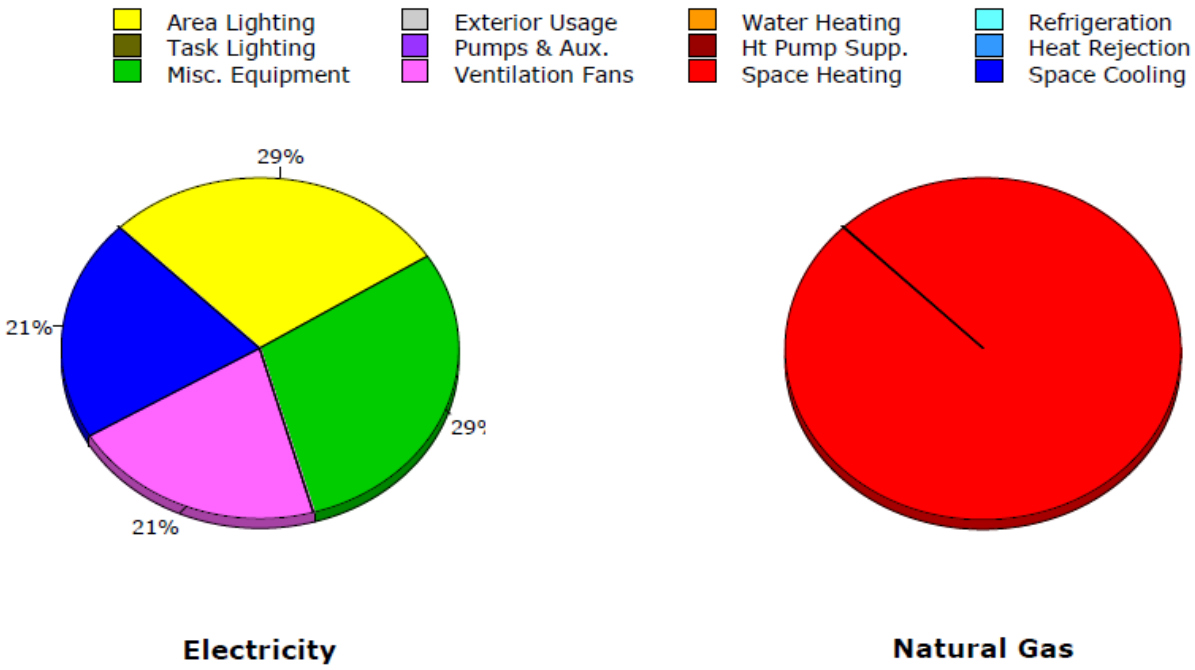


Figure 6.19 Annual Peak Demand by Enduse

Annual peak demand by Enduse for 1 office:

Table 6.6 Annual peak demand by Enduse for 1 office

	Electricity (kW)	Natural gas Btu / h (*000)
Total	15.22	570.30

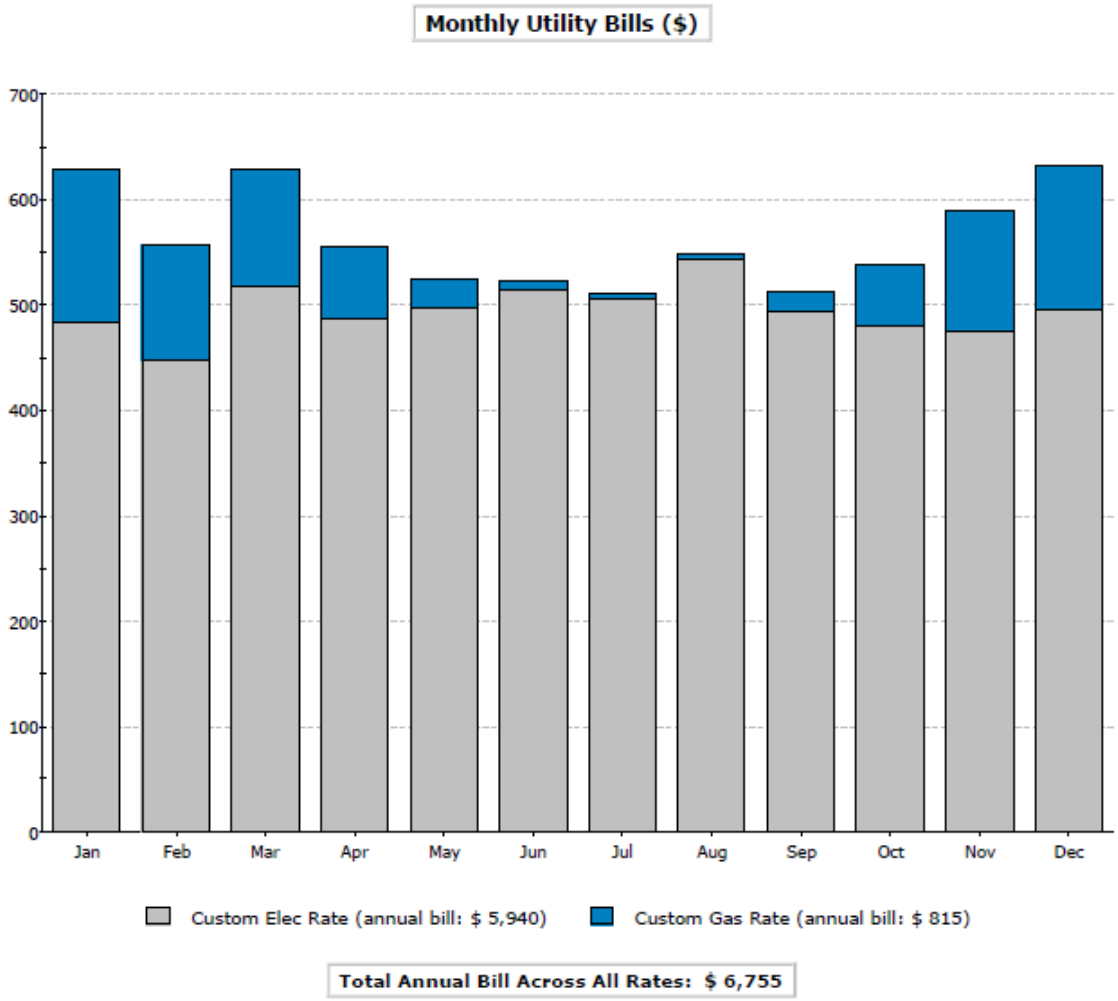
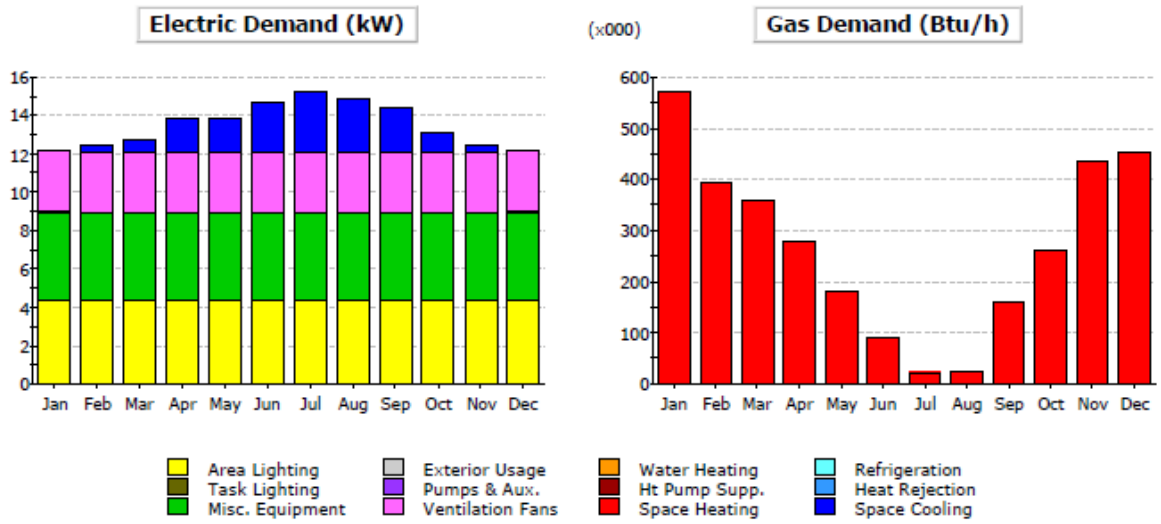


Figure 6.20 Monthly Utility Bills

For 1 office:

Total annual bill across all rates = $6,755



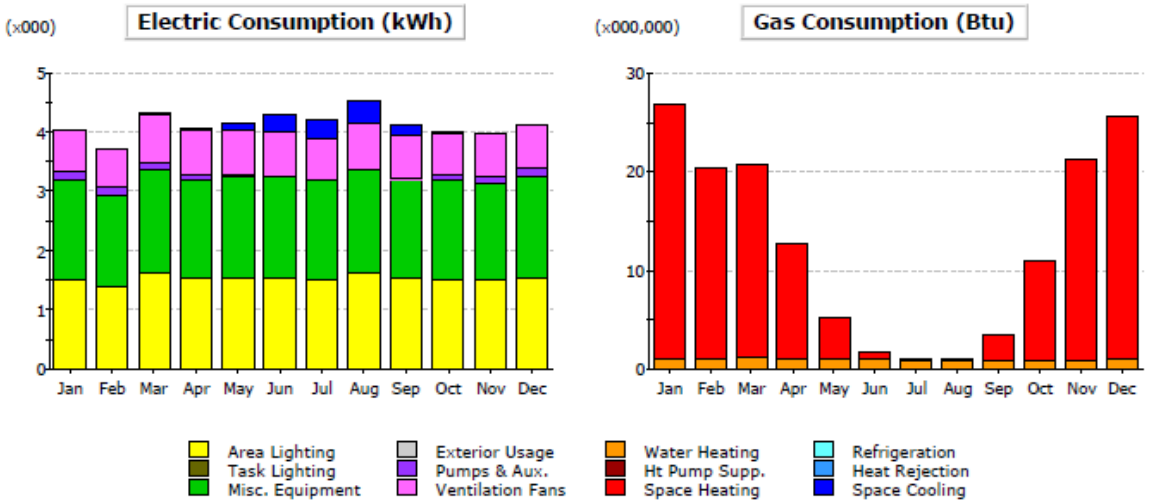
Electric Demand (kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	0.29	0.75	1.78	1.84	2.68	3.22	2.82	2.37	1.08	0.38	-	17.21
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	37.97
Pumps & Aux.	0.20	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.50
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	4.49	4.49	4.49	4.49	4.49	4.49	4.49	4.49	4.49	4.49	4.49	4.49	53.82
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	52.23
Total	12.20	12.39	12.75	13.78	13.85	14.68	15.22	14.83	14.37	13.08	12.38	12.20	161.73

