Building	Building Area (GSF)	Estimated Savings ($) (estimated at the higher of 5% or the vendor's estimate)	Simple payback (yr)	Annual electricity usage reduction (kWh)	Annual natural gas usage reduction (MMBTU)	Annual electricity GHG reduction (MTCO2E)	Annual natural gas GHG reduction (MTCO2E)	Total Annual GHG reduction (MTCO2E)
22 BIOLOGY	168,651	$112,813	4	564,066	5,641	296	298	594
30 BARRACK HALL	39,000	$110,607		553,034	5,530	290	293	582
283 BELL	245,000	$77,229	9	386,145	3,861	202	204	407
230 PNAH	169,976	$72,201	7	361,007	3,610	189	191	380
228 DENTAL (OLD & NEW)	336,676	$68,719	10	343,597	3,436	180	182	362
39 WACHMAN	130,655	$51,086	6	255,430	2,554	134	135	269
223 OLD MED	155,228	$46,341		231,705	2,317	121	123	244
23 BEURY	174,700	$46,164		230,820	2,308	121	122	243
440 NEW TYLER	255,000	$43,600		218,000	2,180	114	115	230
391 1300 C. B. MOORE	310,045	$40,804	5	204,022	2,040	107	108	215
211 HSC CCWP WEST	7,865	$39,394	9	196,968	1,970	103	104	207
26 ANDERSON HALL	207,802	$60,957	6	304,787	3,048	160	161	321
224 MEDICAL RESEARCH BLDG	117,180	$36,860	7	184,302	1,843	97	98	194
282 TUTTLEMAN LEARNING CTR	117,253	$34,771	9	173,854	1,739	91	92	183
18 BARTON	152,006							
14 RITTER ANNEX	153,050	$33,059		165,297	1,653	87	87	174
25 WEISS	159,000	$48,746	6	243,730	2,437	128	129	257
27 GLADFELTER	181,566	$32,674	11	163,370	1,634	86	86	172
35 PEARSON/MCGONIGLE	224,875	$30,418	13	152,092	1,521	80	80	160
231 FACULTY STUDENT UNION	139,460	$29,592	8	147,958	1,480	78	78	156
40 KLEIN	186,123	$28,691	11	143,453	1,435	75	76	151
24 PALEY	184,644	$28,502	11	142,509	1,425	75	75	150
438 NEW MED SCHOOL	485,050	$28,004		140,021	1,400	73	74	147
181 TEMPLE TOWERS	178,596	$27,455		137,275	1,373	72	73	145
33 MITTEN HALL	112,771	$25,968	6	129,838	1,298	68	69	137
34 STUDENT ACTIVITIES CENTER	220,700	$25,170		125,849	1,258	66	67	133
225 KRESGE	129,260	$25,156	13	125,779	1,258	66	67	132
286 PODIATRIC - MAIN & DORM	206,058	$24,711	8	123,555	1,236	65	65	130
21 CEA	160,325	$22,862		114,310	1,143	60	60	120
267 CONWELL	67,644	$20,756	8	103,780	1,038	54	55	109
29 JOHNSON	143,177	$20,142		100,709	1,007	53	53	106
16 SPEAKMAN	110,605	$19,133	14	95,667	957	50	51	101
19 ANNENBERG/TOMLINSON	120,576	$16,991	9	84,955	850	45	45	89
13 RITTER	111,090	$16,685	18	83,425	834	44	44	88
434 SAC 2	86,182	$15,673		78,367	784	41	41	83
263 STANDBY GENERATOR	19,520	$14,999		74,993	750	39	40	79
500 AMBLER LEARNING CTR	71,000	$14,803		74,017	740	39	39	78
208 COMPREHENSIVE CANCER CENTER	38,851	$13,952	14	69,761	698	37	37	73
295 1940 RESIDENCE HALL	133,399	$13,737		68,686	687	36	36	72
292 STUDENT PAVILION	39,802	$10,839		54,194	542	28	29	57
264 WHITE HALL	145,419	$10,457		52,285	523	27	28	55

Building	Building Area (GSF)	Estimated Savings ($) (estimated at the higher of 5% or the vendor's estimate)	Simple payback (yr)	Annual electricity usage reduction (kWh)	Annual natural gas usage reduction (MMBTU)	Annual electricity GHG reduction (MTCO2E)	Annual natural gas GHG reduction (MTCO2E)	Total Annual GHG reduction (MTCO2E)
17 SULLIVAN	52,800	$9,881	10	49,403	494	26	26	52
226 WEST BUILDING	20,139	$9,093	11	45,464	455	24	24	48
422 ECEC	58,020	$8,930		44,648	446	23	24	47
28 PEAB0DY	63,200	$7,989		39,943	399	21	21	42
113 BLAI	8,000							
44 VIVACQUA	84,360	$7,436	20	37,182	372	19	20	39
287 PODIATRIC - HOUSING	59,253	$6,681		33,405	334	18	18	35
20 PRESSER	54,792	$6,042		30,210	302	16	16	32
179 HARDWICK	85,560	$5,622		28,112	281	15	15	30
48 UNIVERSITY SERVICES BUILDING	115,615							
296 EDBERG-OLSEN	23,805	$5,320	9	26,598	266	14	14	28
169 AMBLER DORMS (EAST & WEST)	65,398	$5,058		25,292	253	13	13	27
145 OUTDOOR SPORTS COMPLEX	1	$4,525		22,627	226	12	12	24
435 1800 LIACOURAS WALK	28,552							
118 PENROSE	54,668							
3 ROCK HALL	30,825	$3,569	28	17,843	178	9	9	19
167 TYLER ART DORM/ BEECH HALL	28,536							
37 BMC OFM	35,350	$3,429	17	17,145	171	9	9	18
501 1810 LIACOURAS WALK	74,630							
151 CARNELL HALL	75,931	$3,186	16	15,931	159	8	8	17
246 AMBLER SWIMMING POOL	1,928	$3,062		15,309	153	8	8	16
137 AMBLER CAFETERIA	12,952	$3,052	33	15,259	153	8	8	16
138 AMBLER LIBRARY	18,098	$2,728		13,642	136	7	7	14
144 DIXON HALL	26,510	$2,665	15	13,325	133	7	7	14
503 401 Commerce Drive	15,000							
165 KARDON WAREHOUSE	473,660							
411 IBC REC CTR	69,093	$2,429		12,144	121	6	6	13
122 AMBLER MUSIC FESTIVAL	39,000							
143 WIDENER HALL	14,981	$2,413	10	12,065	121	6	6	13
42 SHUSTERMAN HALL	7,950							
217 3511 N. 13TH STREET	11,000							
177 PARK MALL HOUSES (COMBINED)	46,848							
207 MEDICAL STOREROOM	20,880							
206 HUDSON BUILDING	16,780							
126 BRIGHT HALL	18,858	$1,894	11	9,470	95	5	5	10
252 HSC PHYSICAL PLANT &	15,824	$1,792	25	8,961	90	5	5	9
119 ELKINS HALL	31,234							
43 1920-22 N. BROAD ST.	6,700							
66 BAPTIST TEMPLE	39,500							
288 PODIATRIC - UNIVERSITY	146,805	$1,294		6,469	65	3	3	7
58 1940 N. BROAD ST.	4,075							

Building	Building Area (GSF)	Estimated Savings ($) (estimated at the higher of 5% or the vendor's estimate)	Simple payback (yr)	Annual electricity usage reduction (kWh)	Annual natural gas usage reduction (MMBTU)	Annual electricity GHG reduction (MTCO2E)	Annual natural gas GHG reduction (MTCO2E)	Total Annual GHG reduction (MTCO2E)
132 COTTAGE HALL	16,969							
111 TYLER HALL	23,798							
51 1926 N. BROAD ST.	3,840							
369 AMBLER NEW GREENHOUSE	5,842	$919		4,595	46	2	2	5
127 AMBLER GYMNASIUM	12,564	$874		4,368	44	2	2	5
57 1938 N. BROAD ST.	3,620							
112 AMBLER MISC	1							
60 1426 NORRIS ST.	2,550							
54 1932 N. BROAD ST.	3,510							
53 1930 N. BROAD ST.	3,625							
50 1924 N. BROAD ST.	3,360							
254 TAX-TYLER	1							
419 1515 Market St., TUCC	126,923							
502 425 Commerce Drive	25,500							
55 1934 N. BROAD ST.	3,360							
124 AMBLER ADMINISTRATION	5,250							
59 1424 NORRIS ST.	3,360							
120 TYLER ADMISSIONS	4,668							
164 1926-B N. BROAD ST.	1,280							
140 AMBLER EXTERIOR	1							
56 1936 N. BROAD ST.	3,310							
52 1928 N. BROAD ST.	4,200							
61 1428 NORRIS ST.	2,250							
114 PRESIDENTS HALL	8,706							
214 3423 CARLISLE ADMIN OFFICE	2,500							
294 GUARD HOUSE	100							
163 1926-A N. BROAD ST.	1,280							
62 1430-32 NORRIS ST.	3,327							
38 BMC STEAM PLANT	23,000							
213 3421 CARLISLE ADMIN OFFICE	2,500							
180 ART GALLERY	4,000							
133 HAINES HOUSE	5,513							
121 TYLER PHYS PLT SHOP	512							
304 Grounds Trailers	1,200							
125 AMBLER PHYSICAL PLANT	3,000							
417 Ground Trailers at Anderson	1,500							
134 HILDA JUSTICE	1,117							
139 MODULAR UNITS	2,679							
142 EINSTEIN BUILDING	1,786							
130 AMBLER MAIN GREENHOUSES	7,760	$91		455	5	0	0	0
49 GARAGE 1501 CARLISE	5,002							

Building	Building Area (GSF)	Estimated Savings ($) (estimated at the higher of 5% or the vendor's estimate)	Simple payback (yr)	Annual electricity usage reduction (kWh)	Annual natural gas usage reduction (MMBTU)	Annual electricity GHG reduction (MTCO2E)	Annual natural gas GHG reduction (MTCO2E)	Total Annual GHG reduction (MTCO2E)
12 DAYCARE (1500 N. BROAD ST.)	30,769							
259 AMBLER WEST GREENHOUSES	2,750							
104 1932 Liacouras Walk	3,912							
176 CONWELL HOUSE 2020 N. BROAD	5,000							
297 NORRIS STREET HOUSES	3,000							
64 REAR 1420-22 NORRIS ST.	3,200							
255 1422 W. NORRIS ST.	3,000							
0 Security Shacks	0							
10 1943-45 N. BROAD ST.	10,500							
290 OUTSIDE LIGHTS	0							
388 MISC 1414 NORRIS ST HOUSES	0							
426 Ambler Athletic Fields	0							
443 Alter Hall	0							
81 1810 PARK	0							
9 ALPHA CHI RHO 1942 BROAD	4,570							
92 1900 Liacouras Walk	5,947							
TOTAL	8,860,803	$1,550,695	6	7,753,476	77,535	4,063	4,102	8,165

Appendix B: Phase II - Plant Development Fund Project Summary
Temple University

Project	Range of Annual Energy Cost Savings ($)		Range of Simple Payback (yrs)		Range of Corresponding Annual Usage Reduction		Usage Units	Range of Annual GHG Reduction (MTCO2E)	
Health Sciences Campus - Central Steam Plant									
Design and replace boilers	$ 170,000.00	$ 226,666.67	15	20	17,000	22,667	MMBTU	897	1,196
Summary for HSC-CSP	$ 170,000.00	$ 226,666.67	15	20	17,000	22,667	kWh	9	12
					0	0	MMBTU	0	0
Ambler Campus-Wide Infrastructure									
Lighting upgrades at five buildings: Bright Hall Cottage Hall Dixon Hall Haines House Library	$ 94,000.00	$ 156,666.67	3	5	940,000	1,566,667	kWh	490	817
Summary for Ambler Campus	$ 94,000.00	$ 156,666.67	3	5	940,000	1,566,667	kWh	490	817
					0	0	MMBTU	0	0
Pharmacy Building									
Lighting upgrades	$ 35,000.00	$ 58,333.33	3	5	350,000	583,333	kWh	183	304
Cooling tower replacement	$ 33,103.40	$ 66,206.80	5	10	3,310	6,621	MMBTU	175	349
Summary for Pharmacy Building	$ 68,103.40	$ 124,540.13	4	7	350,000	583,333	kWh	183	304
					3,310	6,621	MMBTU	175	349
Anderson Hall									
Window replacement	$ 167,050.00	$ 222,733.33	15	20	16,705	22,273	MMBTU	881	1,175
Window treatment replacement	$ 4,100.00	$ 5,466.67	15	20	410	547	kWh	22	29
Air handling unit replacement	$ 28,333.33	$ 42,500.00	10	15	283,333	425,000	kWh	148	222
Ceiling and lighting replacement	$ 400,000.00	$ 666,666.67	3	5	4,000,000	6,666,667	kWh	2,086	3,477
Roof replacement	$ 28,333.33	$ 42,500.00	10	15	2,833	4,250	MMBTU	149	224
Summary for Anderson Hall	$ 627,816.67	$ 979,866.67	6	10	4,283,333	7,091,667	kWh	2234	3698
					19,948	27,070	MMBTU	1052	1428
Medical Research Building									
Laboratory fume hood replacement	$ 70,000.00	$ 140,000.00	5	10	700,000	1,400,000	kWh	365	730
Lab restorations	$ 330,000.00	$ 440,000.00	15	20	3,300,000	4,400,000	kWh	1,721	2,295
Plumbing piping replacement	$ 86,666.67	$ 130,000.00	10	15	8,667	13,000	MMBTU	457	686
Motor control center / starter replacement	$ 20,000.00	$ 40,000.00	5	10	200,000	400,000	kWh	104	209
Lighting upgrades	$ 50,000.00	$ 83,333.33	3	5	500,000	833,333	kWh	261	435

