FAU Solar ESCO Project

Boca Raton Campus

ESCO Preliminary Proposal

January 14, 2013

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Executive Summary

Trane US, Inc. (Trane) has been selected by Florida Atlantic University to provide energy performance contracting projects. Florida Atlantic University requested Trane to develop a renewable power generation project for the Boca Raton Campus.

The stated goal of the project is to provide 10% of FAU's power demand from renewable solar energy, reduce carbon emissions, and reducing operating costs. The project provides two large scale solar photovoltaic installations. Proposed solar installations include a 750 kWdc solar canopy on the planned Parking Garage 3 and a 250 kWdc ground-mount solar photovoltaic array on vacant land located east of the University Village Apartments.

In addition to the solar photovoltaic systems, other building retrofit projects are proposed. The retro commissioning of sixteen Education & General buildings on campus is highly recommended. Also, energy upgrades to the Building 5 Utility Plant chilled water pumping systems are proposed. Finally, energy efficient lighting retrofit of existing Parking Garage 1 and 2 is proposed.

The preliminary project cost is $5,456,200 and provides total energy savings of 7,421,465 kilowatt hours of electricity, 3,720 kWD-Mo of billing demand, and 73,041 therms of natural gas. The total projected energy savings, including a recommended FPL rate switch, amounts to $504,476 per year. Including available utility rebates, the project has a simple payback of 10.6 years. The project will be performed by Trane as a guaranteed energy savings performance contract. Financing will be secured through a 14 year municipal lease. The project is cash flow positive including costs of amortization, maintenance, and energy savings monitoring and verification.

Trane US, Inc. is a wholly owned subsidiary of Ingersoll-Rand, Plc, an international industrial manufacturing and engineering conglomerate with annual revenues of approximately US$14 billion. Trane Comprehensive Solutions (TCS) is a division of Trane US, Inc. with an established business of developing energy efficiency projects in the US, Canada and in select global markets. TCS also operates as an Energy Services Company (ESCO) and develops guaranteed energy savings performance contracting projects such as the one described herein. Trane Comprehensive Solutions shall act in the roles of principal developer, general contractor, and energy savings monitoring and verification provider.

Contact Information:

Steve Corson is your contact for the Florida Atlantic University Solar ESCO Project. An organizational chart and qualifications information is included in Exhibit A that shows the Trane project team members and our unique qualifications for this opportunity. Please use Mr. Corson's contact information below for any questions, and note that you will send and receive all communication through him.

Steve Corson
Energy Services Team Leader

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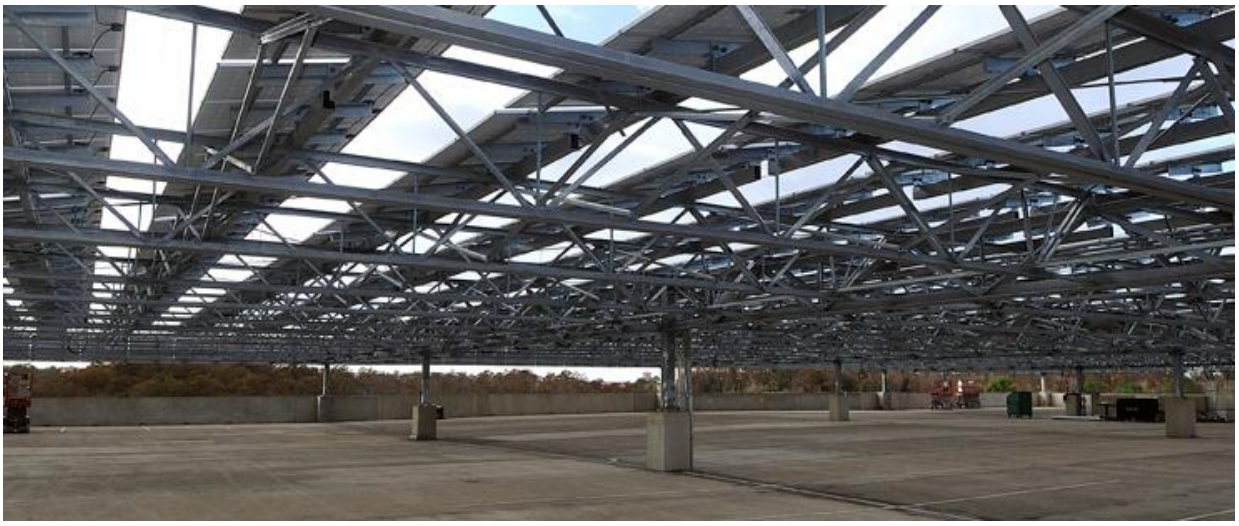
Preliminary Proposal

Parking Garage 3 Solar Canopy:

The central element of the project is a 750 kWdc solar photovoltaic array and structural steel canopy for the roof of Parking Garage 3. The power generated from the solar array will be connected to the electrical service for the main campus. The design of the parking garage has been modified to accept the structural loads from the solar canopy system. The proposed cost of the solar canopy for Parking Garage 3 is $3,473,934. Preliminary annual energy savings for the solar canopy is $114,646. In addition, a solar photovoltaic rebate is planned from FPL in the amount of $50,000.

Trane proposes to furnish and install a 750 kWdc solar photovoltaic array and structural steel canopy for the roof of Parking Garage 3. The solar array includes a structural steel canopy to mount the solar panels. The design elements for the project are similar to a recently completed project by Darden restaurants in Orlando, Florida. The Darden project included a solar photovoltaic parking structure canopy system. Photos of the Darden project are included below to provide a visual representation of the project.

Certain design elements will be unique for the FAU project. The structural steel wind load design criteria are higher than the design for the Darden project in Orlando. The wind loads for parking Garage 3 will be based on the 2010 Florida Building Code and the Palm Beach County wind load technical amendments. Also, the sides of the canopy facing will feature a galvanized steel edge detail instead of solar panels. The edge detail will constructed from galvanized steel and designed to match the architectural theme of the adjacent football stadium.



The power generated from the solar array will be connected to the electrical service for the main campus. The design of the parking garage has been modified to accept the structural loads from the solar canopy system. The project is planned with American-made solar panels.

Trane completed a rigorous review of the power production from the proposed solar array. Power production capacity is based on a 750 kWdc solar array. The actual solar array size may be slightly different based on the final structural steel design.

The solar production model is shown below. The model is calculated by PVSyst, an industry standard software tool for solar photovoltaic project design. The model is based on the performance of 260 watt Solarworld panels and two Solaron 333 inverters. In addition, the model assumes a fixed angle to optimize panel output in the summer on-peak periods. The model shows a projected annual output of 1,204,900 kilowatt hours (kWh) per year. This includes losses for the panel array wiring and the inverter losses. The complete PVSyst model is included in the appendix of this proposal

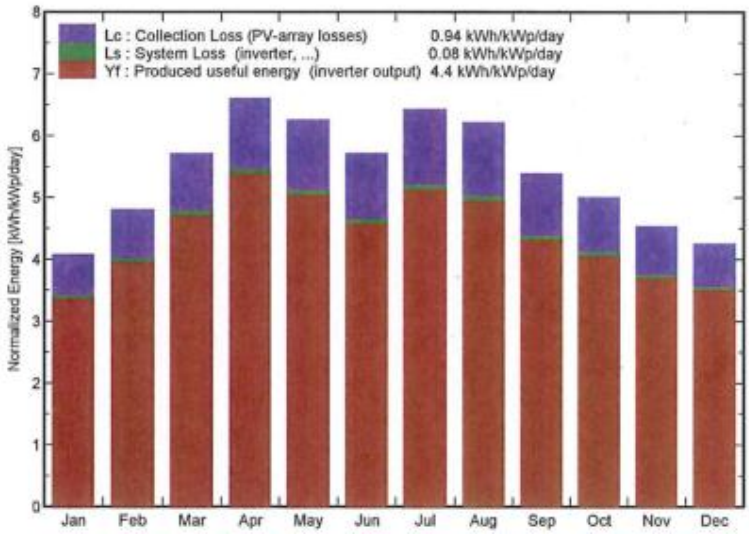
Garage 260W Solarworld

Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	EffArrR	EffSysR
	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	%	%
January	117.0	20.00	126.5	120.9	79.9	78.5	13.05	12.82
February	127.0	20.60	134.6	129.3	84.6	83.2	13.00	12.78
March	171.0	22.20	177.0	171.4	111.6	109.8	13.03	12.82
April	196.0	23.90	198.1	192.3	123.3	121.3	12.87	12.65
May	195.0	26.10	194.0	188.1	119.4	117.3	12.72	12.50
June	173.0	27.80	171.3	165.9	104.9	103.1	12.66	12.44
July	201.0	28.30	199.2	193.3	121.4	119.4	12.60	12.39
August	192.0	28.30	192.6	186.8	117.2	115.2	12.58	12.36
September	158.0	27.80	161.7	156.6	99.0	97.3	12.65	12.44
October	148.0	25.60	155.1	149.6	96.1	94.5	12.81	12.59
November	126.0	22.80	136.0	130.5	84.9	83.5	12.90	12.69
December	120.0	20.60	131.8	125.8	83.1	81.8	13.04	12.83
Year	1924.0	24.52	1977.9	1910.6	1225.6	1205.0	12.81	12.59

Legends:				
	GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
	T Amb	Ambient Temperature	E_Grid	Energy injected into grid
	GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
	GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

Normalized productions (per installed kWp): Nominal power 750 kWp



The annual energy savings associated with the solar array for Parking Garage 3 is shown in the tables below. The actual marginal rates of energy including taxes and fees from your existing FPL HLFT-3 rate are also shown below. The demand savings included is the coincident kW production at 3 pm during the FPL summer season from April through October as given by the PYSyst model which accounts for seasonal variations in solar irradiation levels and solar clearness (clouds). Please note that there is no kW demand savings in the FPL winter period

which includes November through March since the peak demand intervals occurs from 6-10 am and 6-10 pm since the solar array is not producing power during these intervals.

Parking Garage 3 750 kWdc Array - Hourly Energy Produced from PVSyst Model

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Hour												
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	38.6	62.7	46.8	38.8	30.1	17.5	10.0	0.0	0.0
8	30.0	70.7	112.8	172.9	172.0	154.7	166.4	139.6	126.5	126.5	74.4	48.1
9	143.4	191.1	247.2	305.9	282.7	255.7	281.9	276.0	244.9	238.1	217.0	178.1
10	227.6	305.1	352.4	415.4	370.1	339.3	374.5	364.5	338.0	326.8	319.6	312.6
11	338.1	361.3	433.6	479.3	432.9	373.5	440.6	436.6	398.7	380.2	371.1	370.1
12	364.9	403.0	464.6	517.3	474.4	412.0	474.9	468.1	426.6	417.1	406.1	382.3
13	376.5	414.0	470.0	515.6	472.4	441.8	478.4	468.6	426.6	413.8	407.3	390.1
14	356.5	391.5	452.1	488.1	443.2	384.1	452.1	444.1	403.1	380.4	370.1	369.9
15	306.3	334.1	396.4	431.7	397.1	360.5	407.2	396.9	348.2	331.9	319.4	292.4
16	230.9	259.6	318.6	348.7	327.4	314.2	342.9	330.8	277.2	247.2	226.6	195.2
17	137.5	180.1	209.7	225.7	221.4	214.1	238.9	225.2	174.4	147.8	71.8	100.0
18	20.6	61.1	84.7	102.7	111.6	113.8	129.2	121.0	61.5	28.5	0.0	0.0
19	0.0	0.0	0.0	1.4	15.9	26.1	26.1	14.9	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
kWh/Day	2,532.3	2,971.4	3,541.9	4,043.3	3,783.9	3,436.7	3,851.6	3,716.1	3,243.3	3,048.4	2,783.3	2,638.7
kWh/Month	78,500.0	83,200.0	109,800.0	121,300.0	117,300.0	103,100.0	119,400.0	115,200.0	97,300.0	94,500.0	83,500.0	81,800.0

On-Peak Energy Produced	**701,508**	**kWh**
Off-Peak Energy Produced	**503,392**	**kWh**
Total Power Produced	**1,204,900**	**kWH/Year**
Demand Savings	**2,674**	**kWD-Mo**

Dollar Value of Savings

On-Peak kWh Savings	$24,818
Off-Peak kWh Saving	$35,474
Total kWh Savings	$60,292
Demand Savings	$40,293
Total Energy Savings	**$100,585**

Existing FAU Boca HLFT-3 FPL Rates*

On-Peak kWh	$0.07047
Off-Peak kWh	$0.03538
Demand kW	$15.07

* Includes taxes and fees

University Village Apartments Ground Mount Solar:

Additional solar energy will be produced from the installation of 250 kWdc ground-mount solar photovoltaic array to be located on vacant property east of the University Village Apartments. The system will be a stationary mounted system with a fixed tilt to maximize solar production during the summer months.

Renewable power generated from the solar array will be connected to the electrical service for the University Village Apartments. The proposed cost of the ground mounted solar array for the University Village Apartment is $839,232. Preliminary annual energy savings for the ground mount array is $32,430.. In addition, a solar photovoltaic rebate is planned from FPL in the amount of $50,000.

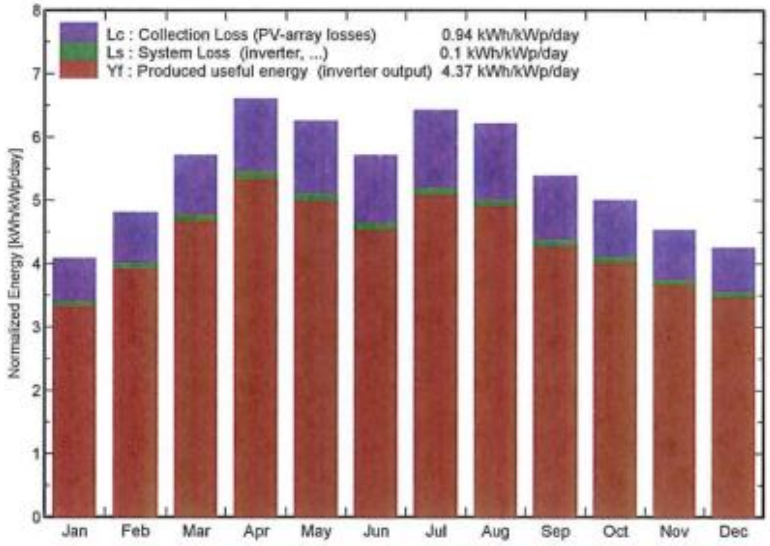
A shaded area is shown on the aerial image of the University Village Apartments to provide a visual reference for the preliminary location of the proposed 250 kWdc solar array. The area required is equal to approximately 25,000 square feet of space. The solar array will occupy land which is not planned for future use. Depending on the final site configuration, some existing vegetation may require removal to eliminate shading issues. The solar array may be an opportunity to create student interest or provide a sustainability-themed amenity. The ultimate shape of the solar array is shown as a parallelogram but can be modified as desired to fit the site.

Ground 260W Solarworld
Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	EffArrR	EffSysR
	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	%	%
January	117.0	20.00	126.5	120.9	26.64	25.94	13.05	12.71
February	127.0	20.60	134.6	129.3	28.21	27.54	13.00	12.68
March	171.0	22.20	177.0	171.4	37.21	36.37	13.03	12.74
April	196.0	23.90	198.1	192.3	41.12	40.16	12.87	12.57
May	195.0	26.10	194.0	188.1	39.79	38.85	12.72	12.42
June	173.0	27.80	171.3	165.9	34.96	34.15	12.66	12.36
July	201.0	28.30	199.2	193.3	40.47	39.60	12.60	12.33
August	192.0	28.30	192.6	186.8	39.07	38.22	12.58	12.30
September	158.0	27.80	161.7	156.6	33.01	32.24	12.65	12.36
October	148.0	25.60	155.1	149.6	32.04	31.26	12.81	12.50
November	126.0	22.80	136.0	130.5	28.29	27.64	12.90	12.60
December	120.0	20.60	131.8	125.8	27.71	27.05	13.04	12.73
Year	1924.0	24.52	1977.9	1910.6	408.53	399.03	12.81	12.51

Legends:				
	GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
	T Amb	Ambient Temperature	E_Grid	Energy injected into grid
	GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
	GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

Normalized productions (per installed kWp): Nominal power 250 kWp



University Village Apartments 250 kWdc Array - Hourly Energy Produced from PVSyst Model

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Hour												
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	12.5	20.7	15.4	12.5	9.5	5.4	3.0	0.0	0.0
8	9.6	23.3	37.1	57.1	56.9	51.1	54.6	45.7	41.7	41.7	25.0	15.7
9	47.3	63.1	81.5	101.0	93.5	84.5	92.5	90.4	80.8	78.6	71.6	58.7
10	75.1	100.8	116.3	137.6	122.6	112.3	123.1	119.6	111.7	108.1	105.6	103.2
11	111.8	119.6	143.4	158.9	143.7	123.8	145.0	143.5	131.9	125.9	122.8	122.4
12	120.7	133.5	153.7	171.4	157.5	136.7	158.9	156.4	141.2	138.2	134.5	126.5
13	124.7	137.3	155.5	170.9	156.8	146.6	160.1	156.5	141.3	137.2	135.0	129.2
14	118.1	129.8	149.6	161.9	147.2	127.4	151.3	148.4	135.8	126.1	122.5	122.5
15	101.3	110.6	133.6	143.2	131.8	119.6	136.5	132.8	115.2	109.9	105.6	96.7
16	76.4	85.9	105.2	115.5	108.6	104.1	115.0	110.7	91.7	81.8	74.9	64.6
17	45.5	59.6	69.3	74.7	73.4	70.9	78.6	75.4	57.7	48.9	23.7	33.1
18	6.3	20.2	28.0	34.0	37.0	37.7	42.5	40.7	20.3	9.1	0.0	0.0
19	0.0	0.0	0.0	0.0	3.6	8.2	7.2	3.3	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
kWh/Day	836.8	983.6	1,173.2	1,338.7	1,253.2	1,138.3	1,277.4	1,232.9	1,074.7	1,008.4	921.3	872.6
kWh/Month	25,940.0	27,540.0	36,370.0	40,160.0	38,850.0	34,150.0	39,600.0	38,220.0	32,240.0	31,260.0	27,640.0	27,050.0

