Killing Watts:
Ghost Loads at the University of Colorado Colorado Springs

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Supplemental data to accompany the original article. This section includes data sets on computer usage for specific computer labs at the University of Colorado Colorado Springs campus and calculations of total costs, CO_2 emissions, and kWh.
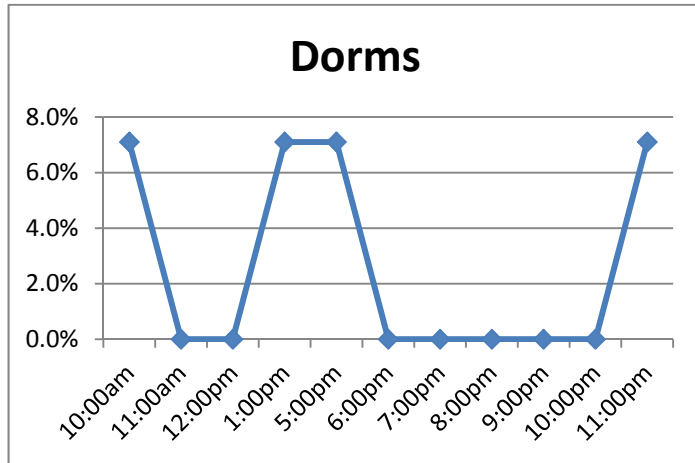
Appendix I: Computers in Use Data

Data for Wednesday, March 18, 2009

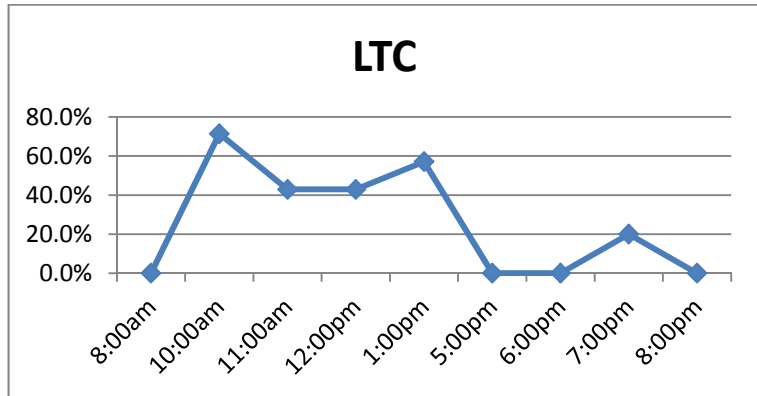| Time	% Computers in use
8:00am	0.0%
10:00am	32.0%
11:00am	70.0%
12:00pm	74.0%
1:00pm	68.0%
5:00pm	36.0%
6:00pm	28.0%
7:00pm	34.0%
8:00pm	14.0%
9:00pm	6.0%
10:00pm	0.0%

CoH 231
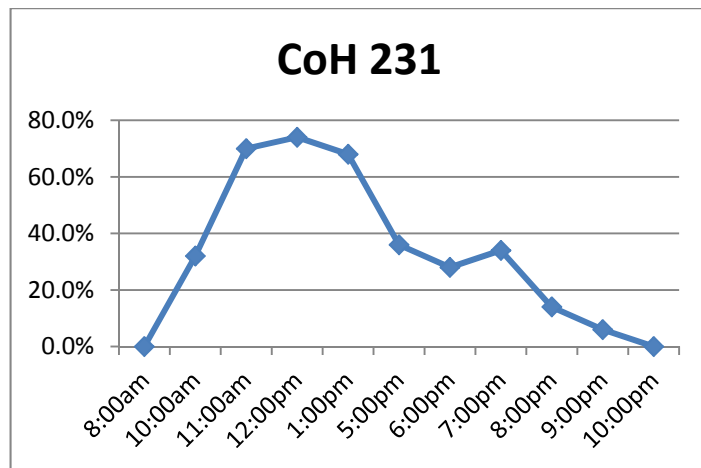
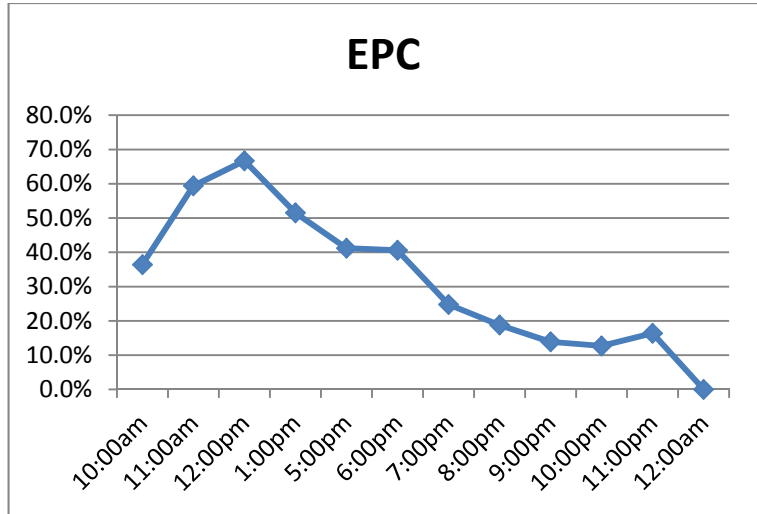| Time	% Computers in use
10:00am	7.1%
11:00am	0.0%
12:00pm	0.0%
1:00pm	7.1%
5:00pm	7.1%
6:00pm	0.0%
7:00pm	0.0%
8:00pm	0.0%
9:00pm	0.0%
10:00pm	0.0%
11:00pm	7.1%

Dorms

Time	% Computers in use
8:00am	0.0%
10:00am	6.7%
11:00am	13.3%
12:00pm	13.3%
1:00pm	40.0%
5:00pm	13.3%
6:00pm	0.0%
7:00pm	20.0%
8:00pm	0.0%

## Math Lab
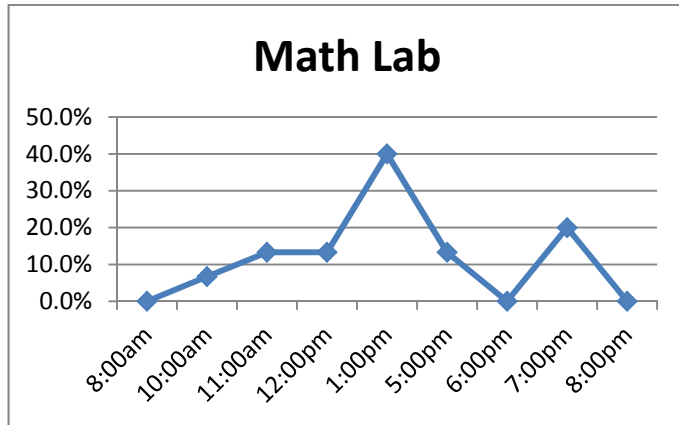
Time	% Computers in use
8:00am	0.0%
10:00am	71.4%
11:00am	42.9%
12:00pm	42.9%
1:00pm	57.1%
5:00pm	0.0%
6:00pm	0.0%
7:00pm	20.0%
8:00pm	0.0%

LTC

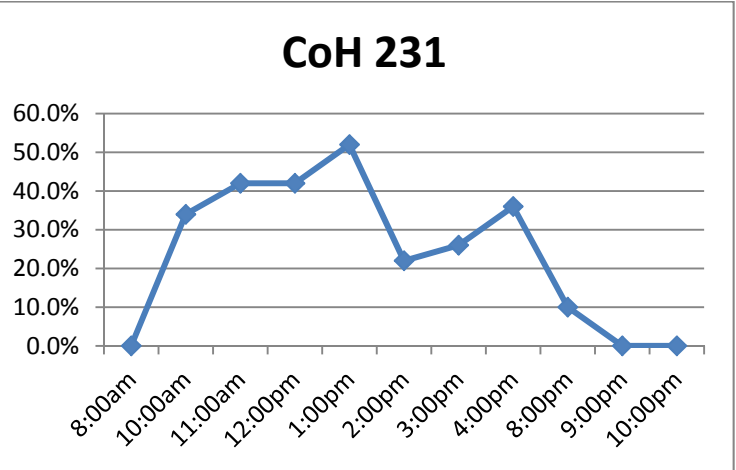| Time	% Computers in use
10:00am	36.4%
11:00am	59.4%
12:00pm	66.7%
1:00pm	51.5%
5:00pm	41.2%
6:00pm	40.6%
7:00pm	24.8%
8:00pm	18.8%
9:00pm	13.9%
10:00pm	12.7%
11:00pm	16.4%
12:00am	0.0%