Gas Demand (Btu/h x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	569.4	391.6	358.2	278.8	179.9	87.3	21.9	22.6	160.2	259.9	433.2	451.0	3,214.2
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.9	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.8	0.8	9.6
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	570.3	392.6	359.1	279.7	180.8	88.1	22.6	23.3	160.9	260.6	434.0	451.8	3,223.8

Figure 6.21 Monthly peak demand



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	0.00	0.01	0.04	0.12	0.27	0.33	0.36	0.17	0.03	0.00	-	1.34
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.70	0.66	0.80	0.73	0.73	0.77	0.70	0.80	0.73	0.70	0.70	0.73	8.74
Pumps & Aux.	0.15	0.13	0.13	0.10	0.05	0.01	0.00	0.00	0.02	0.08	0.13	0.15	0.95
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	1.68	1.54	1.75	1.67	1.70	1.69	1.68	1.75	1.67	1.68	1.64	1.70	20.14
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.52	1.40	1.61	1.52	1.55	1.55	1.52	1.61	1.52	1.52	1.49	1.55	18.33
Total	4.03	3.73	4.31	4.06	4.14	4.29	4.22	4.53	4.11	4.00	3.96	4.13	49.50

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	25.78	19.39	19.59	11.62	4.20	0.74	0.08	0.13	2.70	9.94	20.25	24.58	139.01
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	1.08	1.03	1.19	1.10	1.05	0.98	0.90	0.91	0.86	0.89	0.93	1.04	11.98
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	26.86	20.43	20.78	12.73	5.25	1.72	0.98	1.04	3.56	10.83	21.18	25.62	150.99

Figure 6.22 Monthly energy consumption

Note:

The total electricity, natural gas consumption or other parameters in this project is the sum of all of the 2 apartments, 33 townhouses and 1 office.

So, the total annual energy consumption by Enduse for all buildings:

Table 6.7 Total annual energy consumption by Enduse for all buildings

	Electricity (kWh)	Natural gas (MBtu)
Total	49,499 + 627,594 + 132,976 = 810,069	150.99 + 3,088.635 + 3410.8 = 6,650.425 Equals to 7016.57 GJ Equals to 1949047.222 kWh

Total area of the buildings from the PDF file "Building 2 - BCH - Rosewood Village ASHRAE Energy Water Audit Report" = 14130 m2

the EUI (KWH/ m2) of total electricity consumption = 810,069 /14130 = 57.3;

EUI (KWH/ m2) of total natural gas consumption = 1949047.222/14130= 137.9

Unit price of electricity: $ 0.10 / kWh

Unit price of natural gas: $ 10.29 / GJ

The total annual costs of electricity and natural gas consumption are shown below:

Table 6.8 Total annual costs for all buildings

	Consumption	EUI (KWH/ m2)	Cost ($)	% of total cost
Electricity	810,069 kWh	57.3	81006.9	54.2
Natural Gas	1949047.222 ekWh	137.9	68432.9	45.8

The data summarized in the table above is almost the same with that in the project PDF file:

ELECTRICTY BREAKDOWN	CONSUMPTION (EKWH)	EUI (KWH/M²)	% OF TOTAL ENERGY	% OF TOTAL ELECTRICAL	COST ($)	% OF TOTAL COST
Fans	9,018	0.6	0%	1%	$ 945	1%
Pumps	19,605	1.4	1%	2%	$ 2,054	1%
Townhouse DHW	446,633	31.4	16%	55%	$ 46,792	31%
Cooling	1,349	0.1	0%	0%	$ 141	0%
Lighting	106,498	7.5	4%	13%	$ 11,157	7%
Plug Loads	223,507	15.7	8%	28%	$ 23,416	16%
Subtotal	*806,610*	*56.7*	*29%*	*100%*	*$ 84,506*	*56%*

NATURAL GAS BREAKDOWN	CONSUMPTION (GJ)	EUI (KWH/M²)	% OF TOTAL ENERGY	% OF TOTAL GAS	COST ($)	% OF TOTAL COST
Apartment Heating	2,319	45.3	23%	33%	$ 19,722	13%
Apartment DHW	1,284	25.1	13%	18%	$ 10,918	7%
Townhouse Heating	3,222	62.9	33%	46%	$ 33,151	22%
Office Space Heating	146	2.8	1%	2%	$ 1,239	1%
Office DHW	12	0.2	0%	0%	$ 102	0%
Subtotal	*6,983*	*136.4*	*71%*	*100%*	*$ 65,132*	*44%*

Figure 6.23 Baseline data from provided project information file

total annual peak demand by Enduse for all buildings:

Table 6.9 Total annual peak demand by Enduse for all buildings

	Electricity (kW)	Natural gas Btu / h
Total	167.31 + 42.6 + 15.22 = 225.13	2190,606 + (1158.5 + 570.3) *1000 = 3,919,406

6.2 Comparison reports

Because there are three types of buildings (quantity in total: 36 buildings) and five measures, eQuest simulation and calculation for all the buildings is a big workload. Therefore, only three out of the five measures applied to three types of buildings will be simulated and illustrated in this part.

1) EEM 2 Replace some general lighting areas with low-wattage bulbs for apartments
   The settings in eQuest EEM are shown below:

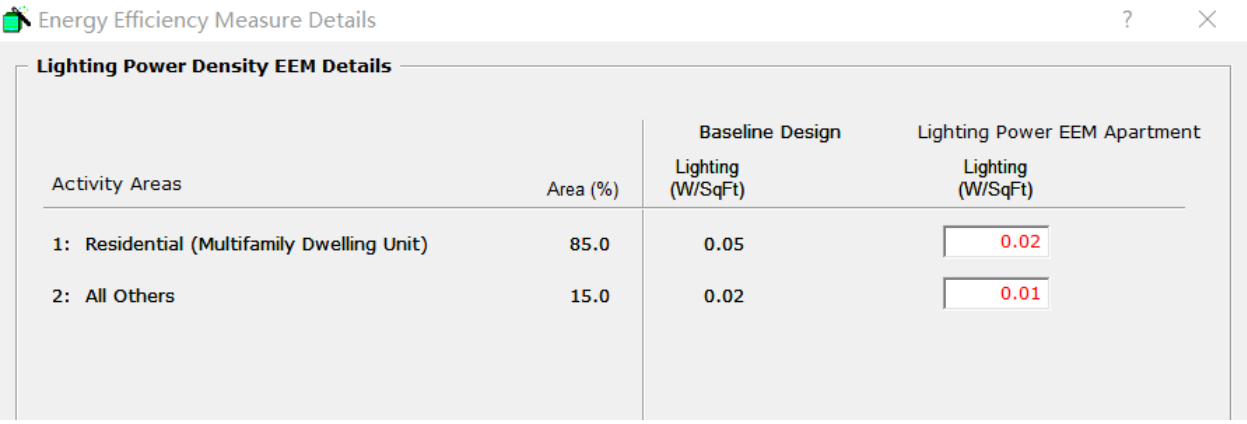
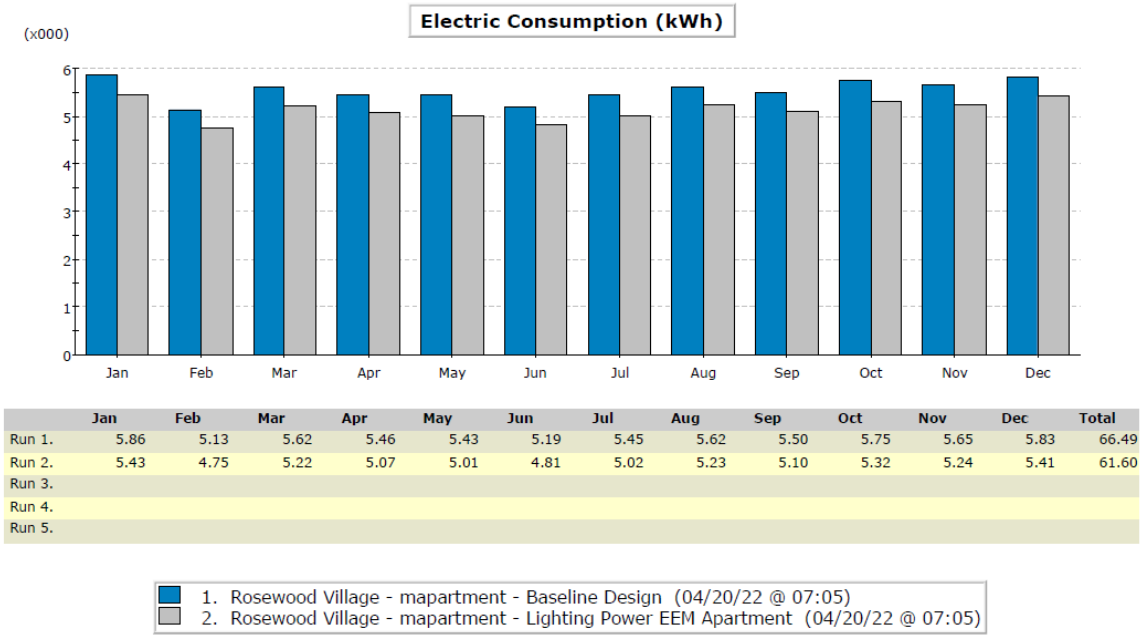


Figure 6.24 Lighting Power Density EEM Details

And then simulate the EEM and compare it with the baseline; the report is shown in the below picture.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	5.86	5.13	5.62	5.46	5.43	5.19	5.45	5.62	5.50	5.75	5.65	5.83	66.49
Run 2.	5.43	4.75	5.22	5.07	5.01	4.81	5.02	5.23	5.10	5.32	5.24	5.41	61.60
Run 3.													
Run 4.													
Run 5.													

Figure 6.25 Electric Consumption Comparison

From the picture above, the electric consumption decreases on a monthly basis after replacing the existing lights with low-wattage bulbs.

Therefore, the monthly and annual utility bills also decrease accordingly.