On-Peak Energy Produced	**399,020**	**kWh/Year**
Total Power Produced	**399,020**	**kWH/Year**
Demand Savings	**889**	**kWD-Mo**

Dollar Value of Savings	
Total kWh Savings	$20,996
Demand Savings	$11,434
Total Energy Savings	**$32,430**

Existing UVA GSLD-1 FPL Rates*	
On-Peak kWh	$0.05262
Demand kW	$12.86

* Includes taxes and fees

Solar Energy Production

The expected lifetime of the solar photovoltaic cells is over 25 years. However, energy production from the solar photovoltaic cells reduces over time due to aging of the solar cells. Scheduled cleaning of the solar panels is included as part of a maintenance agreement. The annual derating factors based on the panel manufacturer warranty are shown below. These factors are included in the project pro forma. These derate factors are very conservative based on our experience

Parking Garage 3 750 kWdc Canopy Array

Year	Derate	kWh Produced	Savings
1		1,204,900	$114,646
2	97%	1,168,753	$111,207
3	96%	1,151,402	$109,556
4	95%	1,142,727	$108,730
5	94%	1,134,052	$107,905
6	93%	1,125,377	$107,079
7	93%	1,116,701	$106,254
8	92%	1,108,026	$105,428
9	91%	1,099,351	$104,603
10	91%	1,090,675	$103,778
11	90%	1,082,000	$102,952
12	89%	1,073,325	$102,127
13	88%	1,064,650	$101,301
14	88%	1,055,974	$100,476
15	87%	1,047,299	$99,650
16	86%	1,038,624	$98,825
17	85%	1,029,949	$97,999
18	85%	1,021,273	$97,174
19	84%	1,012,598	$96,348
20	83%	1,003,923	$95,523
21	83%	995,247	$94,698
22	82%	986,572	$93,872
23	81%	977,897	$93,047
24	80%	969,222	$92,221
25	80%	963,920	$91,717
Totals		**26,664,437**	**$2,537,116**

University Village 250 kWdc Ground Mount

Year	Derate	kWh Produced	Savings
1		399,020	$32,430
2	97%	387,049	$31,457
3	96%	381,304	$30,990
4	95%	378,431	$30,757
5	94%	375,558	$30,523
6	93%	372,685	$30,290
7	93%	369,812	$30,056
8	92%	366,939	$29,823
9	91%	364,066	$29,589
10	91%	361,193	$29,356
11	90%	358,320	$29,122
12	89%	355,447	$28,889
13	88%	352,574	$28,655
14	88%	349,701	$28,422
15	87%	346,828	$28,188
16	86%	343,955	$27,955
17	85%	341,082	$27,721
18	85%	338,209	$27,488
19	84%	335,336	$27,254
20	83%	332,463	$27,021
21	83%	329,591	$26,787
22	82%	326,718	$26,554
23	81%	323,845	$26,320
24	80%	320,972	$26,087
25	80%	319,216	$25,944
Totals		**8,830,313**	**$717,676**

Building Scheduling and Controls Retro Commissioning:

The mechanical systems of buildings on the main campus currently operate 24/7 regardless of occupancy. All of the buildings proposed for controls retro commissioning were designed to cycle off during unoccupied times to maintain a setback temperature and humidity. The decision to operate the air handlers and pumping systems continuously was based on previous limitations of the Building 5 chiller plant and pumping systems. The Building 5 chiller plant issues have been resolved with the replacement of chiller 1 and 2 and the primary loop piping corrections recently completed by Trane in our Chiller 1 and 2 ESCO project. Trane proposes to retro-commission fifteen (16) buildings to bring them back to their original sequence of operations as designed. Please note that none of these facilities include research buildings or auxiliaries. The buildings included are the following:

Building	Building Name	Total Square Feet
2	General Classroom S	85,538
9	University Theatre	110,366
11a	Field House West	15,336
23	Fleming West	13,962
24	Fleming	59,148
25	Kaye Hall	24,119
36	Engineering West	59,419
44	Humanities	102,973
47	Education	93,187
51	Performing Arts	26,167
52	Arts & Humanities	25,508
53	Visual Arts	24,991
73	General Classroom N	12,680
80	Student Support	98,840
84	Nursing	72,998
86	College of Business	59,302
Totals		**884,534**

Trane performed a detailed energy analysis of the proposed retro commissioning. The annual energy savings is 4,130,198 kilowatt hours of electricity, 11 kilowatts of peak electricity billing demand and 49,306 therms of natural gas. The annual energy savings is $190,954 per year.

The scope of the retro commissioning includes programming of the existing controls systems, commissioning services, and testing. Exhaust fan interlock and some controls upgrades are included for building 44 Humanities. A controls upgrade and reduction to the VAV box minimums are planned for Building 36 Engineering West. Also, we expect that some deferred maintenance items will be identified including damper, actuator, valve, and other repairs needed to accomplish the proper controls sequences.

The proposed cost of the retro commissioning services is $318,779. The simple payback of the retro commissioning is less than one and a half years.

Trane performed a detailed evaluation of the as-built building plans and existing controls systems and concludes that the retro commissioning is feasible and highly recommended. The proposed Controls Retro Commissioning will switch to an 80 degree cooling setpoint and 68 degree heating setpoint during unoccupied hours. In addition, a 60% relative humidity high limit setpoint will be used. This follows the original design of the buildings.

Trane will review the operation of the systems to verify proper operation. In a few cases, control dampers, damper actuators, and/or exhaust fan interlock will be added to assure proper building pressurization and control during unoccupied periods.

The basis of design for the variable air volume air handling systems in the buildings is a 30% minimum airflow setting. Building 36 Engineering West is the only exception with a design minimum VAV box minimum of 50%. We propose to revise the VAV box minimum to 30% with the addition of direct digital controls on the VAV boxes. This building is also unusual due to the supply fan/return fan design with a very high design fan horsepower for the size of the building. In our experience, reducing the VAV box minimum has no impact on ventilation effectiveness and provides a significant reduction in both fan energy and reheat energy.

The basis of design for the tertiary, or building, chilled water pumping systems varies throughout the buildings. The most recent design in the majority of the buildings utilize two-way valves and a variable speed drive on the tertiary chilled water pump. This design is not decoupled and decoupling is not required. Decoupling provides the highest chilled water temperature difference, or Delta T, and the lowest chilled water flow rate at all conditions. However, the performance of a pumping system with two-way valves and building differential pressure control of the speed of the chilled water pump utilizing a variable speed drive provides almost all of the benefit of decoupling without the significant piping costs. The addition of variable frequency drives will be added to the chilled water pumps for Building 36.

Retro Commissioning Detailed Scope of Work

Building 2 General Classroom South

General Classroom South is a two-story building that provides 85,538 square feet of instructional space. General Classroom South was built in 1984 as project BR-633. Two large chilled water air handlers are located in a mechanical penthouse on the roof. Control of the air handlers is provided by the campus direct digital control system. Control of the variable air volume boxes is by pneumatic room thermostats. Chilled water is provided to the air handlers through two-way valves by a single 10.0 Horsepower tertiary chilled water pump with a variable frequency drive and differential pressure control.

The mechanical systems in the building were designed to operate on a time schedule with optimal start/stop and an adjustable space temperature setpoint. Currently, the building runs continuously. Outdoor air dampers for air handling unit 1 and 2 and exhaust fans 1 through 5 are currently operated by the controls system. The addition of four space zone temperature sensors and a new occupied/unoccupied duty cycling program logic and schedule will be required to enable the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and exhaust fan start/stop will be verified during the retro-commissioning services. Additionally, Trane will calibrate the existing pneumatic thermostats.

Building 2 General Classroom South System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
85,538	70.0	52,690	20,005	222.10	Yes	Yes	Yes

Building 9 University Theatre

The University Theatre is a two-story building with 110,366 square feet of space that provides instructional space and a performing arts auditorium. The University Auditorium was originally built in 1965 and renovated in 1999 as project BR-620. Thirteen chilled water air handlers are located in mechanical rooms throughout the building. Control of the air handlers, variable air volume boxes, and exhaust fans is provided by the campus direct digital control system. Chilled water is provided to the air handlers through two-way valves by a redundant pair of two 15.0 horsepower tertiary chilled water pumps with variable frequency drives and differential pressure control. Outside air is provided by three dedicated outdoor air units located on the roof.

Currently, the building runs continuously. There is no points list or sequence of operations in the construction drawings for the 1999 building renovation. Outdoor air dampers for all of the air handlers, six relief fan, and six exhaust fans are currently operated by the controls system. The restoration or addition of an occupied/unoccupied duty cycling programming schedule will be required to enable the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and fan start/stop will be verified during the retro-commissioning services.

Building 9 University Theatre System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
110,366	125.6	77,925	29,975	301.50	Yes	Yes	Yes

Building 11a Field House West

Field House West is a single story building with 15,336 square feet of locker room and athletic training space. Field House West was built in 1996. Three small chilled water air handlers are located above the ceiling in the locker rooms and weight room. Control of the air handlers, variable air volume boxes, and exhaust fans is provided by the campus direct digital control system. Chilled water is provided to the air handlers through three-way valves by a redundant pair of 5.0 horsepower tertiary chilled water pumps. A booster pump was added to the chilled water loop serving the Field House in 2005. Outside air is provided by fixed outside air louvers.

Currently, the building runs continuously. The original design of the building provided time clock control of the air conditioning systems. Simple system shutdown is appropriate for the building given the small system size, simple operation, and durable interior finishes of the locker rooms and weight room. We propose to restore time clock control of the mechanical systems with the existing controls system. Creation of a schedule will be required to enable the desired control strategy. The exhaust fans will be added to the scheduling control. The operation of the mechanical system schedule will be verified during the retro-commissioning services.

Building 11a Field House West System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
15,336	11.0	12,600	6,000	30.50	Yes	No	No

Building 23 Fleming West

Fleming West is a single-story building with 13,962 square feet of instructional space for the College of Business. Fleming West was originally built in 1967 and renovated in 2003 as project BR-609. One chilled water air handler is located in mechanical room 128. The air handler is equipped with an outdoor air supply fan and relief fan. A general exhaust fan is also provided. Control of the air handler, variable air volume boxes, and all fans is provided by the campus direct digital control system. Chilled water is provided to the air handler through a two-way valve by a redundant pair of two 20.0 horsepower tertiary chilled water pumps. The pumps serve Buildings 23, 24, and 25 and are equipped with variable frequency drives and differential pressure control.

The building was designed with an occupied/unoccupied mode control strategy. However, the building runs continuously at present. The outdoor air dampers, outdoor air and relief fans, and the exhaust fan are all currently operated by the controls system. The restoration the original occupied/unoccupied is proposed to provide the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and fan start/stop will be verified during the retro-commissioning services.

Building 23 Fleming West System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
13,962	20.0	14,900	2,850	47.75	Yes	Yes	Yes

Building 24 Fleming

Fleming is a four story building with 59,148 square feet of instructional space for the College of Business. Fleming West was originally built in 1967 and renovated in 2003 as project BR-609. Two chilled water air handlers provide cooling for the building. An air handler is located in mechanical rooms 210 serving floors 1 and 2 and in mechanical room 305 serving floors 3 and 4. The air handlers are equipped with an outdoor air supply fan and relief fan. A general exhaust fan is also provided. Control of the air handler, variable air volume boxes, and all fans is provided by the campus direct digital control system. Chilled water is provided to the air handler by a redundant pair of 20.0 horsepower tertiary chilled water pumps that serve Buildings 23, 24, and 25. The chilled water pumps are equipped with variable frequency drives and differential pressure control. Air handler 3-1 has a two-way valve and air handler 3-2 has a three way valve.

The building was designed with an occupied/unoccupied mode control strategy. However, the building runs continuously at present. The outdoor air dampers, outdoor air and relief fans, and the exhaust fan are all currently operated by the controls system. The restoration the original occupied/unoccupied is proposed to provide the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and fan start/stop will be verified during the retro-commissioning services.

Building 24 Fleming System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
59,148	65.0	45,515	13,770	173.83	Yes	Yes	Yes

Building 25 Kaye Hall

Kaye Hall is a single-story building with 24,119 square feet of instructional space for the College of Business. Fleming West was originally built in 1967 and renovated in 2003 as project BR-609. One chilled water air handler is located in mechanical room 128. The air handler is equipped with an outdoor air supply fan and relief fan. A general exhaust fan is also provided. Control of the air handler, variable air volume boxes, and all fans is provided by the campus direct digital control system. Chilled water is provided to the air handler through a three-way valve by a redundant pair of two 20.0 horsepower tertiary chilled water pumps. The pumps serve Buildings 23, 24, and 25 and are equipped with variable frequency drives and differential pressure control.

The building was designed with an occupied/unoccupied mode control strategy. However, the building runs continuously at present. The outdoor air dampers, outdoor air and relief fans, and the exhaust fan are all currently operated by the controls system. The restoration the original occupied/unoccupied is proposed to provide the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and fan start/stop will be verified during the retro-commissioning services.

Building 25 Kaye Hall System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
24,119	25.0	17,800	5,520	69.00	Yes	Yes	Yes

Building 36 Engineering West

Building 36 is a two-story building that provides 59,419 square feet of instructional space for the College of Engineering. Engineering West was built in 1980 and has had a few minor interior renovations. However, the four air handlers from the original mechanical system design and pneumatic VAV box controls remain in place. The original design included a sequence of operation that provided scheduled start/stop of the air handler supply fans, return fans, exhaust fans, and outdoor air dampers. Chilled water is provided to the air handlers through three-way valves by a redundant pair of 7.5 horsepower tertiary chilled water pumps without variable frequency drives or differential pressure control.

Currently, the building runs continuously. Retro commissioning of the sequence of operations in the design documents is proposed by Trane. Trane proposes to retrofit the existing pneumatic VAV box controls with direct digital controls. This controls retrofit will allow the setback control of temperature and the reduction in the VAV box minimums from 50% in the original design to 30% which is the design of all of the other buildings. The operation of the outdoor air dampers, chilled water valves, and exhaust fan start/stop will be verified during the retro-commissioning services.

Building 36 Engineering West System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU/FCU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
59,419	117.5	76,600	5,475	197.0	No	Yes	Yes

Building 44 Humanities

Building 44 is a three-story building that provides 102,973 square feet of instructional space. The Humanities building was built in 1988 and the HVAC systems were replaced with a renovation project in 2000. Many of the approximately 90 fan coil units were replaced and three large chilled water air handlers were installed to provide conditioned outside air to the fan coil unit. Control of the air handlers is provided by the campus direct digital control system. In addition, the control system starts and stops the fan coil units and exhaust fans. Chilled water is provided to the air handlers and fan coil units through three-way valves by a redundant pair of 20.0 horsepower tertiary chilled water pumps without variable frequency drives or differential pressure control.

The 100% outside air handlers mechanical systems in the building were designed to operate on a time schedule with optimal start/stop and an unoccupied temperature setpoint. The design drawings provide an unoccupied space temperature setpoint of 80 degrees F for cooling and 60

degrees F for heating. Currently, the building runs continuously. Outdoor air dampers for air the air handlers and exhaust fan interlock is included in the controls system sequence of operations. Retro commissioning of the sequence of operations in the design documents is proposed by Trane. The operation of the outdoor air dampers, chilled water valves, and exhaust fan start/stop will be verified during the retro-commissioning services. Additionally, Trane will calibrate the pneumatic thermostats serving the fan coil units.

Building 44 Humanities System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU/FCU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
102,973	97.4	105,030	18,030	275.00	Yes- AHU's No – FCU's	Yes	Yes

Building 47 College of Education

The College of Education occupies a four-story building with 93,187 square feet of space that provides instructional space and a performing arts auditorium. The University Auditorium was originally built in 1991 as project BR-640. Ten chilled water air handlers are located in mechanical rooms throughout the building. Control of the air handlers, variable air volume boxes, and exhaust fan EF-5 is provided by the campus direct digital control system. Chilled water is provided to the air handlers through two-way valves by a redundant pair of two 15.0 horsepower tertiary chilled water pumps without variable frequency drives or differential pressure control. Outside air is provided to the air handlers through a wall louver and outside air damper.

Currently, the building runs continuously. The building was designed with an occupied/unoccupied control strategy that has been abandoned. Also included in the original sequence of operation but not currently used is scheduling control of the air handlers. The air handlers are stated and stopped with and optimal start/stop program which includes control of the outdoor air damper and exhaust fan. Trane proposes to restore the original occupied/unoccupied schedule to provide the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and fan start/stop will be verified during the retro-commissioning services.

Building 47 College of Education System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
93,187	118.0	89,400	10,300	248.00	Yes/AHU	Yes	Yes

Building 51 Performing Arts

The College of Arts and Letters occupies Building 51 Performing Arts. Performing Arts has 26,167 square feet of space including a lecture hall, theatre, gallery, and instructional space. Performing Arts was originally built in 1992 as project BR-678. Ten chilled water air handlers are located in mechanical rooms throughout the building. Control of the air handlers is provided by the campus direct digital control system. Fan Powered VAV boxes control the amount of airflow to the space to maintain comfort conditions. Chilled water is provided to the air handlers through two-way valves by a redundant pair of two 7.5 horsepower tertiary chilled water pumps without variable frequency drives or differential pressure control. Outside air is provided to the air handlers through a wall louver and outside air damper.

Currently, the building runs continuously. The available construction documents do not provide controls drawings and the original sequence of operation of the controls system is not known. Trane proposes to provide an occupied/unoccupied schedule to provide scheduling and unoccupied temperature setback control of the building to achieve the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and fan start/stop will be verified during the retro-commissioning services.