EPC

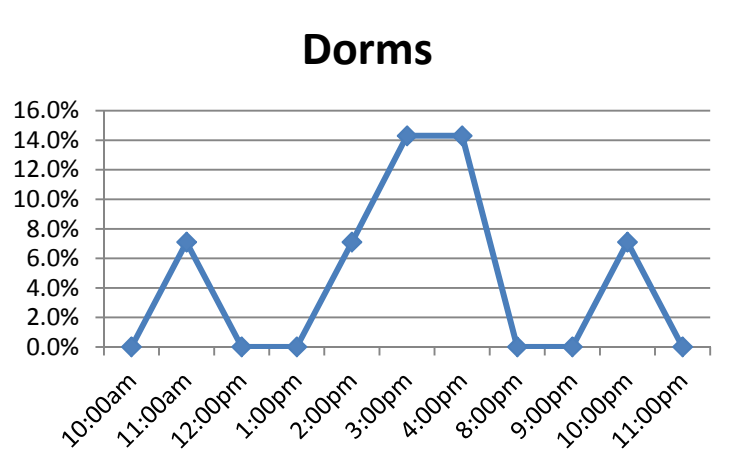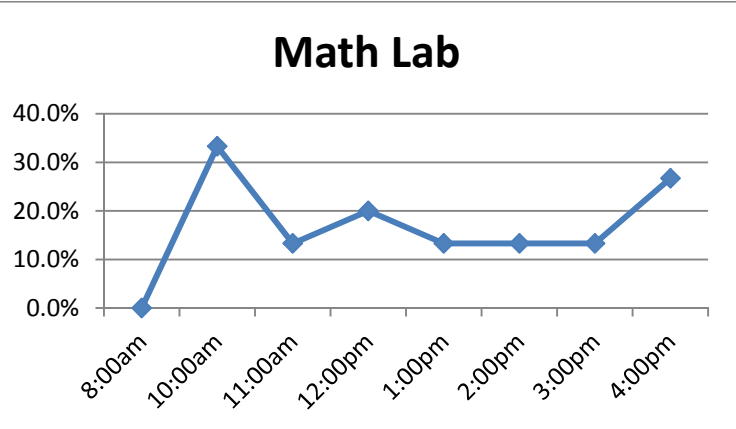| Time	% Computers in use
10:00am	33.1%
11:00am	55.0%
12:00pm	60.6%
1:00pm	51.8%
5:00pm	35.5%
6:00pm	32.3%
7:00pm	24.3%
8:00pm	15.1%
9:00pm	10.4%
10:00pm	8.3%
11:00pm	10.8%

Wednesday Total Campus Usage
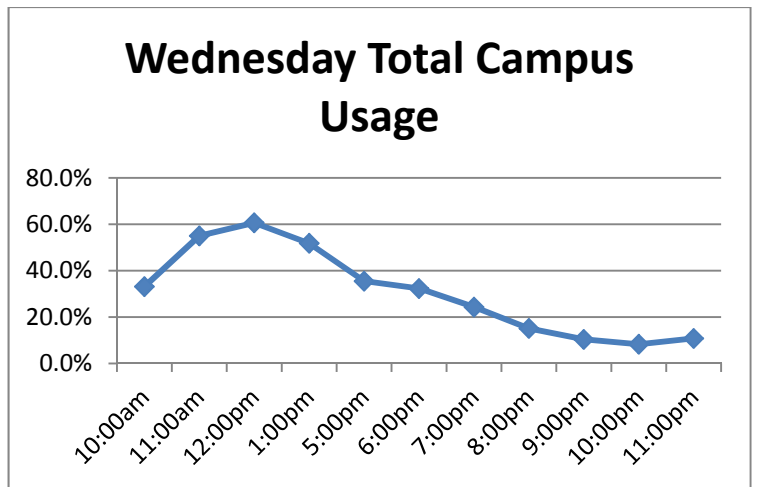
Data for Thursday, March 19, 2009

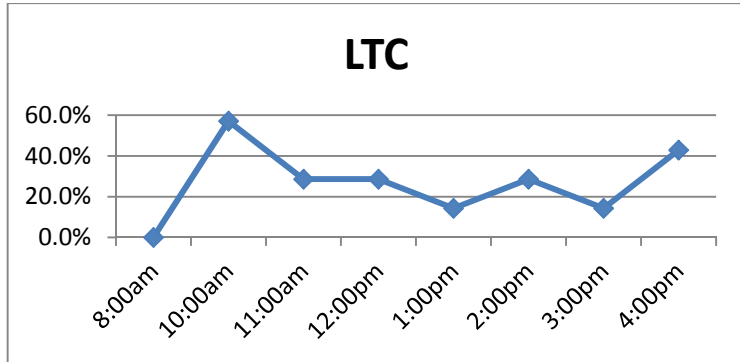| Time	% Computers in use
8:00am	0.0%
10:00am	34.0%
11:00am	42.0%
12:00pm	42.0%
1:00pm	52.0%
2:00pm	22.0%
3:00pm	26.0%
4:00pm	36.0%
8:00pm	10.0%
9:00pm	0.0%
10:00pm	0.0%

CoH 231

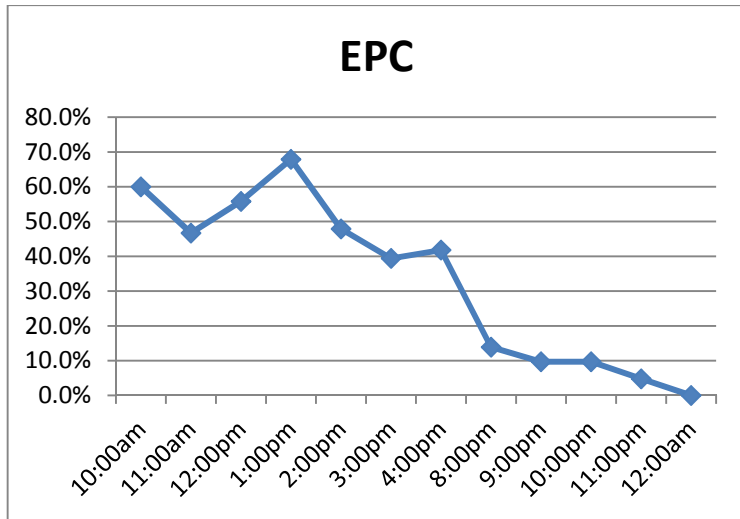| Time	% Computers in use
10:00am	0.0%
11:00am	7.1%
12:00pm	0.0%
1:00pm	0.0%
2:00pm	7.1%
3:00pm	14.3%
4:00pm	14.3%
8:00pm	0.0%
9:00pm	0.0%
10:00pm	7.1%
11:00pm	0.0%

Dorms

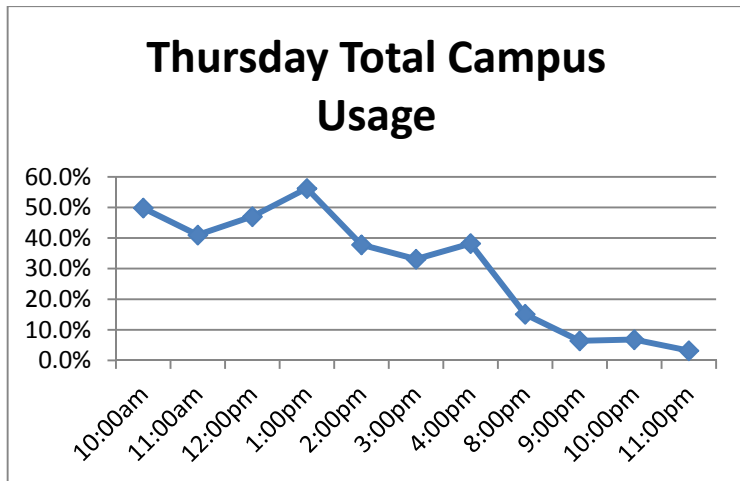| Time	% Computers in use
8:00am	0.0%
10:00am	33.3%
11:00am	13.3%
12:00pm	20.0%
1:00pm	13.3%
2:00pm	13.3%
3:00pm	13.3%
4:00pm	26.7%

Math Lab

Time	% Computers in use
8:00am	0.0%
10:00am	57.1%
11:00am	28.6%
12:00pm	28.6%
1:00pm	14.3%
2:00pm	28.6%
3:00pm	14.3%
4:00pm	42.9%

LTC

Time	% Computers in use
10:00am	60.0%
11:00am	46.7%
12:00pm	55.8%
1:00pm	67.9%
2:00pm	47.9%
3:00pm	39.4%
4:00pm	41.8%
8:00pm	13.9%
9:00pm	9.7%
10:00pm	9.7%
11:00pm	4.8%
12:00am	0.0%

EPC
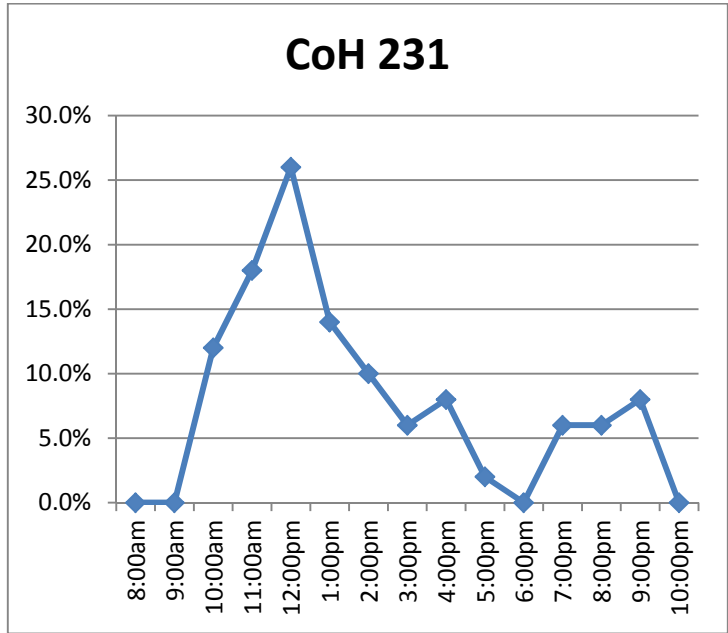
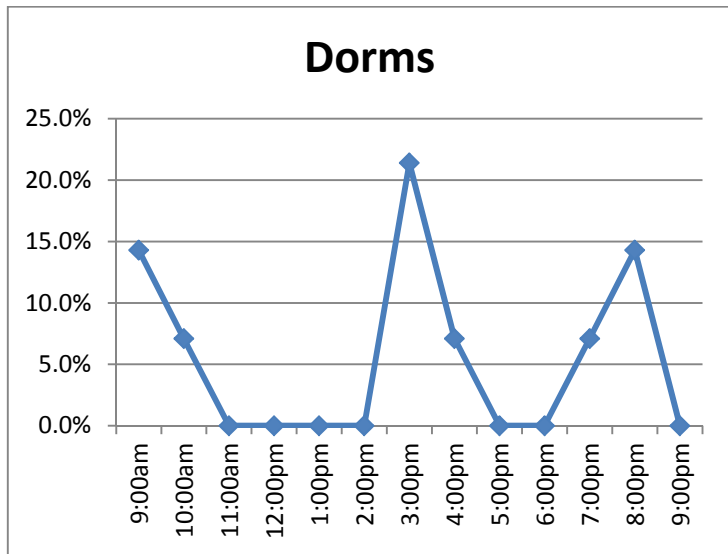| Time	% Computers in use
10:00am	49.8%
11:00am	41.0%
12:00pm	47.0%
1:00pm	56.2%
2:00pm	37.8%
3:00pm	33.1%
4:00pm	38.2%
8:00pm	15.1%
9:00pm	6.4%
10:00pm	6.8%
11:00pm	3.2%