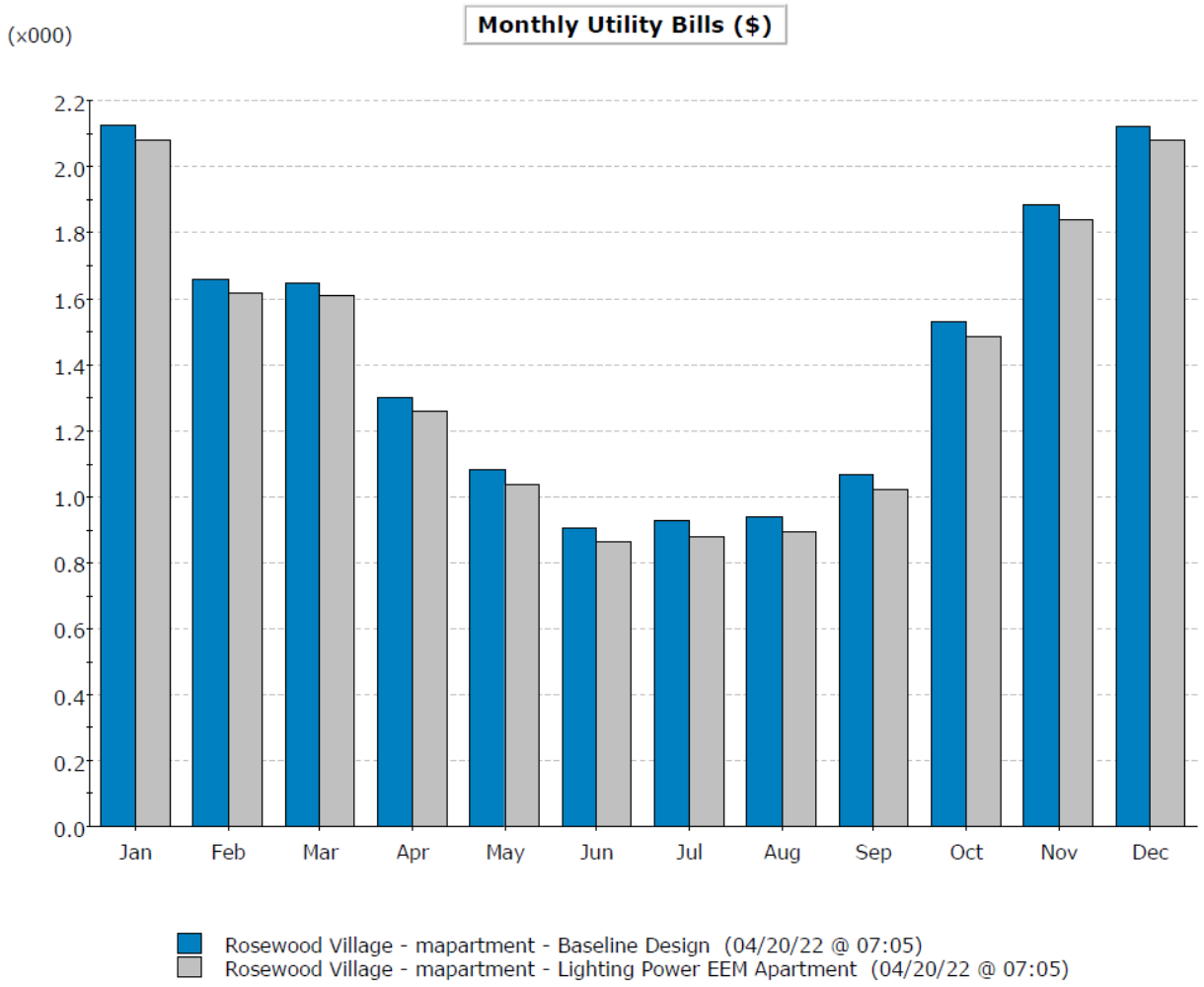


Figure 6.26 Monthly Utility Bills Comparison

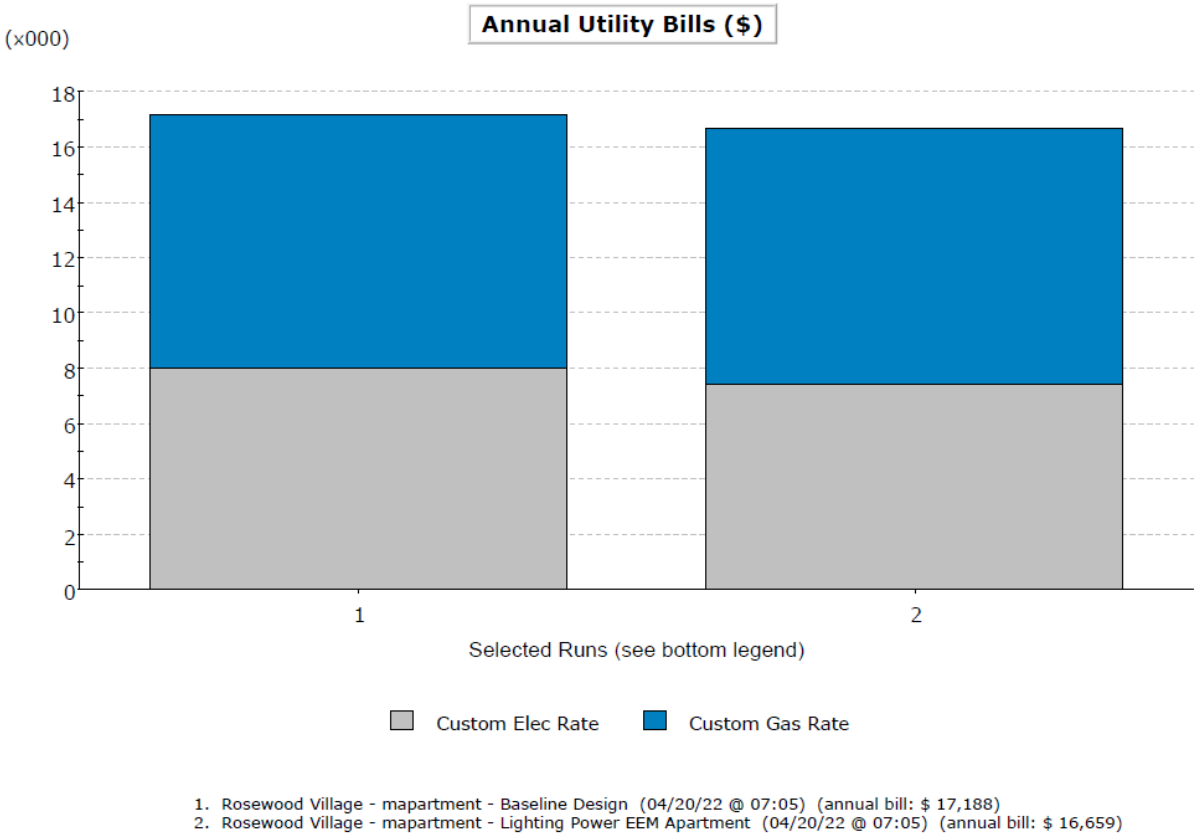


Figure 6.27 Annual Utility Bills Comparison

Other reports related to the EEM are also listed below:

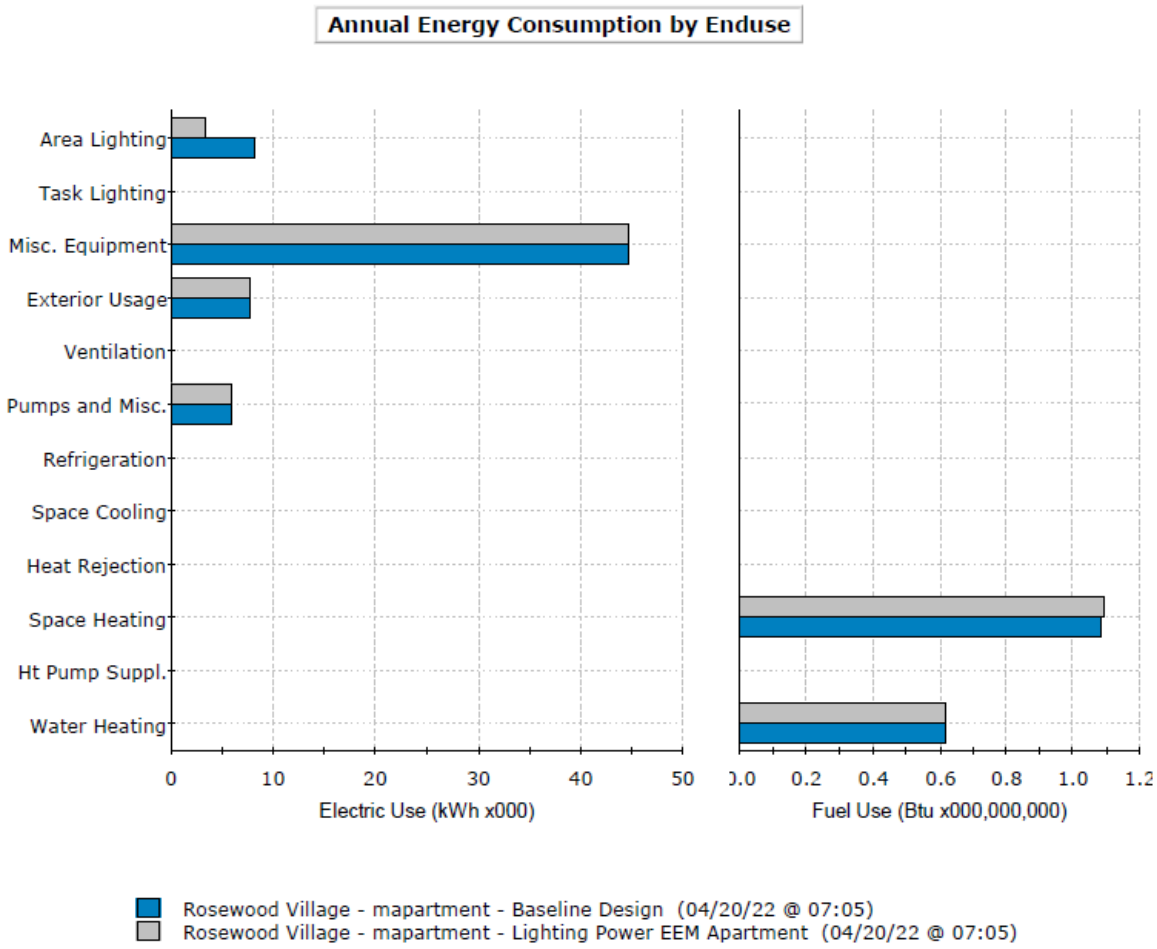


Figure 6.28 Annual Energy Consumption Comparison

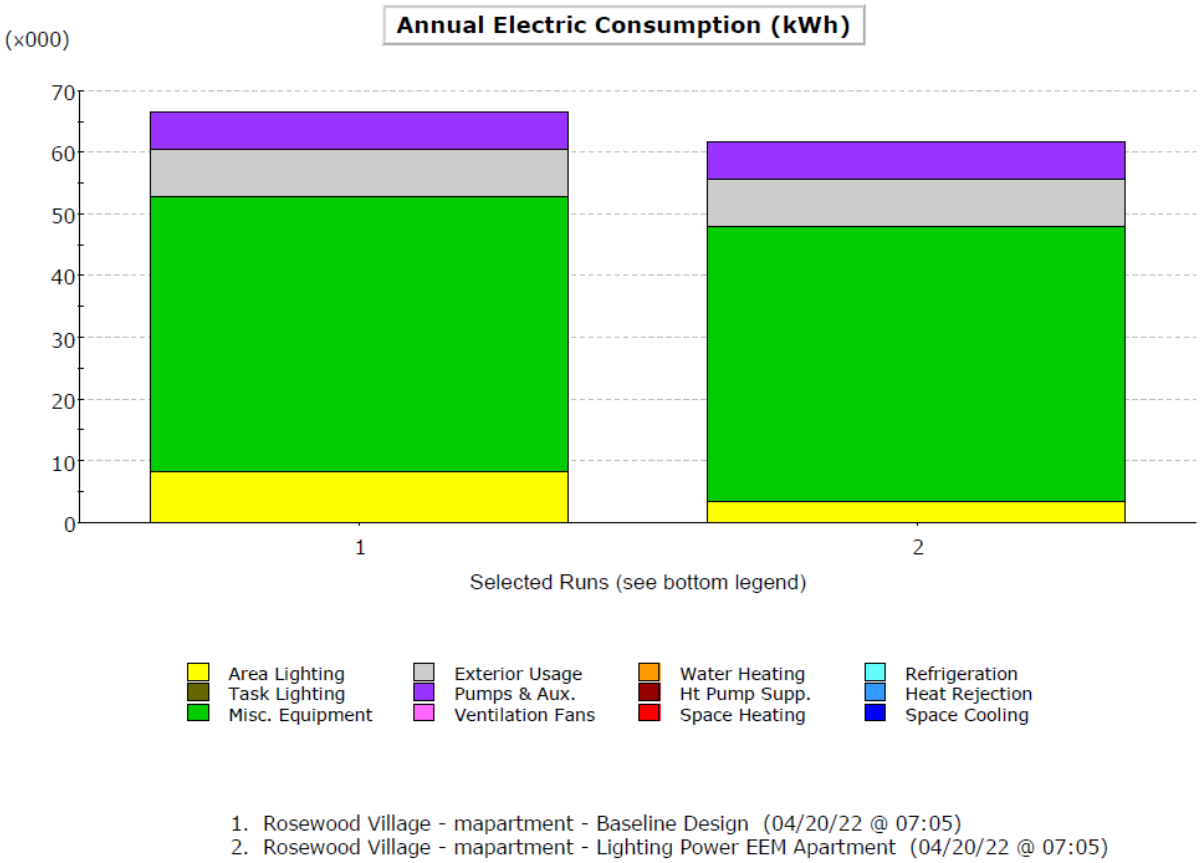


Figure 6.29 Annual Electric Consumption Comparison

Life-Cycle Costs Summary

Case	Description	One-Time Costs 1st year $	One-Time Costs LCC PV$	Total Utility 1st year $	Total Utility LCC PV$	Maintenance 1st year $	Maintenance LCC PV$	Total LCC PV$
Life-Cycle COSTS								
Base	Baseline Design	$0	$0	$17188	$136460	$0	$0	$125690
Alt #1	Lighting Power EEM Apartment	$0	$0	$16659	$132389	$0	$0	$121952

Case	Description	One-Time Costs 1st year $	One-Time Costs LCC PV$	Total Utility 1st year $	Total Utility LCC PV$	Maintenance 1st year $	Maintenance LCC PV$	Net Savings NS	Simple Payback yrs	Discnt'd Payback yrs	Saving-to-Invest Ratio SIR	Adjusted Internal Rate-of-Return AIRR
Incremental Life-Cycle SAVINGS (negative entries indicate increased costs)												
Alt #1	Lighting Power EEM Apartment	$0	$0	$529	$4071	$0	$0	$3738	n/a	0.0	n/a	n/a
Cumulative Life-Cycle SAVINGS (negative entries indicate increased costs)												
Alt #1	Lighting Power EEM Apartment	$0	$0	$529	$4071	$0	$0	$3738	n/a	0.0	n/a	n/a

Figure 6.30 Life-Cycle Costs Comparison

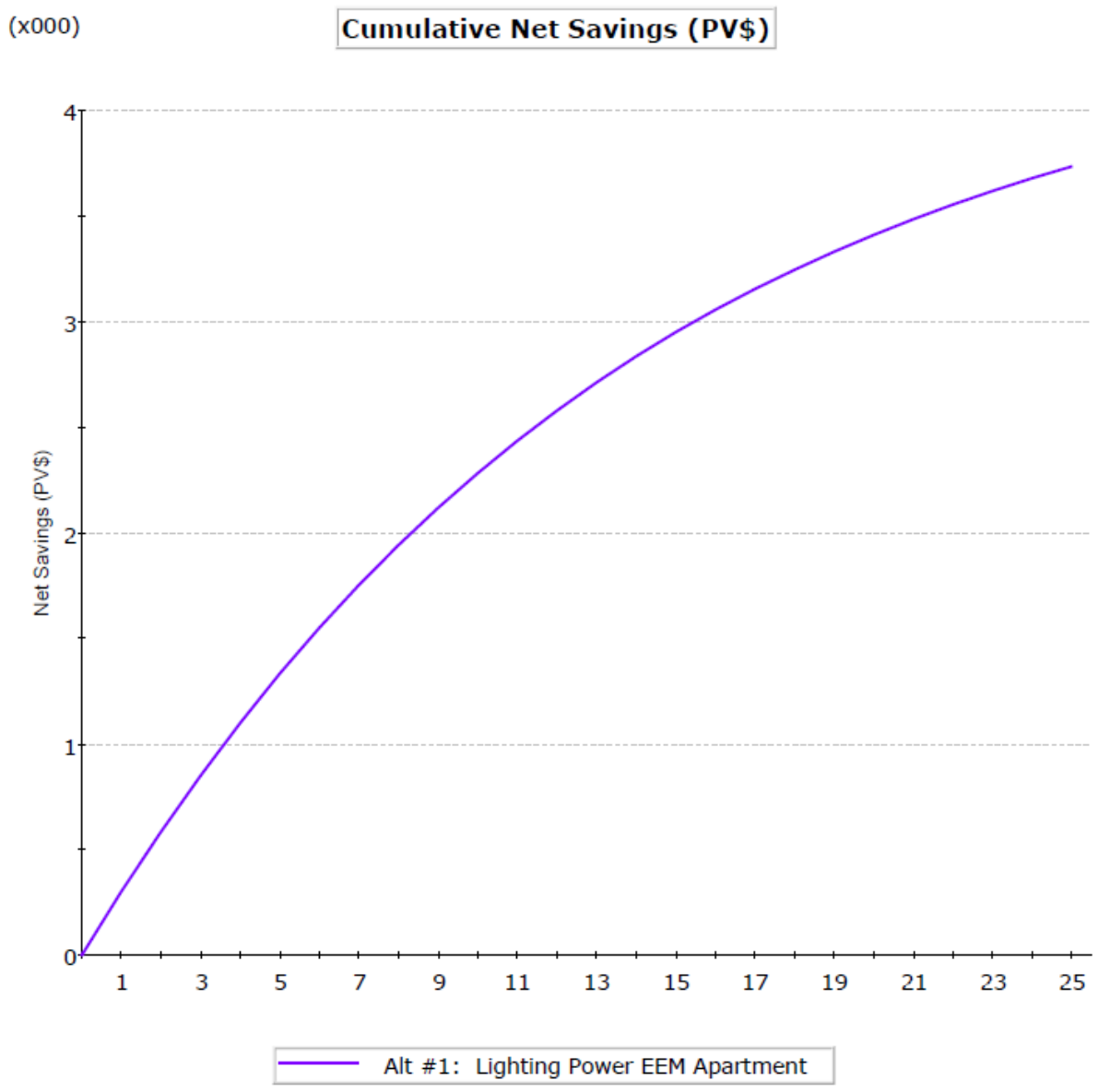


Figure 6.31 Cumulative Net Savings

2) EEM 3 Replace some general lighting areas with LED lights in the office building

The settings in eQuest EEM are shown below:

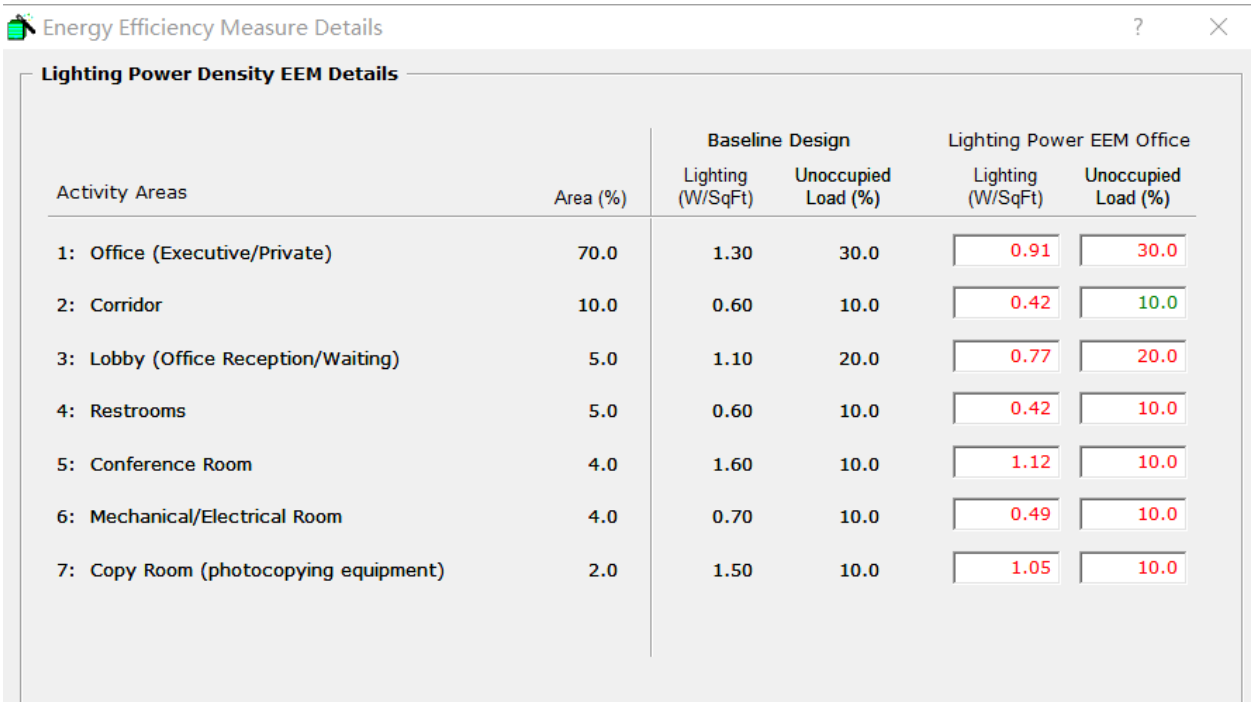


Figure 6.32 Lighting Power Density EEM Details

Then run the EEM in eQuest, relative reports are shown below; from all of the reports, it is clearly that the electric consumption and utility bills decrease accordingly after using LED bulbs.