Building 51 Performing Arts System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
26,167	46.8	38,730	4,760	130.20	Yes	n/a	No

Building 52 Arts & Humanities

The College of Arts and Letters occupies Building 52 Arts & Humanities. Arts & Humanities is a two-story building with 25,508 square feet of instructional space. Performing Arts was originally built in 1992 as project BR-678. Two chilled water air handlers are located in mechanical rooms throughout the building. Control of the air handlers is provided by the campus direct digital control system. Fan Powered VAV boxes control the amount of airflow to the space to maintain

comfort conditions. Chilled water is provided to the air handlers through two-way valves by a redundant pair of two 5 horsepower tertiary chilled water pumps without variable frequency drives or differential pressure control. Outside air is provided to the air handlers through a wall louver and outside air damper.

Currently, the building runs continuously. The available construction documents do not provide controls drawings and the original sequence of operation of the controls system is not known. Trane proposes to provide an occupied/unoccupied schedule to provide scheduling and unoccupied temperature setback control of the building to achieve the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and fan start/stop will be verified during the retro-commissioning services.

Building 52 Arts & Humanities System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
25,508	30.0	23,800	4,000	69.30	Yes	n/a	No

Building 53 Visual Arts

The College of Arts and Letters occupies Building 53 Visual Arts. Visual Arts is a two-story building with 24,991 square feet of instructional space. Performing Arts was originally built in 1992 as project BR-678. Two chilled water air handlers are located in mechanical rooms throughout the building. Control of the air handlers is provided by the campus direct digital control system. Fan Powered VAV boxes control the amount of airflow to the space to maintain comfort conditions. Chilled water is provided to the air handlers through two-way valves by a redundant pair of two 7.5 horsepower tertiary chilled water pumps without variable frequency drives or differential pressure control. Outside air is provided to the air handlers through a wall louver and outside air damper.

Currently, the building runs continuously. The available construction documents do not provide controls drawings and the original sequence of operation of the controls system is not known. Trane proposes to provide an occupied/unoccupied schedule to provide scheduling and unoccupied temperature setback control of the building to achieve the desired control strategy. The operation of the outdoor air dampers, chilled water valves, and fan start/stop will be verified during the retro-commissioning services.

Building 53 Visual Arts System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
24,991	24.0	18,220	8,015	116.60	Yes	n/a	No

Building 73 General Classroom North

General Classroom North is a two-story building that provides 12,860 square feet of lecture hall instructional space. General Classroom South was built in 2002. One large chilled water air handler is located in a mechanical room 107. Control of the air handlers, variable air volume boxes, and exhaust fans are provided by the campus direct digital control system. Chilled water is provided to the air handlers through two-way valves by a single 1 1/2 horsepower tertiary chilled water pump.

Currently, the building runs continuously. The mechanical systems in the building were designed to operate with a time schedule and an occupied/unoccupied control strategy that cycles the air handler with the outdoor air damper in the closed position. Trane proposes to restore the controls system sequence of back to the original design. The operation of the outdoor air dampers, chilled water valves, and exhaust fan start/stop will be verified during the retro-commissioning services.

Building 73 General Classroom North System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
12,680	20.0	13,760	9,030	65.17	Yes	Yes	Yes

Building 80 Student Support

Student Support is a two-story building that provides 98,840 square feet of support services. Student Support was built in 2002 as project BR-663. Five large chilled water air handler is located in a mechanical rooms. Control of the air handlers, variable air volume boxes, and exhaust fans are provided by the campus direct digital control system. Chilled water is provided to the air handlers through two-way valves by a redundant pair of 10.0 horsepower tertiary chilled water pump with a variable frequency drive and differential pressure control.

Currently, the building runs continuously. The mechanical systems in the building were designed to operate with a time schedule and an occupied/unoccupied control strategy that cycles the air handler with the outdoor air damper in the closed position. Trane proposes to restore the controls system sequence of back to the original design. The operation of the outdoor air dampers, chilled water valves, and exhaust fan start/stop will be verified during the retro-commissioning services.

Building 80 Student Support System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
98,840	110.0	80,490	27,400	355.00	Yes	Yes	Yes

Building 84 College of Nursing

Nursing is a four-story building that provides 72,998 square feet of instructional space. Building 84 was built in 2002 as project BR-633. Seven large chilled water air handlers are located in mechanical rooms. The air handlers utilize fresh air injection fans and relief fans to control ventilation air quantity and building pressurization. Control of the air handlers, variable air volume boxes, and fans are provided by the campus direct digital control system. The building exhaust fans are interlocked by the controls systems to the start of the air handlers. Chilled water is provided to the air handlers by a redundant pair of 25.0 horsepower tertiary chilled water pump with a variable frequency drive and differential pressure control. Air Handlers 1-1, 1-2 and 4 have three-way valves. Air Handlers 2-1, 2-2, 3-1 and 3-2 have two-way valves.

Currently, the building runs continuously. The mechanical systems in the building were designed to operate with a time schedule and an occupied/unoccupied control strategy that cycles the air handler with the injection and relief fans off and the outdoor air dampers in the closed position. Trane proposes to restore the controls system sequence of back to the original design. The operation of the outdoor air dampers, chilled water valves, and exhaust fan start/stop will be verified during the retro-commissioning services.

Building 84 College of Nursing System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
72,998	115.0	67,970	28,450	296.60	Yes	Yes	Yes

Building 86 DeSantis Pavilion

The College of Business occupies the DeSantis Pavilion which is a two-story building that was added to Building 23 Fleming West. The DeSantis Pavilion adds approximately 12,000 square feet of instructional space. Building 86 was built in 2004 as project BR-688. One large chilled water air handler is located in mechanical room 104. Control of the air handlers, variable air volume boxes, and fans are provided by the campus direct digital control system. The building exhaust fans are interlocked by the controls systems to the start of the air handler. Chilled water is provided to the air handlers by the chilled water pumps that serve Buildings 23, 24, and 25 for the College of Business.

Currently, the building runs continuously. The mechanical systems in the building were designed to operate with a time schedule and an occupied/unoccupied control strategy that cycles the air handler with the outdoor air dampers in the closed position. Trane proposes to restore the controls system sequence of back to the original design. The operation of the outdoor air dampers, chilled water valves, and exhaust fan start/stop will be verified during the retro-commissioning services.

Building 86 DeSantis Pavilion System Summary

Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock
12,000	80.0	52,050	24,090	246.67	Yes	Yes	Yes

Retro Commissioning Existing System Data Summary

Building	Building Name	Total Square Feet	AHU Hp	AHU Total CFM	AHU Design OA CFM	AHU Tons	DDC Controls	OA Damper Actuators	Exhaust Fan Interlock	Exhaust Fan Hp
2	**General Classroom S**	85,538	51.0	52,690	20,005	222.10	Yes	Yes	Yes	0.75
9	**University Theatre**	110,366	125.6	77,925	29,975	301.50	Yes	Yes	Yes	25.55
11a	**Field House West**	15,336	11.0	12,600	6,000	30.50	Yes	No	No	2.75
23	**Fleming West**	13,962	20.0	14,900	2,850	47.75	Yes	Yes	Yes	5.00
24	**Fleming**	59,148	65.0	45,515	13,770	173.83	Yes	Yes	Yes	10.00
25	**Kaye Hall**	24,119	25.0	17,800	5,520	69.00	Yes	Yes	Yes	4.00
36	**Engineering West**	59,419	117.5	76,600	5,475	197.09	No	Yes	Yes	5.50
44	**Humanities**	102,973	97.4	105,030	18,030	275.00	No	Yes	No	4.00
47	**Education**	93,187	118.0	89,400	10,300	248.00	Yes	Yes	No	2.50
51	**Performing Arts**	26,167	46.8	38,730	4,760	130.20	Yes	n/a	No	0.63
52	**Arts & Humanities**	25,508	30.0	23,800	4,000	69.30	Yes	n/a	No	0.75
53	**Visual Arts**	24,991	24.0	18,220	8,015	116.60	Yes	n/a	No	3.50
73	**General Classroom N**	12,680	20.0	13,760	9,030	65.17	Yes	Yes	Yes	0.25
80	**Student Support**	98,840	110.0	80,490	27,400	355.00	Yes	Yes	Yes	8.75
84	**Nursing**	72,998	115.0	67,970	28,450	296.60	Yes	Yes	Yes	13.00
86	**College of Business**	59,302	80.0	52,050	24,090	246.67	Yes	Yes	Yes	18.75
Totals		**884,534**	**1,056**	**787,480**	**217,670**	**2,844**				**106**

Chilled Water Pumping Systems

Trane proposes to provide variable loop differential secondary pump control on the Building 5 Chilled Water pumps. In addition, Trane proposes to replace the existing three-way chilled water valves with two-way valves to increase the chilled water differential temperature, reduce chilled water flow and pressure requirements, and provide energy savings. The cost of the proposed work for the chilled water pumping systems, as described below, is $109,963. The annual projected savings for the chilled water pumping work is $69,943, which provides a simple payback of less than two years.

Gaining proper control over the chilled water pumping systems in the Building 5 Utilities Plant is a significant opportunity for energy savings. To provide understanding of the current issues with the chilled water pumping systems, Trane captured and evaluated existing flow meter data. The flow meter data shows the status and relative performance of the chilled water flows through the buildings and evaluates the flow rates through the three chilled water loops. A visual representation is provided by using a stoplight analysis based on the temperature difference, or Delta T, between the entering and leaving chilled water to the buildings. The Delta T stoplight analysis is color coded as follows:

Building 5 Plant - Chilled Water Flow Stoplight Analysis	
Delta T greater than 12 degrees F:	Green
Delta T between 9 and 12 degrees F:	Yellow
Delta T < 9 degrees F:	Red

The analysis reveals a very large Delta T variation among the buildings. The design Delta T for the Building 5 chiller plant is 12 degrees. However, the actual Delta T of the buildings ranges from a low of 3.7 degrees F to a high of 21.9 degrees F. The buildings have different design criteria including design chilled water Delta T and building pumping system design. However, what is noticeable from the stoplight analysis is that only a small number of buildings, the “Red” buildings, have very low chilled water Delta T.

We reviewed the design documents of all of the buildings and discovered a common issue. The “Red” buildings have three-way chilled water valves. Three-way valve create mixing of supply and return chilled water and cause the low chilled water Delta T. We surveyed the data in March and October and found that the low Delta T condition persists regardless of outside air temperature and chiller plant load. For the “Red” buildings we calculated the excess water flow caused by the low Delta T. This excess water flow is the difference between the existing and design Delta T for the building. The excess water flow can be reduced at most load conditions with the replacement of the three-way valves with two-way valves. Valve replacement is highly recommended. Reducing the excess water flow reduces the flow and pressure required to be produced by the secondary pumps and creates pumping energy savings.

Building 5 Chiller Plant – Pumping System Stoplight Analysis

Bldg #	Building Name	Actual CHW Flow (GPM)	Chw Delta T	Calculated GPM/Ton	Excess Flow	East Loop	North Loop	South Loop
1	Sanson Life Sciences	293	16.6	1.45		293		
2	General Classroom South	357	14.1	n/a				357
3	Library East	564	4.7	5.11	343.1	564		
3a	Library Annex	90	12.8	1.88		90		
3w	Library West	611	3.7	6.49	422.7	611		
4	Instructional Services	99	10.3	2.33		99		
6	Algonquin[2]	300						300
8	Pharmacy	190	10.4	2.31				190
9	University Threatre	127	11.1	2.16				127
10	Administration[1]	32				32		
11a	Field House Pool	97	9.3	2.58				97
22	Computer Center	184	9.2	2.61			184	
23	Fleming West	72	13.1	1.83			72	
24	Fleming Hall	263					263	
25	Barry Kaye Hall	138					138	
31C	Lifelong Learning	14	21.9	1.10				14
31D	Continuing Ed	45	18.9					45
31E	Student Activities	389	8.2	2.95	125.1			389
36	Engineering West[1]	112						112
39	Ritter Art Gallery	38	4.4	5.45				38
43		610	12.2	1.97		610		
44	Humanities	739	5.4	4.44	406.5	739		
47		219	12.2	1.86			219	
51	Performing Arts	57	7.1	3.54	24.6			57
52	Arts & Humanities	171	4.8	5.00	102.3			171
53	Visual Arts	42	14.0	1.71				42
55	Physical Sciences	747	9.9	2.42		747		
73	General Classroom N[1]	128				128		
74	Nursing	586	8.2	2.95	188.4			586
86	College of Business	516	8.1	2.96	167.8		516	
87	Desantis Pavillion[1]	70					70	
93	Office Depot Ctr[2]	50					50	
97	Culture and Society[2]	450						450
	Building Flow Meter Total:	**8,400**		**Sum Total Loop Flow Rate**		**3,913**	**1,512**	**2,974**
				Total of all Chilled Water Loops		**8,399**		
	Notes:			**Excess Flow by Loop**		**1,172**	**168**	**440**
	1) ChW Temperature Data n/a			**% Excess Flow by Loop**		**30.0%**	**11.1%**	**14.8%**
	2) ChW Flow and Temp Data n/a			**Actual Meter GPM Flow for Loop**		**3,919**	**1,482**	**2,912**

Building #5 Chiller Plant Variable Flow Secondary Pumping:

Currently the secondary chilled water pumps in the Building 5 Utilities Plant are run manually at 100% constant speed at all times. Trane proposes to retro commission the secondary pumps to enable variable chilled water flow. Trane will test and retro commission the variable speed pumping systems for the North, East, and South chilled water loops from the Building 5 plant. Revisions to the existing loop differential pressure controls are included. The secondary chilled water pumps will vary based on actual chilled water demand and will run in automatic control.

The chilled water pumps that transport the chilled water from the Building 5 chiller plant to the campus were designed to vary the pumping energy based on the actual chilled water needs of the campus. The pumps are currently furnished with variable frequency drives and the chiller plant controls system is designed for variable flow pumping. The pumps run manually due to chilled water flow concerns that existed prior to corrections included in Trane's recently completed Chiller 1 and 2 ESCO project.

Three-way Chilled Water Valve Replacement:

Replacement of the existing three-way valves is proposed for the cost of Conversion of the remaining three way valves to two-way valves is highly recommended to reduce flow requirements in the campus and to provide better control of cooling and comfort. Trane surveyed the flow meters and differential chilled water temperatures for all of the campus buildings served by the Building 5 chiller plant in March, 2012 and October, 2012. We recommend replacement of three way valves serving air handlers in seven buildings. The replacement of the valves will reduce the flow rates and improve the performance of the chilled water pumping systems. Our spreadsheet analysis of the flow data shows that an estimated 21.2% or 1,781 GPM of the total 8,400 GPM chilled water flow from the Building 5 chiller plant can be reduced from the installation of two-way valves as proposed.

Building	Building Name	Total AHU Valves
3	Library	1
3W	Library	8
44	Humanities	2
31	Student Activities	6
51	Performing Arts	5
52	Arts & Humanities	2
84	Nursing	4
86	College of Business	3
Totals		31

Parking Garage 1 and 2 Lighting Retrofit:

Parking garage 1 and 2 are not energy efficient. Trane proposes to replace the existing lighting fixtures in the parking garages with vapor proof fluorescent T8 fixtures to reduce the energy costs of the parking garages. There are other LED and Induction fixtures that are available, but fluorescent fixtures provide the best value and are recommended. The cost to replace the lighting fixtures for Parking Garage 1 and 2 is $283,563 and provides $49,420 in annual energy savings.

Project Pricing:

A breakout of the proposed pricing or the project is shown below. The pricing detail can be found in our Pricing Summary worksheet which is included with this proposal or your review.

Pricing Summary

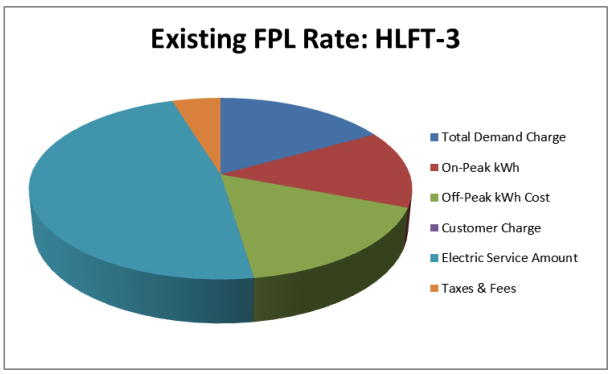
Solar Canopy for Parking Garage 3	$3,473,934
Solar Ground Mount for UVA	$839,232
Retro Commissioning	$318,779
Valve Installation	$109,963
Parking Garage Lighting	$283,563
General Conditions	$266,614
Energy Audit	$164,114
Totals	**$5,456,200**

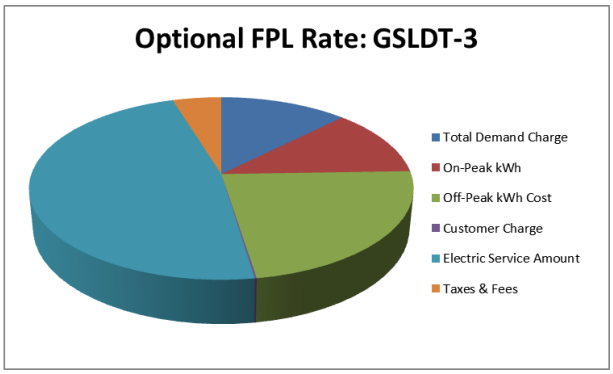
Utility Rate Options:

FAU Boca Raton campus is currently billed by Florida Power and Light on the High Load Factor Time of Use–3 (HLFT-3) rate. This rate is beneficial for electrical loads that run continuously. The rate provides a discounted off-peak energy cost which is offset by an additional maximum demand charge. FAU is considering making a change to the General Service large Demand Time of Use-3 rate (GSLDT-3). The GSLDT-3 rate provides a high off-peak energy charge but a lower demand charge. The rates are effectively the same in the monthly cost of power. A comparison of the June 2012 utility bill for the FAU Boca Raton campus is shown below:

Rate Comparison(June 2012 FPL bill data):

	HLFT-3	GSLDT-3
Total Demand Charge	$174,620.20	$128,479.68
On-Peak kWh	$142,466.56	$122,873.51
Off-Peak kWh Cost	$172,957.93	$236,472.64
Customer Charge	$179.19	$1,441.88
Electric Service Amount	$490,223.87	$489,267.71
Taxes & Fees	$49,052.86	$49,263.29
Total Bill	**$539,276.66**	**$539,972.88**





The comparatively higher kilowatt-hour energy cost in the optional GSLDT-3 rate provides a greater energy savings than the existing HLFT-3 rate. Switching to the GSLDT-3 is highly recommended. The annual energy savings for the project with the existing HLFT-3 rate is $443,331 per year. The annual energy savings for the project with the optional GSLDT-3 rate is $504,476. The savings from switching to the GSLDT-3 rate is an additional $61,145 per year.