Thursday Total Campus Usage

Data for Friday, March 20, 2009

Time	% Computers in use
8:00am	0.0%
9:00am	0.0%
10:00am	12.0%
11:00am	18.0%
12:00pm	26.0%
1:00pm	14.0%
2:00pm	10.0%
3:00pm	6.0%
4:00pm	8.0%
5:00pm	2.0%
6:00pm	0.0%
7:00pm	6.0%
8:00pm	6.0%
9:00pm	8.0%
10:00pm	0.0%

CoH 231

Time	% Computers in use
9:00am	14.3%
10:00am	7.1%
11:00am	0.0%
12:00pm	0.0%
1:00pm	0.0%
2:00pm	0.0%
3:00pm	21.4%
4:00pm	7.1%
5:00pm	0.0%
6:00pm	0.0%
7:00pm	7.1%
8:00pm	14.3%
9:00pm	0.0%

Dorms
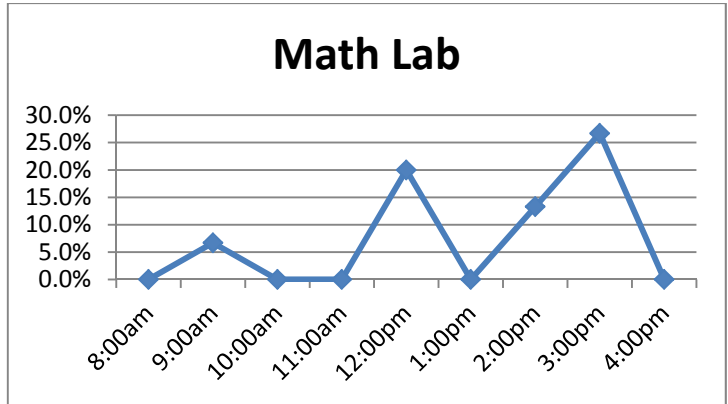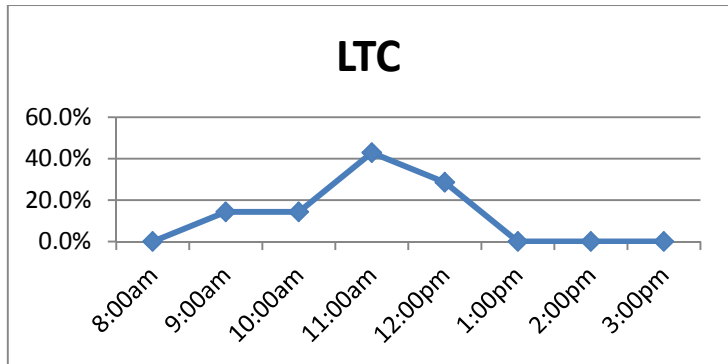
Time	% Computers in use
8:00am	0.0%
9:00am	6.7%
10:00am	0.0%
11:00am	0.0%
12:00pm	20.0%
1:00pm	0.0%
2:00pm	13.3%
3:00pm	26.7%
4:00pm	0.0%

Math Lab

Time	% Computers in use
8:00am	0.0%
9:00am	14.3%
10:00am	14.3%
11:00am	42.9%
12:00pm	28.6%
1:00pm	0.0%
2:00pm	0.0%
3:00pm	0.0%

LTC

Time	% Computers in use
9:00am	12.7%
10:00am	19.4%
11:00am	23.0%
12:00pm	29.7%
1:00pm	22.4%
2:00pm	12.1%
3:00pm	15.2%
4:00pm	20.0%
5:00pm	16.4%
6:00pm	9.7%
7:00pm	6.1%
8:00pm	0.0%

EPC

Time	% Computers in use
9:00am	10.0%
10:00am	15.9%
11:00am	19.9%
12:00pm	26.7%
1:00pm	17.5%
2:00pm	10.8%
3:00pm	13.9%
4:00pm	15.1%
5:00pm	11.2%
6:00pm	6.4%
7:00pm	5.6%
8:00pm	2.0%
9:00pm	1.6%

Friday Total Campus Usage

Data for Monday, March 30, 2009

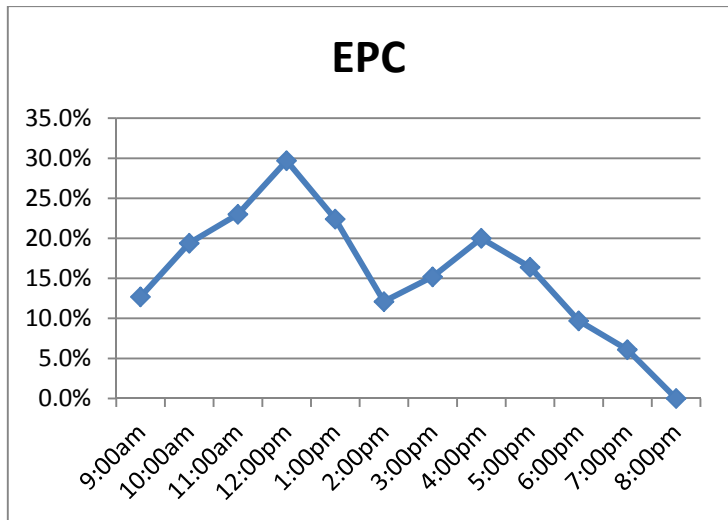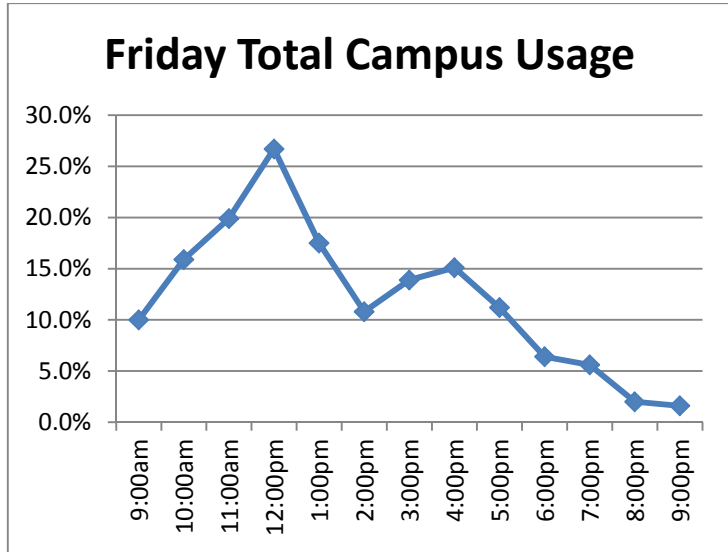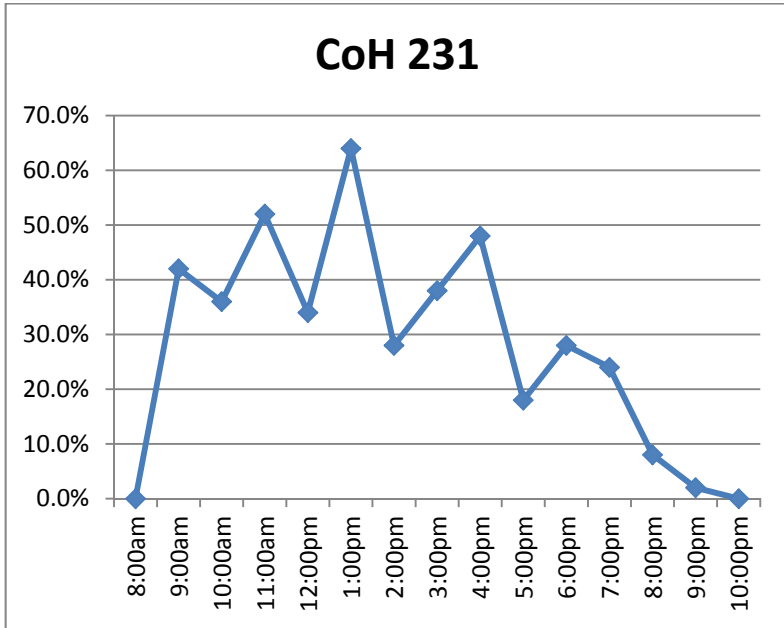| Time	% Computers in use
8:00am	0.0%
9:00am	42.0%
10:00am	36.0%
11:00am	52.0%
12:00pm	34.0%
1:00pm	64.0%
2:00pm	28.0%
3:00pm	38.0%
4:00pm	48.0%
5:00pm	18.0%
6:00pm	28.0%
7:00pm	24.0%
8:00pm	8.0%
9:00pm	2.0%
10:00pm	0.0%