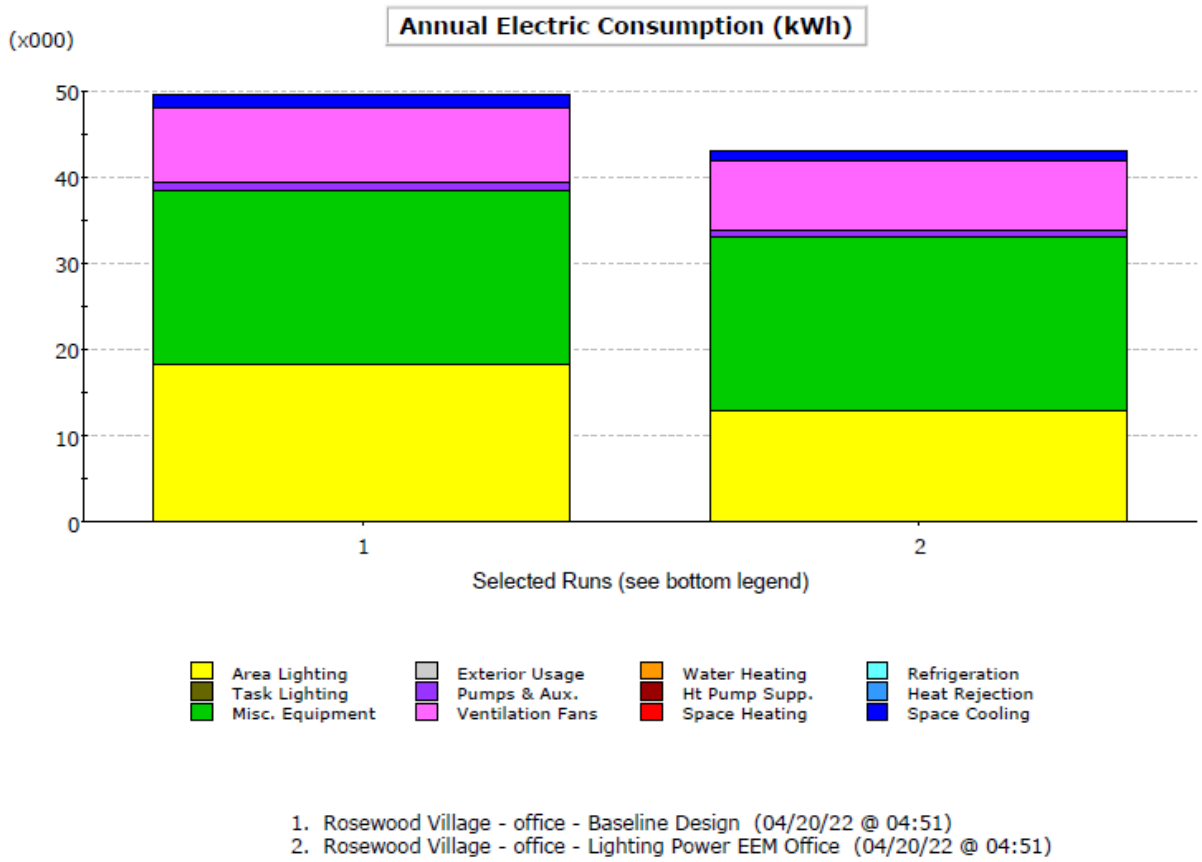


Figure 6.33 Annual Electric Consumption Comparison

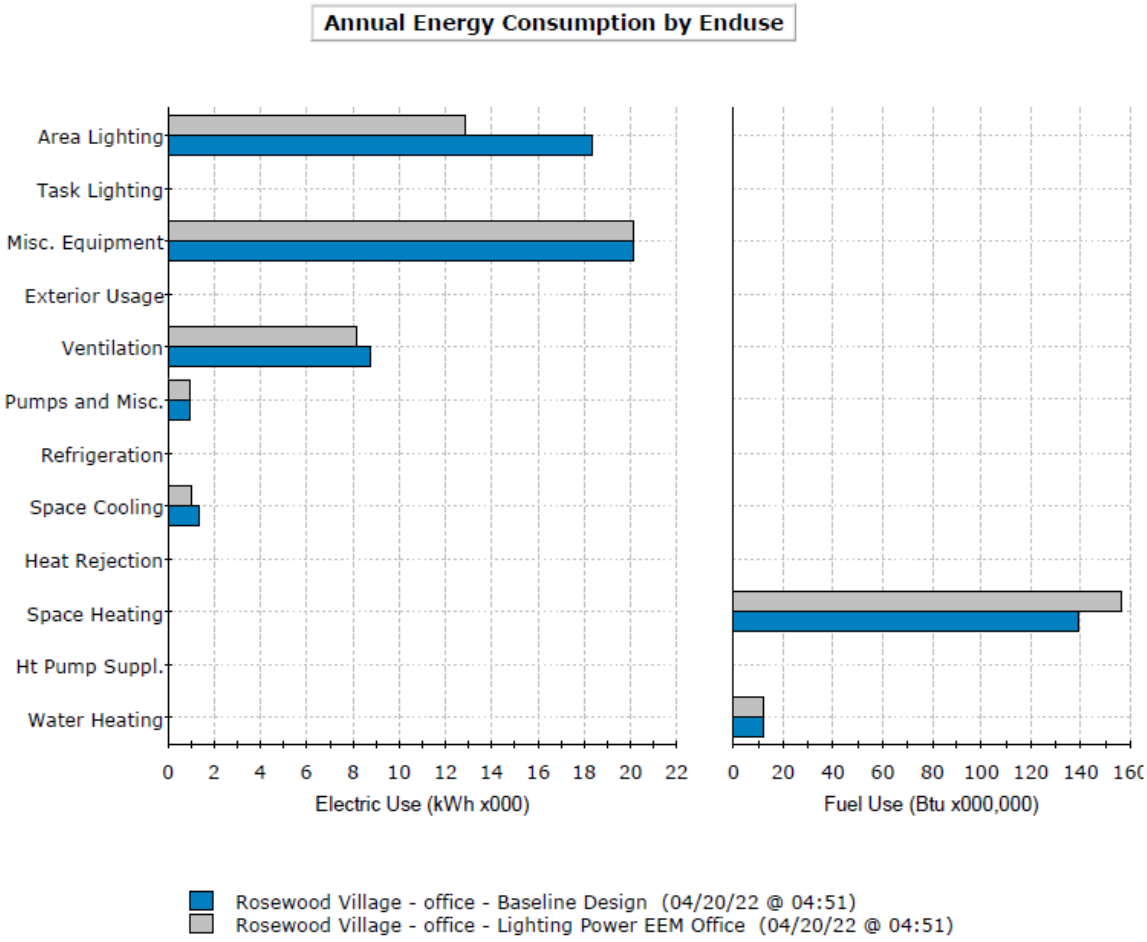


Figure 6.34 Annual Energy Consumption Comparison

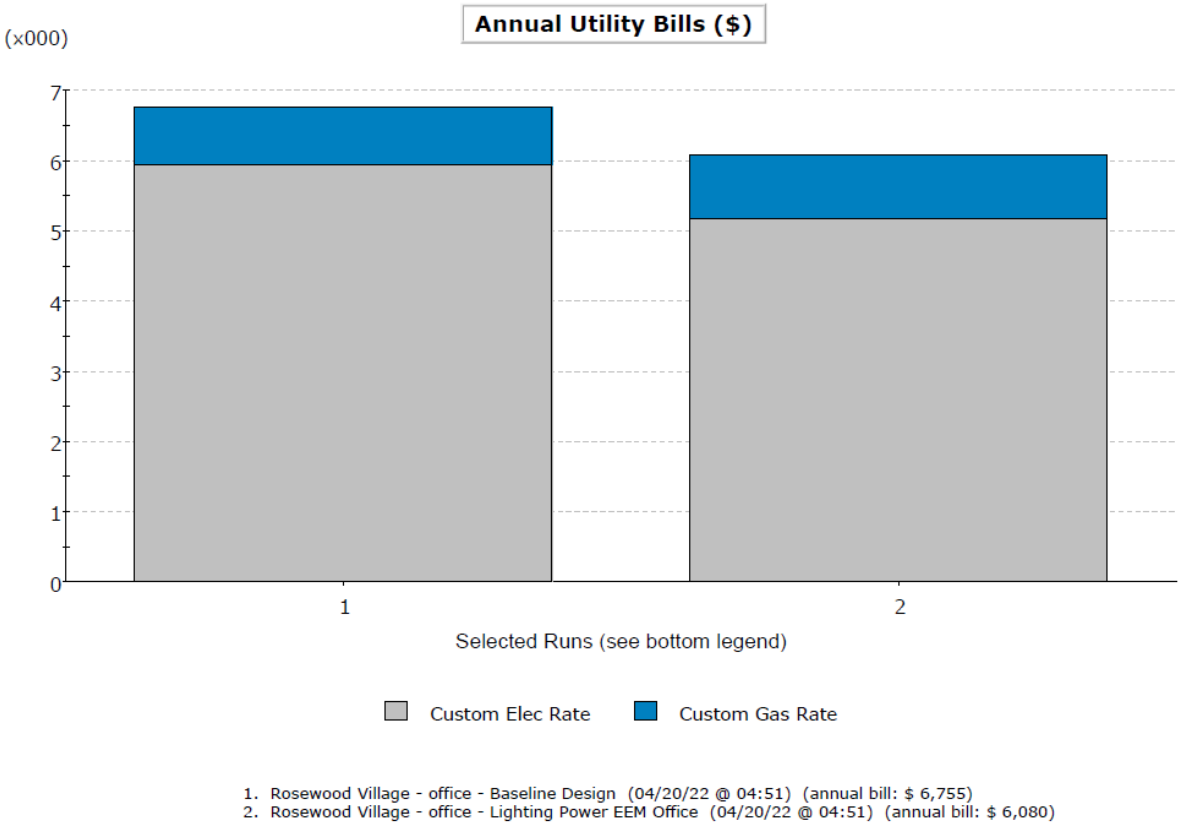
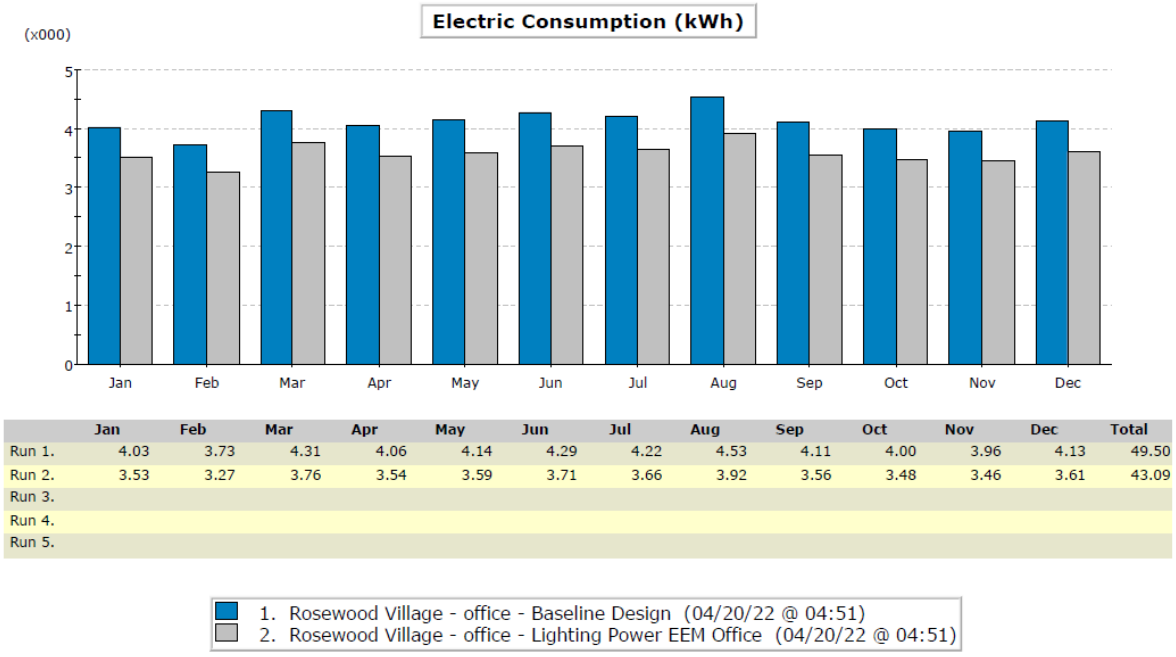