In addition to the recommended rate switch to the GSLDT-3 rate, Trane will evaluate the potential benefit of available FPL demand response programs and the Commercial/Industrial Demand Reduction (CDR) Rider to assure the most beneficial utility rate is applied to maximize the energy savings potential of the project.

Project Pro Forma

FAU Boca Raton Solar ESCO
Municipal Lease with 14 Year Term

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Program Savings															
Energy Savings - PV Derated	$ 504,476	$ 505,424	$ 508,544	$ 512,663	$ 516,823	$ 521,024	$ 525,268	$ 529,553	$ 533,882	$ 538,254	$ 542,670	$ 547,130	$ 551,634	$ 556,184	$ 7,393,529
Operational Savings	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Program Savings	**$ 504,476**	**$ 505,424**	**$ 508,544**	**$ 512,663**	**$ 516,823**	**$ 521,024**	**$ 525,268**	**$ 529,553**	**$ 533,882**	**$ 538,254**	**$ 542,670**	**$ 547,130**	**$ 551,634**	**$ 556,184**	**$ 7,393,529**
Program Cumulative Savings	$ 504,476	$ 1,009,900	$ 1,518,444	$ 2,031,107	$ 2,547,929	$ 3,068,953	$ 3,594,221	$ 4,123,774	$ 4,657,657	$ 5,195,911	$ 5,738,581	$ 6,285,711	$ 6,837,345	$ 5,213,841	
Program Costs															
Principal & Interest	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 466,121	$ 6,525,694
Maintenance Agreement	$ 20,000	$ 20,600	$ 21,218	$ 21,855	$ 22,510	$ 23,185	$ 23,881	$ 24,597	$ 25,335	$ 26,095	$ 26,878	$ 27,685	$ 28,515	$ 26,095	
Savings Measurement	$ 15,000	$ 15,450	$ 15,914	$ 16,391	$ 16,883	$ 17,389	$ 17,911	$ 18,448	$ 19,002	$ 19,572	$ 20,159	$ 20,764	$ 21,386	$ 19,572	$ 253,838
Annual Program Costs	**$ 501,121**	**$ 502,171**	**$ 503,252**	**$ 504,366**	**$ 505,514**	**$ 506,696**	**$ 507,913**	**$ 509,167**	**$ 510,458**	**$ 511,788**	**$ 513,158**	**$ 514,569**	**$ 516,023**	**$ 511,788**	**$ 7,117,983**
Cash Flow															
Annual Net Cash Flow	**$ 3,355**	**$ 3,253**	**$ 5,292**	**$ 8,296**	**$ 11,309**	**$ 14,329**	**$ 17,355**	**$ 20,387**	**$ 23,424**	**$ 26,466**	**$ 29,512**	**$ 32,561**	**$ 35,612**	**$ 44,396**	**$ 275,546**
Cumulative New Cash Flow	$ 3,355	$ 6,608	$ 11,899	$ 20,196	$ 31,505	$ 45,833	$ 63,188	$ 83,575	$ 106,999	$ 133,465	$ 162,977	$ 195,538	$ 231,150	$ 151,395	

Program Financial Summary	
Project Cost	**$ 5,456,200**
FPL Rebate	**$ 100,000**
Loan/Lease Amount	**$ 5,356,200**
Amount Financed	**$ 5,356,200**
Year 1 - Simple Payback (years)	**10.6**
Annual Interest Rate	**2.75%**
Loan/Lease Term (years)	**14**
Payments per Year	**1**
Annual Energy Cost Escalation Factor	**1.0%**
Annual Service Program Cost Escalation Factor	**3.0%**

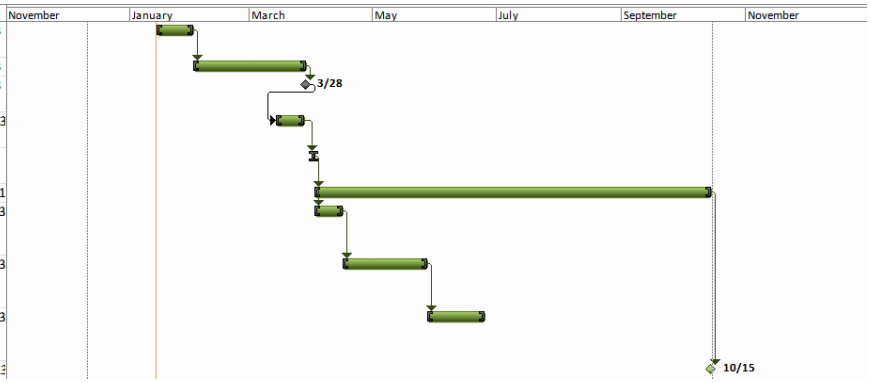
Project Timeline

Approval of the energy audit agreement is required no later than early January to allow the ESCO project to mirror the construction sequence of the Parking Garage 3 project as planned.

The project schedule is designed to match the construction timeline of the Parking Garage 3 project. The remainder of the project is not on the critical path to project completion. The milestone dates for the project are as follows:

February 1, 2013	Approval of Energy Audit Agreement
March 1, 2013	Completion of Energy Audit
March 25, 2013	Approval of ESCO Contract
March 29, 2013	ESCO Financing Closing and Funding
April 1, 2013	Project Mobilization
April 19, 2013	FAU Approval of Parking Garage 3 Solar Canopy Design
May, 2013	Steel Fabrication for Parking Garage 3 Solar Canopy
June, 2013	Steel Erection of Parking Garage 3 Solar Canopy
October 31, 2013	Project Completion

ID	Task Name	Duration	Start	Finish
1	Approval of Energy Audit Agreement	14 days	Mon 1/14/13	Thu 1/31/13
2	Energy Audit	8 wks	Fri 2/1/13	Thu 3/28/13
3	ESCO Contract Documents Complete	0 days	Thu 3/28/13	Thu 3/28/13
4	Approval of ESCO Project	10 days	Thu 3/14/13	Wed 3/27/13
5	ESCO Financing Closing and Funding	1 day	Mon 4/1/13	Mon 4/1/13
6	Project Construction	7 mons	Tue 4/2/13	Mon 10/14/1
7	FAU Approval of Parking Garage 3 Solar Canopy Design	10 days	Tue 4/2/13	Mon 4/15/13
8	Steel Fabrication for Parking Garage 3 Solar Canopy	6 wks	Tue 4/16/13	Mon 5/27/13
9	Steel Erection for Parking Garage 3 Solar Canopy	4 wks	Tue 5/28/13	Mon 6/24/13
10	Project Completion	0 days	Tue 10/15/13	Tue 10/15/13



Trane Solar Photovoltaic Project Experience

CITY of RIDGECREST, Ridgecrest, CA

Customer Contact:	Craig Bradley, Facilities Manager, (760) 382-1826
Type of Project:	**Turnkey Ground Mount Tracking Solar**
Projected Start Date:	June 6, 2010
Projected End Date:	May 2011
Projected Rated Capacity:	496kW DC
Total Project Value in US Dollars:	$1.8M
Type of Equipment Installed:	2,158 Yingli-230 panels
Type of Mounting:	Ground Mount, Single-axis trackers
Project Footprint:	1.4 million lbs of carbon dioxide
Annual Production:	1,085,270 kwh
Monthly Production:	90,439kwh
Project Inception:	May 2011
Other Firms Involved in the Project:	Borrego Solar – subcontractor

COMMONWEALTH of VIRGINIA

Customer Contact:	Jeff Montgomery, (804) 225-2800
Type of Project:	**Turnkey Parking Structure Solar**
Projected Start Date:	May 2011
Projected End Date:	November 2011
Projected Rated Capacity:	549,020kWh
Total Project Value in US Dollars:	$4.5M
Type of Equipment Installed:	1,830 photovoltaic panels
Type of Mounting:	Parking Garage Photovoltaic Solar Canopy, Walkway & Awning Systems
Project Footprint:	394 metric tons of carbon dioxide
Annual Output:	549,020 kWh
Other Firms Involved in the Project and their Role:	Moseley Architects, Gilbane Inc. (contractor)

MADERA COMMUNITY HOSPITAL, Madera, CA

Customer Contact:	Mark Foote, VP Finance, (559)675-5505
Type of Project:	**Turnkey Ground Mount Tracking Solar**
Projected Start Date:	February 11, 2010
Projected End Date:	October 3, 2011
Total Project Value in US Dollars:	$6M
Projected Rated Capacity:	1022kW DC
Type of Equipment Installed:	12kV Solar PV
Type of Mounting:	Ground Mount, Single-axis trackers
Project Footprint:	2,783,949 annual carbon dioxide offset
Annual Production:	2,183,220 kWh
Monthly Production:	181,93 kWh
Project Inception:	October 3, 2011
Other Firms Involved in the Project and their Role:	Borrego Solar – PPA Provider

By accepting the materials herein, Recipient acknowledges that the material is Proprietary and Confidential and is the Property of Trane U.S. Incorporated. Recipient agrees that it and its representatives shall not duplicate or distribute this material. Further, Recipient agrees that it shall destroy or return these materials at such time as it has decided not to participate in the potential transaction described herein.

Appendices

1) Energy Audit Agreement
2) PVSyst Solar Energy Production Models
3) System Analyzer Energy Model results for Controls Retro Commissioning

FLORIDA ATLANTIC UNIVERSITY / TRANE ENERGY AUDIT AGREEMENT

BOCA RATON CAMPUS
SOLAR ESCO PROJECT

This Energy Audit Agreement ("Agreement"), effective the last date signed below, is by and between the Florida Atlantic University ("FAU") and Trane ("Company") (each a "Party" and collectively the "Parties").

Whereas, the Company is an energy performance contractor licensed and experienced in the analysis, design, implementation, an installation of energy conservation measures through the implementation of energy performance based contracts, as defined in Section 1013.23 of the Florida Statures, and;

Whereas, FAU is responsible for the operation, management and maintenance of the facilities identified on Attachment A to this Agreement (the "Facilities"); and

Whereas, a comprehensive investment grade technical energy audit (the "Energy Audit") must be performed at the Facility in order to determine the feasibility of entering into a guaranteed energy performance savings contract ("Energy Performance Contract") to provide for the installation and implementation of energy conservation measures ("ECMs") at the Facilities; and

Whereas, if the project is demonstrated to be feasible, and if the amount of energy cost savings can be reasonably ascertained and guaranteed in an amount sufficient to cover all costs associated with an energy performance contracting project at the Facilities, the Parties intend to negotiate an Energy Performance Contract under which the Company shall design, procure, install, implement, maintain and monitor such ECMs at the Facilities;

Therefore, the Parties agree as follows:

Article 1: Scope of Energy Audit

The Company will perform the Energy Audit for the facilities listed in Attachment A and prepare the detailed engineering and economic Energy Audit and Report that specifically identifies the energy improvements and operational changes which are recommended to be installed or implemented at the Facilities. The Energy Audit and Report shall contain detailed projections of energy and cost savings to be obtained at the Facilities as a result of the installation of the recommended ECMs. The savings calculations must utilize assumptions, projections and baselines which best represent the true value of future energy or operational savings for the Facilities, i.e., utilize: accurate marginal cost for each unit of savings at the time the audit is performed; documented material and operational costs actually avoided; adjustments to the baseline to reflect current conditions at the Facilities compared to the historic base period; calculations which account for the interactive effects of the recommended ECMs; etc. The report shall clearly describe how utility tariffs were used to calculate savings for all ECMs. The

report shall describe the Company's plan for installing or implementing the measures in the Facilities, including all anticipated costs associated with such installation and implementation. The primary purpose of the report is to provide an engineering and economic basis for negotiating an Energy Performance Contract between the FAU and the Company; however, the FAU shall be under no obligation to negotiate such a contract.

The Company shall perform the following tasks in performing and preparing the Energy Audit and Report:

A. Collect General Facilities Information

The Company shall collect general information such as: size, age, construction type, condition and general use of the Facilities. The Company shall also collect and summarize utility cost and consumption data for the most recent 24-36 month period. Company shall evaluate the impact on utility cost and consumption of any energy initiatives currently being installed or currently planned to be installed by FAU in the Facilities which will remain separate from the Energy Performance Contract throughout the duration of that agreement.

FAU shall make available (or cause its energy suppliers to make available) all available records and data concerning energy and water usage for the Facilities for the most current 24-36 month period, if available, including: Utility records; occupancy information; descriptions of any changes in the structure of the Facilities or its heating, cooling, lighting or other systems or energy requirements; descriptions of all major energy and water consuming or energy and water saving equipment used in the Facilities; any comfort problems, code deficiencies and description of energy management procedures presently utilized. FAU shall also make available a record of any energy related improvements or modifications that have been installed during the past three years, or are currently being installed or are currently planned to be installed by FAU in the Facilities separate from the energy service agreement throughout the duration of that agreement. FAU shall also make available copies of drawings, equipment logs and maintenance work orders to the Company.

B. Analyze Existing Systems and Equipment

Company shall compile an analysis based on a physical inspection of the major electrical and mechanical systems at the Facilities, including:

1. Solar Photovoltaic Canopy for Parking Garage 3
2. Retro-Commissioning of Controls Systems
3. Variable Flow Control of Building 5 Secondary Chilled Water Pumps
4. Replacement of Three-Way Valves in selected facilities
5. Energy Efficient Lighting Retrofit of Parking Garages 1 & 2
6. Reduction of VAV Box Minimum Flow Setting (Building 36 only)
7. Other major energy using systems, as applicable

The analysis shall address the following considerations:

1. the loads, efficiencies or hours of operation for each system (where Facilities operating or climatic conditions necessitate, engineering estimates may be used, but for large fluctuating loads with high potential savings appropriate measurements are required unless waived by FAU);

2. current operating condition for each system;

The Company shall conduct interviews with Facilities operation and maintenance staff regarding the Facilities's mechanical systems operation, occupancy patterns and problems with comfort levels or equipment reliability.

C. Establish Base Year Consumption and Reconcile with End Use Consumption Estimates

Company shall examine the most recent 24-36 months of utility bills and establish Base Year consumption for electricity, fossil fuels and water by averaging; or selecting the most representative contiguous 12 months. Company shall consult with Facilities staff and account for any unusual or anomalous utility bills which may skew Base Year consumption from a reasonable representation. This project will be comprehensive in scope with energy baselines based on actual building submetering data to allow a bil comparison guarantee format.

Company shall analyze loading, usage and/or hours of operation for all major end uses representing more than 5% of total Facilities consumption including, but not limited to:

1. Lighting
2. Heating
3. Cooling
4. HVAC motors (fans and pumps)
5. plug load (independent devices greater than 5%)
6. kitchen equipment
7. other equipment
8. miscellaneous

Where loading and/or usage are highly uncertain Company shall employ spot measurement and/or short term monitoring as mutually agreed by Trane and FAU . Reasonable applications of measurement typically include variable loads that are likely candidates for conservation measures, such as cooling equipment.

D. Develop List of Potential Energy Conservation Measures (ECMs)

1. identify and propose potential ECMs for installation or implementation at the Facilities, including water conservation measures

2. estimate the cost, savings and life expectancy of each proposed ECM;

3. specify Facilities operations and maintenance procedures which will be affected by the installation/implementation of the proposed ECMs;

4. provide analysis methodology, supporting calculations and assumptions used to estimate savings, which shall be based on life cycle cost calculations provided in section 255.255 of the Florida Statutes. Manual calculations should disclose essential data, assumptions, formulas, etc. so that a reviewer could replicate the calculations based on the data provided;

5. for savings estimates using computer simulations, Company shall provide access to the program and all inputs and assumptions used, if requested by FAU;

6. provide a preliminary savings measurement and verification plan for the proposed project;

7. provide a preliminary commissioning plan for the proposed project;

8. provide detailed calculations for any rate savings proposals;

9. provide detailed supporting calculations for any proposed maintenance or other operational savings;

10. estimate any environmental costs or benefits of the proposed ECMs (e.g., disposal costs, avoided emissions, water conservation, etc.)

11. For all proposed ECMs, Company shall comply with all applicable state, federal and local codes and regulations in effect at the time of this analysis.

E. Select Final Recommended ECMs

Company shall, in consultation with FAU, recommend specific ECMs from its preliminary compilation for installation and implementation at the Facilities.

F. Cost and Fee Estimates

Company shall provide detailed estimates of all costs and fees associated with the installation and implementation of the ECMs including:

1. engineering/design costs for the project
2. contractor/vendor estimates for individual ECM hard costs
3. construction management fees for the project
4. commissioning costs for the project
5. initial training costs
6. annual service fees including:
   - measurement and verification
   - maintenance

- performance monitoring
- ongoing training services

7. other costs/fee (specify)

G. Savings Estimates

FAU has endeavored to provide the Company with sufficient general and specific guidance in this Article 1 to develop the savings estimates for the Report. In the event that questions arise as to the calculation of savings or whether certain items will be allowed as savings, the Company shall seek written guidance from FAU.

The following items will be allowed as savings or in the development of savings:[1]

- FAU material/commodity cost
- Agreed escalation rates for natural gas
- Agreed escalation rates for electricity
- Agreed escalation rates for water
- Agreed escalation rates for material/commodity cost savings
- Outside contracted maintenance contract costs

The following items will not be allowed as savings or in the development of savings:

- FAU in-house labor cost
- Agency deferred maintenance cost
- Offset of future FAU capital cost

H. Report Format

1. An executive summary which describes the Facilities, measures evaluated, analysis methodology, results and a summary table presenting the cost and savings estimates for each measure.