CoH 231

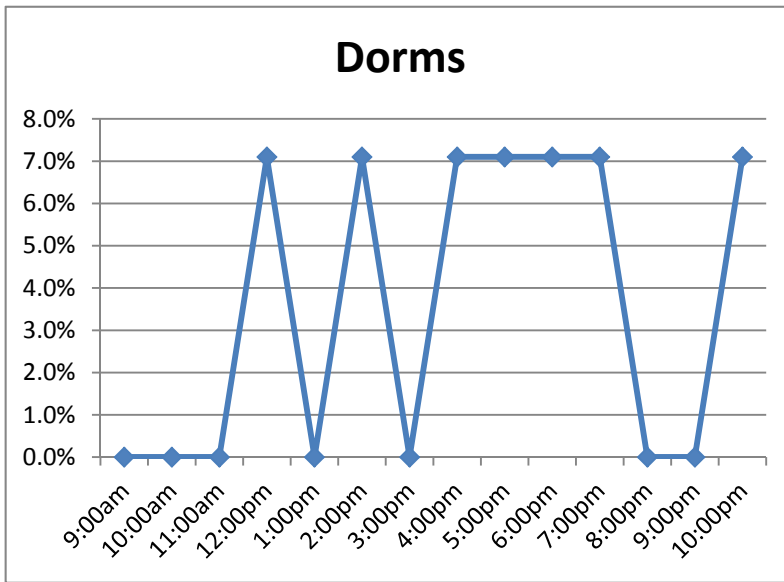| Time	% Computers in use
9:00am	0.0%
10:00am	0.0%
11:00am	0.0%
12:00pm	7.1%
1:00pm	0.0%
2:00pm	7.1%
3:00pm	0.0%
4:00pm	7.1%
5:00pm	7.1%
6:00pm	7.1%
7:00pm	7.1%
8:00pm	0.0%
9:00pm	0.0%
10:00pm	7.1%

Dorms

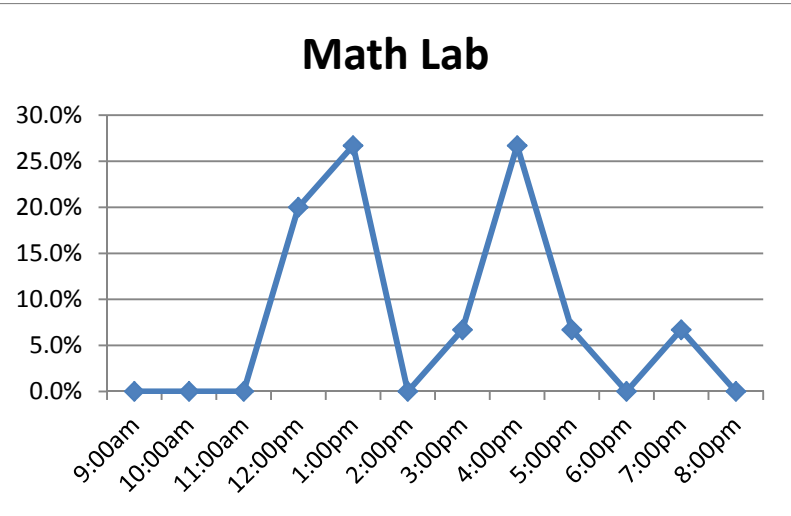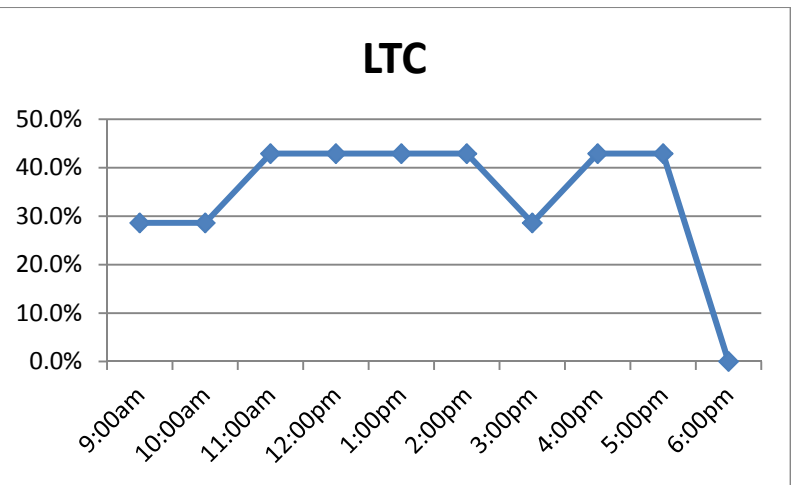| Time	% Computers in use
9:00am	0.0%
10:00am	0.0%
11:00am	0.0%
12:00pm	20.0%
1:00pm	26.7%
2:00pm	0.0%
3:00pm	6.7%
4:00pm	26.7%
5:00pm	6.7%
6:00pm	0.0%
7:00pm	6.7%
8:00pm	0.0%

Math Lab

Time	% Computers in use
9:00am	28.6%
10:00am	28.6%
11:00am	42.9%
12:00pm	42.9%
1:00pm	42.9%
2:00pm	42.9%
3:00pm	28.6%
4:00pm	42.9%
5:00pm	42.9%
6:00pm	0.0%
7:00pm	0.0%

LTC

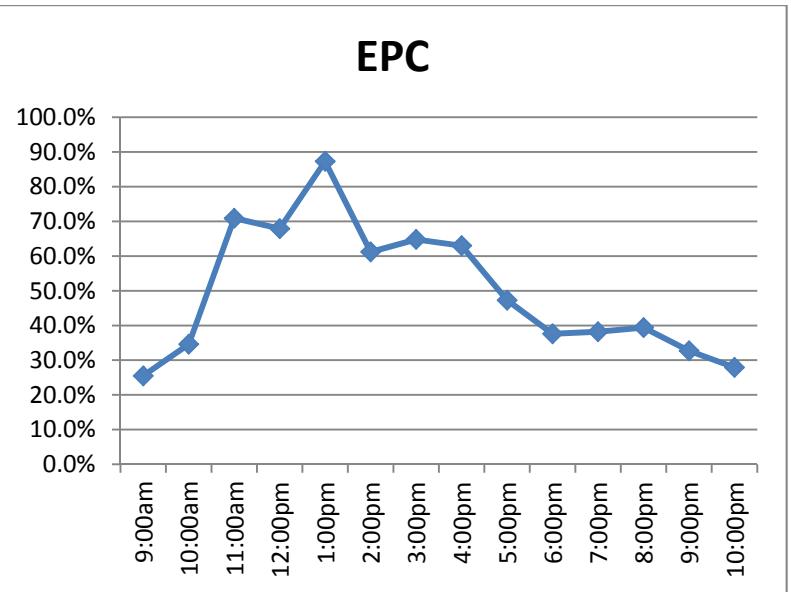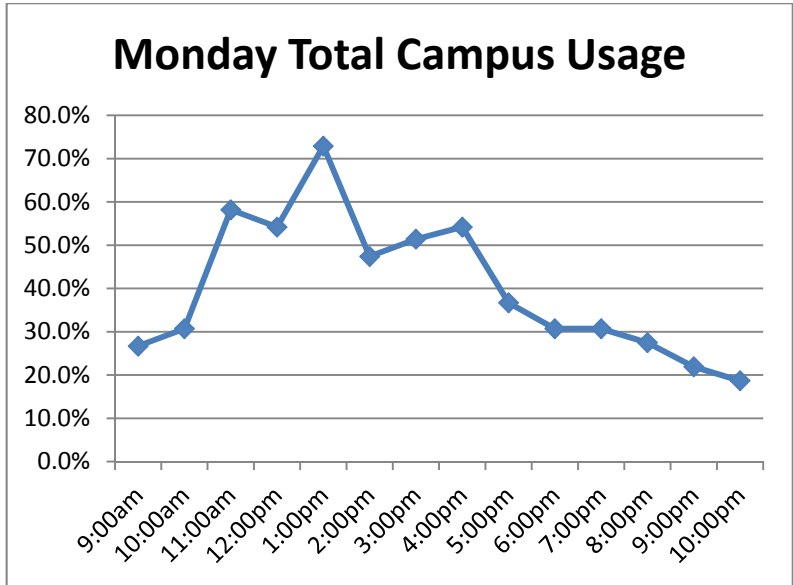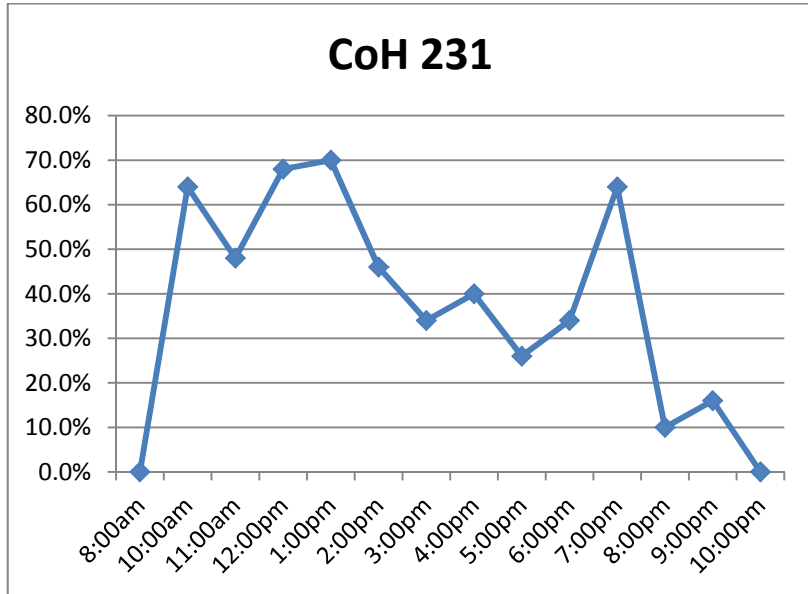| Time	% Computers in use
9:00am	25.5%
10:00am	34.6%
11:00am	70.9%
12:00pm	67.9%
1:00pm	87.3%
2:00pm	61.2%
3:00pm	64.8%
4:00pm	63.0%
5:00pm	47.3%
6:00pm	37.6%
7:00pm	38.2%
8:00pm	39.4%
9:00pm	32.7%
10:00pm	27.9%