Appendix B: Phase II - Plant Development Fund Project Summary
Temple University

Project	Range of Annual Energy Cost Savings ($)		Range of Simple Payback (yrs)		Range of Corresponding Annual Usage Reduction		Usage Units	Range of Annual GHG Reduction (MTCO2E)	
Health Sciences Campus - Central Steam Plant									
Summary for Medical Research Building	$ 556,666.67	$ 833,333.33	11	16	4,700,000	7,033,333	kWh	2451	3668
					8667	13000	MMBTU	457	686
Gladfelter Hall									
Window replacement	$ 176,700.00	$ 235,600.00	15	20	17,670	23,560	MMBTU	932	1,243
Window treatment replacement	$ 2,750.00	$ 3,666.67	15	20	275	367	MMBTU	15	19
Summary for Gladfelter Hall	$ 179,450.00	$ 239,266.67	15	20	0	0	kWh	0	0
					17,945	23,927	MMBTU	947	1,262
Faculty Student Union									
Lighting upgrades	$ 60,000.00	$ 100,000.00	3	5	600,000	1,000,000	kWh	313	521
Exterior door replacement	$ 6,250.00	$ 8,333.33	15	20	625	833	MMBTU	33	44
Summary for FSU	$ 66,250.00	$ 108,333.33	4	6	600,000	1,000,000	kWh	313	521
					625	833	MMBTU	33	44
Kresge Hall									
Exterior Window Replacement	$ 5,850.00	$ 7,800.00	15	20	585	780	MMBTU	31	41
Laboratory fume hood replacement	$ 77,300.00	$ 154,600.00	5	10	773,000	1,546,000	kWh	403	806
Office / Research lab renovations	$ 220,000.00	$ 293,333.33	15	20	2,200,000	2,933,333	kWh	1,147	1,530
Plumbing fixture replacement	$ 7,466.67	$ 11,200.00	10	15	747	1,120	MMBTU	39	59
Pneumatic controls replacement	$ 24,200.00	$ 48,400.00	5	10	242,000	484,000	kWh	126	252
Lighting upgrade	$ 29,816.20	$ 49,693.67	3	5	298,162	496,937	kWh	155	259
Summary for Kresge Hall	$ 364,632.87	$ 565,027.00	10	16	3,513,162	5,460,270	kWh	1832	2848
					1,332	1,900	MMBTU	70	100
Podiatric Medicine Building									
Air handling unit replacement	$ 63,333.33	$ 95,000.00	10	15	633,333	950,000	kWh	330	495
Summary for PMB	$ 63,333.33	$ 95,000.00	10	15	633,333	950,000	kWh	330	495
					0	0	MMBTU	0	0
College of Engineering & Architecture									
Window replacement	$ 130,000.00	$ 173,333.33	15	20	13,000	17,333	MMBTU	686	914
Summary for Engineering	$ 130,000.00	$ 173,333.33	15	20	0	0	kWh	0	0
					13,000	17,333	MMBTU	686	914
Conwell Hall									
Window replacement	$ 20,000.00	$ 26,666.67	15	20	2,000	2,667	MMBTU	106	141
Summary for Conwell	$ 20,000.00	$ 26,666.67	15	20	0	0	kWh	0	0
					2,000	2,667	MMBTU	106	141
Ritter Hall									
Reheat coil replacement	$ 13,333.33	$ 20,000.00	10	15	1,333	2,000	MMBTU	70	106

Appendix B: Phase II - Plant Development Fund Project Summary
Temple University

Project	Range of Annual Energy Cost Savings ($)		Range of Simple Payback (yrs)		Range of Corresponding Annual Usage Reduction		Usage Units	Range of Annual GHG Reduction (MTCO2E)	
Health Sciences Campus - Central Steam Plant									
Summary for Ritter	$ 13,333.33	$ 20,000.00	10	15	0	0	kWh	0	0
					1,333	2,000	MMBTU	70	106
Medical Office Building									
Air handling unit replacement	$ 36,666.67	$ 55,000.00	10	15	366,667	550,000	kWh	191	287
Summary for MOB	$ 36,666.67	$ 55,000.00	10	15	366,667	550,000	kWh	191	287
					0	0	MMBTU	0	0
Main OFM									
Vehicle CNG fueling station	$ 5,500.00	$ 7,333.33	15	20	550	733	MMBTU	29	39
Summary for MOB	$ 5,500.00	$ 7,333.33	15	20	0	0	kWh	0	0
					550	733	MMBTU	29	39
Dixon Hall									
HVAC control system upgrade	$ 9,000.00	$ 18,000.00	5	10	900	1,800	MMBTU	47	95
Summary for MOB	$ 9,000.00	$ 18,000.00	5	10	0	0	kWh	0	0
					900	1,800	MMBTU	47	95
Widener Hall									
Boiler replacement	$ 2,350.00	$ 3,133.33	15	20	235	313	MMBTU	12	17
Heating valve replacement	$ 800.00	$ 1,600.00	5	10	80	160	MMBTU	4	8
Pipe insulation replacement	$ 200.00	$ 300.00	10	15	20	30	MMBTU	1	2
Summary for Widener	$ 3,350.00	$ 5,033.33	12	17	0	0	kWh	0	0
					335	503	MMBTU	18	27
Bright Hall									
Central AC installation	$ 28,266.67	$ 42,400.00	10	15	2,827	4,240	kWh	1	2
HVAC control system upgrade	$ 6,600.00	$ 13,200.00	5	10	660	1,320	MMBTU	35	70
Summary for Bright	$ 34,866.67	$ 55,600.00	9	14	2,827	4,240	kWh	1	2
					660	1,320	MMBTU	35	70
Ambler Administration									
Central AC installation	$ 4,066.67	$ 6,100.00	10	15	407	610	kWh	0	0
Summary for Ambler Administration	$ 4,066.67	$ 6,100.00	10	15	407	610	kWh	0	0
					0	0	MMBTU	0	0
Totals (All Buildings)	**$ 2,447,036.27**	**$ 3,695,767.13**	**9**	**14**	**15,406,729**	**24,262,787**	**kWh**	**11,759**	**17,913**
					70,605	**99,707**	**MMBTU**		

Appendix C: Phase III - Summary of ECMs for High Energy Using Buildings
Temple University

Entech ID	Project	Range of Annual Energy Cost Savings ($)		Range of Simple Payback (yrs)		Range of Corresponding Annual Usage Reduction		Usage Units	Range of Annual GHG Reduction (MTCO2E)		Project Description
Biology and Life Sciences Building											
460	Laboratory Fume Hood Replacement	$ 451,006.00	$ 902,012.00	5	10	4,510,060	9,020,120	kWh	2,352	4,704	Replace the existing substandard laboratory fume hoods with new "Class A" Bistable Vortex units, including controls, local alarms, electrical wiring and utilities. This project is to be completed in conjunction with a complete conversion of the HVAC system to VAV for a potential energy savings of 15 to 30%.
479	Fume Hood Exhaust Systems Upgrade	$ 48,994.00	$ 97,988.00	5	10	489,940	979,880	kWh	256	511	Replace the existing fume hood exhaust fans with new dedicated high velocity, vertical discharge exhaust fans, including new ductwork, controls, electrical wiring and system rebalancing as required. Modify roof curbing as necessary. As described above, fume hood replacement and upgrades are to be completed in conjunction with a conversion of the HVAC system to VAV.
476	Variable Speed Drive for Pumps	$ 37,322.00	$ 62,203.33	3	5	373,220	622,033	kWh	195	324	Provide variable speed drives for the three 75 HP chilled water pumps and the three 30 HP hot water pumps. Tie start/stop controls into the proposed EMS system.
4089	Corridor Lighting Upgrades	$ 22,950.00	$ 38,250.00	3	5	229,500	382,500	kWh	120	199	Disconnect, remove and replace the existing fluorescent lighting fixtures with new lighting fixtures which have T-8 lamps, energy efficient ballasts, and improved lighting efficiencies/throws. Reconnect to the existing wiring connections. Do not replace corridor lighting fixtures in the newly renovated areas. Lighting upgrades will be done throughout building and will be linked to ventilation control.
4088	Insulate Chases and Room Walls	$ 1,313.50	$ 1,751.33	15	20	131	175	MMBTU	7	9	Survey the building to determine where insulation can be applied to the inside walls. Insulating walls in some storage room walls may require the relocation of equipment, shelving, or working around electrical panels, conduits and devices. Insulate the walls of the inside of the exterior chase walls with glued in place styrofoam panels. Insulate the inside of exterior walls in storage rooms, where it is practical to do so.
4072	Insulation Improvements	$ 874.00	$ 1,165.33	15	20	87	117	MMBTU	5	6	Survey the building to determine where the insulation of mechanical and plumbing piping systems are in need of improvement. Remove and replace damaged insulation. Insulate pipe, fittings and specialties where insulation is missing. Insulate chilled water piping complete including piping specialties and pump bodies. Provide Velcro removable reusable fitting covers on large steam piping valves. Insulate hot water pipe and fittings, but leave hot water valves, unions and specialties uninsulated for future maintenance. Utilize fiberglass pipe insulation and PVC fitting covers. Label new pipe insulation and include flow arrows. Provide insulation panels on the concrete ceiling of the concrete ceiling of the basement mechanical room. Locate the panels over the steam heating systems.
466	LED Retrofits for Exit Signs	$ 514.00	$ 856.67	3	5	5,140	8,567	kWh	3	4	Replace the fluorescent lamps with LED lamp retrofits.
Summary for Biology & Life Sciences		$ 562,973.50	$ 1,104,226.67	5	9	5,607,860	11,013,100	kWh	2,924	5,743	
						219	292	MMBTU	12	15	

Beury Hall											
103	Laboratory Fume Hood Replacement	$ 458,634.00	$ 917,268.00	5	10	4,586,340	9,172,680	kWh	2,392	4,784	Replace the existing substandard laboratory fume hoods with new "Class A" Bistable Vortex units, including controls, local safety monitors, electrical wiring and utilities. Replace deteriorated stainless ducts with fiberglass reinforced plastic ducts. Additionally, if Perchloric acid is being used in any laboratory fume hood it is required to be dedicated, acid and spark resistant with a wash down system. Project will include coordination with lighting and AHU projects, including VFDs on AHUs, lighting-based ventilation control and VAVs throughout building for potential energy savings of 15 to 30%.
122	Lighting Upgrades	$ 92,928.00	$ 154,880.00	3	5	929,280	1,548,800	kWh	485	808	Replace the older lighting fixtures with modern T8 electronically ballasted fluorescent fixtures. Improve lighting levels in corridors to a minimum of 10 foot-candles. Replace incandescent spots with compact fluorescent bulbs.
95	Air Handling Unit Replacement	$ 63,268.00	$ 94,902.00	10	15	632,680	949,020	kWh	330	495	Replace the four-pipe air handling units and trim. Reconnect hot and chilled water piping. Balance water systems upon completion. Provide new controls compatible with the campus EMS standard (Siemens). Replace starters and reconnect electrical supplies. Provide variable speed drives on larger fan motors. Test for and abate asbestos on piping and ductwork as necessary. Cut and patch the building as necessary.
338	Windows and Vertical Blinds Replacement	$ 68,006.00	$ 90,674.67	15	20	6,801	9,067	MMBTU	359	478	Replace the single-pane windows with double-glazed units. A low-emittance coating will reduce energy costs. Replace the vertical blinds with new horizontal blinds.
116	Pneumatic Controls Replacement	$ 10,000.00	$ 20,000.00	5	10	100,000	200,000	kWh	52	104	Replace pneumatic controls for major equipment not being replaced under other projects (such as the air handlers and reheat coils) with DDC controls. Systems shall be compatible with the campus standard (Siemens). Install a central monitoring station in the building. Provide a link via the campus fiber optic system to provide central control and monitoring. This project is partially complete.
553	Variable Speed Drive for Chilled Water Pumps	$ 15,000.00	$ 25,000.00	3	5	150,000	250,000	kWh	78	130	Provide variable speed drives for the two 50 HP chilled water pumps. Tie start/stop controls into the proposed EMS system.
433	Exterior Site Lighting Replacement	$ 7,824.00	$ 13,040.00	3	5	78,240	130,400	kWh	41	68	Replace the site lighting (damaged and not functional).
124	Emergency Lighting Replacement	$ 2,060.00	$ 3,433.33	3	5	20,600	34,333	kWh	11	18	Replace the incandescent fixtures with new sealed beam emergency lighting fixtures.
115	LED Retrofits for Exit Signs	$ 1,184.00	$ 1,973.33	3	5	11,840	19,733	kWh	6	10	Replace the fluorescent lamps with LED lamp retrofits.
112	Pipe Insulation Replacement	$ 1,166.00	$ 1,749.00	10	15	117	175	MMBTU	6	9	Replace all the cork type insulation on the chilled water piping with new closed cell foam rubber insulation. Prep and prime any deteriorated piping. Provide color coded ID labels on piping. Install insulation boxes on chilled water pumps.
Summary for Beury Hall		$ 720,070.00	$ 1,322,920.33	6	11	6,508,980	12,304,967	kWh	3,394	6,417	
						6,917	9,242	MMBTU	365	488	

Mitten Hall & Annex											
747	HVAC Control System Upgrade	$ 80,000.00	$ 160,000.00	5	10	8,000	16,000	MMBTU	422	844	Replace the existing pneumatic temperature control system with a new Siemens/ Powers DDC control system. Utilize electronic sensors and pneumatic valves and actuators. Replace reheat coil control valves and zone temperature sensors. Verify that sensors are not obstructed by furniture, etc. Provide expansion capability as other areas of the building are renovated. Tie the DDC system to the Facilities Management Office, via the telephone network, for central monitoring. This project will include a total HVAC retrofit for energy savings on the order of 15%.
1175	Window Replacement	$ 47,908.00	$ 63,877.33	15	20	4,791	6,388	MMBTU	253	337	In December of 2006 this building was resurveyed as part of Temple University's reassessment. The conditions were found to still exist; therefore the project is relevant and should be undertaken. However, to meet Temple University's budget requirements, and to coordinate with other recommended work in the building, it has been moved from the originally scheduled year of 2008 to 2012. Replace the windows with new historically correct and energy efficient units.
788	Corridor/ Stairwell Lighting Upgrades	$ 6,012.00	$ 10,020.00	3	5	60,120	100,200	kWh	31	52	Upgrade corridor and stairwell lighting with modern T8 electronically ballasted fluorescent fixtures. Improve lighting levels to a minimum of 10 foot-candles in these areas. Provide decorative fixtures where needed to maintain aesthetics. Tie-in these fixtures to emergency power circuits. Reconnect electrical supplies.
796	HVAC Upgrades for the Tutoring Wing	$ 13,333.33	$ 20,000.00	10	15	1,333	2,000	MMBTU	70	106	Evaluate and install central air conditioning in the tutoring wing. This can consist of 2-pipe fan coils and piping or a small air handler and ductwork. Provide a mechanical closet for the air handler. Cut and patch finishes as necessary. Provide DDC controls compatible with the campus standard and tie to building EMS system. Provide electrical connections. Provide outside air via louvers and/or duct. Replace the original cast iron radiators with modern fin-tube units if air handler option is used, or else place fan coil units in their stead. Tie into building chilled water system.
760	Exit Sign Replacement	$ 884.00	$ 1,473.33	3	5	8,840	14,733	kWh	5	8	Evaluate and replace the old and unlit exit signs with new LED-type exit signs. Add exit signs in areas where lacking. Connect to normal and emergency power circuits.
Summary for Mitten Hall & Annex		$ 148,137.33	$ 255,370.67	8	13	68,960	114,933	kWh	36	60	
						14,124	24,388	MMBTU	745	1,287	
Ritter Annex											
1228	Lighting Upgrades	$ 61,688.00	$ 102,813.33	3	5	616,880	1,028,133	kWh	322	536	Replace the older lighting fixtures with modern T8 electronically ballasted fluorescent fixtures. Replace incandescent bulbs and spotlights with compact fluorescent bulbs.
1217	Occupancy Sensor Installation	$ 3,324.00	$ 5,540.00	3	5	33,240	55,400	kWh	17	29	Install ceiling-mounted occupancy sensors and tie into existing lighting circuits.
2173	Duct Insulation Replacement	$ 3,046.67	$ 4,570.00	10	15	305	457	MMBTU	16	24	Remove all damaged duct insulation and flexible connectors not covered under other projects. Replace with new insulation, cover jacketing and flexible connectors. Prep and prime rusted ductwork.
Summary for Ritter Annex		$ 68,058.67	$ 112,923.33	3	5	650,120	1,083,533	kWh	339	565	
						305	457	MMBTU	16	24	