2. A discussion of measures not evaluated in detail and the explanation of why a detailed analysis was not performed.

3. A summary of all utility bills, Base Year consumption and how it was established, and end use reconciliation with respect to the Base Year including a discussion of any unusual characteristics and findings.

4. Detailed descriptions for each ECM including analysis method, supporting calculations (may be submitted in appendices), results, proposed equipment and implementation issues.

5. Conclusions, observations and caveats regarding cost and savings estimates.

6. Thorough appendices which document the data relied upon to prepare the analysis and how that data was collected.

[1.] FAU and Trane shall mutually agree in writing to the escalation rates that apply to the project. The value of fuel and water unit savings shall be calculated using actual rate increases as they occur over the term of the contract. The base rate value for each fuel and water unit shall not devalue in the event of any rate decrease.

The Energy Audit and Report shall be completed within 120 days of the effective date of this Agreement, unless otherwise stated in Attachment A. FAU shall conduct and complete a technical review within sixty (60) days of its receipt of the Energy Audit and Report.
Upon FAU's request, Company will meet with FAU during the technical review period to discuss and revise the recommended ECMs, price, and energy savings. After the parties have reached agreement for project ECM scope, price, and energy savings (not later than the conclusion of the technical review period) the Company will submit a revised Report containing the agreed ECMs with associated revisions. Notwithstanding Article 3 – Payment, if the parties cannot reach agreement on the project ECM scope, price, and energy savings during the technical review period, the parties may agree to continue discussions and project development beyond the stated 60 day technical review period.

Article 2: <u>Energy Performance Contract</u>

The Parties intend to negotiate an Energy Performance Contract under which the Company shall design, install and implement ECMs and provide certain maintenance and monitoring services. However, nothing in this Agreement should be construed as an obligation on any of the Parties to execute such an Energy Performance Contract. The terms and provisions of such an Energy Performance Contract shall be set forth in a separate agreement. This Agreement shall automatically terminate upon the Parties' execution of an Energy Performance Contract relating to the Facilities.

Article 3: <u>Payment</u> Upon conclusion of the 60 day technical review period described above, FAU will be invoiced by Company for the cost of the audit in the amount of One Hundred Sixty Four Thousand One Hundred Fourteen and no/100 ($164,114.00) for the facilities detailed in Attachment A hereto. The fee for the Energy Audit is due and payable within 60 days of the date of receipt of the invoice. Parties understand and intend that the Company's costs for services performed under this Agreement shall be included in the total project cost as defined in the Energy Performance Contract. In the event that the FAU and Trane enter into the proposed Energy Performance Contract within 60 days from the date of the delivery of the Energy Audit, this invoice will be cancelled and the Energy Audit Fee will become part of the Energy Performance Contract. Meeting.

Article 4: <u>Termination</u>

A. <u>By Company:</u>

Company may terminate this Agreement prior to the completion of the Energy Audit and Report or subsequent to the completion of the Energy Audit and Report if:

(i) It determines that it cannot guarantee a minimum amount of energy and cost savings through the implementation of an energy performance contracting project at the Facility(s); or

(ii) It determines that even though it can guarantee a minimum amount of energy and cost savings in energy costs, that amount would be insufficient to cover the costs associated with performing this analysis, installing ECMs and related maintenance and monitoring services.

Termination under this section shall be effective upon FAUs receipt of written notification from the Company stating the reason for the termination and all supporting

documents. Company shall provide the Facility(s) with any preliminary notes, reports or analysis which have been produced or prepared prior to the effective date of the termination.

B. By FAU:

FAU may terminate this Agreement:

(i) If the Company fails to complete the Energy Audit and deliver the Report to FAU within the time established in Article 1, above; or fails to obtain a written extension of that time from FAU. Termination under this subsection B (i) shall be effective upon Company's receipt of written notification from FAU that the deadline for submission of the Report has passed. Company shall provide the Facility(s) with any preliminary notes, reports or analysis which have been produced or prepared prior to the effective date of the termination.

(ii) If, prior or subsequent to the completion of the Energy Audit, the Company notifies FAU in writing that it is unable to guarantee a sufficient level of savings pursuant to subsection 4 A (i) or (ii) above. Termination under this subsection B (ii) shall be effective upon Company's receipt of written notification from the FAU. Company shall provide the Facility(s) with any preliminary notes, reports or analysis which have been produced or prepared prior to the effective date of the termination.

C. By Either Party:

Either Party may terminate this Agreement, when the Party deems it to be in its best interest to do so, by providing the other Party thirty (30) days written notice of its intent to do so. Termination shall be effective thirty (30) days after receipt of the written notice. In the event of a termination by FAU for its convenience, Company will stop performing the Energy Audit services and follow FAU's instructions for invoicing all services complete to date. Company will then be entitled to payment for all services completed to date; except that in no event shall Consultant be entitled to receive payment for more than the audit cost as specified in Article 3.

Article 5: Standard Terms and Conditions

Section 1. Agreement Term

The Agreement term shall commence on the effective date of the Agreement and end on [date], unless earlier terminated pursuant to the provisions of Article 4 hereof. Notwithstanding, Company shall adhere to the deadlines set forth in Article 1 regarding the completion and submittal of the list of ECMs and the Energy Audit and Report.

Section 2. Appropriations

Obligations of FAU shall cease immediately without penalty if in any fiscal year covered by the Agreement term, FAU fails to appropriate, reappropriate or otherwise make available funds for this Agreement. FAU shall provide written notification to Company of any impending change in the status of appropriations which may affect this Agreement of which it has notice.

Section 3. Materials, Equipment and Supplies

The Company shall provide or cause to be provided all facilities, materials, equipment and supplies necessary to perform and prepare the Energy Audit and Report.

Section 4. Subcontractor Disclosure

As of the execution date of this Agreement, the following subcontractors are expected to perform material work (i.e., greater than 5% of the total work) pursuant to this Agreement:

Thermal Concepts Hypower Ally Engineering

If, during the term of this Agreement, the Company retains subcontractors to perform material work pursuant to this Agreement who were not disclosed, the Company shall so notify the Agency in writing.

Section 5. Patent and Copyright Responsibility

The Company agrees that any material or design specified by the Company or supplied by the Company pursuant to this Agreement shall not knowingly infringe any patent or copyright, and the Company shall be solely responsible for securing any necessary licenses required for patented or copyrighted material utilized by the Company in the performance of the Energy Audit and preparation of the Report.

Section 6. Release and Indemnity

The Company agrees to indemnify and hold FAU, its officers, agents and employees harmless from and against any and all liabilities, demands, claims, suits, losses, damages, causes of action, fines or judgments, including costs, attorney's and witnesses. Fees, and expenses incident thereto, for injuries to persons (including death) and for loss of, damage to or destruction of property (including property of FAU) to the extent cause by Company's negligent or intentional acts or omissions. In the event that demand or claim is made or suit is commenced against FAU, FAU shall give [prompt written notice thereof to Company and Company shall have the right to compromise or defend the same to the extent of its own interest. Company further agrees to maintain adequate insurance to protect FAU against such risks. Company also agrees to indemnify and hold FAU harmless should any goods or services provided by Company infringe upon the patent, copyright, or trade secret of another. Notwithstanding any contrary provision, neither party shall be liable to the other for any special, indirect, consequential or punitive damages.

Section 7. Lobbying, Integrity, and Retention of Records

Pursuant to section 216.347 of the Florida Statutes, the Company may not expend any State funds for the purpose of lobbying the Legislature, the judicial branch, or a state agency. In addition, the Company shall not, in connection with this or any other agreement with the State, directly or indirectly (1) offer, confer, or agree to confer any pecuniary benefit on anyone as consideration for any State officer or employee's decision, opinion, recommendation, vote, other exercise of discretion, or violation of a known legal duty, or (2) offer, give, or agree to give to anyone any gratuity for the benefit of, or at the direction or request of, any State officer or

employee. For purposes of clause (2), "gratuity" means any payment of more than nominal monetary value in the form of cash, travel, entertainment, gifts, meals, lodging, loans, subscriptions, advances, deposits of money, services, employment, or agreements of any kind. Upon request of the Agency's Inspector General, or other authorized State official, the Company shall provide any type of information the Inspector General deems relevant to the Company's integrity or responsibility. Such information may include, but shall not be limited to, the Company's business or financial records, documents, or files of any type or form that refer to or relate to the Agreement. The Company shall retain such records for the longer of (1) three years after the expiration of the Agreement or (2) the period required by the General Records Schedules maintained by the Florida Department of State (available at: http://dlis.dos.state.fl.us/barm/genschedules/gensched.htm). Failure to maintain the books, records, and supporting documents required by this Section shall establish a presumption in favor of the Agency for the recovery of any funds paid by the Agency under the Agreement for which adequate books, records, and supporting documents are not available to support their purported disbursement. The Company agrees to reimburse the State for the reasonable costs of investigation incurred by the Inspector General or other authorized State official for investigations of the Company's compliance with the terms of this or any other agreement between the Company and the State which results in the suspension or debarment of the Company. Such costs shall include, but shall not be limited to: salaries of investigators, including overtime; travel and lodging expenses; and expert witness and documentary fees. The Company shall not be responsible for any costs of investigations that do not result in the Company's suspension or debarment.

Section 8. Dispute Resolution

FAU and the Company recognize and acknowledge that efforts should always be made to avoid or prevent disputes through effective partnering, good communications, and joint decision making; and that timely requests for clarification and for information will help ensure a better understanding of issues and problems and lead to the elimination of doubts, uncertainties, and ambiguities. Nevertheless, the FAU and the Company also recognize that disputes may develop between them and, in such event, wish to establish procedures to be followed to resolve such disputes in the shortest possible time and at the least possible expense to the FAU and the Company.

Any conflict or dispute between the FAU and the Company shall be resolved in accordance with the procedures specified in this Agreement, which shall be the sole and exclusive procedures for the resolution of any such disputes. This Agreement establishes successive steps of conflict prevention and alternative dispute resolution prior to litigation, completion of which shall be conditions precedent to the right to commence litigation over any dispute arising out of or relating to the Agreement. The successive steps are: (1) informal negotiations between project-level management personnel; (2) formal negotiations between executive-level management, initiated by written notice and completed within thirty days, or longer as mutually agreed; and (3) mediation, initiated by written notice. Except as otherwise agreed by the Parties in a mediation contract, all mediation proceedings shall be conducted in accordance with this Agreement and, where applicable, the then-current Model Procedure for Mediation of Business Disputes published by the Center for Public Resources (CPR), 366 Madison Avenue New York, NY 10017, (212) 949-6490 (http://www.cpradr.org). If the Agency and the Company have not

agreed within ten (10) business days of the request for mediation on the selection of a neutral mediator willing to serve, then the Parties agree that a mediator shall be selected by the Florida Conflict Resolution Consortium (FCRC), Florida State University, Tallahassee, (850) 644-6320 (http://consensus.fsu.edu). The appointment by FCRC of a qualified mediator shall be binding on both Parties, and both Parties shall promptly cooperate with the appointed mediator to effectuate mediation.

Any action legal or equitable action arising out of or relating to this Agreement shall be brought in the appropriate state court in Palm Beach County, Florida, and not elsewhere, and shall be governed by Florida law. The threshold issue for determination shall be whether the Party bringing the action has complied with the alternative dispute resolution processes specified above.

Section 9. Personnel

All Company employees, subcontractors, or agents performing work under the Agreement shall be properly trained technicians who meet or exceed any specified training qualifications. Upon request, Company shall furnish a copy of technical certification or other proof of qualification. All employees, subcontractors, or agents performing work under the Agreement must comply with all security and administrative requirements of the FAU. FAU may conduct, and the Company shall cooperate in, a security background check or otherwise assess any employee, subcontractor, or agent furnished by the Company. The Agency may refuse access to, or require replacement of, any personnel for cause, including, but not limited to, technical or training qualifications, quality of work, change in security status, or non-compliance with the Agency's security or other requirements. Such approval shall not relieve the Company of its obligation to perform all work in compliance with the Agreement. The Agency may reject and bar from any facility for cause any of the Company's employees, subcontractors, or agents.

The Company, together with its agents, subcontractors, officers and employees, shall have and always retain under the Agreement the legal status of an independent contractor, and in no manner shall they be deemed employees of the Agency or deemed to be entitled to any benefits associated with such employment. During the term of the Agreement, the Company shall maintain at its sole expense those benefits to which its employees would otherwise be entitled to by law, including health benefits, and all necessary insurance for its employees, including workers' compensation, disability, and unemployment insurance, and provide the Agency with certification of such insurance upon request. The Company remains responsible for all applicable federal, state, and local taxes, and all FICA contributions.

Section 10. Compliance with Applicable Law

In performing this Agreement, the Company shall comply with all laws, rules, codes, ordinances, and licensing requirements that are applicable to the conduct of its business, including those of federal, State, and local agencies having jurisdiction and authority, as well as all FAU regulations and policies, including without limitation FAU's sexual harassment regulations and policies. By further way of non-exhaustive example, the Company shall comply with section 247A(e) of the Immigration and Nationalization Act, the Americans with Disabilities Act, and all

prohibitions against discrimination on the basis of race, religion, sex, cred, national origin, handicap, marital status, or veteran's status. Violation of such laws shall be grounds for Agreement termination. The Agency may cancel the Agreement if the Company refuses to allow public access to all records made or received by the Company in conjunction with the Agreement, unless the records are exempt from section 24(a) of Article I of the State Constitution and section 119.07(1) of the Florida Statutes.

Section 11. Waivers

No right of either party hereto shall be deemed to have been waived by non-exercise thereof, or otherwise, unless such waiver is reduced to writing and executed by the party entitled to exercise such right.

Section 12. Assignment

Neither Party may assign this Agreement without the prior written consent of the other Party, which shall not be unreasonably withheld.

Section 13. Capacity to Contract

Each person signing the Agreement warrants that he or she is duly authorized to do so and to bind the respective Party to the Agreement. The Company warrants that it is in good standing and legally authorized to transact business in Florida. The Company warrants that, to the best of its knowledge, there is no pending or threatened action, proceeding, or investigation, or any other legal or financial condition, that would in any way prohibit, restrain, or diminish the Company's ability to satisfy its Agreement obligations. The Company warrants that neither it nor any affiliate is currently on the convicted vendor list maintained pursuant to section 287.133 of the Florida Statutes, or on any similar list maintained by any other state or the federal government. The Company shall immediately notify the FAU in writing if its ability to perform is compromised in any manner during the term of the Agreement.

Section 14. Confidential Information

Each Party may have access to confidential information made available by the other Party (see particularly, but not exclusively, subsection 119.07(ee) and section 119.071 of the Florida Statutes). Each Party shall protect such confidential information in the same manner as it protects its own confidential information of like kind. Disclosure of any confidential information received by the FAU will be governed by the Public Records Act, chapter 119 of the Florida Statutes.

Section 15. Convicted or Discriminatory Vendors

A person or affiliate placed on the convicted vendor list following a conviction for a public entity crime is prohibited from doing any of the following for a period of 36 months from the date of being placed on the convicted vendor list: submitting a bid on a contract to provide any goods or services to a public entity; submitting a bid on a contract with a public entity for the construction or repair of a public building or public work; submitting bids on leases of real property to a public entity; being awarded or performing work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and transacting business with any public

entity in excess of the Category Two threshold amount ($25,000) provided in section 287.017 of the Florida Statutes.

An entity or affiliate placed on the discriminatory vendor list pursuant to section 287.134 of the Florida Statutes may not submit a bid on a contract to provide any goods or services to a public entity; may not submit a bid on a contract with a public entity for the construction or repair of a public building or public work; may not submit bids on leases of real property to a public entity; may not be awarded or perform work as a contractor, supplier, sub-contractor, or consultant under a contract with any public entity; and may not transact business with any public entity.

Section 16. Project Management

All necessary and ordinary communications, submittals, approvals, requests and notices related to Project work shall be issued or received by:

Florida Atlantic University
777 Glades Road
PO Box 3091
561-297-3000
Attn: Mr. Jeff Modlin
Jmodlin@fau.edu

Trane
6965 Vista Parkway North #11
West Palm Beach, FL 33411
561-683-1521
Attn: Mr. Steve Corson
sdcorson@ trane.com

Either Party may change its point of contact by written notice to other Party's then-current designated contact, which shall not constitute a formal amendment to this Agreement.

Section 17. Modification of Terms

The Agreement contains all the terms and conditions agreed upon by the Parties. The Agreement may only be modified or amended upon mutual written agreement of the Parties. No oral agreements or representations shall be valid or binding upon the FAU or the Company.

Section 18. Execution in Counterparts

The Agreement may be executed in counterparts, each of which shall be an original and all of which shall constitute but one and the same instrument.

Section 19. Severability

If a court deems any provision of the Agreement void or unenforceable, that provision shall be enforced only to the extent that it is not in violation of law or is not otherwise unenforceable, and all other provisions shall remain in full force and effect.

Section 20. Invoices

The Company agrees that bills and invoices for fees or other compensation for services or expenses shall cite the Agreement and shall be submitted in detail sufficient for a proper preaudit and postaudit. Each bill or invoice must clearly identify the services, portion of the services, and expenses for which compensation is sought. Payment will be tendered only for services or the portion of services completed prior to the submission of the bill or invoice, or for expenses incurred prior to such submission.

Section 21. Soverign Immunity

The University , as a public entity of the State of Florida, is entitled to the benefits of sovereign immunity coextensive therewith, including immunities from taxation. In the event either party is required to obtain from any governmental authority any permit, license or authorization as a prerequisite to perform its obligations, the cost shall be borne by the party required to obtain such permit, license, or authorization.