EPC

Time	% Computers in use
9:00am	26.7%
10:00am	30.7%
11:00am	58.2%
12:00pm	54.2%
1:00pm	72.9%
2:00pm	47.4%
3:00pm	51.4%
4:00pm	54.2%
5:00pm	36.7%
6:00pm	30.7%
7:00pm	30.7%
8:00pm	27.5%
9:00pm	21.9%
10:00pm	18.7%

Monday Total Campus Usage

Data for Tuesday, March 31, 2009

Time	% Computers in use
8:00am	0.0%
10:00am	64.0%
11:00am	48.0%
12:00pm	68.0%
1:00pm	70.0%
2:00pm	46.0%
3:00pm	34.0%
4:00pm	40.0%
5:00pm	26.0%
6:00pm	34.0%
7:00pm	64.0%
8:00pm	10.0%
9:00pm	16.0%
10:00pm	0.0%

CoH 231

Time	% Computers in use
10:00am	0.0%
11:00am	7.1%
12:00pm	0.0%
1:00pm	21.4%
2:00pm	14.3%
3:00pm	7.1%
4:00pm	21.4%
5:00pm	14.3%
6:00pm	14.3%
7:00pm	21.4%
8:00pm	14.3%
9:00pm	0.0%
10:00pm	14.3%
11:00pm	21.4%

Dorms

Time	% Computers in use
8:00am	0.0%
10:00am	13.3%
11:00am	13.3%
12:00pm	33.3%
1:00pm	40.0%
2:00pm	20.0%
3:00pm	13.3%
4:00pm	6.7%
5:00pm	13.3%
6:00pm	20.0%
7:00pm	20.0%
8:00pm	0.0%

Math Lab
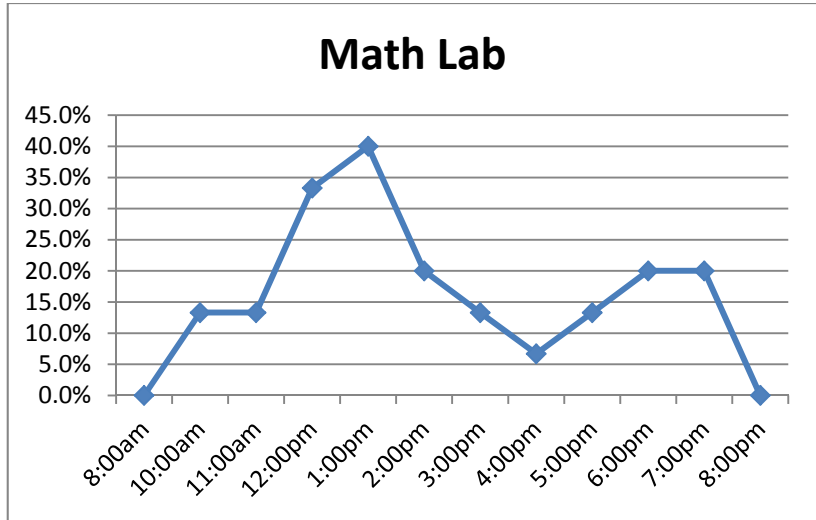
Time	% Computers in use
10:00am	14.3%
11:00am	28.6%
12:00pm	42.9%
1:00pm	14.3%
2:00pm	14.3%
3:00pm	14.3%
4:00pm	42.9%
5:00pm	0.0%
6:00pm	28.6%
7:00pm	0.0%

LTC

Time	% Computers in use
10:00am	78.9%
11:00am	72.1%
12:00pm	76.4%
1:00pm	89.7%
2:00pm	87.3%
3:00pm	63.6%
4:00pm	63.6%
5:00pm	47.9%
6:00pm	36.4%
7:00pm	44.2%
8:00pm	40.0%
9:00pm	25.5%
10:00pm	20.0%
11:00pm	12.7%
12:00pm	0.0%

EPC

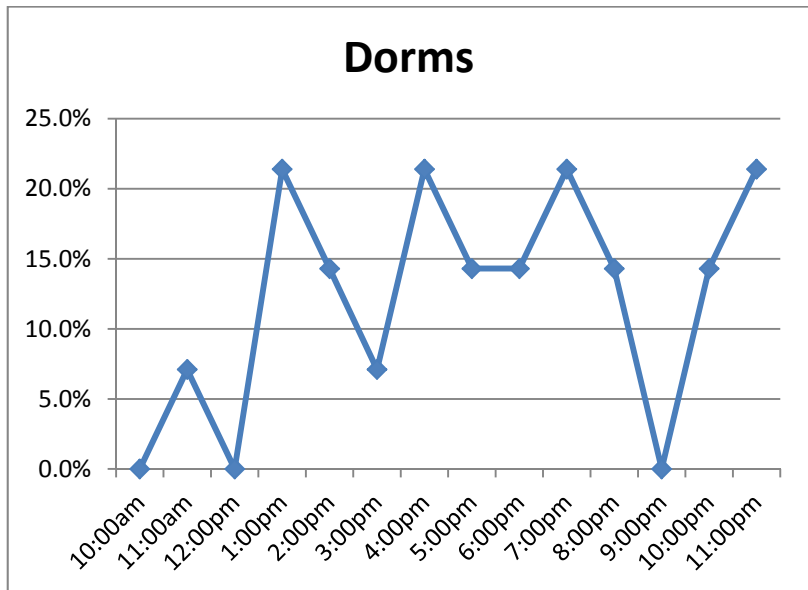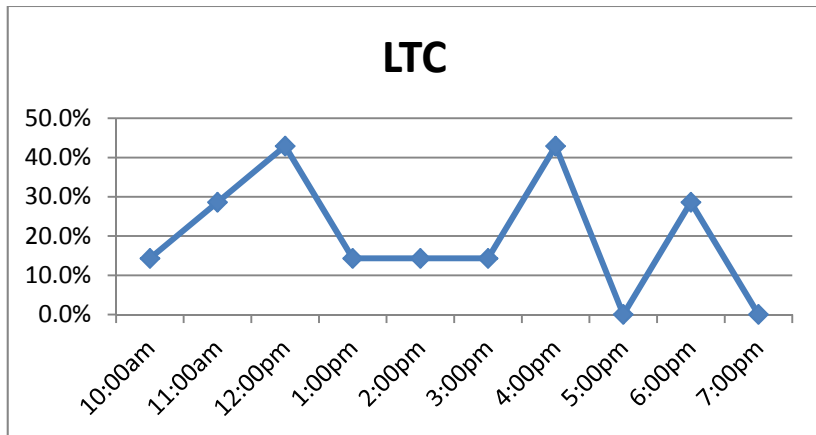| Time	% Computers in use
10:00am	65.7%
11:00am	59.0%
12:00pm	66.9%
1:00pm	76.9%
2:00pm	68.9%
3:00pm	50.2%
4:00pm	52.6%
5:00pm	38.2%
6:00pm	33.5%
7:00pm	40.2%
8:00pm	29.1%
9:00pm	19.9%
10:00pm	10.0%
11:00pm	9.6%

Tuesday Total Campus Usage

Cumulative Daily Average

Time	% Computers in use
9:00am	18.3%
10:00am	39.0%
11:00am	46.6%
12:00pm	51.0%
1:00pm	55.0%
2:00pm	36.3%
3:00pm	37.1%
4:00pm	40.2%
5:00pm	30.0%
6:00pm	25.9%
7:00pm	25.1%
8:00pm	17.9%
9:00pm	12.0%
10:00pm	12.0%
11:00pm	8.0%