Figure 6.35 Annual Utility Bills Comparison



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	4.03	3.73	4.31	4.06	4.14	4.29	4.22	4.53	4.11	4.00	3.96	4.13	49.50
Run 2.	3.53	3.27	3.76	3.54	3.59	3.71	3.66	3.92	3.56	3.48	3.46	3.61	43.09
Run 3.													
Run 4.													
Run 5.													

Figure 6.36 Electric Consumption Conparison

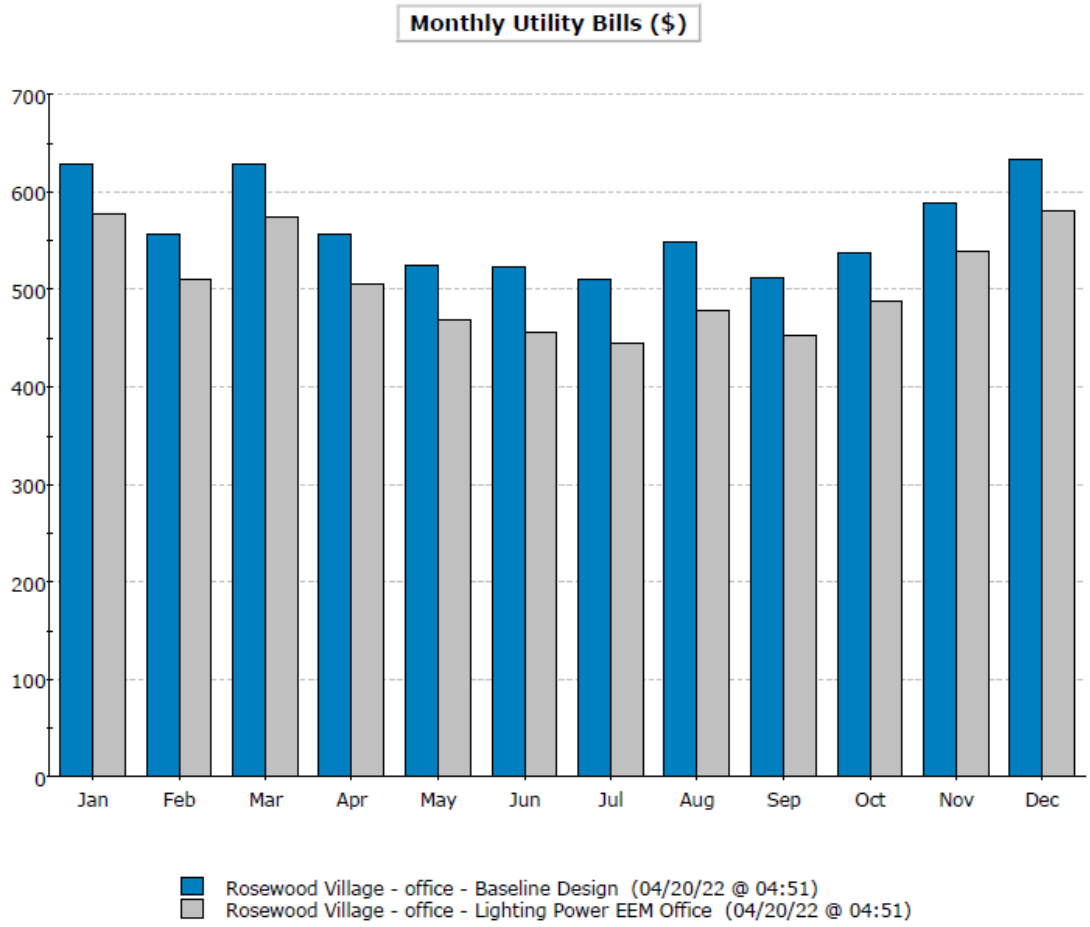


Figure 6.37 Monthly Utility Bills Comparison

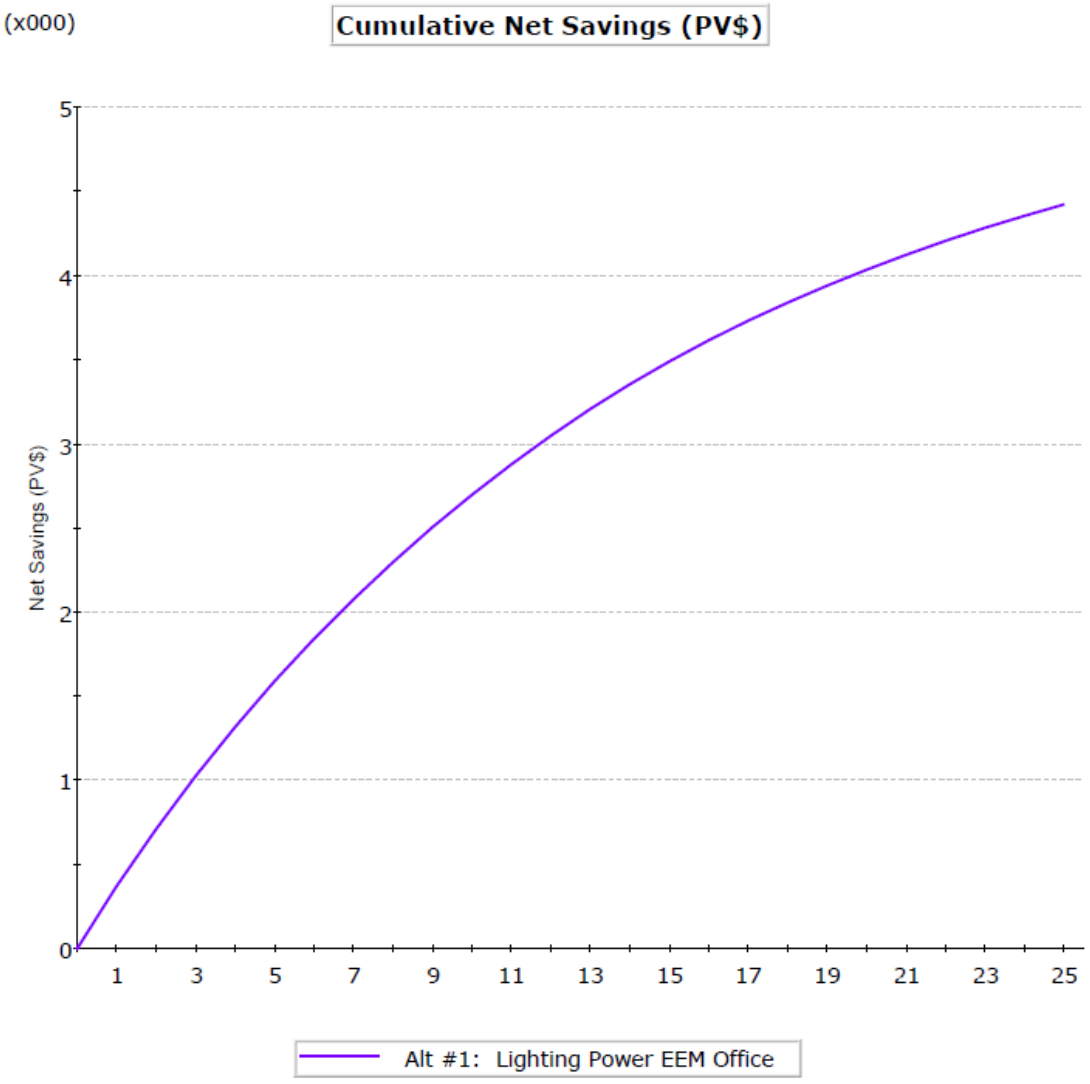


Figure 6.38 Cumulative Net Savings

3) EEM5- Envelope upgradation for townhouse

Retrofitting the exterior wall is good way to save the energy consumption. The settings in eQuest EEM are shown below:

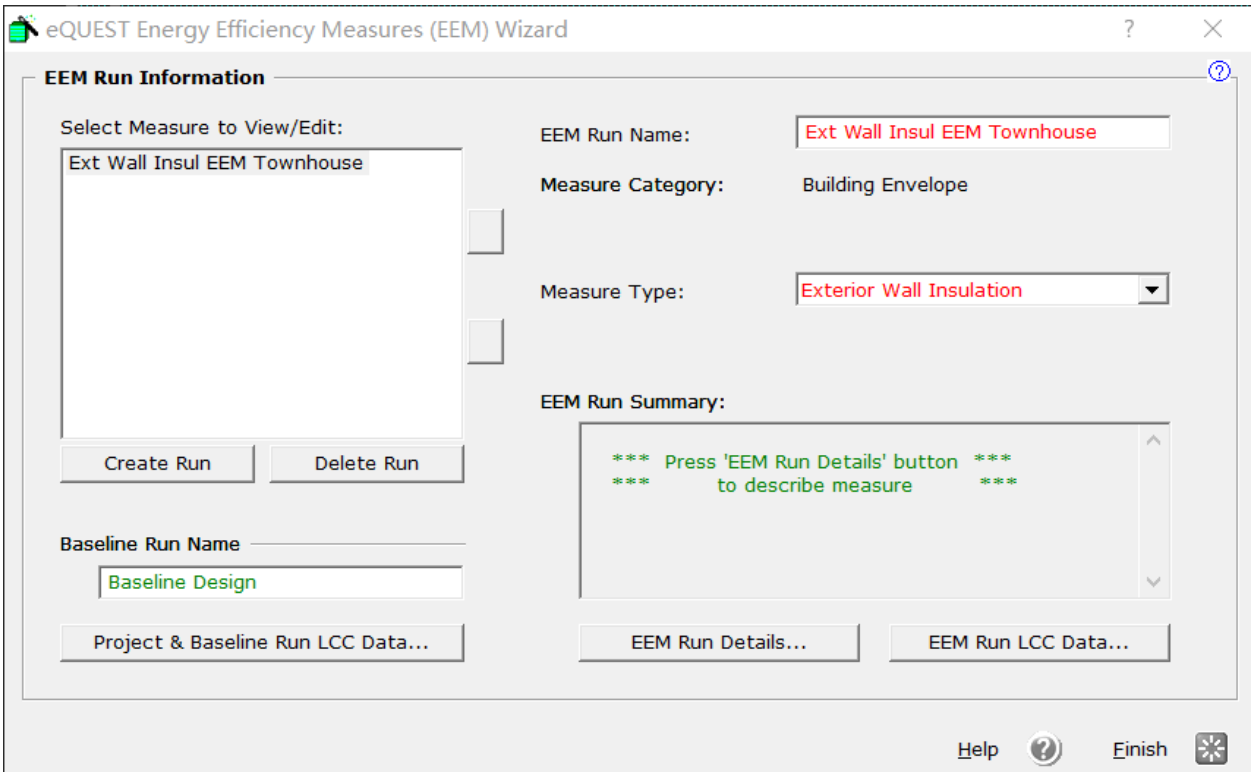


Figure 6.39 EEM Run Information

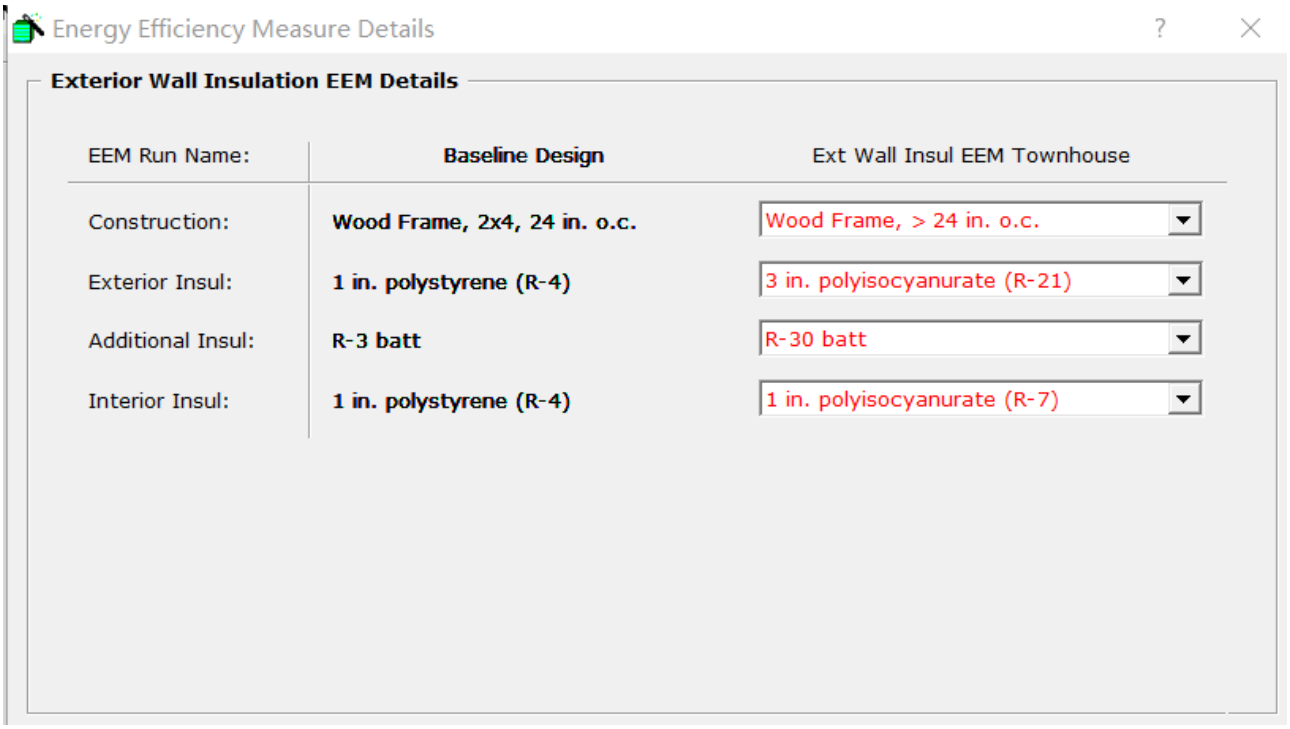


Figure 6.40 Exterior Wall Insulation EEM Details

After running the EEM, some key reports are displayed below; gas consumption is obviously reduced with the effective energy measure based on the figures.