Section 22. Force Majeure

No default, delay or failure to perform shall be considered a default, delay or failure to perform otherwise chargeable, hereunder, if such default, delay or failure to perform is due to causes beyond either party's control including, but no limited to, strikes, lockouts or inactions of governmental authorities; epidemics; war; embargoes, fire; earthquake; acts of God; default of common carrier. In the event of such default, delay or failure to perform, any date or times by which either party is otherwise scheduled to perform shall be extended automatically for a period of time equal in duration to the time lost be reason of the excused default, delay or failure to perform.

Article 6: <u>Execution</u>

SO AGREED:

FLORIDA ATLANTIC UNIVERISTY

_____	_____
By:	
Its:	Date

TRANE

_____	_____
By:	Date
Its:	

Attachment A
Florida Atlantic University Energy Audit Facility List

Scope includes comprehensive energy audit including baseline energy usage, identification
of energy conservation measures, data acquisition of selected energy use and environmental
conditions, energy savings calculations, and development of energy conservation measures

Building #	Building Description	Gross Square Feet	Usage
2	General Classroom S	85,538	E&G
9	University Theatre	110,366	E&G
11a	Field House West	15,336	E&G
23	Fleming West	13,962	E&G
24	Fleming	59,148	E&G
25	Kaye Hall	24,119	E&G
36	Engineering West	59,419	E&G
44	Humanities	102,973	E&G
47	Education	93,187	E&G
51	Performing Arts	26,167	E&G
52	Arts & Humanities	25,508	E&G
53	Visual Arts	24,991	E&G
73	General Classroom N	12,680	E&G
80	Student Support	98,840	E&G
84	Nursing	72,998	E&G
86	College of Business	59,302	E&G
P1	Parking Garage 1	n/a	Aux
P2	Parking Garage 2	n/a	Aux
P3	Parking Garage 3	n/a	Aux
Grand Total		**83,754**	**GSF**

Grid-Connected System: Simulation parameters

Project : **FAU Boca Raton**

Geographical Site	**Miami**		**Country**	**USA**
Situation	Latitude	25.6°N	Longitude	80.0°W
Time defined as	Legal Time	Time zone UT-5	Altitude	5 m
	Albedo	0.20		

Meteo data : Miami, Synthetic Hourly data

Simulation variant : **Garage 260W Solarworld**

Simulation date 03/01/13 13h36

Simulation parameters

Collector Plane Orientation	Tilt	5°	Azimuth	0°
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module Si-poly	Model	**Sunmodule Plus SW 260 poly**		
	Manufacturer	Solarworld AG		
Number of PV modules	In series	26 modules	In parallel	111 strings
Total number of PV modules	Nb. modules	2886	Unit Nom. Power	260 Wp
Array global power	Nominal (STC)	**750 kWp**	At operating cond.	664 kWp (50°C)
Array operating characteristics (50°C)	U mpp	+/-362 V	I mpp	918 A
Total area	Module area	**4839 m²**		

Inverter	Model	**Solaron 333**		
	Manufacturer	Advanced Energy Industries, Inc.		
Characteristics	Operating Voltage	+/-330-550 V	Unit Nom. Power	333 kW AC
Inverter pack	Number of Inverter	2 units	Total Power	666 kW AC

PV Array loss factors

Thermal Loss factor	Uc (const)	27.7 W/m²K	Uv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind=1 m/s.)			NOCT	46 °C
Wiring Ohmic Loss	Global array res.	14 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	0.0 %
Module Mismatch Losses			Loss Fraction	0.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs : Unlimited load (grid)

Grid-Connected System: Main resultsEconomic evaluation

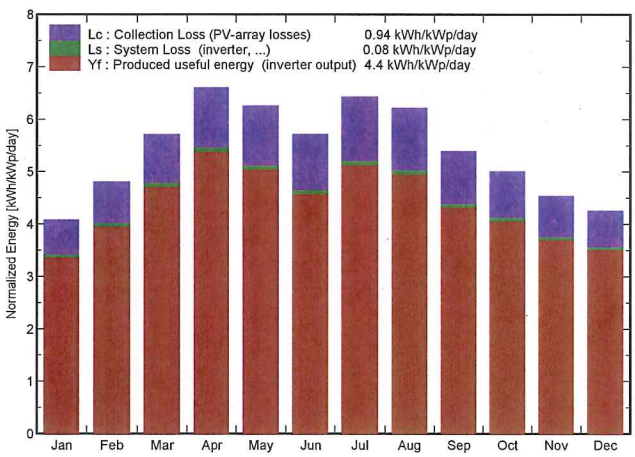
Project : **FAU Boca Raton**

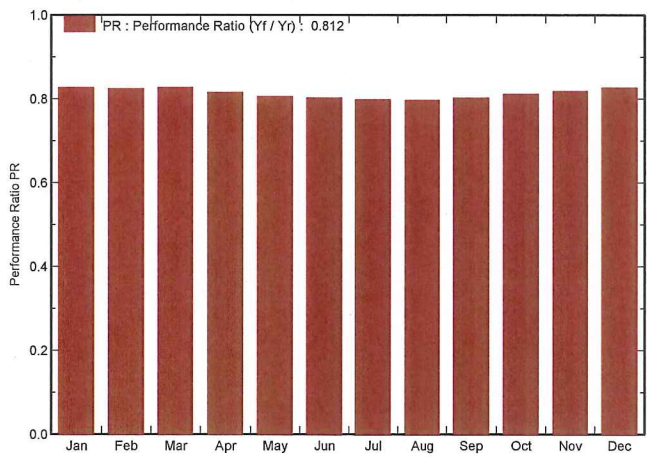
Simulation variant : **Garage 260W Solarworld**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	5°	azimuth	0°
PV modules	Model	Sunmodule Plus SW 260 poly	Pnom	260 Wp
PV Array	Nb. of modules	2886	Pnom total	**750 kWp**
Inverter	Model	Solaron 333	Pnom	333 kW ac
Inverter pack	Nb. of units	2.0	Pnom total	**666 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results

System Production	**Produced Energy**	**1205 MWh/year**	Specific prod.	1606 kWh/kWp/year
	Performance Ratio PR	81.2 %		





Garage 260W Solarworld

Balances and main results

	GlobHor kWh/m²	T Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	EffArrR %	EffSysR %
January	117.0	20.00	126.5	120.9	79.9	78.5	13.05	12.82
February	127.0	20.60	134.6	129.3	84.6	83.2	13.00	12.78
March	171.0	22.20	177.0	171.4	111.6	109.8	13.03	12.82
April	196.0	23.90	198.1	192.3	123.3	121.3	12.87	12.65
May	195.0	26.10	194.0	188.1	119.4	117.3	12.72	12.50
June	173.0	27.80	171.3	165.9	104.9	103.1	12.66	12.44
July	201.0	28.30	199.2	193.3	121.4	119.4	12.60	12.39
August	192.0	28.30	192.6	186.8	117.2	115.2	12.58	12.36
September	158.0	27.80	161.7	156.6	99.0	97.3	12.65	12.44
October	148.0	25.60	155.1	149.6	96.1	94.5	12.81	12.59
November	126.0	22.80	136.0	130.5	84.9	83.5	12.90	12.69
December	120.0	20.60	131.8	125.8	83.1	81.8	13.04	12.83
Year	1924.0	24.52	1977.9	1910.6	1225.6	1205.0	12.81	12.59

Legends:				
	GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
	T Amb	Ambient Temperature	E_Grid	Energy injected into grid
	GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
	GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

Investment

PV modules (Pnom = 260 Wp)	2886 units	0 € / unit	0 €
~~Supports / Integration~~		~~0 € / module~~	~~0 €~~
Inverters (Pnom = 333 kW ac)	2 units	0 € / unit	0 €

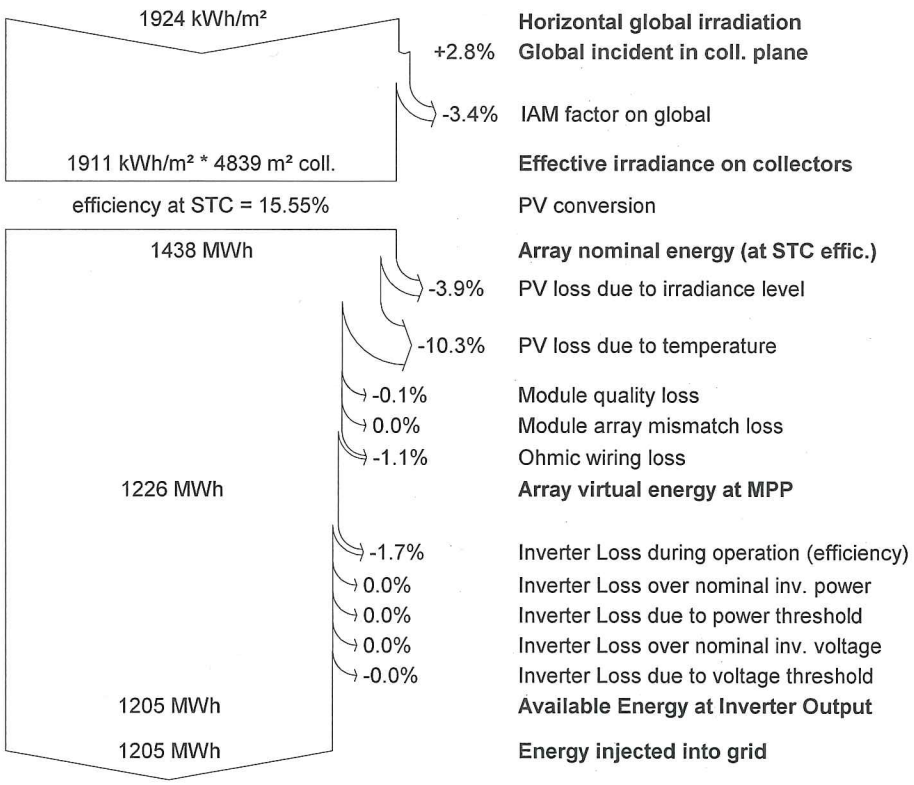
Grid-Connected System: Loss diagram

Project : **FAU Boca Raton**

Simulation variant : **Garage 260W Solarworld**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	5°	azimuth	0°
PV modules	Model	Sunmodule Plus SW 260 poly	Pnom	260 Wp
PV Array	Nb. of modules	2886	Pnom total	**750 kWp**
Inverter	Model	Solaron 333	Pnom	333 kW ac
Inverter pack	Nb. of units	2.0	Pnom total	**666 kW ac**
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



Grid-Connected System: Simulation parameters

Project : **FAU Boca Raton**

Geographical Site	**Miami**		**Country**	**USA**
Situation	Latitude	25.6°N	Longitude	80.0°W
Time defined as	Legal Time	Time zone UT-5	Altitude	5 m
	Albedo	0.20		

Meteo data : Miami, Synthetic Hourly data

Simulation variant : **Ground 260W Solarworld**

Simulation date 03/01/13 15h27

Simulation parameters

Collector Plane Orientation	Tilt	5°	Azimuth	0°
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-poly	Model	**Sunmodule Plus SW 260 poly**		
		Manufacturer	Solarworld AG		
Number of PV modules		In series	26 modules	In parallel	37 strings
Total number of PV modules		Nb. modules	962	Unit Nom. Power	260 Wp
Array global power		Nominal (STC)	**250 kWp**	At operating cond.	221 kWp (50°C)
Array operating characteristics (50°C)		U mpp	+/-362 V	I mpp	306 A
Total area		Module area	**1613 m²**		

Inverter	Model	**Solaron 250KW-480 MFG**		
	Manufacturer	Advanced Energy Industries, Inc.		
Characteristics	Operating Voltage	+/-330-600 V	Unit Nom. Power	250 kW AC

PV Array loss factors

Thermal Loss factor	Uc (const)	27.7 W/m²K	Uv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind=1 m/s.)			NOCT	46 °C
Wiring Ohmic Loss	Global array res.	41 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	0.0 %
Module Mismatch Losses			Loss Fraction	0.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs : Unlimited load (grid)

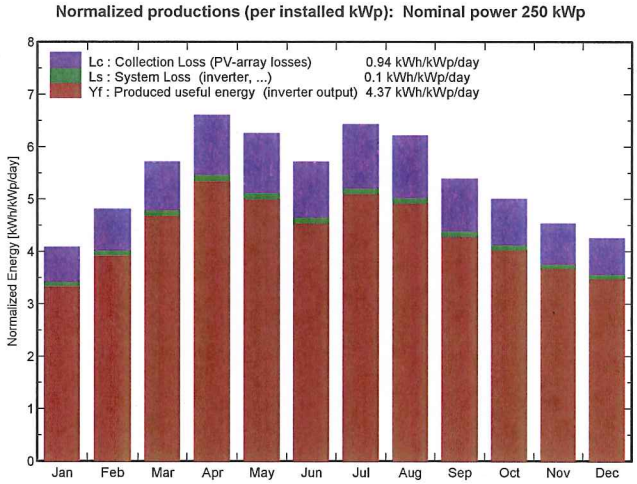
Grid-Connected System: Main results

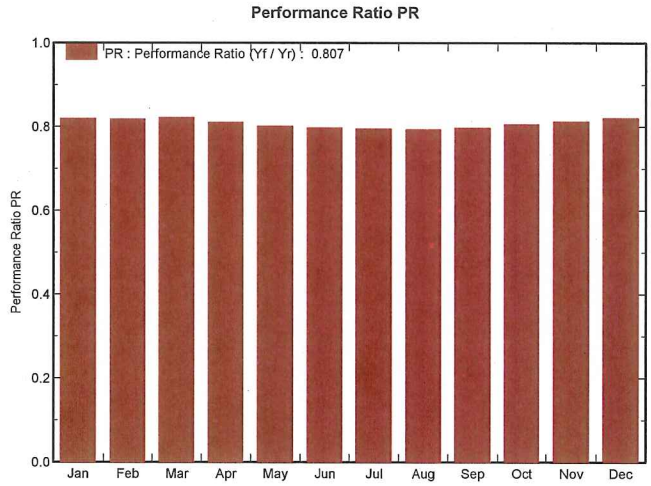
Project : **FAU Boca Raton**

Simulation variant : **Ground 260W Solarworld**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	5°	azimuth	0°
PV modules	Model	Sunmodule Plus SW 260 poly	Pnom	260 Wp
PV Array	Nb. of modules	962	Pnom total	**250 kWp**
Inverter	Model	Solaron 250KW-480 MFG	Pnom	250 kW ac
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**399.0 MWh/year**	Specific prod.	1595 kWh/kWp/year
	Performance Ratio PR	80.7 %		





Ground 260W Solarworld

Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	EffArrR	EffSysR
	kWh/m²	°C	kWh/m²	kWh/m²	MWh	MWh	%	%
January	117.0	20.00	126.5	120.9	26.64	25.94	13.05	12.71
February	127.0	20.60	134.6	129.3	28.21	27.54	13.00	12.68
March	171.0	22.20	177.0	171.4	37.21	36.37	13.03	12.74
April	196.0	23.90	198.1	192.3	41.12	40.16	12.87	12.57
May	195.0	26.10	194.0	188.1	39.79	38.85	12.72	12.42
June	173.0	27.80	171.3	165.9	34.96	34.15	12.66	12.36
July	201.0	28.30	199.2	193.3	40.47	39.60	12.60	12.33
August	192.0	28.30	192.6	186.8	39.07	38.22	12.58	12.30
September	158.0	27.80	161.7	156.6	33.01	32.24	12.65	12.36
October	148.0	25.60	155.1	149.6	32.04	31.26	12.81	12.50
November	126.0	22.80	136.0	130.5	28.29	27.64	12.90	12.60
December	120.0	20.60	131.8	125.8	27.71	27.05	13.04	12.73
Year	1924.0	24.52	1977.9	1910.6	408.53	399.03	12.81	12.51

Legends:				
	GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
	T Amb	Ambient Temperature	E_Grid	Energy injected into grid
	GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
	GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

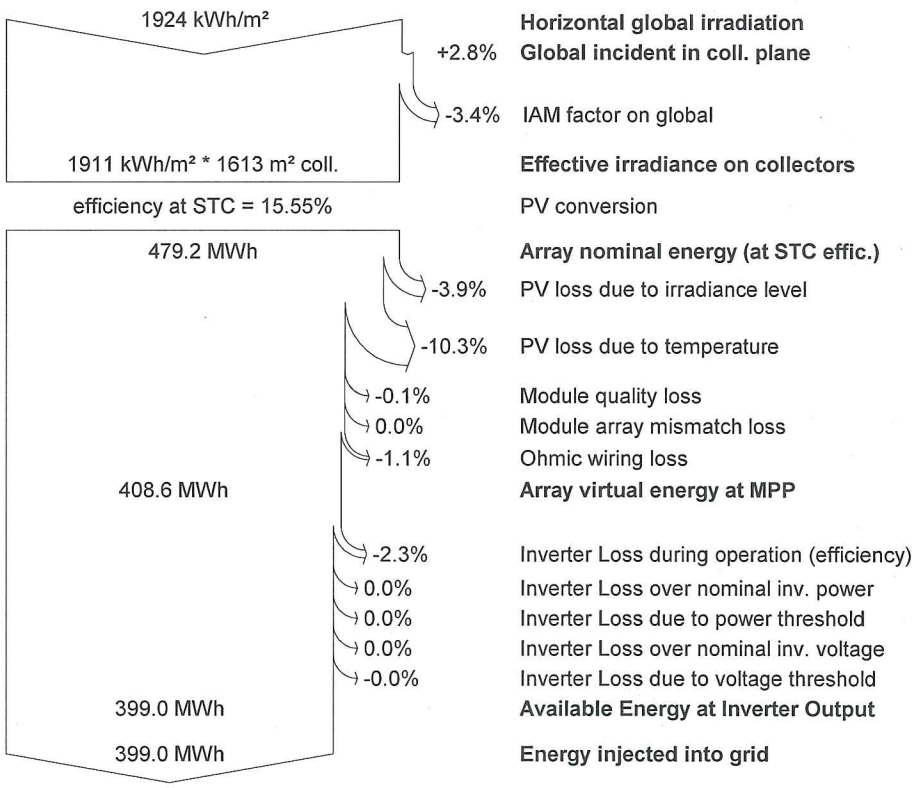
Grid-Connected System: Loss diagram

Project : **FAU Boca Raton**

Simulation variant : **Ground 260W Solarworld**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	5°	azimuth	0°
PV modules	Model	Sunmodule Plus SW 260 poly	Pnom	260 Wp
PV Array	Nb. of modules	962	Pnom total	**250 kWp**
Inverter	Model	Solaron 250KW-480 MFG	Pnom	250 kW ac
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