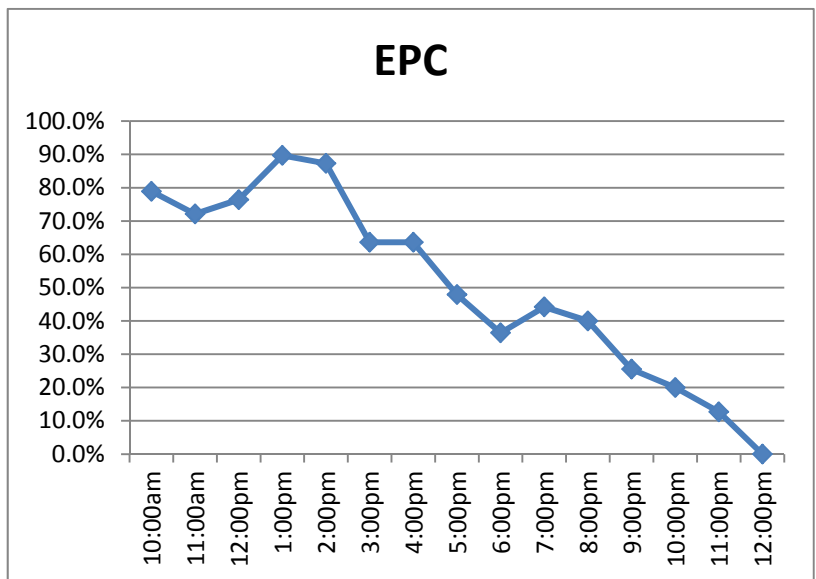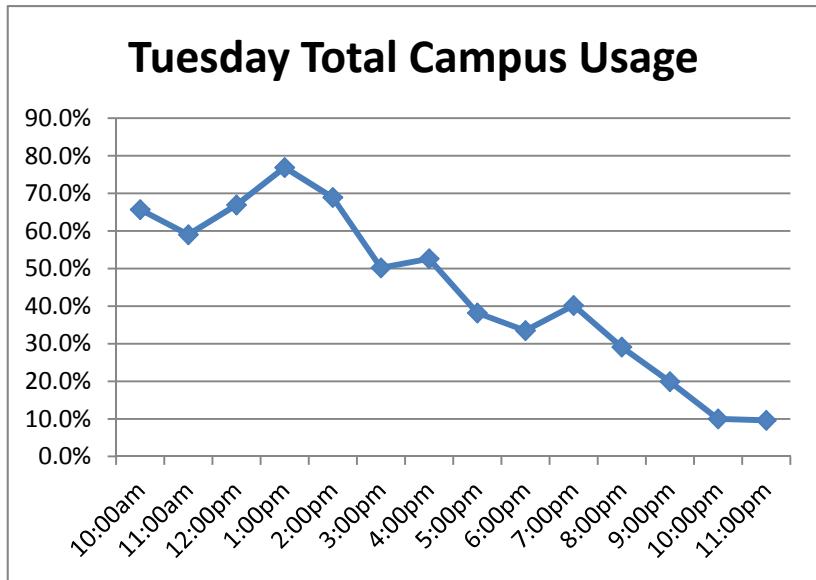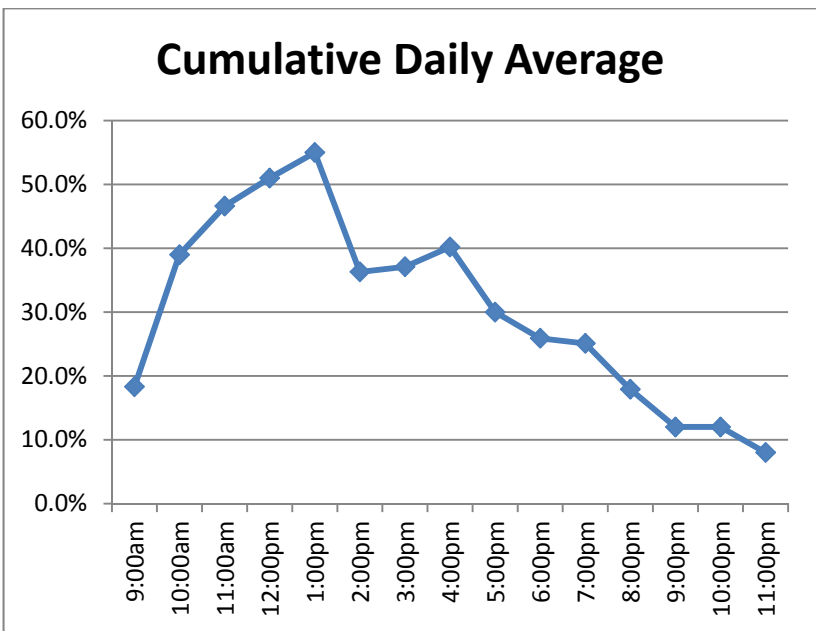**Cumulative Daily Average**

Monday through Thursday Daily Average
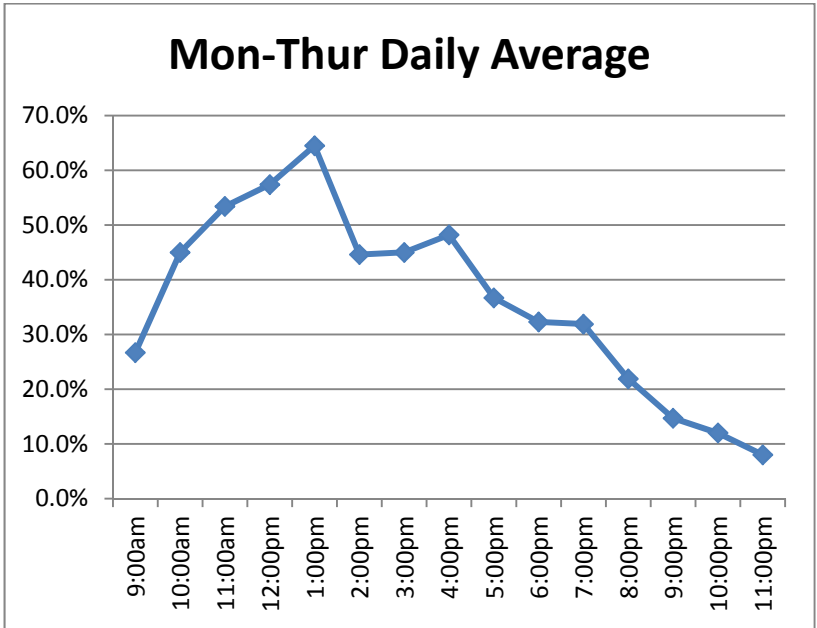
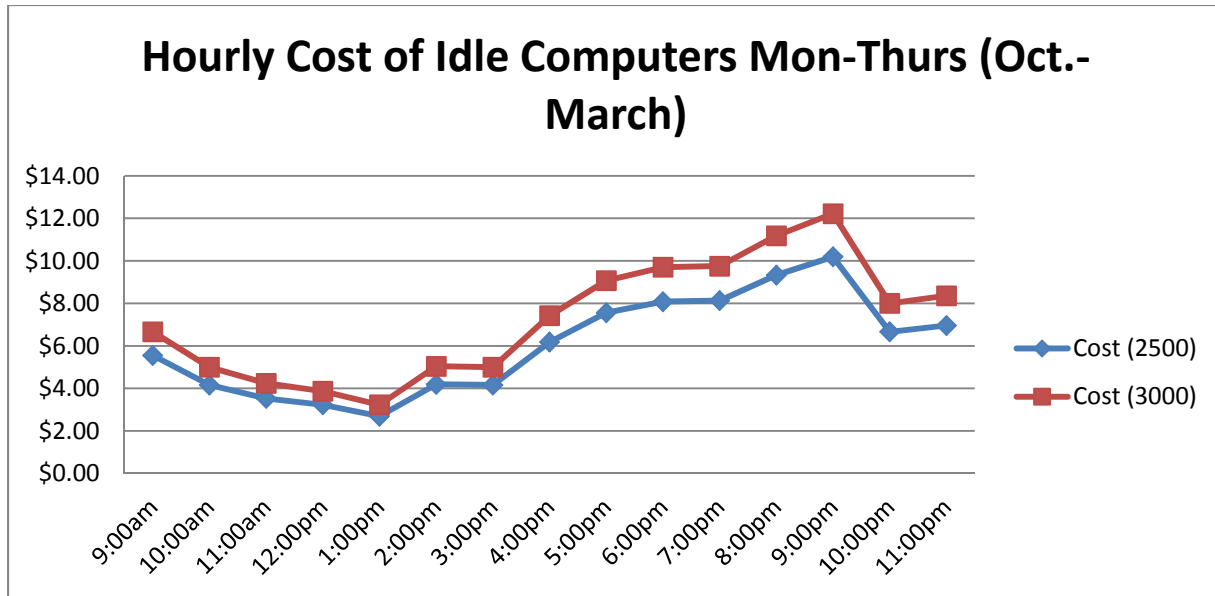| Time	% Computers in use
9:00am	26.7%
10:00am	45.0%
11:00am	53.4%
12:00pm	57.4%
1:00pm	64.5%
2:00pm	44.6%
3:00pm	45.0%
4:00pm	48.2%
5:00pm	36.7%
6:00pm	32.3%
7:00pm	31.9%
8:00pm	21.9%
9:00pm	14.7%
10:00pm	12.0%
11:00pm	8.0%

Mon-Thur Daily Average

Appendix II: Cost Calculations

2500 Computer Energy Consumption	3000 Computer Energy Consumption
91.5 kWh-202.5 kWh	109.8 kWh-243 kWh
Mean:147	Mean: 176.4
Off-Peak Cost per kWh: $7.57	Off-Peak Cost per kWh: $9.09
On-Peak Cost per kWh: $11.94	On-Peak Cost per kWh: $14.32
Off-Peak per kWh Rate: $0.0515	On-Peak per kWh Rate: $0.0812