Wachman Hall											
1498	Lighting Upgrades	$ 59,158.00	$ 98,596.67	3	5	591,580	985,967	kWh	309	514	Replace the older lighting fixtures with modern T8 electronically ballasted fluorescent fixtures. Improve lighting levels in corridors to a minimum of 10 foot-candles. Replace incandescent spots with new fluorescent fixtures. This project is to be integrated with ventilation controls project.
1492	Air Handling Unit Overhauls	$ 39,888.00	$ 59,832.00	10	15	398,880	598,320	kWh	208	312	Inspect each air handling unit and determine if the units can be overhauled. Air handler overhauls should include replacement of coils including valve trim and instrumentation, drain pans, access doors and panels, fan motors and belts, dampers, flexible duct connections, insulation, DDC sensors, pneumatic control valves and damper operators. Replace original starters. Clean AHU housings and rebalance air handling units upon completion. Reuse duct, piping, and electrical rough ins. Project includes VAV renewal ($350,000).
1499	Occupancy Sensor Installation	$ 1,662.00	$ 2,770.00	3	5	16,620	27,700	kWh	9	14	Install ceiling-mounted occupancy sensors and tie into existing lighting circuits.
1497	Exit Sign Replacement	$ 1,106.00	$ 1,843.33	3	5	11,060	18,433	kWh	6	10	Replace the old and unlit incandescent exit signs with new LED-type exit signs. Connect to normal and emergency power circuits.
Summary for Wachman Hall		$ 101,814.00	$ 163,042.00	6	9	1,018,140	1,630,420	kWh	531	850	
						0	0	MMBTU	0	0	
Weiss Hall											
787	Lighting Upgrades	$ 73,452.00	$ 122,420.00	3	5	734,520	1,224,200	kWh	383	638	Replace the older lighting fixtures with modern T8 electronically ballasted fluorescent fixtures. Improve lighting levels in corridors to a minimum of 10 foot-candles and reading areas to 30 foot-candles. Replace incandescent spots with new fluorescent or HID fixtures.
863	Variable Speed Drives for Pumps	13798	$ 22,996.67	3	5	137,980	229,967	kWh	72	120	Provide variable speed drives for the two 25 HP chilled water and two 15 HP hot water pumps. Tie start/stop controls into the EMS system.
782	Air Handling Unit Overhauls	$ 14,300.67	$ 21,451.00	10	15	143,007	214,510	kWh	75	112	Inspect each air handling unit. Determine which units can be overhauled and which, if any, require complete replacement. Air handler overhauls should include the replacement of valve trim and instrumentation, drain pans, fan motors and belts, dampers, flexible duct connections, insulation, DDC sensors, pneumatic control valves and damper operators. Replace original starters. Abandoned spray pumps should be removed. Clean AHU housings and rebalance air handling units upon completion. Provide vibration isolators on new units. Reuse duct, piping, and electrical rough ins.
859	Pump Rebuild and Insulation	$ 4,852.00	$ 8,086.67	3	5	48,520	80,867	kWh	25	42	The chilled water pumps are uninsulated and sweating. Rebuild the two chilled water and four hot water pumps, including disassembly, inspection, cleaning, lubrication, reassembly, and testing. Replace seals and gaskets and any other worn parts. Prep, prime and repaint pump body. Provide insulation boxes for chilled water pumps.
1292	Exterior Window Repairs	$ 5,267.00	$ 7,022.67	15	20	527	702	MMBTU	28	37	Repair/replace internal horizontal blinds. Replace window gasketing. Repair/ adjust window latches. Repair/ adjust/ lubricate window hinges.
785	Occupancy Sensor Installation	$ 1,662.00	$ 2,770.00	3	5	16,620	27,700	kWh	9	14	Install ceiling-mounted occupancy sensors and tie into existing lighting circuits.
860	Duct and Pipe Insulation Replacement	$ 822.00	$ 1,233.00	10	15	82	123	MMBTU	4	7	Replace deteriorated sections of duct and pipe insulation. Prep and prime before applying new insulation. Fix any leaks found. Paint new pipe insulation per campus color scheme or apply color coded ID labels. Replace deteriorated relief valves.

857	Ductwork Sealing on 10th Floor	$ 214.67	$ 322.00	10	15	21	32	MMBTU	1	2	Seal all duct openings and cracks on the 10th floor ductwork to reduce significant energy losses. Maintain pressurization between the corridors and the animal rooms.
Summary for Weiss Hall		$ 114,368.33	$ 186,302.00	4	7	1,080,647	1,777,243	kWh	564	927	
						630	858	MMBTU	33	45	
Dental School (old)											
568	Air Distribution System Replacement	$ 326,800.00	$ 490,200.00	10	15	3,268,000	4,902,000	kWh	1,704	2,556	The air distribution systems in the building are older and at the end of their useful life. Each floor has a number of small air handlers above the ceiling in classrooms or in the hallways. Many of the units are noisy and distract from instructional purposes. The large air handling unit on the roof is rusting out in several places. Ductwork is deteriorated in many places with air leaking out. Many diffusers and leaky access doors show a lot of dirt, either from deteriorated internal insulation or dirt buildup. Some areas of hot water pipe insulation are moldy, damaged or missing. Some may be asbestos containing. Replace the air distribution systems in their entirety. Replace the numerous air handlers with modular roof-mounted air handlers with VAV boxes and reheat coils in room or suite duct systems. Revise hot and chilled water piping runs as necessary. Replace all damaged or missing insulation. Test for and abate asbestos as necessary. Replace ductwork. Provide variable speed drives on larger fan motors. Provide new controls compatible with the hospital campus EMS standard (Johnson Metasys). Provide new electrical supplies. Balance air and water systems upon completion. Cut and patch the building as necessary.
569	Chiller/ Cooling Tower Replacement	$ 218,251.00	$ 436,502.00	5	10	21,825	43,650	MMBTU	1,151	2,303	The two Trane chillers and cooling tower serving the old building are aging and nearing the end of their useful life. This includes the Trane CenTraVac on the first floor, the Trane steam absorber in the mezzanine, and the cooling tower on the north end of the building. Replace the chillers and tower with new units. Provide variable speed drives on tower fans. Provide new controls compatible with the hospital campus EMS standard (Johnson Metasys). Provide new electrical supplies. Reconnect piping and chemical treatment. Balance water systems upon completion.
573	Lighting Upgrade	$ 159,568.00	$ 265,946.67	3	5	1,595,680	2,659,467	kWh	832	1,387	Lighting in the building is aged in many places. Some incandescent fixtures are still in use and old fluorescent fixtures may contain PCB ballasts. Renovated areas largely have T12 fluorescent fixtures. Upgrade lighting in the building. Replace incandescent with fluorescent. Remove of PCB ballasts per Federal regulations. Install modern T8 electronically ballasted fluorescent fixtures. Provide new fixture whips, conduit and wiring. Install occupancy sensors in classrooms.
558	Window/ Curtain Wall Replacement	$ 147,349.50	$ 196,466.00	15	20	14,735	19,647	MMBTU	777	1,036	The existing steel frame windows with single-glazing are energy inefficient and in poor condition. Replace with new thermally efficient windows and spandrels.
570	Pneumatic Controls Replacement	$ 77,853.00	$ 155,706.00	5	10	778,530	1,557,060	kWh	406	812	The HVAC controls in the building are older pneumatics, which are aged and nearing the end of their useful life. They provide poor temperature control and waste energy. Replace the pneumatic controls with new DDC or pneumatic-electronic hybrid controls. Systems shall be compatible with the hospital campus EMS standard (Johnson Metasys). Install a central monitoring station in the building. Provide a link via the hospital campus fiber optic system to provide central monitoring and control.

571	Variable Speed Drive Installation	$ 27,930.00	$ 46,550.00	3	5	279,300	465,500	kWh	146	243	Larger pump and fan motors in the building lack variable speed drives. Install variable speed drives on chilled water pumps and south end cooling tower fans. Tie start-stop controls into the planned EMS system. Provide electrical supplies.
4791	Exit Sign Upgrade	$ 1,354.00	$ 2,256.67	3	5	13,540	22,567	kWh	7	12	Although many of the exit signs have been upgraded to LED units, some signs were found to be either damaged or unlighted. Additionally, exit signs were lacking in some areas. Several egress doors lack adequate illuminated exit signage, such as in the first floor mechanical room (see photo). Exits may not be clearly marked in case of emergency. Evaluate and install additional LED-type illuminated exit signs at egress doors as required. Replace damaged and unlit exit signs. Locate signs to adequately show egress routes. Provide conduit and wiring as needed. Connect to normal and emergency power circuits. Cut, patch, and fireseal the building as necessary.
Summary for Dental School (old)		$ 959,105.50	$ 1,593,627.33	7	12	5,935,050	9,606,593	kWh	3,095	5,010	
						36,560	63,297	MMBTU	1,929	3,339	
Dental School (new)											
1545	Lighting Upgrade	$ 41,494.00	$ 69,156.67	3	5	414,940	691,567	kWh	216	361	Much of the lighting in the building consists of older two- and four-tube fluorescent fixtures. Many ballasts and tubes have failed. Lighting levels in the corridors are poor. Older T12 fluorescent lighting and incandescent spotlights are used in various areas including the museum, main entries, exits, mechanical rooms and corridors. Replace the older lighting fixtures with modern T8 electronically ballasted and fluorescent fixtures. Improve lighting levels in corridors to a minimum of 10 foot-candles. Replace incandescent spots with compact fluorescent bulbs. Reconnect electrical supplies.
4796	Rooftop Air Handling Unit Overhaul	$ 14,106.00	$ 21,159.00	10	15	141,060	211,590	kWh	74	110	The large rooftop air handling unit is original, starting to deteriorate and approaching the end of its useful life. In addition, the unit has not received any extensive overhauls. Trim, coils, and piping are deteriorated. Some deck sections are rusted out and out of service. Inspect the air handling unit and determine if the unit can be overhauled. Air handler overhauls should include replacement of coils including valve trim and instrumentation, drain pans, access doors and panels, fan motors and belts, dampers, flexible duct connections, insulation, DDC sensors, pneumatic control valves and damper operators. Replace original starters. Clean AHU housings and rebalance air handling units upon completion. Reuse duct, piping, and electrical rough-ins where possible.
1629	Occupancy Sensor Installation	$ 1,720.00	$ 2,866.67	3	5	17,200	28,667	kWh	9	15	The labs, classrooms and clinical rooms in the building lack occupancy sensors. Lights were found to be on in many of these unoccupied rooms. Install ceiling-mounted occupancy sensors and tie into existing lighting circuits.
Summary for Dental School (new)		$ 57,320.00	$ 93,182.33	5	7	573,200	931,823	kWh	299	486	
						0	0	MMBTU	0	0	

Faculty Student Union											
1992	Lighting Upgrade	$ 62,502.00	$ 104,170.00	3	5	625,020	1,041,700	kWh	326	543	Much of the lighting in the building consists of older two- and four-tube fluorescent fixtures. Some ballasts and tubes have failed. Lighting levels in the corridors are poor. Older T12 fluorescent lighting and incandescent spotlights are used in various areas including the main entries, exits, mechanical rooms and corridors. Replace the older lighting fixtures with modern T8 electronically ballasted and fluorescent fixtures. Improve lighting levels in corridors to a minimum of 10 foot-candles. Replace incandescent spots with compact fluorescent bulbs. Reconnect electrical supplies.
4846	Circulating Pump Replacement	$ 37,340.00	$ 62,233.33	3	5	373,400	622,333	kWh	195	325	The chilled, hot and domestic water circulating pumps and motors, in the penthouse and basement mechanical room, are older and approaching the end of their useful life. There is suspected asbestos insulation on some of the trim. Replace the old chilled and hot water circulating pumps in the penthouse and basement mechanical rooms with new adequately sized units. Test for and abate asbestos on pipe trim as necessary. Reconnect piping and electrical supplies. Replace trim, insulation, color I.D. label piping and rebalance water systems upon completion.
1995	Air Handling Unit Replacement	$ 13,333.33	$ 20,000.00	10	15	133,333	200,000	kWh	70	104	Air handling unit #1 located in the penthouse and #2 in the sub-basement mechanical room are original equipment and approaching the end of their useful lives. Housings are rusting; fan bearings are noisy. Insulation and trim is deteriorated. Starters are original and controls are old pneumatic systems, which provide poor temperature control. The air louvers, coils, electronic air cleaners, motors, controls, and humidifiers are all items, which are due for replacement. Replace the existing four-pipe air handling units and trim with new adequately sized units. Reconnect hot and chilled water piping, reinsulate and I.D. label as necessary. Balance water systems upon completion. Provide new controls compatible with the hospital campus EMS standard (Johnson Metasys). Replace starters and reconnect electrical supplies. Provide variable speed drives on larger fan motors. Test for and abate asbestos on piping and ductwork as necessary. Replace damaged and deteriorated ductwork and insulation. Cut and patch the building as necessary. AHU motors and coils were replaced two years ago; remaining modifications to be completed.
2018	Steam Components Replacement	$ 12,577.33	$ 18,866.00	10	15	1,258	1,887	MMBTU	66	100	Some of the steam system components in the penthouse and sub-basement mechanical room are leaking, rusting and at the end of their useful life. These items include the steam to hot water heat exchangers, expansion tanks, steam traps, piping, valves and trim. Replace the heat exchangers, expansion tanks, steam traps, valves and associated trim. Test for and abate asbestos as necessary. Reinsulate new items and provide I. D. labels.
2026	Occupancy Sensor Installation	$ 2,408.00	$ 4,013.33	3	5	24,080	40,133	kWh	13	21	Classrooms, conference rooms and offices in the building lack occupancy sensors. Lights were found to be on in many of these unoccupied rooms. Install ceiling-mounted occupancy sensors and tie into existing lighting circuits.
2002	Exit Sign Replacement	$ 2,096.00	$ 3,493.33	3	5	20,960	34,933	kWh	11	18	Some of the illuminated exit signs in the building are the original fluorescent units. These use more energy than modern fixtures. Many of the older exit signs were found to be unlit. Additionally, exit signs were lacking in some areas, such as the subbasement Gym exit. Evaluate and replace the old and unlit exit signs with new LED-type exit signs. Add exit signs in areas where lacking. Connect to normal and emergency power circuits.