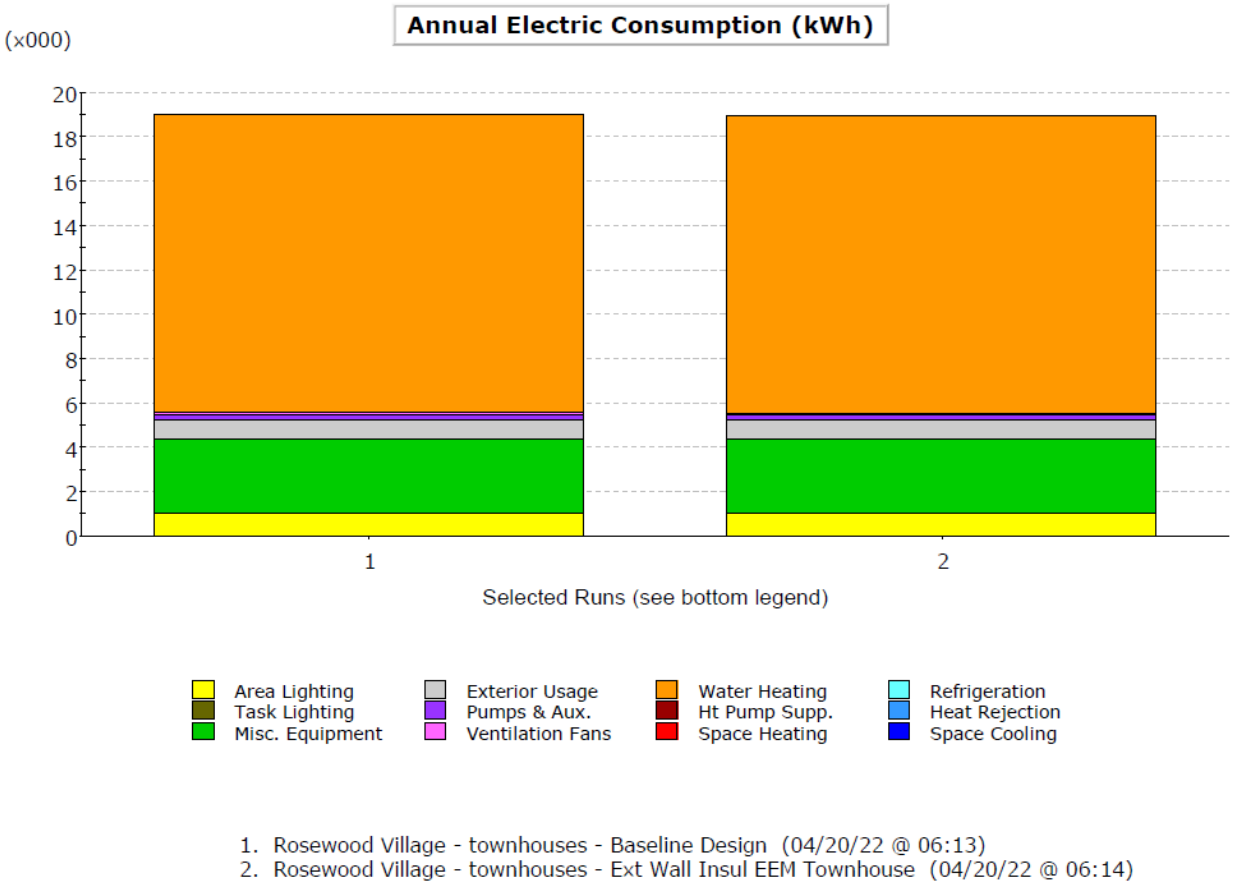


Figure 6.41 Annual Electric Consumption Comparison

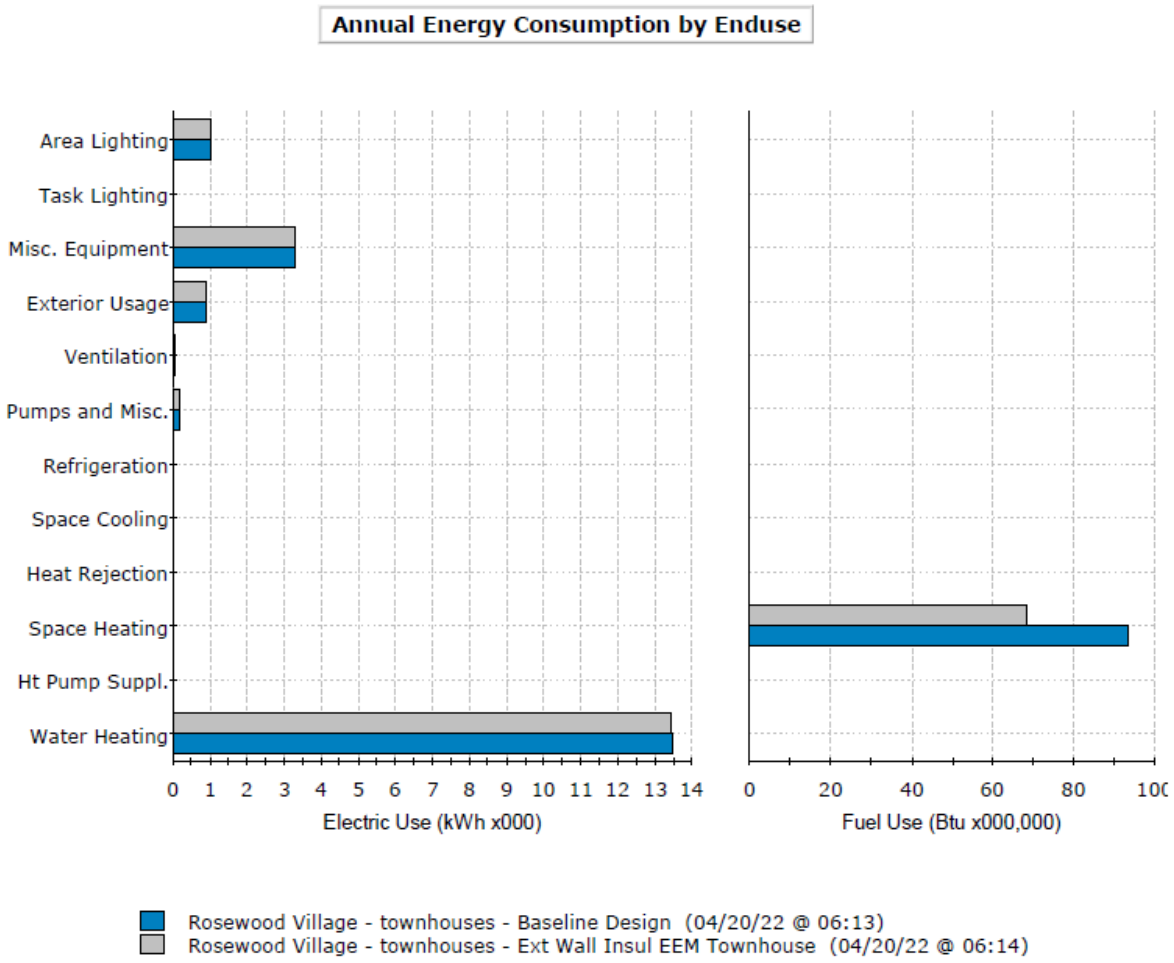


Figure 6.42 Annual Energy Consumption Comparison

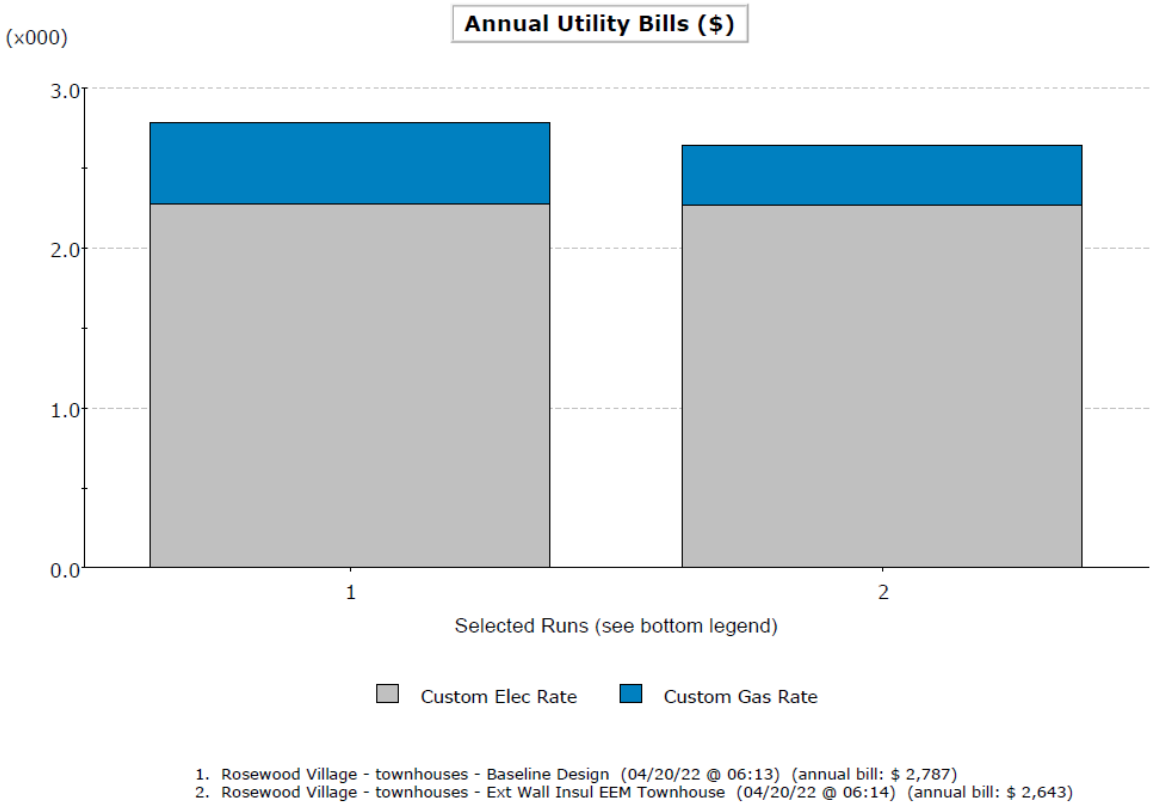
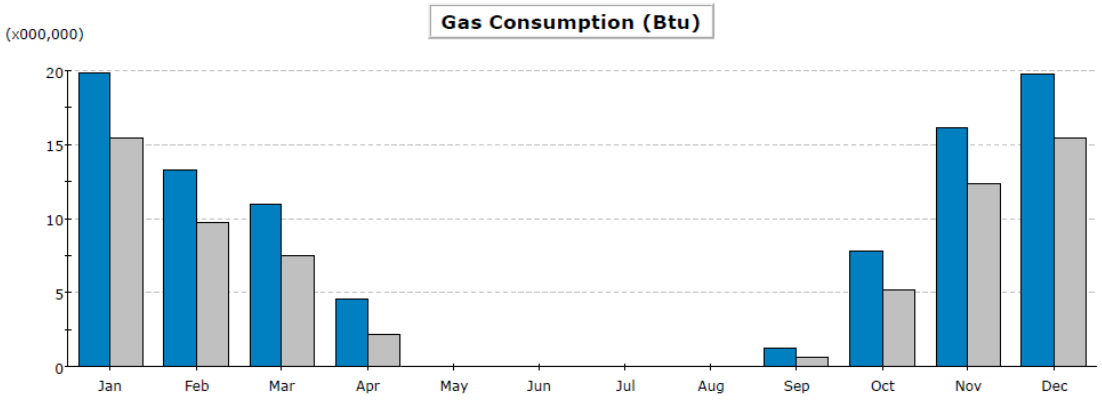


Figure 6.43 Annual Utility Bills Comparison



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	19.86	13.27	10.97	4.53	-	-	-	-	1.26	7.84	16.13	19.73	93.60
Run 2.	15.42	9.74	7.50	2.20	-	-	-	-	0.59	5.20	12.34	15.43	68.44
Run 3.													
Run 4.													
Run 5.													

Figure 6.44 Gas Consumption Comparison

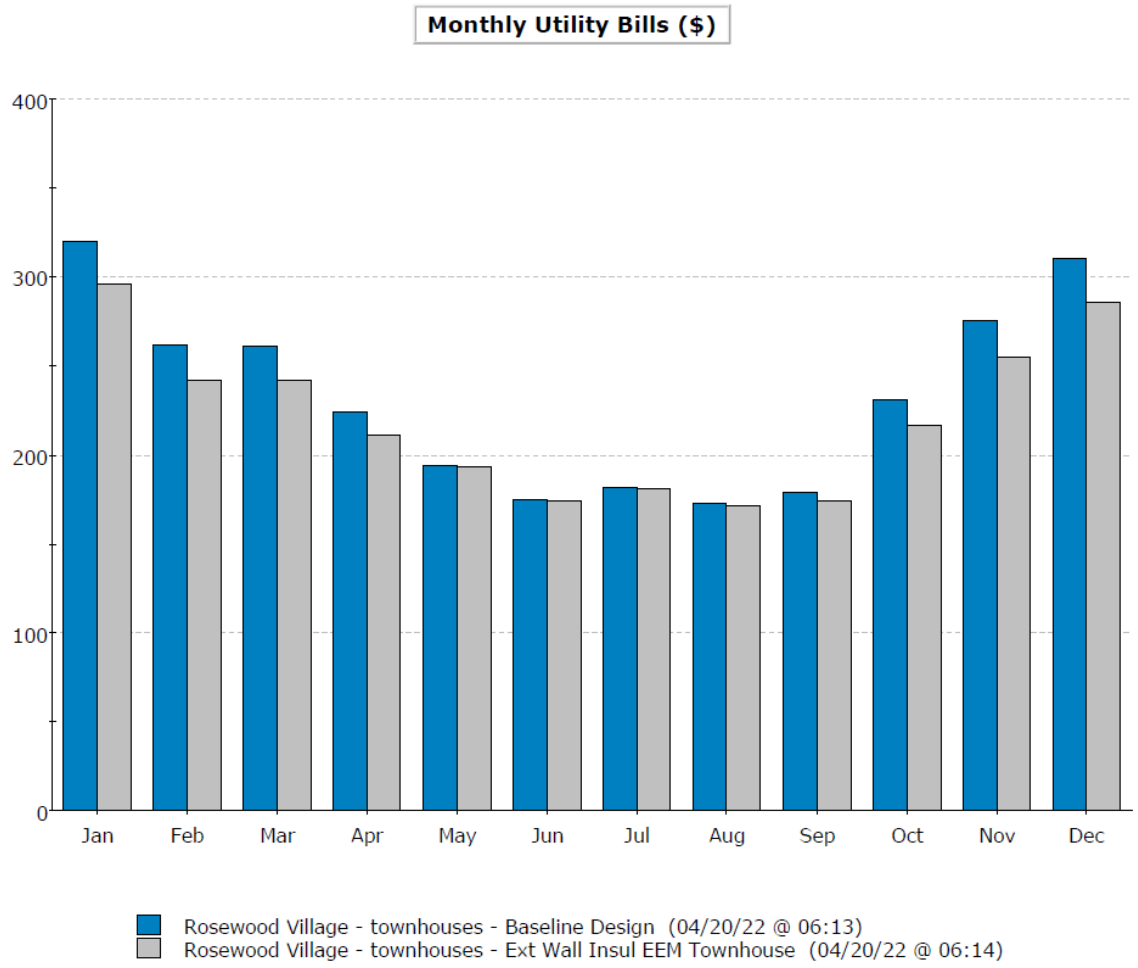


Figure 6.45 Monthly Utility Bills

Summary for chapter 6:

1) The simulated EEMs here only considered about 1 apartment, 1 office, and 1 townhouse; to get the comprehensive results, all of the buildings should be taken into account;
2) From the reports, proposed EEMs are effective and practical; energy consumption and bills can be reduced gradually;
3) financial issues (life cycle savings, simple pay back, etc.) need to be discussed further with more input in details.