Title / Summary Report

FAU RCx

Location: West Palm Beach, Florida

	Alternative - 1	Alternative - 2
Alternative Description	Alternative - 1	FAU Boca RCX Occ/Unocc
Building Template	College/University	College/University
Building Floor Area	812,400 ft²	812,400 ft²
System #1	Variable Volume Reheat (30% Min Flow Default)	Variable Volume Reheat (30% Min Flow Default)
Max Clg Load	2,544.3 ton	2,543.3 ton
Max Htg Load	6,820.5 MBh	6,817.8 MBh
System #2		
Max Clg Load		
Max Htg Load		
Opt Ventilation Clg Load		
Opt Ventilation Htg Load		
Total Building Clg Load	2,544.3 ton	2,543.3 ton
Total Building Htg Load	6,820.5 MBh	6,817.8 MBh
Plant #1		
Clg Equipment Type #1	Centrifugal 2-Stage	Centrifugal 2-Stage
Clg Equipment Type #2	Same as chiller 1	Same as chiller 1
Clg Equipment Type #3	Same as chiller 1	Same as chiller 1
Htg Equipment Type	Gas Fired Hot Water Boiler	Gas Fired Hot Water Boiler
Plant #2		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
MAU Plant #3		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
Building Clg Coil Load	9,439,511 ton·hrs/year	6,145,867 ton·hrs/year
Building Htg Coil Load	-5,562,289 kBtu/year	-1,455,101 kBtu/year
Building Energy Usage	76,625 Btu/ft²·year	54,652 Btu/ft²·year
Building Energy Cost	1.786 $/ft²·year	1.588 $/ft²·year

	Alternative - 3	Alternative - 4
Alternative Description	RcX Three Way Valve Replacement	Switch to GSLD-3
Building Template	College/University	College/University
Building Floor Area	812,400 ft²	812,400 ft²
System #1	Same as Alt - 2	Same as Alt - 2
Max Clg Load		
Max Htg Load		
System #2	Same as Alt - 2	Same as Alt - 2
Max Clg Load		
Max Htg Load		
Opt Ventilation Clg Load		
Opt Ventilation Htg Load		
Total Building Clg Load		
Total Building Htg Load		
Plant #1		
Clg Equipment Type #1	Centrifugal 2-Stage	Centrifugal 2-Stage
Clg Equipment Type #2	Same as chiller 1	Same as chiller 1
Clg Equipment Type #3	Same as chiller 1	Same as chiller 1
Htg Equipment Type	Gas Fired Hot Water Boiler	Gas Fired Hot Water Boiler
Plant #2		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
MAU Plant #3		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
Building Clg Coil Load	6,145,867 ton·hrs/year	6,145,867 ton·hrs/year
Building Htg Coil Load	-1,455,101 kBtu/year	-1,455,101 kBtu/year
Building Energy Usage	50,523 Btu/ft²·year	50,523 Btu/ft²·year
Building Energy Cost	1.506 $/ft²·year	1.417 $/ft²·year

Title / Summary Report

FAU RCx

Location: West Palm Beach, Florida

Life Cycle Payback on Investment

	Alt 1 vs 2	Alt 1 vs 3	Alt 1 vs 4	Alt 2 vs 3
Internal Rate of Return	0.0 %	0.0 %	0.0 %	0.0 %
Life Cycle Cost Difference	-$1,951,835	-$2,762,662	-$3,638,330	-$810,826
Net Present Value of Cash Flow	-$1,951,835	-$2,762,662	-$3,638,330	-$810,826
Life Cycle Payback on Invest.	Does Not Payback	Does Not Payback	Does Not Payback	NA
Simple Payback on Invest.	Does Not Payback	Does Not Payback	Does Not Payback	NA

	Alt 2 vs 4	Alt 3 vs 4
Internal Rate of Return	0.0 %	0.0 %
Life Cycle Cost Difference	-$1,686,495	-$875,669
Net Present Value of Cash Flow	-$1,686,495	-$875,669
Life Cycle Payback on Invest.	NA	NA
Simple Payback on Invest.	NA	NA

Environmental Impact Analysis

	Alt 1	Alt 2	Alt 3	Alt 4
CO2 Impact	72,213,180 lbm/year	53,920,100 lbm/year	49,731,040 lbm/year	49,731,040 lbm/year
SO2 Impact	307,104 gm/year	229,308 gm/year	211,493 gm/year	211,493 gm/year
NOX Impact	171,038 gm/year	127,710 gm/year	117,789 gm/year	117,789 gm/year

Energy Star Building Label Benchmarking Tool

	Alt - 1	Alt - 2	Alt - 3	Alt - 4
Building Floor Area	812,400 ft²	812,400 ft²	812,400 ft²	812,400 ft²
Weekly Operating Hours	168 hrs	77 hrs	77 hrs	77 hrs
Number of Occupants	16,248 People	16,248 People	16,248 People	16,248 People
Annual Electric Consumption	16,244,940 kWh	12,459,370 kWh	11,476,420 kWh	11,476,420 kWh
Annual Gas Consumption	68,063 therms	18,757 therms	18,757 therms	18,757 therms
Annual Oil Consumption	0 therms	0 therms	0 therms	0 therms
Annual Steam Consumption	0 therms	0 therms	0 therms	0 therms

Design Load Summary Report

FAU RCx

Location: West Palm Beach, Florida
Summer Design DB: 92.3 °F
Summer Design WB: 79.2 °F
Winter Design DB: 45.0 °F

	Alternative - 1				Alternative - 2			
	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)
Envelope Loads								
Skylight Solar	0	0.0	0	0.0	0	0.0	0	0.0
Skylight Conduction	0	0.0	0	0.0	0	0.0	0	0.0
Roof Conduction	1,055,058	3.5	-618,996	9.4	1,055,029	3.5	-618,986	9.4
Glass Solar	2,294,257	7.5	0	0.0	2,294,257	7.5	0	0.0
Glass Conduction	528,916	1.7	-937,954	14.3	528,916	1.7	-937,954	14.3
Wall Conduction	307,165	1.0	-315,356	4.8	307,162	1.0	-315,354	4.8
Infiltration	0	0.0	0	0.0	0	0.0	0	0.0
Sub Total:	**4,185,396**	**13.7**	**-1,872,305**	**28.51**	**4,185,364**	**13.7**	**-1,872,294**	**28.53**
Internal Loads								
Lights	3,684,297	12.1	0	0.0	3,684,297	12.1	0	0.0
People	7,092,677	23.2	0	0.0	7,083,992	23.2	0	0.0
Miscellaneous	580,257	1.9	0	0.0	580,257	1.9	0	0.0
Sub Total:	**11,357,231**	**37.2**	**0**	**0.0**	**11,348,546**	**37.2**	**0**	**0.0**
Ventilation Load **	14,200,720	46.5	-3,813,294	58.1	14,199,670	46.5	-3,812,032	58.1
Exhaust Heat	-577,101	-1.9	219,221	-3.3	-577,379	-1.9	219,207	-3.3
Reheat	0	0.0	0	0.0	0	0.0	0	0.0
Fan Heat	1,095,704	3.6	0	0.0	1,094,741	3.6	0	0.0
User Oversizing	269,958	0.9	0	0.0	268,374	0.9	0	0.0
Grand Total:	**30,531,900**	**100.0**	**-6,566,761**	**100.0**	**30,519,310**	**100.0**	**-6,563,485**	**100.0**
Main Coil Capacities:	**2,544.3 tons**		**-6,567 MBh**		**2,543.3 tons**		**-6,563 MBh**	
MAU Capacity:	**N/A**		**N/A**		**N/A**		**N/A**	

	Alternative - 3				Alternative - 4			
	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)
Envelope Loads								
Skylight Solar								
Skylight Conduction								
Roof Conduction								
Glass Solar								
Glass Conduction								
Wall Conduction								
Infiltration								
Sub Total:	Same As Alt - 2				Same As Alt - 2			
Internal Loads								
Lights								
People								
Miscellaneous								
Sub Total:								
Ventilation Load **								
Exhaust Heat								
Reheat								
Fan Heat								
User Oversizing								
Grand Total:								
Main Coil Capacities:			**-6,563 MBh**				**-6,563 MBh**	
MAU Capacity:	**N/A**		**N/A**		**N/A**		**N/A**	

** Includes the impact of optional ventilation

System Report

FAU RCx

Monthly Coil Loads

	Alternative - 1		Alternative - 2		Alternative - 3		Alternative - 4	
	Cooling Coil Load ton-hrs	Heating Coil Load kBtu	Cooling Coil Load ton-hrs	Heating Coil Load kBtu	Cooling Coil Load ton-hrs	Heating Coil Load kBtu	Cooling Coil Load ton-hrs	Heating Coil Load kBtu
January	405,573	-785,786	290,511	-140,465	290,511	-140,465	290,511	-140,465
February	322,996	-647,497	246,697	-132,856	246,697	-132,856	246,697	-132,856
March	664,242	-472,613	471,303	-135,579	471,303	-135,579	471,303	-135,579
April	752,428	-402,110	495,131	-119,067	495,131	-119,067	495,131	-119,067
May	857,480	-390,586	573,032	-130,140	573,032	-130,140	573,032	-130,140
June	1,024,555	-328,917	675,271	-122,285	675,271	-122,285	675,271	-122,285
July	1,137,662	-310,027	674,329	-108,684	674,329	-108,684	674,329	-108,684
August	1,180,600	-282,138	758,655	-117,269	758,655	-117,269	758,655	-117,269
September	1,039,505	-329,166	628,097	-102,213	628,097	-102,213	628,097	-102,213
October	820,921	-436,860	535,715	-114,523	535,715	-114,523	535,715	-114,523
November	664,944	-530,810	433,060	-116,520	433,060	-116,520	433,060	-116,520
December	568,606	-645,780	364,064	-115,501	364,064	-115,501	364,064	-115,501
Total:	**9,439,512**	**-5,562,289**	**6,145,866**	**-1,455,101**	**6,145,866**	**-1,455,101**	**6,145,866**	**-1,455,101**

System Airflows

	Alternative - 1	Alternative - 2	Alternative - 3	Alternative - 4
System #1				
System Type	Variable Volume Reheat (30% Min Flow Default)	Variable Volume Reheat (30% Min Flow Default)	Variable Volume Reheat (30% Min Flow Default)	Variable Volume Reheat (30% Min Flow Default)
Outside Airflow	212,195 cfm	212,195 cfm	212,195 cfm	212,195 cfm
Cooling Supply Airflow	463,323 cfm	462,991 cfm	462,991 cfm	462,991 cfm
Heating Supply Airflow	165,487 cfm	165,375 cfm	165,375 cfm	165,375 cfm
System #2				
System Type				
Outside Airflow				
Cooling Supply Airflow				
Heating Supply Airflow				
Optional Ventilation Unit				
Cooling Supply Airflow				
Heating Supply Airflow				

System Report

FAU RCx

Alternative - 1 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	127.2	1	112	-341,025	18	1,617	23,166	0	0			
5 - 10	254.4	2	214	-682,051	58	5,097	46,332	0	0			
10 - 15	381.6	3	254	-1,023,076	9	785	69,498	0	0			
15 - 20	508.9	8	677	-1,364,102	4	361	92,665	0	0			
20 - 25	636.1	8	709	-1,705,127	5	441	115,831	0	0			
25 - 30	763.3	11	984	-2,046,152	3	248	138,997	0	0			
30 - 35	890.5	7	651	-2,387,178	1	45	162,163	0	0			
35 - 40	1,017.7	10	860	-2,728,203	1	75	185,329	55	4,860			
40 - 45	1,144.9	11	949	-3,069,229	1	56	208,495	7	596			
45 - 50	1,272.2	7	585	-3,410,254	0	35	231,661	4	371			
50 - 55	1,399.4	7	576	-3,751,279	0	0	254,828	6	508			
55 - 60	1,526.6	4	323	-4,092,305	0	0	277,994	4	350			
60 - 65	1,653.8	5	406	-4,433,330	0	0	301,160	2	159			
65 - 70	1,781.0	4	312	-4,774,356	0	0	324,326	3	229			
70 - 75	1,908.2	4	322	-5,115,381	0	0	347,492	5	476			
75 - 80	2,035.5	3	276	-5,456,406	0	0	370,658	3	245			
80 - 85	2,162.7	2	143	-5,797,432	0	0	393,824	6	547			
85 - 90	2,289.9	2	165	-6,138,457	0	0	416,990	3	227			
90 - 95	2,417.1	2	196	-6,479,483	0	0	440,157	2	192			
95 - 100	2,544.3	1	46	-6,820,508	0	0	463,323	0	0			
Hours Off	0.0	0	0	0	0	0	0	0	0	No heating fan for selected system		

Alternative - 1 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	127.2	1	112	-341,025	18	1,617	23,166	0	0			
5 - 10	254.4	2	214	-682,051	58	5,097	46,332	0	0			
10 - 15	381.6	3	254	-1,023,076	9	785	69,498	0	0			
15 - 20	508.9	8	677	-1,364,102	4	361	92,665	0	0			
20 - 25	636.1	8	709	-1,705,127	5	441	115,831	0	0			
25 - 30	763.3	11	984	-2,046,152	3	248	138,997	0	0			
30 - 35	890.5	7	651	-2,387,178	1	45	162,163	0	0			
35 - 40	1,017.7	10	860	-2,728,203	1	75	185,329	55	4,860			
40 - 45	1,144.9	11	949	-3,069,229	1	56	208,495	7	596			
45 - 50	1,272.2	7	585	-3,410,254	0	35	231,661	4	371			
50 - 55	1,399.4	7	576	-3,751,279	0	0	254,828	6	508			
55 - 60	1,526.6	4	323	-4,092,305	0	0	277,994	4	350			
60 - 65	1,653.8	5	406	-4,433,330	0	0	301,160	2	159			
65 - 70	1,781.0	4	312	-4,774,356	0	0	324,326	3	229			
70 - 75	1,908.2	4	322	-5,115,381	0	0	347,492	5	476			
75 - 80	2,035.5	3	276	-5,456,406	0	0	370,658	3	245			
80 - 85	2,162.7	2	143	-5,797,432	0	0	393,824	6	547			
85 - 90	2,289.9	2	165	-6,138,457	0	0	416,990	3	227			
90 - 95	2,417.1	2	196	-6,479,483	0	0	440,157	2	192			
95 - 100	2,544.3	1	46	-6,820,508	0	0	463,323	0	0			
Hours Off	0.0	0	0	0	0	0	0	0	0	No heating fan for selected system		

System Report

FAU RCx

Alternative - 2 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	127.2	14	835	-340,892	37	1,438	23,150	12	757			
5 - 10	254.3	14	810	-681,784	63	2,453	46,299	9	563			
10 - 15	381.5	3	188	-1,022,676	1	33	69,449	8	516			
15 - 20	508.7	1	37	-1,363,568	0	0	92,598	4	239			
20 - 25	635.8	3	172	-1,704,460	0	0	115,748	1	81			
25 - 30	763.0	3	164	-2,045,352	0	0	138,897	0	0			
30 - 35	890.1	3	153	-2,386,244	0	0	162,047	0	0			
35 - 40	1,017.3	3	196	-2,727,136	0	0	185,196	2	126			
40 - 45	1,144.5	6	336	-3,068,028	0	0	208,346	7	412			
45 - 50	1,271.6	5	316	-3,408,920	0	0	231,495	5	303			
50 - 55	1,398.8	10	572	-3,749,812	0	0	254,645	5	288			
55 - 60	1,526.0	6	378	-4,090,704	0	0	277,795	3	162			
60 - 65	1,653.1	6	362	-4,431,596	0	0	300,944	1	41			
65 - 70	1,780.3	5	283	-4,772,488	0	0	324,094	5	289			
70 - 75	1,907.5	5	287	-5,113,380	0	0	347,243	7	417			
75 - 80	2,034.6	4	244	-5,454,272	0	0	370,393	8	507			
80 - 85	2,161.8	2	117	-5,795,164	0	0	393,542	7	414			
85 - 90	2,288.9	3	185	-6,136,056	0	0	416,692	8	506			
90 - 95	2,416.1	3	184	-6,476,948	0	0	439,841	4	250			
95 - 100	2,543.3	1	46	-6,817,840	0	0	462,991	5	333			
Hours Off	0.0	0	2,895	0	0	4,836	0	0	2,556	No heating fan for selected system		

Alternative - 2 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	127.2	14	835	-340,892	37	1,438	23,150	12	757			
5 - 10	254.3	14	810	-681,784	63	2,453	46,299	9	563			
10 - 15	381.5	3	188	-1,022,676	1	33	69,449	8	516			
15 - 20	508.7	1	37	-1,363,568	0	0	92,598	4	239			
20 - 25	635.8	3	172	-1,704,460	0	0	115,748	1	81			
25 - 30	763.0	3	164	-2,045,352	0	0	138,897	0	0			
30 - 35	890.1	3	153	-2,386,244	0	0	162,047	0	0			
35 - 40	1,017.3	3	196	-2,727,136	0	0	185,196	2	126			
40 - 45	1,144.5	6	336	-3,068,028	0	0	208,346	7	412			
45 - 50	1,271.6	5	316	-3,408,920	0	0	231,495	5	303			
50 - 55	1,398.8	10	572	-3,749,812	0	0	254,645	5	288			
55 - 60	1,526.0	6	378	-4,090,704	0	0	277,795	3	162			
60 - 65	1,653.1	6	362	-4,431,596	0	0	300,944	1	41			
65 - 70	1,780.3	5	283	-4,772,488	0	0	324,094	5	289			
70 - 75	1,907.5	5	287	-5,113,380	0	0	347,243	7	417			
75 - 80	2,034.6	4	244	-5,454,272	0	0	370,393	8	507			
80 - 85	2,161.8	2	117	-5,795,164	0	0	393,542	7	414			
85 - 90	2,288.9	3	185	-6,136,056	0	0	416,692	8	506			
90 - 95	2,416.1	3	184	-6,476,948	0	0	439,841	4	250			
95 - 100	2,543.3	1	46	-6,817,840	0	0	462,991	5	333			
Hours Off	0.0	0	2,895	0	0	4,836	0	0	2,556	No heating fan for selected system		