1608	Window/ Gasket Replacement & Repairs	$ 12,500.00	$ 16,666.67	15	20	1,250	1,667	MMBTU	66	88	The gaskets on the existing windows at the 3rd floor front office suites are extremely worn and in need of replacement. The air infiltration is severe creating an uncomfortable work environment and putting undue stress on the mechanical heating and cooling systems. Replace the gaskets as soon as possible. This work will be completed throughout the building.
Summary for Faculty Student Union		$ 142,756.67	$ 229,442.67	5	8	1,176,793	1,939,100	kWh	614	1,011	
						2,508	3,553	MMBTU	132	187	
Kresge Hall											
251	Laboratory Fume Hood Replacement	$ 91,821.00	$ 183,642.00	5	10	918,210	1,836,420	kWh	479	958	Many of the existing laboratory fume hood systems are substandard, do not meet OSHA requirements, have out of date and failed inspection stickers, and air flows lower than 100 FPM face velocity, which is below the minimum "Class A" rating of 100 FPM face velocity. They also have poorly functioning utility hookups, such as water, air and gas, and are at the end of their useful lives. Replace the existing substandard laboratory fume hoods with new "Class A" Bistable Vortex units, including controls, local safety monitors, electrical wiring and utilities.
254	Air Handling Unit Replacement	$ 81,592.00	$ 122,388.00	10	15	815,920	1,223,880	kWh	425	638	The air handling units in this building are original equipment and past their useful lives. Fan bearings are noisy. Trim is deteriorated. Some belt guards are missing. Starters are old and use mercury switches. Controls are old pneumatic systems which provide poor temperature control. Returns are via return grilles in hall walls which have no fire dampers. Replace the four-pipe air handling units and trim. Reconnect hot and chilled water piping and reinsulate as necessary. Balance water systems upon completion. Provide new controls compatible with the hospital campus EMS standard (Johnson Metasys). Replace starters and reconnect electrical supplies. Provide variable speed drives on larger fan motors. Test for and abate asbestos on piping and ductwork as necessary. Replace damaged and deteriorated ductwork and insulation. Modify return ductwork to eliminate open transfer grilles in walls without fire dampers. Cut and patch the building as necessary. This project is currently in progress.
281	Lighting Upgrades	$ 71,584.00	$ 119,306.67	3	5	715,840	1,193,067	kWh	373	622	Much of the lighting in the building consists of older three- and four-tube fluorescent fixtures. Many ballasts and tubes have failed. Lighting levels in the corridors are poor. Incandescent spotlights are used in various areas including the main entry corridors. Replace the older lighting fixtures with modern T8 electronically ballasted fluorescent fixtures. Improve lighting levels in corridors to a minimum of 10 foot-candles. Replace incandescent spots with compact fluorescent bulbs. Reconnect electrical supplies.
260	Pneumatic Controls Replacement	$ 27,790.00	$ 55,580.00	5	10	277,900	555,800	kWh	145	290	The building uses the original pneumatic system for HVAC controls, which presently has a hybrid electric Trane Tracer interface. These controls are past the end of their useful life. They provide poor temperature control and waste energy. The University is beginning to implement direct digital controls. The hospital complex uses a Johnson Metasys DDC system, while the three buildings west of Broad St. use Trane Tracer, which cannot communicate with the other system. Replace pneumatic controls for major equipment not being replaced under other projects (such as the air handlers and reheat coils) with DDC controls. Systems shall be compatible with the hospital campus standard (Johnson Metasys). Install a central monitoring station in the building. Provide a link via the campus fiber optic system to provide central control and monitoring.

267	Steam Components Replacement	$ 15,644.67	$ 23,467.00	10	15	1,564	2,347	MMBTU	83	124	Some of the steam system components in the basement mechanical room are leaking and nearing the end of their useful life. These items include the steam to hot water heat exchangers, steam traps, valves and trim. Replace the heat exchangers, steam traps, valves and associated trim. Test for and abate asbestos as necessary. Reinsulate new items and provide I. D. labels.
555	Variable Speed Drive for Chilled Water Pumps	$ 8,158.00	$ 13,596.67	3	5	81,580	135,967	kWh	43	71	The three chilled water pumps do not have variable speed drives. Installation of these devices will save energy. Provide variable speed drives for the three 25 HP chilled water pumps. Tie start/stop controls into the proposed EMS (Johnson Metasys) system. Reconnect electrical supplies.
285	Domestic Water Pump Replacement	$ 7,148.00	$ 11,913.33	3	5	71,480	119,133	kWh	37	62	The domestic water booster pumps are older and near the end of their useful life. Wear is evident. Replace the two 250 GPM, 15 HP booster pumps and trim. Reconnect electrical supplies. Provide new solid state controls.
535	Exterior Window Replacement	$ 10,000.00	$ 13,333.33	15	20	1,000	1,333	MMBTU	53	70	The vertical slot windows are exhibiting signs of wear; and the windows have begun to leak. Replace the windows with new double-glazed fixed units. Install new vertical blinds at all window locations.
557	Duct Insulation Replacement	$ 3,888.00	$ 5,832.00	10	15	389	583	MMBTU	21	31	The insulation on the HVAC duct elbows and flexible connectors in the penthouse and basement mechanical rooms are deteriorated and coming apart. Some duct deterioration is occurring. Remove all damaged duct insulation and flexible connectors not covered under other projects. Replace with new insulation, cover jacketing and flexible connectors. Prep and prime rusted ductwork.
262	Pipe Insulation Replacement	$ 1,174.67	$ 1,762.00	10	15	117	176	MMBTU	6	9	Much of the insulation on the chilled water piping is deteriorated. This insulation is past its useful life. Portions are missing. This leads to excessive sweating and ponding in the mechanical rooms. Pipes are beginning to corrode. Replace all the deteriorated and missing insulation on the chilled water piping with new closed cell foam rubber insulation. Prep and prime any deteriorated piping. Provide color coded ID labels on piping.
Summary for Kresge Hall		$ 318,800.33	$ 550,821.00	6	11	2,880,930	5,064,267	kWh	1,502	2,641	
						3,071	4,439	MMBTU	162	234	
Medical Research Building											
220	Laboratory Fume Hood Replacement	$ 78,172.00	$ 156,344.00	5	10	781,720	1,563,440	kWh	408	815	Many of the existing laboratory fume hood systems are substandard, do not meet OSHA requirements, and have out of date and failed inspection stickers. They also have poorly functioning utility hookups, such as water, air, vacuum and gas, and are at the end of their useful lives. There are also a number of units that are no longer used for their original purpose. Replace the existing substandard laboratory fume hoods with new "Class A" Bistable Vortex units, including controls, local alarms, electrical wiring and utilities. Units no longer in use should be removed.
234	Lighting Upgrades	$ 57,098.00	$ 95,163.33	3	5	570,980	951,633	kWh	298	496	Much of the lighting in the building consists of older three- and four-tube fluorescent fixtures. Many ballasts and tubes have failed. Lighting levels in the corridors are poor. Replace the older lighting fixtures with modern T8 electronically ballasted fluorescent fixtures. Improve lighting levels in corridors to a minimum of 10 foot-candles. Reconnect electrical supplies.

431	Pneumatic Controls Replacement	$ 27,363.00	$ 54,726.00	5	10	273,630	547,260	kWh	143	285	This building uses the original pneumatic system for HVAC controls, which now has a hybrid electric Trane Tracer interface. These controls are at the end of their useful life. They provide poor temperature control and waste energy. The University uses a Johnson Metasys DDC system in the hospital complex, while the three west of Broad St. buildings use Trane Tracer, which cannot communicate with the other system. Replace the pneumatic-electric controls for major equipment not being replaced under other projects (such as the air handlers and reheat coils) with new DDC controls. Systems shall be compatible with the hospital campus standard (Johnson Metasys). Install a central monitoring station in the building. Provide a link via the hospital campus fiber optic system to provide central control and monitoring.
554	Variable Speed Drive for Chilled Water Pumps	$ 5,860.00	$ 9,766.67	3	5	58,600	97,667	kWh	31	51	The two chilled water pumps do not have variable speed drives. Installation of these devices will save energy. Provide variable speed drives for the two 25 HP chilled water pumps. Tie start/stop controls into the proposed EMS system.
Summary for Medical Research Building		$ 168,493.00	$ 316,000.00	4	8	1,684,930	3,160,000	kWh	879	1,648	
						0	0	MMBTU	0	0	
Pharmacy Building											
346	Laboratory Fume Hood Replacement	$ 137,209.00	$ 274,418.00	5	10	1,372,090	2,744,180	kWh	716	1,431	Many of the existing laboratory fume hood systems are substandard, do not meet OSHA requirements, and air flows as low as 50 FPM face velocity, which is below the minimum "Class A" rating of 100 FPM face velocity. They also have poorly functioning utility hookups, such as water, air and gas, and are at the end of their useful lives. The fan control switch on many of the older hoods does not operate to turn the fans off and this leads to a waste of energy when the hood is not in use. Replace 30 of the older existing laboratory fume hoods with new "Class A" Bistable Vortex style units, including controls, local alarms, electrical wiring and utilities. Insure that fan switches control exhaust fan at roof and provide control wiring connections to fan starters, as needed.
349	Pneumatic Controls Replacement	$ 57,171.00	$ 114,342.00	5	10	571,710	1,143,420	kWh	298	596	The building uses the original pneumatic system for HVAC controls. These controls are past the end of their useful life. They provide poor temperature control and waste energy. The University uses a Johnson Controls Metasys DDC system in the hospital complex. Replace pneumatic controls for major equipment not being replaced under other projects (such as the air handlers and reheat coils) with new DDC controls. Systems shall be compatible with the hospital campus standard (Johnson Metasys). Install a central monitoring station in the building. Provide a link via the campus fiber optic system to provide central control and monitoring.

4801	Basement Air Handling Unit Replacement	$ 33,333.33	$ 50,000.00	10	15	333,333	500,000	kWh	174	261	The four air handling units, AC-1, 2, 3, and 4, located in the basement mechanical room, are original equipment, housings are deteriorated, leaking air and the units are near the end of their useful lives (see additional photos). Also, there is suspected asbestos insulation on some of the piping, ductwork and trim. Evaluate and disassemble and remove the existing air handling units. Test for and abate asbestos on piping, ductwork and trim as necessary. Provide four new adequately sized built-up units complete with dampers, pre-filters, steam and chilled water coils, final filters, fans, inverter duty motors, and access sections. Reconnect existing ductwork, steam and chilled water piping. Replace starters and reconnect electrical supplies. Provide new controls compatible with the hospital campus EMS standard (Johnson Metasys). Test and balance water systems and overall airflows upon completion. AHU motors and coils were replaced two years ago; remaining modifications to be completed.
347	Lighting Upgrades	$ 33,646.00	$ 56,076.67	3	5	336,460	560,767	kWh	175	292	Much of the lighting in the building, including the lab spaces, consists of older two tube fluorescent fixtures. Some of labs have had newer fluorescent fixtures added to supplement lighting levels. See photo. Lighting levels in labs without the supplemental fixtures remains poor. Provide new fluorescent lighting fixtures with T8 lamps and electronic ballasts to supplement lighting levels in lab spaces where lighting levels have not yet been increased. Provide additional power supplies from adjacent panels where existing circuits are not of adequate capacity for the additional load. Provide switches at doors.
427	Exhaust Fan Variable Frequency Drive Installation	$ 30,260.00	$ 50,433.33	3	5	302,600	504,333	kWh	158	263	The general area exhaust fans, located in the penthouse, are not equipped with variable frequency drives. These fans exhaust air which must be made-up by the air handling units. Install variable frequency drives on the one-7 1/2 Hp and three-15 Hp exhaust fans. Replace the existing fan motors with new inverter duty motors. Include DDC controls to reduce air speeds during lightly occupied periods.
408	AHU Variable Frequency Drive Installation	$ 29,802.00	$ 49,670.00	3	5	298,020	496,700	kWh	155	259	The existing air handling systems operate at fixed volume and are mostly 100% outdoor air systems. There are no variable frequency drives on the existing air handling units. Installation of these devices will save energy. Install variable frequency drives on the five air handler fan motors. Reconnect electrical supplies. Must be completed in conjunction with fume hood replacement.
4811	Hot Water Circulating Pump Replacement	$ 27,540.00	$ 45,900.00	3	5	2,754	4,590	MMBTU	145	242	The hot water circulating pumps located in the basement mechanical room are older, deteriorated, and nearing the end of their useful lives. Some units are leaking. Replace the old hot water circulating pumps in the mechanical room with new adequately sized units. Reconnect piping and electrical supplies. Replace trim, insulation, color I.D. label piping, and rebalance water systems upon completion.
376	Variable Speed Drive for Chilled Water Pumps	$ 18,294.00	$ 30,490.00	3	5	182,940	304,900	kWh	95	159	The three chilled water pumps in the basement are original equipment and were not installed with variable speed drives. Installation of these devices will save energy when cooling requirements are reduced. Provide variable speed drives for the three-50 Hp chilled water pumps. Tie start/stop and speed controls into the proposed DDC (Johnson Metasys) system. Reuse the existing MCC starters and electrical supplies.