Data for Hourly Cost for Monday - Thursday, October - March

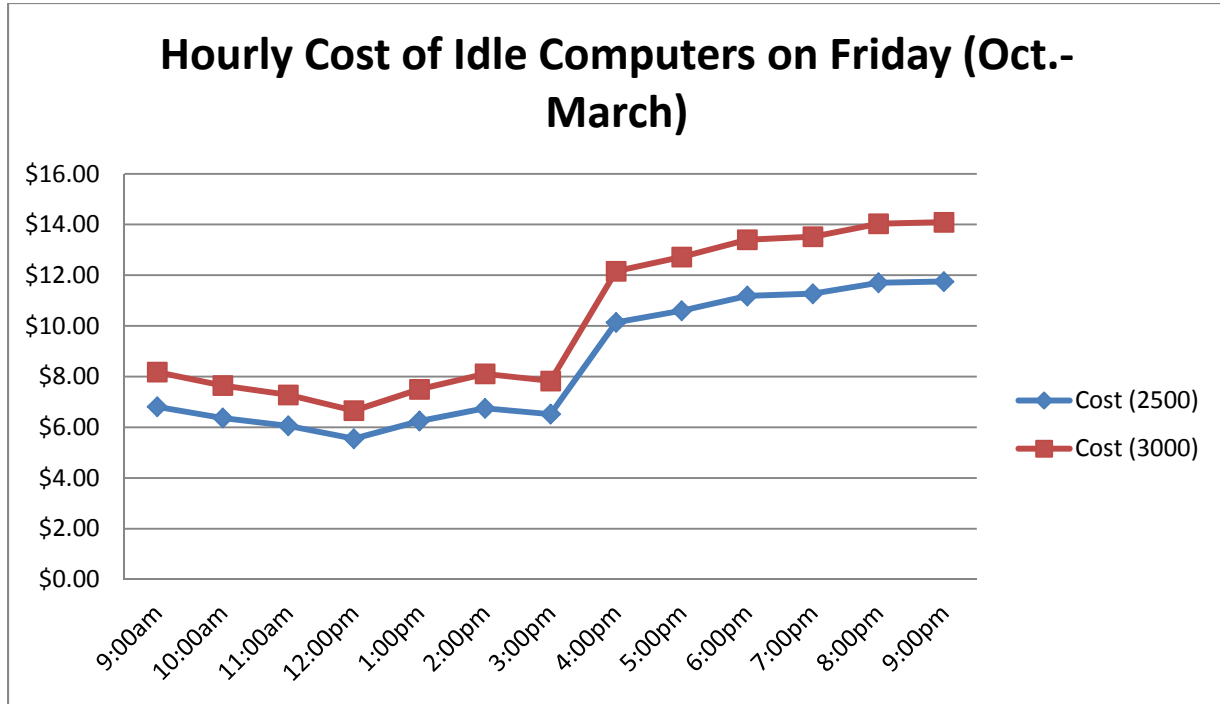| Time	Cost (2500)	Cost (3000)	% Computers Unused on Campus (Mon-Thurs)
9:00am	$5.55	$6.66	73.3
10:00am	$4.16	$5.00	55
11:00am	$3.53	$4.24	46.6
12:00pm	$3.23	$3.87	42.6
1:00pm	$2.69	$3.23	35.5
2:00pm	$4.19	$5.04	55.4
3:00pm	$4.16	$5.00	55
4:00pm	$6.18	$7.42	51.8
5:00pm	$7.56	$9.07	63.3
6:00pm	$8.08	$9.70	67.7
7:00pm	$8.13	$9.75	68.1
8:00pm	$9.33	$11.18	78.1
9:00pm	$10.19	$12.22	85.3
10:00pm	$6.66	$8.00	88
11:00pm	$6.96	$8.36	92
Daily Total Cost	$90.60	$108.74	On Peak 4:00pm-10:00pm

Hourly Cost of Idle Computers Mon-Thurs (Oct.-March)

Data for Hourly Cost for Fridays, October - March

Time	Cost (2500)	Cost (3000)	% Computers Unused on Campus (Friday)
9:00am	$6.81	$8.18	90
10:00am	$6.37	$7.65	84.1
11:00am	$6.06	$7.28	80.1
12:00pm	$5.55	$6.66	73.3
1:00pm	$6.25	$7.50	82.5
2:00pm	$6.75	$8.11	89.2
3:00pm	$6.52	$7.83	86.1
4:00pm	$10.14	$12.16	84.9
5:00pm	$10.60	$12.72	88.8
6:00pm	$11.18	$13.40	93.6
7:00pm	$11.27	$13.52	94.4
8:00pm	$11.70	$14.03	98
9:00pm	$11.75	$14.09	98.4
Daily Total Cost	$110.95	$133.13	On Peak 4:00pm-10:00pm

Hourly Cost of Idle Computers on Friday (Oct.-March)

Legend: Cost (2500), Cost (3000)

Data for Hourly Cost for Monday - Thursday, April - September

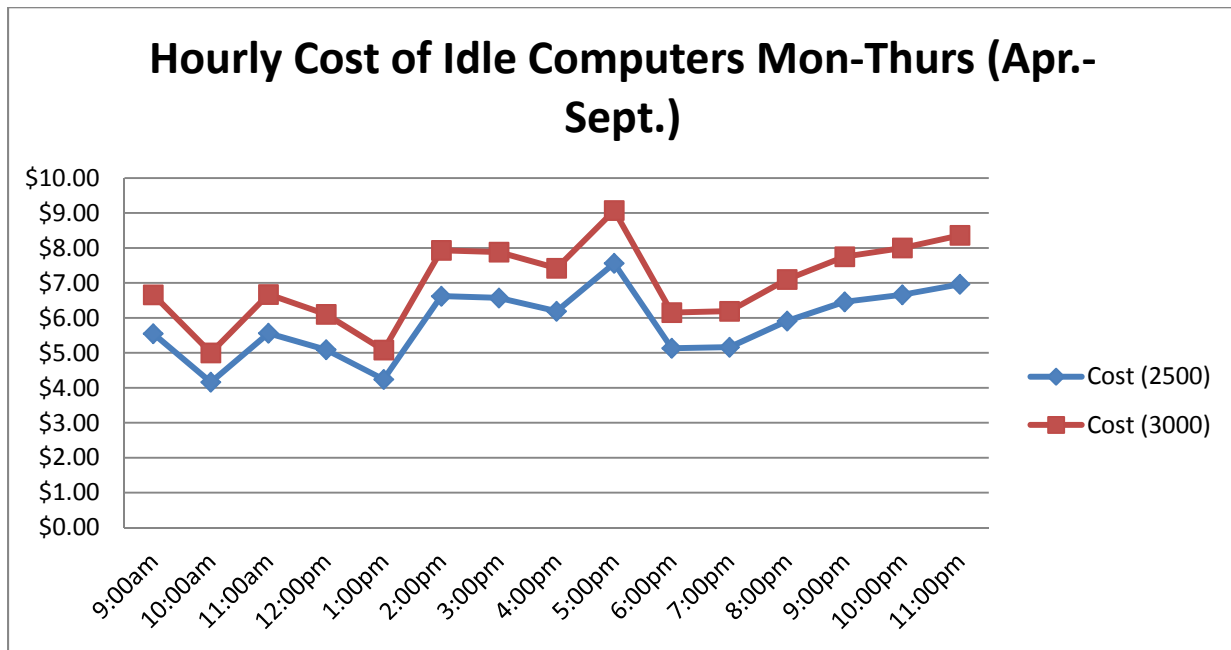| Time	Cost (2500)	Cost (3000)	% Computers Unused on Campus (Mon-Thurs)
9:00am	$5.55	$6.66	73.3
10:00am	$4.16	$5.00	55
11:00am	$5.56	$6.67	46.6
12:00pm	$5.09	$6.10	42.6
1:00pm	$4.24	$5.08	35.5
2:00pm	$6.62	$7.93	55.4
3:00pm	$6.57	$7.88	55
4:00pm	$6.19	$7.42	51.8
5:00pm	$7.56	$9.07	63.3
6:00pm	$5.13	$6.15	67.7
7:00pm	$5.16	$6.19	68.1
8:00pm	$5.91	$7.10	78.1
9:00pm	$6.46	$7.75	85.3
10:00pm	$6.66	$8.00	88
11:00pm	$6.96	$8.36	92
Daily Total Cost	$87.82	$105.36	On-Peak 11:00am-6:00pm

Hourly Cost of Idle Computers Mon-Thurs (Apr.-Sept.)

Data for Hourly Cost for Fridays, April - September

Time	Cost (2500)	Cost (3000)	% Computers Unused on Campus (Friday)
9:00am	$6.81	$8.18	90
10:00am	$6.37	$7.65	84.1
11:00am	$9.56	$11.47	80.1
12:00pm	$8.75	$10.50	73.3
1:00pm	$9.69	$11.81	82.5
2:00pm	$10.65	$12.77	89.2
3:00pm	$10.28	$12.33	86.1
4:00pm	$10.14	$12.16	84.9
5:00pm	$10.60	$12.72	88.8
6:00pm	$11.18	$13.40	93.6
7:00pm	$11.27	$13.52	94.4
8:00pm	$11.70	$14.03	98
9:00pm	$11.75	$14.09	98.4
Daily Total Cost	$128.75	$154.63	On-Peak 11:00am-6:00pm

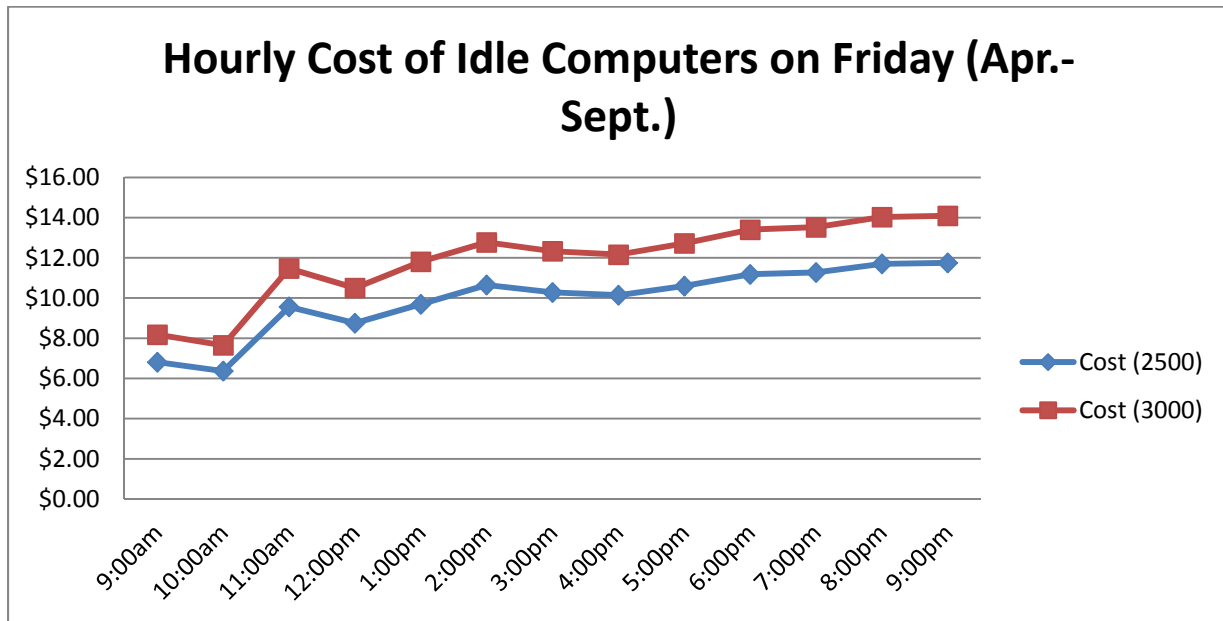Hourly Cost of Idle Computers on Friday (Apr.-Sept.)