342	Hot Water Heat Exchanger Replacement	$ 12,608.00	$ 25,216.00	5	10	1,261	2,522	MMBTU	67	133	The steam to hot water heat exchanger located in the basement mechanical room is nearing the end of its useful life. The unit is critical since it is the buildings sole source of heating hot water. The heat exchanger is not insulated. Remove and replace the heat exchanger, steam traps, steam control valves and associated trim. Reinsulate new items and provide I.D. labels.
387	Domestic Hot Water Heat Exchanger Replacement	$ 5,057.50	$ 10,115.00	5	10	506	1,012	MMBTU	27	53	The skid mounted domestic hot water tanks with heat exchangers are original to the building. The steam coils and trim are deteriorating and nearing the end of their useful lives. Replace the heat exchanger tube bundles, steam control valves and traps. Reconnect steam piping, reinsulate and provide I.D. labels as necessary. This project is partially complete.
Summary for Pharmacy Building		$ 384,920.83	$ 706,661.00	5	9	3,397,153	6,254,300	kWh	1,772	3,262	
						4,521	8,123	MMBTU	238	429	
Totals (All Buildings)		**$ 3,746,818.17**	**$ 6,634,519.33**	**6**	**10**	**30,582,763**	**54,880,280**	**kWh**	**19,581**	**34,668**	
						68,854	**114,649**	**MMBTU**			

Appendix D: Central Plants Project Summary
Temple University

Project	Estimated Annual Energy Cost Savings Range ($)		Range of Simple Payback (yrs)		Estimated Annual Energy Use Reduction Range (kWh) or (MMBTU)		Usage Units	*Energy Type (Fuel or Electricity)*	*Unit Cost (per kWh or MMBTU)*	Estimated Annual GHG Reduction Range (MTCO2E)		Project Description
Main Campus Central Steam Plant												
Replace four existing 1000 BHP water tube boilers and controls with new high pressure boilers rated at 350 PSIG (suitable for steam microturbine application)	$ 248,000	$ 330,667	15	20	24,800	33,067	MMBTU	*Fuel*	*$10.00*	1,308	1,744	New boilers offer improved efficiencies and better controls to optimize operations in steam and hot water systems
Four Flue Gas Economizers associated with existing boiler replacement	$ 30,000	$ 40,000	15	20	3,000	4,000	MMBTU	*Fuel*	*$10.00*	158	211	Extract heat from the products of combustion to pre-heat make-up, return water, or condensate to the system.
Bowdown heat recovery associated with existing boiler replacement	$ 6,250	$ 8,333	15	20	625	833	MMBTU	*Fuel*	*$10.00*	33	44	Extract heat from the boiler blow-down to pre-heat boiler feed-water
Provide one 1 MW Backpressure Steam Microturbine	$ 320,000	$ 960,000	1	3	3,200,000	9,600,000	kWh	*Electricity*	*$0.10*	1,669	5,006	Install a back pressure turbine to produce electricity.
Summary for Main Campus Central Steam Plant	$ 604,250	$ 1,339,000	5	11	3,200,000	9,600,000	kWh			3,168	7,006	
					28,425	37,900	MMBTU					
Health Sciences Campus Central Steam Plant												
Replace three existing 1900 BHP water tube boilers and controls with new high pressure boilers rated at 350 PSIG (suitable for steam microturbine application)	$ 276,000	$ 368,000	15	20	27,600	36,800	MMBTU	*Fuel*	*$10.00*	1,456	1,941	New boilers offer improved efficiencies and better controls to optimize operations in steam and hot water systems
Flue Gas Economizers	$ 30,000	$ 40,000	15	20	3,000	4,000	MMBTU	*Fuel*	*$10.00*	158	211	Extract heat from the products of combustion to pre-heat make-up, return water, or condensate to the system.
Bowdown heat recovery	$ 10,000	$ 13,333	15	20	1,000	1,333	MMBTU	*Fuel*	*$10.00*	53	70	Extract heat from the boiler blow-down to pre-heat boiler feed-water
Provide one 1 MW Backpressure Steam Microturbine	$ 640,000	$ 1,920,000	1	3	6,400,000	19,200,000	kWh	*Electricity*	*$0.10*	3,338	10,013	Install a back pressure turbine to produce electricity.
Summary for Health Sciences Campus Central Steam Plant	$ 956,000	$ 2,341,333	4	9	6,400,000	19,200,000	kWh			5,005	12,236	
					31,600	42,133	MMBTU					

Appendix D: Central Plants Project Summary
Temple University

Project	Estimated Annual Energy Cost Savings Range ($)		Range of Simple Payback (yrs)		Estimated Annual Energy Use Reduction Range (kWh) or (MMBTU)		Usage Units	*Energy Type (Fuel or Electricity)*	*Unit Cost (per kWh or MMBTU)*	Estimated Annual GHG Reduction Range (MTCO2E)		Project Description
Main Campus Central Steam Plant												
Replace four existing 1000 BHP water tube boilers and controls with new high pressure boilers rated at 350 PSIG (suitable for steam microturbine application)	$ 248,000	$ 330,667	15	20	24,800	33,067	MMBTU	*Fuel*	*$10.00*	1,308	1,744	New boilers offer improved efficiencies and better controls to optimize operations in steam and hot water systems
Four Flue Gas Economizers associated with existing boiler replacement	$ 30,000	$ 40,000	15	20	3,000	4,000	MMBTU	*Fuel*	*$10.00*	158	211	Extract heat from the products of combustion to pre-heat make-up, return water, or condensate to the system.
Bowdown heat recovery associated with existing boiler replacement	$ 6,250	$ 8,333	15	20	625	833	MMBTU	*Fuel*	*$10.00*	33	44	Extract heat from the boiler blow-down to pre-heat boiler feed-water
Provide one 1 MW Backpressure Steam Microturbine	$ 320,000	$ 960,000	1	3	3,200,000	9,600,000	kWh	*Electricity*	*$0.10*	1,669	5,006	Install a back pressure turbine to produce electricity.
Summary for Main Campus Central Steam Plant	$ 604,250	$ 1,339,000	5	11	3,200,000	9,600,000	kWh			3,168	7,006	
					28,425	37,900	MMBTU					
Health Sciences Campus Central Steam Plant												
Barrack Hall Central Chilled Water Plant												
Chiller Replacement	$ 41,760	$ 52,200	20	25	417,600	522,000	kWh	*Electricity*	*$0.10*	218	272	Replace the old inefficient chillers with a more efficient chillers.
Water side economizer (6000 tons total capacity)	$ 11,143	$ 26,000	3	7	111,429	260,000	kWh	*Electricity*	*$0.10*	58	136	A plate and frame heat exchanger is installed to utilize condenser water for cooling in low ambient temperatures. The cooling tower can sufficiently cool water to be used for cooling through a heat exchanger so mechanical cooling is not required.
Variable-Primary Pumping	$ 40,000	$ 66,667	3	5	400,000	666,667	kWh	*Electricity*	*$0.10*	209	348	Two-way valves replace 3-way valves at the air handler chilled and/or hot water coils. The chilled and/or hot water pumps are then provided with Variable Frequency Drives (VFDs) to modulate the water flow based on a pressure sensor in the piping.
Summary for Barrack Hall Central Chilled Water Plant	$ 92,903	$ 144,867	9	14	929,029	1,448,667	kWh			484	755	
					0	0	MMBTU					
Liacouras Center Cooling Plant												
Water side economizer (6000 tons total capacity)	$ 8,000	$ 18,667	3	7	80,000	186,667	kWh	*Electricity*	*$0.10*	42	97	A plate and frame heat exchanger is installed to utilize condenser water for cooling in low ambient temperatures. The cooling tower can sufficiently cool water to be used for cooling through a heat exchanger so mechanical cooling is not required.

Appendix D: Central Plants Project Summary
Temple University

Project	Estimated Annual Energy Cost Savings Range ($)		Range of Simple Payback (yrs)		Estimated Annual Energy Use Reduction Range (kWh) or (MMBTU)		Usage Units	*Energy Type (Fuel or Electricity)*	*Unit Cost (per kWh or MMBTU)*	Estimated Annual GHG Reduction Range (MTCO2E)		Project Description
Main Campus Central Steam Plant												
Replace four existing 1000 BHP water tube boilers and controls with new high pressure boilers rated at 350 PSIG (suitable for steam microturbine application)	$ 248,000	$ 330,667	15	20	24,800	33,067	MMBTU	*Fuel*	*$10.00*	1,308	1,744	New boilers offer improved efficiencies and better controls to optimize operations in steam and hot water systems
Four Flue Gas Economizers associated with existing boiler replacement	$ 30,000	$ 40,000	15	20	3,000	4,000	MMBTU	*Fuel*	*$10.00*	158	211	Extract heat from the products of combustion to pre-heat make-up, return water, or condensate to the system.
Bowdown heat recovery associated with existing boiler replacement	$ 6,250	$ 8,333	15	20	625	833	MMBTU	*Fuel*	*$10.00*	33	44	Extract heat from the boiler blow-down to pre-heat boiler feed-water
Provide one 1 MW Backpressure Steam Microturbine	$ 320,000	$ 960,000	1	3	3,200,000	9,600,000	kWh	*Electricity*	*$0.10*	1,669	5,006	Install a back pressure turbine to produce electricity.
Summary for Main Campus Central Steam Plant	$ 604,250	$ 1,339,000	5	11	3,200,000	9,600,000	kWh			3,168	7,006	
					28,425	37,900	MMBTU					
Health Sciences Campus Central Steam Plant												
Variable-Primary Pumping	$ 22,400	$ 37,333	3	5	224,000	373,333	kWh	*Electricity*	*$0.10*	117	195	Two-way valves replace 3-way valves at the air handler chilled and/or hot water coils. The chilled and/or hot water pumps are then provided with Variable Frequency Drives (VFDs) to modulate the water flow based on a pressure sensor in the piping.
Summary for Liacouras Center Cooling Plant	$ 30,400	$ 56,000	3	6	304,000	560,000	kWh			159	292	
					0	0	MMBTU					
Bio Life Central Cooling Plant												
Water side economizer (6000 tons total capacity)	$ 8,000	$ 18,667	3	7	80,000	186,667	kWh	*Electricity*	*$0.10*	42	97	A plate and frame heat exchanger is installed to utilize condenser water for cooling in low ambient temperatures. The cooling tower can sufficiently cool water to be used for cooling through a heat exchanger so mechanical cooling is not required.
Variable-Primary Pumping	$ 22,400	$ 37,333	3	5	224,000	373,333	kWh	*Electricity*	*$0.10*	117	195	Two-way valves replace 3-way valves at the air handler chilled and/or hot water coils. The chilled and/or hot water pumps are then provided with Variable Frequency Drives (VFDs) to modulate the water flow based on a pressure sensor in the piping.
Summary for Bio Life Central Cooling Plant	$ 30,400	$ 56,000	3	6	304,000	560,000	kWh			159	292	
					0	0	MMBTU					

Appendix D: Central Plants Project Summary
Temple University

Project	Estimated Annual Energy Cost Savings Range ($)		Range of Simple Payback (yrs)		Estimated Annual Energy Use Reduction Range (kWh) or (MMBTU)		Usage Units	*Energy Type (Fuel or Electricity)*	*Unit Cost (per kWh or MMBTU)*	Estimated Annual GHG Reduction Range (MTCO2E)		Project Description
Main Campus Central Steam Plant												
Replace four existing 1000 BHP water tube boilers and controls with new high pressure boilers rated at 350 PSIG (suitable for steam microturbine application)	$ 248,000	$ 330,667	15	20	24,800	33,067	MMBTU	*Fuel*	*$10.00*	1,308	1,744	New boilers offer improved efficiencies and better controls to optimize operations in steam and hot water systems
Four Flue Gas Economizers associated with existing boiler replacement	$ 30,000	$ 40,000	15	20	3,000	4,000	MMBTU	*Fuel*	*$10.00*	158	211	Extract heat from the products of combustion to pre-heat make-up, return water, or condensate to the system.
Bowdown heat recovery associated with existing boiler replacement	$ 6,250	$ 8,333	15	20	625	833	MMBTU	*Fuel*	*$10.00*	33	44	Extract heat from the boiler blow-down to pre-heat boiler feed-water
Provide one 1 MW Backpressure Steam Microturbine	$ 320,000	$ 960,000	1	3	3,200,000	9,600,000	kWh	*Electricity*	*$0.10*	1,669	5,006	Install a back pressure turbine to produce electricity.
Summary for Main Campus Central Steam Plant	$ 604,250	$ 1,339,000	5	11	3,200,000	9,600,000	kWh			3,168	7,006	
					28,425	37,900	MMBTU					
Health Sciences Campus Central Steam Plant												
Bell Building Central Cooling Plant												
Chiller Replacement	$ 37,800	$ 47,250	20	25	378,000	472,500	kWh	*Electricity*	*$0.10*	197	246	Replace the old inefficient chillers with a more efficient chillers.
Summary for Bell Building Central Cooling Plant	$ 37,800	$ 47,250	20	25	378,000	472,500	kWh			197	246	
					0	0	MMBTU					
HSC Central Chilled Water Plant - West												
Chiller Replacement	$ 34,560	$ 43,200	20	25	345,600	432,000	kWh	*Electricity*	*$0.10*	180	225	Replace the old inefficient chillers with a more efficient chillers.
Summary for HSC Central Chilled Water Plant - West	$ 34,560	$ 43,200	20	25	345,600	432,000	kWh			180	225	
					0	0	MMBTU					
Totals - All Buildings	**$ 1,786,313**	**$ 4,027,650**	**5**	**10**	**11,860,629**	**32,273,167**	**kWh**			**9,352**	**21,053**	
					60,025	**80,033**	**MMBTU**					

Appendix E: Sustainability Student Survey Response
Temple University

Category/Question	**Response**	**Response Percent**
ENERGY USAGE		
Do you open windows with heat/AC on?	Yes **No**	30.9 **69.1**
Do you turn off lights when not in use/away from your room?	**Yes** No	**95.7** 4.3
Do you turn off electronic equipment when not in use/away from your room?	**Yes** No	**76.3** 23.7
Do you use a master power strip to turn off electronics in your room?	Yes **No**	32.4 **67.6**
Do you use CFL bulbs?	**Yes** No	**55.4** 44.6
SOLID WASTE/RECYCLING		
Do you recycle?	**Yes** No	**88.4** 11.6
Is it convenient to recycle in your residence hall?	**Yes** No	**79.3** 20.7
If you recycle, what do you recycle?	Paper **Plastic** Cans Electronics Batteries	65.1 **94.9** 85.4 11.4 11.2
Would you be interested in "recycling" unwanted items at the end of semester (a Temple 'yard sale')?	**Yes** No	**71.0** 29.0
In the residence halls, do you use styrofoam or glass cups?	Styrofoam Glass Both **Own container**	5.7 33.4 9.3 **51.6**
Would you be willing to help manage or participate in a composting effort on campus?	**Yes** No	**51.3** 48.7
Would you carry a cloth bag for your shopping needs?	**Yes** No	**81.6** 18.4
WATER USAGE		
How long are your showers?	5 minutes **10 minutes** 15 minutes	9.6 **46.3** 44.1
TRANSPORTATION		
When living on campus, what is your primary method of getting places?	**Walk** Drive Carpool Public transit Temple shuttle Bicycle Other	**96.8** 2.9 2.1 43.2 4.0 6.1 1.6
When living on campus, how many miles per week do you drive?	**0-10** 11-20 21-30 31-40 41-50 Over 50	**95.6** 2.2 1.0 0.3 0.4 0.6
Have you used public transportation and/or Temple shuttle service?	**Yes** No	**93.8** 6.2

Appendix E: Sustainability Student Survey Response
Temple University

Category/Question	Response	Response Percent
Have you found public transportation and/or Temple shuttle service convenient and satisfactory?	**Yes** No	**86.8** 13.2
Would you participate in a car share program?	Yes **No**	48.8 **51.2**
Do you have a car on campus?	Yes **No**	6.3 **93.7**
OTHER		
What is your perception of Temple's sustainability efforts?	Outstanding **Good** Fair Poor	6.4 **58.4** 31.5 3.7
To what extent would you be willing to endure personal sacrifice and/or inconvenience in your daily routine to effect a greener, more environmentally friendly Temple?	Unlimited Significant **Moderate** Little bit No Sacrifice	2.5 21.1 **49.9** 22.2 4.4
Would you get involved in a sustainability organization or attend sustainability events?	**Yes** No	**53.3** 46.7

Appendix F: Climate Action Plan Project Summary
Temple University

Wedge	Annual Electrical Savings (kWh)	Annual Fossil Fuel Savings (Therms)	Annual Energy Cost Savings	Annual GHG Reduction	Simple Payback (yr)
Plant Development Fund (PDF)					
Phase I Building Automation Systems	7,753,500	775,000	$1,550,700	8,165	6
Phase II Plant Development Fund Projects	15,406,700 – 24,262,800	706,000 – 997,100	$2,447,000 - $3,695,800	11,760 – 17,900	10-14
Phase III ECM for High Energy Using Buildings	30,582,800 – 54,880,300	688,500 – 1,146,500	$3,746,800 - $6,634,500	19,580 – 34,670	6 – 10
Non-PDF					
Behavior Change	16,000,000	890,000	$2,500,000	18,100	<1
Recycling and Waste Minimization	N/Ap	N/Ap	$45,000	400	<1
Transportation Alternatives	N/Ap	N/Ap	N/Ap	16,192	N/Ap
Biofuel	N/Ap	N/Ap	$112,191	5,610	N/Ap
Design Standards for New Construction	15,840,000	533,400	$2,120,000	11,130	N/Ap
Recycled Computer & Construction Waste	N/Ap	N/Ap	$139,392	5,419	N/Ap
Pearson/McGonigle wind turbines	18,000-36,000	N/Ap	$1,800-$3,600	9-18	N/Ap
Combined Heat & Power (CHP)	N/Ap	350,000	350,000	1,833	3
Purchased RECs	N/Ap	N/Ap	N/Ap	6,554	N/Ap

G. Offsets

G.1 Reduction Opportunities Outside of Temple's Boundaries

Beyond implementing internal emission reduction projects, Temple may need to purchase offsets to mitigate a portion of its emissions. Offsets may include Renewable Energy Credits or Certificates (RECs) for green power, carbon credits from voluntary and regulatory markets, and carbon allowances under regulatory markets. Purchasing offsets would allow Temple to mitigate emissions without having to implement infrastructure or behavioral changes. However, purchasing offsets provide no return on investment. In addition, offsets are projected to become more costly under expected future regulatory programs. For these reasons, in most instances, offsets will be a lower priority than implementing emission reduction projects.

Despite this, Temple recognizes that offsets can and do play a vital role in providing a means to achieve immediate emissions reductions in a cost-effective manner. Temple also recognizes that offsets also provide an opportunity for additional research and development in addressing climate change. As such, Temple has determined that there are instances when it furthers the dual mission of achieving climate and educational gains to participate in offset projects, especially those which will have a local impact. Temple has seven campuses and sites in Pennsylvania, international campuses in Rome, Tokyo, and London, and programs in other international locations including China, Korea, Greece, Israel, and more. Thus, Temple's definition of local may be defined to include these locations.

Therefore, in this section, Temple examines offsets and describes their features, reputable categories and current and future projected cost. We also describe potential local offset projects (i.e., urban forestry, community solar) in which purchased offsets can be based in the local Philadelphia community. Where these options are consistent with the recommendations in the ACUPCC Offset Protocol, Temple may selectively engage in this market to meet its ACUPCC commitment.

G.2 Renewable Energy Credits or Certificates (RECs)

RECs, which may be known also as Renewable Obligation Certificates (ROCs), Tradeable Renewable Certificates (TRCs), Green Tags and Green Certificates, represent electricity produced from a qualifying renewable energy technology of a qualifying vintage. A REC is a generic term for a financial instrument reflecting the attributes of renewable energy independently of the actual electricity. The certificate can be presented in either physical (i.e., paper) or more commonly, electronic format. The standard unit used internationally to measure RECs is a megawatt-hour (MWh). For tracking and recording purposes, each REC has an identifying number linking it back to the actual electric generating device from which it was produced.

Renewable Energy Credits or Certificates (RECs)

A REC is a unique and exclusive proof that one megawatt-hour (MWh) of electricity has been generated from a renewable resource.

Although in most instances, the renewable energy is additional to what would have been generated otherwise in absence of the REC that is not necessarily always the case. Moreover, since the renewable generation may be meeting increased demand, it also does not necessarily represent a reduction in any existing carbon emissions. For example, a wind farm may produce more electricity in an area – adding to the total amount of electricity generated – but without displacing any of the existing carbon-based electricity generation, or reducing net emissions. In the absence of a limit to the total amount of electricity produced or a way to track actual generation displacement, it is unclear as to whether the renewable energy produced would result in any actual reduction in emissions.

For these reasons, RECs are not the same as carbon offsets and the two terms should not be used interchangeably. Like offsets, RECs are energy-related tradable commodities, and often purchased by companies to represent — and claim the use of — renewable electricity. Unlike offsets, REC markets do not have the same additionality requirements of offsets.

However, renewable energy projects can provide environmental advantages including reduced land and water impacts and improved air quality. Further, the purchase of RECs can encourage the development of additional renewable energy projects.

RECs can still play an important role in Temple's Climate Action Plan, as a way to reduce the climate impact of Scope 2 emissions (indirect emissions from purchased electricity). The procurement of RECs to pair with electricity purchases is a common way to secure and document the use of renewable energy. In the 2005-2006 Fiscal Year, Temple began to purchase a percentage of its annual electric power from RECs. In recent years, these REC purchases have been slightly over two percent (2%) of Temple's electricity purchases.

As long as RECs are sold only once, sufficient tracking mechanisms are in place, and calculated grid-average emissions figures appropriately account for them, RECs can provide a valid way of obtaining zero-emissions electricity in calculating GHG inventories. To both ensure high-quality and support continued improvement, Temple will procure only those RECs certified by a reputable organization.

Currently not all projects that generate RECs would meet the criteria of the ACUPCC Protocol. However, if a developer builds a grid-connected renewable energy project with the intent of generating offsets, and demonstrates it is additional, it results in a measurable reduction in GHG emissions that will not be double-counted, and it meets the rest of the criteria outlined in the ACUPCC Protocol (see Section 4.3.4 below), a renewable energy project could generate offsets. The ACUPCC Guidelines call for the intellectual and research capacity of ACUPCC institutions to engage on these topics, to continue to improve emissions-reduction mechanism, and to create innovative new approaches to GHG reduction. For more guidance on this, the "Renewable Energy Credits" section of the ACUPCC Guidelines should be consulted.

For these reasons, Temple may use RECs as a short-tem tool for driving the development of renewable energy infrastructure that will lead to a GHG neutral future or in the longer-term as a mechanism to manage the risk of underperforming reduction projects to meet stated objectives. As is stated in other sections of the plan, Temple will put priority on reducing electrical demand and increasing energy efficiency. However, Temple also believes that partnering with local government, utilities and others, including renewable energy developers and providers, to increase the amount of carbon-free electricity available on its regional electricity grid is a worthwhile pursuit.

Renewable Energy Offerings of Temple's Local Electric Distribution Company

PECO Energy (PECO) is the local electric distribution company servicing Temple. PECO, in association with Community Energy, a leading wind energy marketer, offers PECO WIND™, a 100 percent pollution-free wind-generated electricity product to its customers. PECO WIND is generated by wind turbines located in Pennsylvania. The wind energy is delivered directly to the electricity grid that supplies most of the homes and businesses in the mid-Atlantic region. By participating in the PECO WIND program, Temple would be supporting this new renewable source of electricity and reducing the need to generate electricity from other sources. In addition, building and maintaining wind farms creates jobs and revenue for landowners and local communities.

The cost of producing electricity from wind energy is slightly higher than generating electricity from a conventional power source like coal or nuclear power. The price of wind energy is directly related to the cost of developing and constructing a wind farm and the seasonal production at wind power projects. PECO WIND is available for purchase in blocks of 100 kilowatt-hours for $2.54 per block. As of January 2010, PECO Wind is fully subscribed and is not available for increased or new subscribers.

Temple recognizes that concerns have been raised about the impact of wind farms on bird populations. Studies are now conducted to understand bird migration patterns to ensure the safe positioning and siting of wind farms. Ideally, sites should be free of ground prey and bodies of water that attract birds, not be within the hunting range of raptor nests or located on bird migratory routes. In addition, modern wind turbine designs are much more bird-friendly; solid tubular towers are used to prevent birds from perching and turbine blades rotate much more slowly than earlier designs.

Temple recognizes that any use of natural resources may have attendant environmental aspects. For this reason, Temple will seek to support only those renewable energy projects that have appropriately and adequately assessed and addressed these environmental aspects and any related impacts.

Direct Procurement of Renewable Energy

Temple could enter into a long-term renewable power purchase agreement as an alternative to buying RECs. Community Energy Inc. (http://www.communityenergyinc.com/) is currently pursuing solar farm developments in the mid-Atlantic region, including Pennsylvania. Community Energy's market experience, local relationships and financial backing can combine to provide a reliable source of high quality solar development projects and REC creation.

Renewable energy development goes much deeper than protecting the environment. The development and operation of the solar project creates temporary construction jobs and long-term management jobs, again providing an economic co-benefit.

Community Energy (CEI) has RECs available for sale. The RECs would be from Green-e certified wind that is sourced from anywhere in the U.S. A 3-year contract for quantities of 10,000MWh or more entered into effective February 2010 would be priced as follows:

$1.43 per MWh in the 1st year
$1.67 per MWh in the 2nd year
$2.11 per MWh in the 3rd year

It should be stated that there is a risk to REC purchases for years 2012 and beyond. It is possible that federal carbon regulation will become effective which would eliminate the carbon benefit associated with REC purchases. This is a risk to purchases in years for which such federal rules might be effective (most likely 2012 or beyond).

As Temple pursues its 2020 plan, Temple may also pursue LEED certification for its new or renovated buildings. To earn the point(s) available under the Green Energy section of Energy and Atmosphere, projects generally have to enter into a contract to purchase at least 35 percent of their electricity for two years that is Green-e eligible from a green power supplier, as defined by Green-e program. If an institution purchases an amount double the threshold, Temple could also get an innovation credit under the LEED program. At a minimum, Temple may decide to procure RECs as part of a LEED certification effort.

CEI also develops wind and solar projects under three business models:

- Retail Division - Solar and wind projects can be sited on host properties. The host can then enter into a long-term power purchase agreement (PPA) and REC purchase agreement. CEI would be the owner and operator of the installation.
- Large-Scale Solar – These projects, usually located on 20 or more acre parcels, range in the project size of 5 to 10 MW. The power purchase and REC agreements can be arranged to suit host needs.
- Large Scale Wind – These projects are usually owned and operated by CEI and are the support for their retail REC sales.

Temple might be able to identify existing locations where on-site generation can be located (20 acre parcels of land, building roofs which would require 100 square feet per kW). Temple could then decide to enter into a long-term (perhaps 20 year) PPA for the electricity from the project. If the PPA pricing was more favorable than Temple's current retail procurement costs, the savings could be used to fund additional sustainable investments.

Alternatively, Temple could site a solar generation project on its property, retaining both the electricity and the RECs. Temple could then sell the RECs into the market and use the proceeds to invest in other sustainable investments. It is expected that, in Pennsylvania, solar RECs could sell for $200 per MWh.

In addition, CEI is working with a Pennsylvania company, PaceControls, on delivering an HVAC optimization solution that reduces energy usage. CEI is able to support pricing structures that take advantage of Pennsylvania Act 129 incentives for energy efficiency. PaceControls, an ENERGY STAR Partner, develops and manufactures eco-smart, easy-to-install, energy-saving HVACR solutions. Designed for a wide variety of commercial, industrial and residential heating, cooling and refrigeration equipment, PaceControls technology is a highly flexible retrofit solution. The patented technology establishes optimal run times for compressors and burner units, "pacing" the equipment's consumption of electricity, natural gas, fuel oil or propane saving 10 to 20 percent or more on energy bills. A typical payback for a project ranges from just one to three years. The technology — designed and refined with significant input from the HVACR maintenance industry and equipment manufacturers — complies with all accepted industry standards for control equipment. PaceControls products have proven successful in thousands of installations, including hundreds installed by electric utilities under demand side management programs. Temple may choose to implement this or a similar energy saving technology in existing buildings.

Finally, CEI also offers carbon offsets that Temple could purchase to offset emissions. Temple most likely will consider this for Scope 3 travel and commuting emissions, but could also purchase offsets to address Scope 1 emissions.

Discussions with CEI on these and other options are recommended.

Other Incentives for Renewable Energy Investment in Pennsylvania

There are numerous investment funds available that may provide financing for Temple to make a direct investment in a renewable energy project whether on Temple property or in another location.
The **Philadelphia Industrial Development Corporation** (PIDC) is a private, not-for-profit Pennsylvania corporation, founded in 1958 by the City of Philadelphia and the Greater Philadelphia Chamber of Commerce to promote economic development throughout the city. PIDC's central strategy is to leverage financing and real estate resources to retain and to grow employment in Philadelphia. PIDC also coordinates tax incentive and work force development programs offered by the City and the Commonwealth. Clients range from the traditional base of commercial and industrial businesses to the developers of large, public purpose facilities to non-profits, in all neighborhoods of Philadelphia. Throughout its over fifty year history, PIDC has closed a total of 5,350 individual transactions with combined project costs of $15 billion, which have contributed to retaining and creating over 442,000 jobs in Philadelphia. To learn more about PIDC, visit www.pidc-pa.org.

The Reinvestment Fund (TRF) is a national innovator in capitalizing distressed communities and stimulating economic growth for low- and moderate-income families. TRF identifies the point of impact where capital can deliver its greatest financial and social influence. TRF's investments in homes, schools and businesses reclaim and transform neighborhoods, driving economic growth and improving lives throughout the Mid-Atlantic region. Since its inception in 1985, TRF has made almost $600 million in community investments. In the area of energy, TRF has managed the Sustainable Development Fund (SDF), a $32 million energy fund created by the Pennsylvania Public Utility Commission in its final order in the PECO Energy electric utility restructuring proceeding. The SDF is one of several energy funds managed by TRF. To learn more about TRF, visit www.trfund.com. To learn about the requirements for energy-related financing, visit http://www.trfund.com/financing/energy/energy-guidelines.html.