## Appendix III: CO$_2$ Emissions Calculations

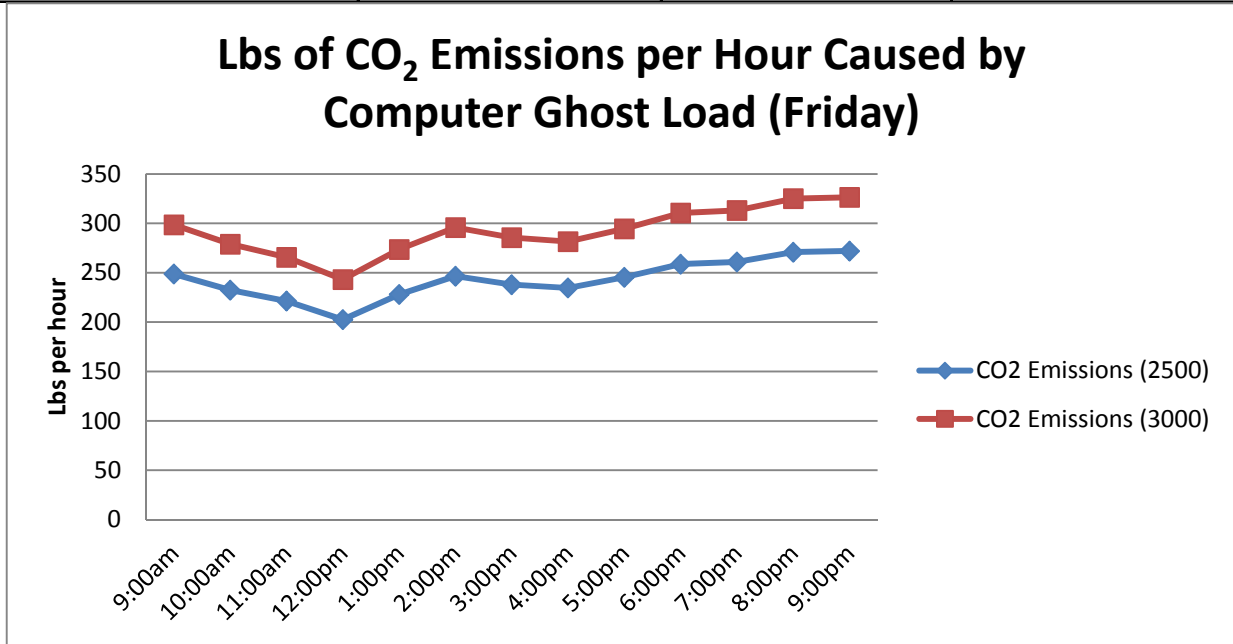| 2500 Computer Energy Consumption	3000 Computer Energy Consumption
91.5 kWh-202.5 kWh	109.8 kWh-243 kWh
Mean:147	Mean: 176.4
276.36 lbs/hr	331.63 lbs/hr
1.88 lbs of CO2 emitted per kWh of electricity consumed	

Monday - Thursday lbs of CO$_2$ Emissions Attributable to Computer Ghost Load

Time	CO2 Emissions (2500)	CO2 Emissions (3000)	% Unused Computers
9:00am	202.57	243.09	73.3
10:00am	152	182.4	55
11:00am	128.78	154.54	46.6
12:00pm	117.73	141.27	42.6
1:00pm	98.11	117.73	35.5
2:00pm	153.1	183.72	55.4
3:00pm	152	182.4	55
4:00pm	143.16	171.78	51.8
5:00pm	174.94	209.92	63.3
6:00pm	187.1	224.51	67.7
7:00pm	188.2	225.84	68.1
8:00pm	215.84	259	78.1
9:00pm	235.74	282.88	85.3
10:00pm	243.2	291.83	88
11:00pm	254.25	305.1	92
Total Daily CO2 Emissions	2646.72	3176.01	
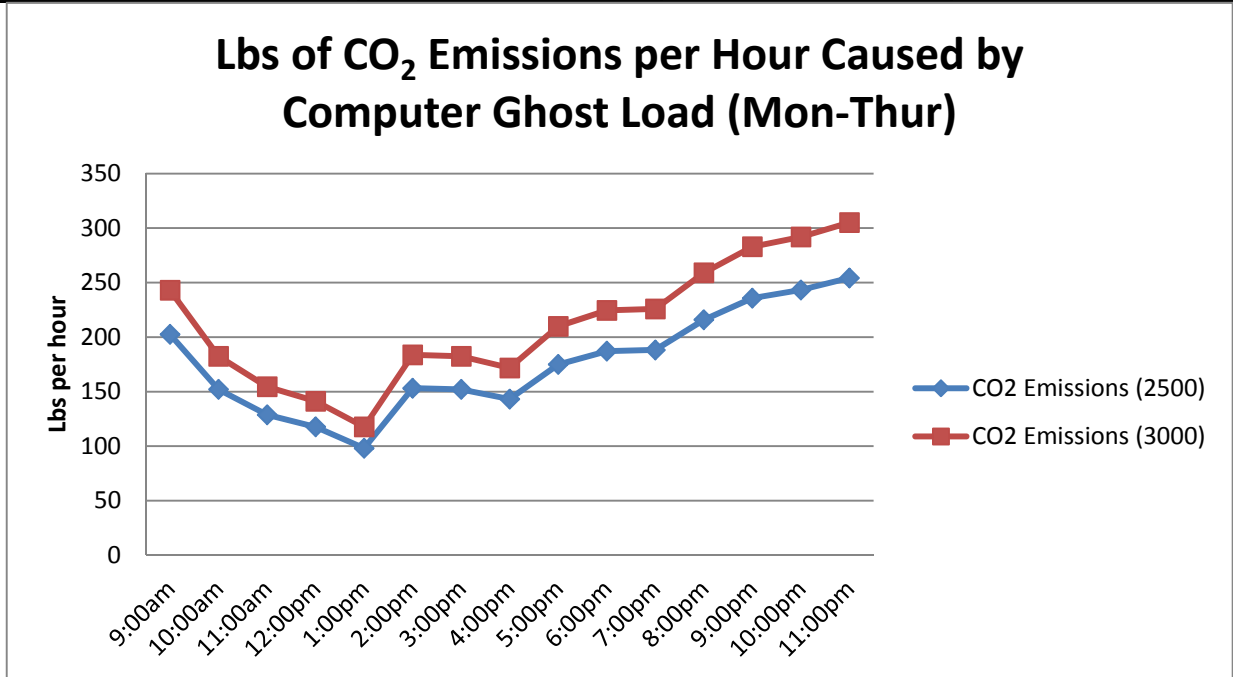
Friday lbs of CO_2 Emissions Attributable to Computer Ghost Load

Time	CO2 Emissions (2500)	CO2 Emissions (3000)	% Unused Computers
9:00am	248.72	298.47	90
10:00am	232.42	278.9	84.1
11:00am	221.36	265.64	80.1
12:00pm	202.57	243.09	73.3
1:00pm	228	273.6	82.5
2:00pm	246.51	295.81	89.2
3:00pm	237.95	285.53	86.1
4:00pm	234.63	281.55	84.9
5:00pm	245.41	294.49	88.8
6:00pm	258.67	310.41	93.6
7:00pm	260.88	313.06	94.4
8:00pm	270.83	325	98
9:00pm	271.94	326.32	98.4
Total Daily CO2 Emissions	3159.89	3791.87	

Lbs of CO_2 Emissions per Hour Caused by Computer Ghost Load (Friday)

Appendix IV: Total kWh Used Calculations

2500 Computer Energy Consumption	3000 Computer Energy Consumption
91.5 kWh-202.5 kWh	109.8 kWh-243 kWh
Mean: 147	Mean: 176.4

Monday –Thursday Total kWh Attributed to Ghost Load

Time	Total kWh/Hour (2500)	Total kWh/Hour (3000)	% Computers unused
9:00am	107.751	129.301	73.3
10:00am	80.850	97.02	55
11:00am	68.502	82.202	46.6
12:00pm	62.622	75.146	42.6
1:00pm	52.185	62.622	35.5
2:00pm	81.438	97.726	55.4
3:00pm	80.850	97.02	55
4:00pm	76.146	91.375	51.8
5:00pm	93.051	111.661	63.3
6:00pm	99.519	119.582	67.7
7:00pm	100.107	120.128	68.1
8:00pm	114.807	137.768	78.1
9:00pm	125.391	150.469	85.3
10:00pm	129.360	155.232	88
11:00pm	135.240	162.288	92
Total Ghost Load (kWh)	1407.819	1689.54	

Friday Total kWh Attributed to Ghost Load

Time	Total kWh/Hour (2500)	Total kWh/Hour (3000)	% Computers unused
9:00am	132.300	158.76	90
10:00am	123.627	148.352	84.1
11:00am	117.747	141.296	80.1
12:00pm	107.751	129.301	73.3
1:00pm	121.275	145.53	82.5
2:00pm	131.124	157.348	89.2
3:00pm	126.567	151.88	86.1
4:00pm	124.803	149.764	84.9
5:00pm	130.536	156.643	88.8
6:00pm	137.592	165.11	93.6
7:00pm	138.768	166.522	94.4
8:00pm	144.060	172.872	98
9:00pm	144.648	173.578	98.4
Total Ghost Load (kWh)	1680.798	2016.956	