Founded in 1999, **Community Energy Inc.** (CEI) is a leading developer and marketer of renewable energy generation. To learn more about CEI, visit http://www.communityenergyinc.com/. Community Energy On-Site Solar is meeting the demand for clean energy with new on-site solar energy projects that deliver emission-free electricity directly to customers. Community Energy On-Site Solar provides a solar power option with no upfront costs to commercial and institutional customers in New Jersey and Pennsylvania through Power Purchase Agreements (PPAs). To learn more about CEI's On-Site Solar program, visit http://www.communityenergyinc.com/wind-farms/highered100/.

Renewable Energy Requirements in Pennsylvania

In 2004, Pennsylvania enacted the Alternative Energy Portfolio Standards (AEPS) which requires that by 2011, 3.5 percent of the energy sold to PECO customers be comprised of energy generated from alternative and renewable resources such as wind, low-impact hydro, methane, geothermal, biomass, or fuel cells, increasing to 8 percent by 2020. In the fall of 2008, PECO became the first utility in Pennsylvania to buy and bank credits to meet the state's requirements. On May 20, 2009, PECO announced that it had signed five-year agreements for the purchase of renewable energy credits equal to 412,000 MWhs of renewable energy. This agreement, along with a similar agreement made in August 2008, brought PECO's renewable energy credit purchase to 452,000 per year. Under this May 2009 purchase, PECO's aggregate supply of renewable energy credits has a weighted average price of $20.42 per credit.

Thus, starting in 2011, this act means that the amount of emission-free power that supplies the University will increase, and the carbon footprint of the electricity available on the grid will be lower, with little effort on the part of the University. Thus, we may see the emission rates for electricity actually begin to decline with this increase in generation from alternative and renewable sources. The Act 213 regulations are being incorporated into the University's plans.

Excess Self-Generated Electricity

If Temple were to purchase and install renewable energy fueled electricity generation equipment to offset its usage from PECO, Temple might generate more electricity than it needs. Through Net Metering programs, PECO purchases any excess electricity produced from customers' renewable energy equipment via its Net Metering (RS-2) tariff. Under this tariff, if any excess electricity is produced, PECO will provide a credit to Temple. To utilize net metering, Temple would work with PECO operations personnel to approve and connect the generation to the PECO distribution system.
PECO's Net Metering process is completely independent of PECO's efforts to comply with AEPS regulations in Pennsylvania.

For specific details on this process, reference PECO's Net Metering and Interconnection Information (see http://www.peco.com/pecores/energy_rates/Net+Metering+and+Interconnections.htm) for more details and contact information.

G.3 Carbon Offsetting and Use of Carbon Credits

The ACUPCC is an initiative to address global climate disruption through actions to reduce and eventually neutralize GHG emissions on their campuses, and to develop the capability of students to help all of society to do the same. The means to achieve GHG neutrality can include offsetting a portion of GHG emissions by purchasing carbon credits (or generating credits by developing emissions reduction projects outside of the boundary of the specified activities being neutralized).

Offsets are a potentially effective mechanism for complementing internal reduction activities, but cannot replace them. While internal efforts to directly reduce their GHG emissions focused on planning, funding, and initiating avoidance, reduction, and replacement programs are a higher priority and should be evaluated first, the ACUPCC permits investments in offsets to be made as soon as the internal activities are initiated.

Temple may invest in offsets, develop its own offset projects, invest directly in the offset projects of others or purchase credits generated from offset projects. Offsets provide an effective way of achieving interim targets and climate neutrality, measuring the cost/value of carbon reduction activities, and creating a financial incentive for reducing internal emissions.

When done correctly, investment in high quality carbon offsets is scientifically valid and results in the absolute reduction of GHG emissions to the atmosphere. To ensure offset quality, the ACUPCC has adopted a common Voluntary Carbon Offset Protocol ("the Protocol") to guide institutions in the evaluation and investments of offsets. The protocol establishes clear guidelines for higher education institutes to invest in the purchase of offsets. An accompanying document, "Investing in Carbon Offsets: Guidelines for ACUPCC Institutions" ("the Guidelines"), was issued in November 2008. The Protocol provides guidance to institutions evaluating investments in offsets to help determine whether or not to invest, when to do so, and what to look for in an offset to ensure they are credible, high-quality and effective – that is, they are real, measurable and permanent. The Protocol and Guidelines also encourage institutions to view offsets as a short-term tool to address the gap to a climate neutral future which also have other social and environmental co-benefits in addition to reducing emissions, and add value to the education, research, and service missions of higher education by helping to create a healthy, just and sustainable society.

Carbon Offsets Defined

A carbon offset is a reduction or removal of carbon dioxide equivalent (CO2e) GHG emissions that is used to counterbalance or offset emissions from other activities. Offset projects are those that reduce GHG emissions outside of an entity's boundary and generate credits that can be purchased by that entity to meet its own targets for reducing its GHG emissions. Use of offsets is possible because climate change is a non-localized problem; greenhouse gases spread evenly throughout the atmosphere, so reducing them anywhere contributes to overall climate protection.

Generally, offsets fall into two categories: 1) emissions reductions or avoidance, such as replacing a diesel generator with wind turbines or solar panels, and 2) sequestration, or removing GHGs from the atmosphere, such as planting trees that will absorb CO2 as they grow. There are many different types of projects that generate offsets in both categories.

Carbon Offsets May Be a Component of Temple's CAP

While the question of when to reduce versus offset is akin to the classic "make-or-buy" decision (e.g., choosing whether to purchase electricity or generate it yourself), an evaluation based solely on quantitative metrics would not be desirable here. This is partly because initiatives to reduce internally and buy offsets each come with broader costs and benefits that provide value linked to the organization's capabilities and objectives.

Purchasing offsets would allow Temple University to mitigate some portion of emissions beyond those that are possible by implementing infrastructure or behavioral changes alone. Additionally, offsets can drive real emissions reductions, potentially at a lower cost than is immediately feasible on campus. Offsetting also serves to internalize some of the true costs associated with GHG emissions, providing an additional incentive for eliminating emissions. Finally, offsetting can be used as a last resort, so to speak, when emissions reductions opportunities within a class of emissions, *e.g.*, commuting and travel-related emissions, have been taken as far as they can.

However, a common objection to offsetting is that it does not actually reduce an institution's baseline emissions; offsets do little to drive the internal business process innovations and systems-level changes needed. Moreover, some critics say, offsets may lead to complacency or "absolve climate guilt," in turn forestalling the necessary commitments to new behaviors, policies and business practices. Additionally, purchasing offsets provide no return on investment and are projected to become more costly under future regulatory programs. Finally, since achieving carbon neutrality is not a one-time accomplishment, offsets must be purchased for each period to which they are intended to be applied.

As in all aspects of Climate Action Plan preparation, consultation with internal stakeholders, who may have surprisingly varying awareness and attitudes about the best role of offsets for Temple University, will be pursued. Temple also recognizes that the two functions of reducing emissions internally and purchasing offsets fall under the purview of different internal organizations: in the former case, operations and facilities managers with access to data; in the latter, financial managers who have more authority over budgets. This Climate Action Plan will enable coordination of the efforts of these two (as well as many other) areas to ensure alignment in the achievement of our climate goal.

Benefits and Costs of Offsetting

The practice of offsetting can lead to benefits, including:

- Improved reputation and environmental credibility
- Increased experience in voluntary carbon markets in anticipation of a carbon-constrained economy
- Enhanced credibility, dialogue and networks with regulators in order to gain a hand in shaping policy
- More internal attention on the environmental balance sheet
- Faculty, employees and students who are inspired and prepared to conserve and innovate
- Opportunities to become a net emissions *reducer* and sell offsets to retail or compliance markets at a profit

Despite these benefits, however, offsetting presents fixed and variable costs as well as risk:

- Research into appropriate offset projects and providers, which may take months (*Fixed*)
- Corporate offset program design and administration, which may require additional staffing (*Fixed*)
- Unit offset costs (*Variable*)
- Being potentially accused of "greenwashing." Negative environmental publicity may both lead to significant costs and dissuade further investment in environmental leadership. (*Risk*)

As Temple University's assesses progress towards its goals and the range of prospective offset options increase over time, an educated process of assessing risks will be undertaken. These risks, however, will be balanced by the benefits associated with taking a leadership position on advancing the standards for and use of offsets to address climate change.

G.3.3 Carbon Offsets Enable Internalizing Carbon Costs

The act of offsetting puts a price on GHG emissions. This internalization of at least some of the true costs of carbon emissions is an important consideration in taking a strategic approach to GHG neutrality, and a potentially effective driver for accelerating internal reductions.

Temple will strive to pursue an effective, strategic approach which would look for emissions reductions that have the highest cost-savings associated with them, and use those savings to invest in further emissions reductions and/or offsets.

When Temple is subject to a compliance obligation, an effective strategy would be to evaluate the marginal cost of internal versus external GHG abatement, or the cost-per-ton of reducing internal emissions as compared to the price-per-ton of a carbon credit. While this cost-per-ton approach makes sense in compliance markets, it is less relevant in voluntary markets. Because these acts of leadership are voluntary, aiming to simply comply at least-cost is not necessarily the optimal course of action.

Required Attributes of Carbon Offsets

The ACUPCC Protocol and Guidelines articulate key principles of high-quality offsets as follows:

1. **Real:** Offsets are sourced from tangible physical projects with evidence that they have or will imminently occur.
2. **Additionality:** The principle that only those projects that would not have happened anyway should be recognized as carbon credits, i.e., reductions are "surplus" offsets that would not have occurred under "business as usual" and should not cause leakage or additional emissions elsewhere.
3. **Transparent**: All project details are provided, including, among others, type, duration, standards, measurements, location and price, are all known and made clear to the offset purchaser and other stakeholders.
4. **Measurable:** Reductions are objectively quantifiable by peer-reviewed methodologies within acceptable standard margins of error.
5. **Permanent:** Reduction streams are unlikely to be reversed, with safeguards to ensure that reversals will be timely replaced or compensated.
6. **Verifiable:** Performance of a particular emissions reduction project is monitored by an independent third-party with appropriate local and sector expertise to assess the expected or actual emissions reductions.
7. **Synchronous:** Offset flows are matched to emission flow time periods with rigorous and conservative accounting that designates boundaries and baseline calculations.
8. **Leakage:** A net change in anthropogenic emissions by sources of greenhouse gases (GHG) which occurs outside the project boundary, and which is measurable and attributable to the project activity.
9. **Registered:** A third party recording of ownership of an offset that enables clarity in identifying the chain of custody of credits.
10. **Double Counting:** Double counting occurs when a carbon emissions reduction is counter toward multiple offsetting goals or targets, whether voluntary or regulated. It may occur whenever carbon reductions are achieved in one point on a supply chain and multiple points on the chain try to take ownership of the reductions.
11. **Retired:** The removal of an allowance or offset from the market, after which it cannot be resold or used to permit emitting, thereby reducing overall emitting.

Emission reductions should be:

- Real
- Additional
- Transparent
- Measurable
- Permanent
- Verified
- Synchronous
- Leakage accountable
- Registered
- Accounted for once
- Retired

From Temple's perspective, it is also important that the agreement to fund or procure carbon credits is enforceable, i.e., backed by legal instruments that define offsets' creation, provide for transparency and ensure exclusive ownership.

Additional Considerations for Offset Attributes: Geography and Co-Benefits

The Protocol does not proscribe a preference as to the location of offset projects; however, it does point to the relative merits of different geographical projects locations in relation to some of the principles outlined in the Protocol, including: educational value, transparency, co-benefits, and the service mission of higher education.

For Temple, the geographic location of a project will provide advantages in meeting these aspects of the Protocol. Having direct contact and the ability to meet often and develop personal relationships with project participants will increase Temple's ability to ensure that such projects provide climate gains while ensuring sustainable results. Temple will consider engaging in projects that are in proximity to its domestic campus and also projects that are in international locations where we have study abroad programs.

While the primary goal of carbon offsets is to reduce global carbon emissions, many offset projects also claim to lead to other improvements in the quality of life for a local population. These additional improvements are termed co-benefits, and may be considered when evaluating and comparing carbon offset projects. Depending on the type and location of a project, there can also be numerous cascading social, economic, and environmental benefits, such as improved air quality, reduced costs, bringing communities onto an energy grid, job opportunities, and possibly indirect effects on congestion, land quality, and fuel security, etc. And finally, a significant benefit for higher education institutions is that there are educational benefits that can arise from working directly on an offset project or for students, staff, and faculty to engage in this growing market.

Communicating Use of Carbon Offsets

Temple will ensure a clear communication strategy with respect to its use of offsets to avoid the risk of negative stakeholder perception. For example, we will clearly communicate which Scope emissions are covered in a GHG neutral claim, i.e., Scope 1 and Scope 2 emissions, as well as specific Scope 3 emissions. As carbon management practices continue to improve, expansion of GHG inventory scope may necessitate an adjustment in offset policies to ensure that Temple's claims are and continue to be accurate and consistent with its Climate Action Plan. A recent report from Clean Air-Cool Planet and Forum for the Future called "Getting to Zero: Defining Corporate Carbon Neutrality," also provides some clear guidance on institutional carbon neutrality claims.

The State of the Carbon Markets

The carbon markets are growing rapidly. Over the past several years, the voluntary carbon markets have not only become an opportunity for citizen consumer action, but also an alternative source of carbon finance and an incubator for carbon market innovation.

Though carbon offsets are not tangible commodities, they are commodities that are subject to free market influences nonetheless. The market for voluntary carbon offsets has grown significantly over the past 6 years. Annually, a survey is conducted to gauge the State of the Voluntary Carbon Markets. Two components of the market are reviewed. For the analysis of the "over-the-counter" (OTC) side of the voluntary carbon markets, data was obtained from over 182 suppliers from 28 different countries involving all stages of the supply chain: developers, aggregators, brokers, and retailers. Thus, the numbers in the report may not contain every single OTC transaction in the marketplace and should be considered conservative. Alternatively, all data on the Chicago Climate Exchange (CCX) was obtained directly from the exchange and hence presents a greater degree of completeness.

In 2008 the market was responsible for offsetting 123.4 million metric tons CO2e. The voluntary carbon markets were estimated to be valued at US$705 million in 2008, more than twice their value in 2007

Voluntary Credit Prices Increased a Further 20% from 2007 to 2008, Resulting in a Total Market Value of US$705 million

($335 million). While the OTC market traded a smaller share of the transaction volume than the CCX, most of this value increase was driven by OTC credits, as they traded at a price premium of 66% in 2008 over CCX credits. Generally speaking, the price of a carbon offset follows the principles of free market economics – supply and demand. If demand for a certain project type or a project input is high, the price of that project will go up and vice versa. In 2008, the price for a carbon offset ranged from $2.00 per metric ton CO2e (tCO2e) to $33.00 per metric ton CO2e (EM 2009). These variations are dependent on the type of project, the third party standard used and the offset provider (retailer, broker, aggregator, developer). The average price of a voluntary carbon credit transacted on the OTC market was $7.34/tCO2e in 2008, up 22% from $6.10/tCO2e in 2007 and up 79% from $4.10/tCO2e in 2006. This compares to an average price of $4.43/tCO2e on the CCX.

Claims about carbon offset co-benefits, project type, and project location have no direct connection to the quality of a metric ton CO2 reduced (the benefit of a ton of CO2 reduced is the same whether it happens with a renewable energy project in the region or a reforestation project in Lebanon), but additional benefits, such as habitat preservation, sustainable development, etc., can increase the price of an offset because these additional benefits increase the quality of the surrounding environment and are generally more marketable.

Assessing Carbon Offset Project Types

Carbon offset project types generally fall into three categories: 1) renewable energy, 2) energy efficiency projects, and 3) land use/land change projects like reforestation and avoided deforestation. Landfill gas destruction and agricultural methane destruction are also common projects available on the market today. Temple may choose to meet its carbon offset needs by authorizing a Request for a Proposal (RFP) that is distributed to a selected list of offset providers. The RFP would include Temple's requirements for its offset portfolio such as criteria for project type, location, or specific co-benefits The RFP process may provide Temple with better leverage in negotiations. However, Temple may also choose to bypass the RFP process by simply contacting a provider to acquire a specific quote for carbon offsets.

Temple Initiating and Partnering on Carbon Offset Projects

Temple will look to undertake projects in its community that can generate offsets, such as,

- Community home energy audits and retrofits, with the Energy Coordinating Agency and Habitat for Humanity;
- Urban forestry through the public-private partnership called TreeVitalize; and
- Energy efficiency investments with the organizations listed above.

The **Energy Coordinating Agency** (ECA) is a non-profit corporation, founded in 1984, whose mission is to help people conserve energy and to promote a sustainable and socially equitable energy future for all in the Philadelphia region. Services to low income people are at the heart of their mission and are provided in collaboration with a citywide network of 14 Neighborhood Energy Centers (NEC). In the past year, ECA provided over 40,000 low income families with 86,218 energy services, valued at more than $27 million, generating value over 3 times that of a budget of $8.4 million. These services include: budget and energy counseling; bill payment assistance; energy conservation treatments, and energy education. ECA conservation services saved families an average of 20% of their energy costs, enabling them to meet their expenses and stay in their homes. To learn more about ECA, visit www.ecasavesenergy.org. Although there is not a NEC in the 19122 zip code, there are ones in the adjacent zip codes (see http://www.ecasavesenergy.org/nec.html). The Philadelphia Weatherization, Rehabilitation and Asset Preservation (WRAP) Partnership, which brought energy conservation, education, and bill payment assistance services, together with home repair in order to reduce low income homeowners' maintenance and operating costs, Is an example of ECA's community work. Concentrated in a section of South Philadelphia, the project allowed homeowner's to reduce their debt and build equity in their homes while helping to revitalize the surrounding community.

TreeVitalize (http://www.treevitalize.net/index.aspx) is a public-private partnership to help restore tree cover, educate citizens about planting trees as an act of caring for our environment, and build capacity among local governments to understand, protect and restore their urban trees. The program involves a combination of trees, technical assistance, education and funding to support tree planting in neighborhoods (street and park trees) and along streams (forest buffers).Tree-lined streets enhance the sense of community. Trees also clean the air, provide shade to plants, animals and people, increase property values, and help control stormwater.

In conjunction with the Temple 2020 framework, Temple will seek to ensure the reuse or recycling of all construction waste and demolition materials. This material reduction can reduce construction costs and conserve energy and natural resources while also reducing soil, air and water pollution.

Temple will also leverage the volunteer spirit of its student body through its Office of Community Service whose mission is "Immersing ourselves in action for positive social change". The office has coordinated projects with Habitat for Humanity in the past.

Temple will also employ use of appropriate standards, such as The Climate, Community & Biodiversity Standards (see the website for further information: http://www.climate-standards.org/standards/pdf/ccb_standards_second_edition_december_2008.pdf), the name for the certification developed by the Climate, Community & Biodiversity Alliance (CCBA). The CCB Standards identify land-based climate change mitigation projects that simultaneously generate climate, biodiversity and local community sustainable-development benefits. The standards were developed through a broad partnership between the nonprofit and private environmental communities, including Conservation International, Rainforest Alliance, The Nature Conservancy and CARE.

Assessing Carbon Offset Providers

There are five main types of offset sellers: 1) project developers 2) retailers/wholesalers, 3) brokers, 4) aggregators, and 5) utility companies. Each type offers different value-added services, from providing messaging plans and outreach services, to facilitating faster, larger scale transactions. Several organizations provide services typical of each type of provider. Temple's offset provider choice should be based on the credibility of the organization, their ability to meet your standards and requirements, and their ability to provide the best service for your needs. After deciding the volume of emissions that will be offset, Temple will determine the level of services that will be needed from its provider, be it small or large scale purchasing, a diversified portfolio or outreach and communication consulting. When evaluating a provider inquire about third party standards, their method for offset retirement, and their organizational auditing procedures.

Temple will consult various resources to determine and assess its offset providers including:

- The Carbon Offset Provider Evaluation Matrix from Carbon Concierge[1];

- Carbon Offset Research & Education (CORE) initiative of the Stockholm Environment Institute (SEI) which has lists of Studies that Rate Offset Providers and a Comprehensive List of Offset Providers[2];

- Carbon Catalog, a website with a directory of carbon offsets, listing and rating offset providers and offset projects worldwide. Carbon Catalog is an independent service which does not sell offsets or have commercial relationships with providers. The listings and ratings follow transparent guidelines. Carbon Catalog. Carbon Catalog was founded by Gideon Greenspan and launched in September 2007[3];

- CarbonOffsetList.org, a website maintained by the Environmental Defense Fund that lists a set of offset projects that they reviewed and recommend as real, additional and verified.[4]

G.4 Options to Consider

In order to finalize an approach, a range of options were evaluated to determine the best path for Temple to pursue. Here we examine the potential costs of purchasing RECs or offsets equivalent to all of its emissions associated with its Scope 2 purchase of electricity and purchasing offsets equivalent to all of its emissions associated with its Scope 3 commuting and travel, in years 2020 and 2030.

[1] http://www.carbonconcierge.com/.

[2] http://sei-international.org/; http://www.co2offsetresearch.org/consumer/OffsetRatings.html; and http://www.co2offsetresearch.org/consumer/Providers.html.

[3] http://www.carboncatalog.org/; http://www.carboncatalog.org/providers/; http://www.carboncatalog.org/projects/; and http://www.carboncatalog.org/for-providers/.

[4] http://innovation.edf.org/page.cfm?tagid=23994

TABLE G-1. PROJECTIONS OF REC AND OFFSET COST FOR SELECT SCOPE 2 AND SCOPE 3 EMISSIONS

Projections of REC and Offset Cost For Select Scope 2 and Scope 3 Emissions ($ 000s)						
	2020			2030		
	Low	*High*	*Projection*	*Low*	*High*	*Projection*
Scope 2						
Electricity Usage (REC)			8,628			8,628
Electricity Usage (Offset)	846	13,974	5,795	3,028	22,639	9,008
Scope 3						
Faculty/Staff Commuting	76	1,248	518	270	2,022	805
Student Commuting	171	2,829	1,173	613	4,584	1,824
Air Travel	50	825	342	179	1,337	532

G.5 Listing of U.S-Based Offset Providers Which Sell to Businesses

Carbon Offset Research & Education (CORE), an initiative of the Stockholm Environment Institute (SEI) has a Comprehensive List of Offset Providers, which can be found at the website http://www.co2offsetresearch.org/consumer/Providers.html. Below is a sub-set of the CORE listing for U.S.-based providers; some additions have also been made to CORE's list. The providers highlighted in green have been identified by Temple as preferred potential suppliers.

TABLE G-2. U.S.-BASED OFFSET PROVIDERS					
Name and URL of Company	**For-profit or non-profit**	**HQ Location**	**Type of Offset Provider**	**Type of Offsets** BS= Bio-sequestration EE= Energy Efficiency GS= Geo-sequestration MC= Methane Capture* RE= Renewable Energy TR= Transportation	**Customers**
3Degrees Energy Services	FP	U.S.	Retailer, energy service provider, consulting service	RE, BS, MC	business, individuals
BeGreen Now	FP	U.S.	Retail subsidiary of Green Mountain Energy	RE, BS, MC	business, individuals
Blue Source	FP	U.S.	Project aggregator, project developer	BS, EE, RE, MC	Business

TABLE G-2. U.S.-BASED OFFSET PROVIDERS					
Name and URL of Company	**For-profit or non-profit**	**HQ Location**	**Type of Offset Provider**	**Type of Offsets** BS= Bio-sequestration EE= Energy Efficiency GS= Geo-sequestration MC= Methane Capture* RE= Renewable Energy TR= Transportation	**Customers**
Bonneville Environmental Foundation	NP	U.S.	Retailer	RE	business, individuals
BP	FP	Global	Energy provider, project developer	EE, MC	Business
Carbon Angel	FP	U.S.	Retailer	RE, BS, MC	business, individuals
Carbon Counter	NP	U.S.	Retailer for the Climate Trust	TR	business, individuals
Carbonfund.org	NP	U.S.	Retailer	RE, EE, BS	business, individuals
CELB	NP	U.S.	Conservation International (see below) / Ford partnership. Project developer	BS	business, individuals
Certified Clean Car	FP	U.S.	Project of MMA Renewable Ventures investment firm	RE	business, individuals
Clean and Green	NP	U.S.	Retailer affiliate of Keep America Beautiful	RE	business, individuals
Cleaner and Greener	NP	U.S.	Retailer	RE, EE	business, individuals
ClearSky Climate Solutions	FP	U.S.	Retailer, consultant, project developer	BS, MC	business, individuals, institutions
Climate Save	NP	U.S.	Retailer	RE	business, individuals
Climate Trust	NP	U.S.	Retailer, project developer	RE, EE, BS, MC	business, individuals
Climate Wedge	FP	U.K./Global	Carbon management advisory firm for Cheyne Carbon Fund	N/A	business, institutions
Community Energy Inc	FP	U.S.	Retailer	RE	business, individuals
Conservation Fund: Go Zero	NP	U.S.	Conservation charity, offers offsets	BS	business, individuals, institutions

TABLE G-2. U.S.-BASED OFFSET PROVIDERS					
Name and URL of Company	**For-profit or non-profit**	**HQ Location**	**Type of Offset Provider**	**Type of Offsets** BS= Bio-sequestration EE= Energy Efficiency GS= Geo-sequestration MC= Methane Capture* RE= Renewable Energy TR= Transportation	**Customers**
Conservation International	NP	U.S.	Conservation charity, offers offsets	BS	business, individuals
COzero	FP	Australia, U.K., U.S.A, China (Hong Kong)	Retailer	RE	business, individuals, institutions
Delta Offsets	NP	U.S.	Project developer	BS, GS, MC	business and institutions
Drive Neutral	FP	U.S.	Retailer	EE	individuals
e-Blue Horizons	NP	U.S.	Retailer works in cooperation with the Conservation Fund a non-profit	BS	business, individuals, institutions
EcoSecurities	FP	International	Project developer, project aggregator	RE, GS, MC, EE	business and government
EcoVoom	FP	U.S.	Retailer	RE	business, individuals
Go Neutral	NP	U.S./Israel	Retailer and project manager	BS	business, individuals
Greenlife	FP	U.S.	Retailer and project manager	FS, MC, RE	business, individuals
GroPower	FP	U.S. / U.K.	Project manager	EE	business, individuals
Live Climate	NP	U.S.	Retailer	RE, BS	business, individuals
LiveCooler	NP	U.S.	Project developer: provides CFL lightbulbs to low-income families	EE	business, individuals
LiveNeutral	NP	U.S.	Retailer	EE, MC, BS	business, individuals
NativeEnergy	FP	U.S.	Retailer	RE	business, individuals
Nature Conservancy	NP	U.S.	Retailer	BS	business, government
Reforest the Tropics	NP	U.S.	Retailer	BS	business, individuals
Standard Carbon	FP	U.S.	Retailer	BS	business, institutions, individuals

TABLE G-2. U.S.-BASED OFFSET PROVIDERS					
Name and URL of Company	**For-profit or non-profit**	**HQ Location**	**Type of Offset Provider**	**Type of Offsets** BS= Bio-sequestration EE= Energy Efficiency GS= Geo-sequestration MC= Methane Capture* RE= Renewable Energy TR= Transportation	**Customers**
Sterling Plant[5]	FP	U.S.	Retailer		Business, university, individual
Sustainable Travel International	NP	U.S.	Retailer for myclimate offsets	RE, EE	business, individuals
Terra Pass	FP	U.S.	Retailer, project developer	RE, EE	business, individuals
TIST - International Small Group and Tree Planting Service	FP	U.S.	Program working with subsistence farmers, offsetting one aspect	BS	business, individuals
Veolia Environmental Services	FP	U.S. / Canada	Environmental remediation company, project developer	MC, EE	Business

*** Methane Capture includes landfill, agricultural and coal mine methane projects**

G.6 Summary

Temple recognizes that offsets not only provide a means to achieve immediate climate benefit, but also they provide an opportunity to achieve sustainable co-benefits, advance educational objectives and augment community economic development. As such, Temple will pursue use of offsets as follows:

- Opportunities to site renewable generation projects on its own property to generate RECs;
- Opportunities to partner with local renewable energy companies to develop power purchase agreements and/or REC purchase agreements that would enable the development of new renewable generation resources;
- Purchasing RECs as a means to offset some or all of its emissions associated with its Scope 2 purchase of electricity; and
- Purchasing carbon credits as a means to offset some or all of its emissions associated with its Scope 3 commuting and travel.

Local opportunities for use of offsets include an expansion of Temple's current involvement with Habitat for Humanity to build energy efficient homes. For example, the Partners in Sustainable Building Program has issued grants to Habitat for Humanity affiliates for homes built following Energy Star, LEED or other nationally recognized green building guidelines. Additionally, as discussed in Section 4.2.2, Temple could enter into a long-term renewable power purchase agreement as an alternative to buying RECs with

[5] Sterling Planet was not included on the reference list, but was added.

an organization such as Community Energy, Inc., which is pursuing renewable energy developments in the mid-Atlantic region.