System Report

FAU RCx

Alternative - 3 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	127.2	14	835	-340,892	37	1,438	23,150	12	757			
5 - 10	254.3	14	810	-681,784	63	2,453	46,299	9	563			
10 - 15	381.5	3	188	-1,022,676	1	33	69,449	8	516			
15 - 20	508.7	1	37	-1,363,568	0	0	92,598	4	239			
20 - 25	635.8	3	172	-1,704,460	0	0	115,748	1	81			
25 - 30	763.0	3	164	-2,045,352	0	0	138,897	0	0			
30 - 35	890.1	3	153	-2,386,244	0	0	162,047	0	0			
35 - 40	1,017.3	3	196	-2,727,136	0	0	185,196	2	126			
40 - 45	1,144.5	6	336	-3,068,028	0	0	208,346	7	412			
45 - 50	1,271.6	5	316	-3,408,920	0	0	231,495	5	303			
50 - 55	1,398.8	10	572	-3,749,812	0	0	254,645	5	288			
55 - 60	1,526.0	6	378	-4,090,704	0	0	277,795	3	162			
60 - 65	1,653.1	6	362	-4,431,596	0	0	300,944	1	41			
65 - 70	1,780.3	5	283	-4,772,488	0	0	324,094	5	289			
70 - 75	1,907.5	5	287	-5,113,380	0	0	347,243	7	417			
75 - 80	2,034.6	4	244	-5,454,272	0	0	370,393	8	507			
80 - 85	2,161.8	2	117	-5,795,164	0	0	393,542	7	414			
85 - 90	2,288.9	3	185	-6,136,056	0	0	416,692	8	506			
90 - 95	2,416.1	3	184	-6,476,948	0	0	439,841	4	250			
95 - 100	2,543.3	1	46	-6,817,840	0	0	462,991	5	333			
Hours Off	0.0	0	2,895	0	0	4,836	0	0	2,556	No heating fan for selected system		

Alternative - 3 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	127.2	14	835	-340,892	37	1,438	23,150	12	757			
5 - 10	254.3	14	810	-681,784	63	2,453	46,299	9	563			
10 - 15	381.5	3	188	-1,022,676	1	33	69,449	8	516			
15 - 20	508.7	1	37	-1,363,568	0	0	92,598	4	239			
20 - 25	635.8	3	172	-1,704,460	0	0	115,748	1	81			
25 - 30	763.0	3	164	-2,045,352	0	0	138,897	0	0			
30 - 35	890.1	3	153	-2,386,244	0	0	162,047	0	0			
35 - 40	1,017.3	3	196	-2,727,136	0	0	185,196	2	126			
40 - 45	1,144.5	6	336	-3,068,028	0	0	208,346	7	412			
45 - 50	1,271.6	5	316	-3,408,920	0	0	231,495	5	303			
50 - 55	1,398.8	10	572	-3,749,812	0	0	254,645	5	288			
55 - 60	1,526.0	6	378	-4,090,704	0	0	277,795	3	162			
60 - 65	1,653.1	6	362	-4,431,596	0	0	300,944	1	41			
65 - 70	1,780.3	5	283	-4,772,488	0	0	324,094	5	289			
70 - 75	1,907.5	5	287	-5,113,380	0	0	347,243	7	417			
75 - 80	2,034.6	4	244	-5,454,272	0	0	370,393	8	507			
80 - 85	2,161.8	2	117	-5,795,164	0	0	393,542	7	414			
85 - 90	2,288.9	3	185	-6,136,056	0	0	416,692	8	506			
90 - 95	2,416.1	3	184	-6,476,948	0	0	439,841	4	250			
95 - 100	2,543.3	1	46	-6,817,840	0	0	462,991	5	333			
Hours Off	0.0	0	2,895	0	0	4,836	0	0	2,556	No heating fan for selected system		

System Report

FAU RCx

Alternative - 4 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	127.2	14	835	-340,892	37	1,438	23,150	12	757			
5 - 10	254.3	14	810	-681,784	63	2,453	46,299	9	563			
10 - 15	381.5	3	188	-1,022,676	1	33	69,449	8	516			
15 - 20	508.7	1	37	-1,363,568	0	0	92,598	4	239			
20 - 25	635.8	3	172	-1,704,460	0	0	115,748	1	81			
25 - 30	763.0	3	164	-2,045,352	0	0	138,897	0	0			
30 - 35	890.1	3	153	-2,386,244	0	0	162,047	0	0			
35 - 40	1,017.3	3	196	-2,727,136	0	0	185,196	2	126			
40 - 45	1,144.5	6	336	-3,068,028	0	0	208,346	7	412			
45 - 50	1,271.6	5	316	-3,408,920	0	0	231,495	5	303			
50 - 55	1,398.8	10	572	-3,749,812	0	0	254,645	5	288			
55 - 60	1,526.0	6	378	-4,090,704	0	0	277,795	3	162			
60 - 65	1,653.1	6	362	-4,431,596	0	0	300,944	1	41			
65 - 70	1,780.3	5	283	-4,772,488	0	0	324,094	5	289			
70 - 75	1,907.5	5	287	-5,113,380	0	0	347,243	7	417			
75 - 80	2,034.6	4	244	-5,454,272	0	0	370,393	8	507			
80 - 85	2,161.8	2	117	-5,795,164	0	0	393,542	7	414			
85 - 90	2,288.9	3	185	-6,136,056	0	0	416,692	8	506			
90 - 95	2,416.1	3	184	-6,476,948	0	0	439,841	4	250			
95 - 100	2,543.3	1	46	-6,817,840	0	0	462,991	5	333			
Hours Off	0.0	0	2,895	0	0	4,836	0	0	2,556	No heating fan for selected system		

Alternative - 4 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	127.2	14	835	-340,892	37	1,438	23,150	12	757			
5 - 10	254.3	14	810	-681,784	63	2,453	46,299	9	563			
10 - 15	381.5	3	188	-1,022,676	1	33	69,449	8	516			
15 - 20	508.7	1	37	-1,363,568	0	0	92,598	4	239			
20 - 25	635.8	3	172	-1,704,460	0	0	115,748	1	81			
25 - 30	763.0	3	164	-2,045,352	0	0	138,897	0	0			
30 - 35	890.1	3	153	-2,386,244	0	0	162,047	0	0			
35 - 40	1,017.3	3	196	-2,727,136	0	0	185,196	2	126			
40 - 45	1,144.5	6	336	-3,068,028	0	0	208,346	7	412			
45 - 50	1,271.6	5	316	-3,408,920	0	0	231,495	5	303			
50 - 55	1,398.8	10	572	-3,749,812	0	0	254,645	5	288			
55 - 60	1,526.0	6	378	-4,090,704	0	0	277,795	3	162			
60 - 65	1,653.1	6	362	-4,431,596	0	0	300,944	1	41			
65 - 70	1,780.3	5	283	-4,772,488	0	0	324,094	5	289			
70 - 75	1,907.5	5	287	-5,113,380	0	0	347,243	7	417			
75 - 80	2,034.6	4	244	-5,454,272	0	0	370,393	8	507			
80 - 85	2,161.8	2	117	-5,795,164	0	0	393,542	7	414			
85 - 90	2,288.9	3	185	-6,136,056	0	0	416,692	8	506			
90 - 95	2,416.1	3	184	-6,476,948	0	0	439,841	4	250			
95 - 100	2,543.3	1	46	-6,817,840	0	0	462,991	5	333			
Hours Off	0.0	0	2,895	0	0	4,836	0	0	2,556	No heating fan for selected system		

Equipment Energy Consumption Report

FAU RCx

Alternative - 1

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Base utility		Gas(thm)	107	97	117	102	112	112	102	117	102	112	107	102	1,289
Lights		Elec(kWh)	338,893	306,417	358,756	324,757	348,824	344,620	328,961	358,756	324,757	348,824	334,688	328,961	4,047,214
MISC LD		Elec(kWh)	36,782	33,279	40,285	35,031	38,534	38,534	35,031	40,285	35,031	38,534	36,782	35,031	443,138
Fans:															
System 1		Elec(kWh)	151,252	139,437	169,451	170,446	179,304	180,808	186,706	201,330	172,095	165,961	151,779	152,815	2,021,383
Cooling:															
P1	Centrifugal 2-Stage	Elec(kWh)	159,033	126,818	213,823	227,227	255,926	235,184	259,069	274,427	238,563	246,431	221,567	206,549	2,664,619
	Cooling tower for Cent. Chillers	Elec(kWh)	146,257	126,241	146,257	141,539	146,257	141,539	146,257	146,257	141,539	146,257	141,539	146,257	1,716,196
	Cooling accessories	Elec(kWh)	206,832	186,816	206,833	200,160	206,832	200,160	206,832	206,833	200,160	206,832	200,160	206,832	2,435,285
	Centrifugal 2-Stage	Elec(kWh)	31,444	28,137	111,402	119,366	141,807	235,184	259,069	274,427	238,563	144,114	106,624	66,346	1,756,482
	Cooling accessories	Elec(kWh)	8,442	7,638	24,053	25,460	28,475	48,240	49,848	49,848	48,240	30,552	22,311	15,008	358,118
	Centrifugal 2-Stage	Elec(kWh)	0	0	0	30,713	44,693	91,636	119,872	122,644	95,800	29,552	0	0	534,911
	Cooling accessories	Elec(kWh)	0	0	0	6,700	8,844	15,946	19,899	19,162	16,750	6,231	0	0	93,533
Heating:															
P1	Gas Fired Hot Water Boiler	Gas(thm)	9,433	7,773	5,674	4,827	4,689	3,949	3,722	3,387	3,952	5,244	6,372	7,752	66,774
	Heating accessories	Elec(kWh)	14,783	13,353	14,783	14,307	14,783	14,307	14,783	14,783	14,307	14,783	14,307	14,783	174,063
Utility Summary:			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Electrical Consumption		Peak(kWh)	278,323	244,856	346,689	461,138	526,498	579,582	549,208	646,799	528,765	506,966	315,999	287,552	5,272,376
		Off Peak(kWh)	815,395	723,280	938,954	834,568	887,784	966,577	1,077,120	1,061,954	997,040	871,106	913,758	885,031	10,972,570
Electrical Demand		Peak (kW)	2,479	2,395	2,888	3,792	3,906	4,175	4,288	4,386	4,161	3,747	2,823	2,806	4,386
		Off Peak (kW)	2,985	3,037	3,600	3,363	3,477	3,705	3,858	3,871	3,704	3,314	3,541	3,227	3,871
Gas Consumption		Peak(thm)	9,540	7,870	5,791	4,929	4,801	4,061	3,824	3,504	4,053	5,357	6,479	7,854	68,063
Gas Demand		Peak (thm/hr)	38	40	32	30	29	24	10	8	26	30	34	35	40
Water Consumption		(kgals)	1,471	1,175	2,422	2,751	3,147	3,790	4,221	4,389	3,848	3,009	2,427	2,068	34,717

Equipment Energy Consumption Report

FAU RCx

Alternative - 2

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Base utility		Gas(thm)	107	97	117	102	112	112	102	117	102	112	107	102	1,289
Lights		Elec(kWh)	338,893	306,417	358,756	324,757	348,824	344,620	328,961	358,756	324,757	348,824	334,688	328,961	4,047,214
MISC LD		Elec(kWh)	36,782	33,279	40,285	35,031	38,534	38,534	35,031	40,285	35,031	38,534	36,782	35,031	443,138
Fans:															
System 1		Elec(kWh)	89,986	85,392	128,741	126,552	141,151	149,238	139,682	162,774	129,851	123,801	104,776	91,625	1,473,568
Cooling:															
P1	Centrifugal 2-Stage	Elec(kWh)	85,630	79,193	127,080	124,419	143,025	161,733	163,470	180,067	149,257	134,283	120,021	103,596	1,571,774
	Cooling tower for Cent. Chillers	Elec(kWh)	66,024	71,473	100,608	104,146	107,683	103,752	110,827	106,896	103,163	103,163	91,766	81,941	1,151,441
	Cooling accessories	Elec(kWh)	93,399	102,572	142,322	147,326	152,329	146,770	156,777	151,217	145,936	145,936	129,813	115,915	1,630,311
	Centrifugal 2-Stage	Elec(kWh)	48,078	33,553	109,382	102,829	121,372	139,536	130,541	155,881	124,387	118,461	100,496	75,331	1,259,845
	Cooling accessories	Elec(kWh)	13,194	9,108	23,374	21,431	23,574	23,574	21,431	24,646	21,431	23,574	20,226	16,274	241,839
	Centrifugal 2-Stage	Elec(kWh)	0	0	0	30,863	40,829	80,851	100,462	109,942	86,400	29,772	0	0	479,119
	Cooling accessories	Elec(kWh)	0	0	0	6,697	7,903	13,796	16,408	17,212	14,935	6,228	0	0	83,180
Heating:															
P1	Gas Fired Hot Water Boiler	Gas(thm)	1,686	1,595	1,628	1,429	1,562	1,468	1,305	1,408	1,227	1,375	1,399	1,387	17,468
	Heating accessories	Elec(kWh)	6,674	6,038	7,230	6,277	6,555	6,555	5,959	6,853	5,959	6,892	6,594	6,356	77,941
Utility Summary:			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Electrical Consumption		Peak(kWh)	279,004	242,423	345,669	464,914	530,463	582,103	551,021	648,881	531,636	511,096	312,842	287,719	5,287,771
		Off Peak(kWh)	499,655	484,602	692,108	565,413	601,316	626,857	658,527	665,649	609,471	568,373	632,321	567,310	7,171,602
Electrical Demand		Peak (kW)	2,812	2,558	2,963	3,784	3,899	4,167	4,279	4,375	4,149	3,739	2,973	3,091	4,375
		Off Peak (kW)	2,987	3,120	3,590	3,435	3,555	3,797	3,954	3,967	3,745	3,356	3,533	3,311	3,967
Gas Consumption		Peak(thm)	1,793	1,692	1,745	1,531	1,674	1,580	1,407	1,525	1,329	1,487	1,506	1,488	18,757
Gas Demand		Peak (thm/hr)	12	8	6	6	6	6	6	6	6	6	6	6	12
Water Consumption		(kgals)	1,051	892	1,723	1,819	2,111	2,509	2,517	2,834	2,338	1,971	1,586	1,328	22,680

Equipment Energy Consumption Report

FAU RCx

Alternative - 3

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Base utility		Gas(thm)	107	97	117	102	112	112	102	117	102	112	107	102	1,289
Lights		Elec(kWh)	338,893	306,417	358,756	324,757	348,824	344,620	328,961	358,756	324,757	348,824	334,688	328,961	4,047,214
MISC LD		Elec(kWh)	36,782	33,279	40,285	35,031	38,534	38,534	35,031	40,285	35,031	38,534	36,782	35,031	443,138
Fans:															
System 1		Elec(kWh)	89,986	85,392	128,741	126,552	141,151	149,238	139,682	162,774	129,851	123,801	104,776	91,625	1,473,568
Cooling:															
P1	Centrifugal 2-Stage	Elec(kWh)	85,630	79,193	127,080	124,419	143,025	161,733	163,470	180,067	149,257	134,283	120,021	103,596	1,571,774
	Cooling tower for Cent. Chillers	Elec(kWh)	66,024	71,473	100,608	104,146	107,683	103,752	110,827	106,896	103,163	103,163	91,766	81,941	1,151,441
	Cooling accessories	Elec(kWh)	31,025	32,008	50,155	53,979	59,559	67,090	71,729	75,655	65,077	55,373	46,024	39,686	647,361
	Centrifugal 2-Stage	Elec(kWh)	48,078	33,553	109,382	102,829	121,372	139,536	130,541	155,881	124,387	118,461	100,496	75,331	1,259,845
	Cooling accessories	Elec(kWh)	13,194	9,108	23,374	21,431	23,574	23,574	21,431	24,646	21,431	23,574	20,226	16,274	241,839
	Centrifugal 2-Stage	Elec(kWh)	0	0	0	30,863	40,829	80,851	100,462	109,942	86,400	29,772	0	0	479,119
	Cooling accessories	Elec(kWh)	0	0	0	6,697	7,903	13,796	16,408	17,212	14,935	6,228	0	0	83,180
Heating:															
P1	Gas Fired Hot Water Boiler	Gas(thm)	1,686	1,595	1,628	1,429	1,562	1,468	1,305	1,408	1,227	1,375	1,399	1,387	17,468
	Heating accessories	Elec(kWh)	6,674	6,038	7,230	6,277	6,555	6,555	5,959	6,853	5,959	6,892	6,594	6,356	77,941
Utility Summary:			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Electrical Consumption		Peak(kWh)	250,842	216,526	316,461	437,525	502,416	559,603	533,050	629,798	511,680	481,510	286,237	262,175	4,987,822
		Off Peak(kWh)	465,443	439,935	629,149	499,456	536,593	569,677	591,450	609,170	548,569	507,396	575,136	516,626	6,488,601
Electrical Demand		Peak (kW)	2,632	2,367	2,793	3,665	3,796	4,100	4,226	4,337	4,082	3,620	2,803	2,933	4,337
		Off Peak (kW)	2,818	2,953	3,451	3,298	3,434	3,707	3,885	3,900	3,650	3,215	3,396	3,159	3,900
Gas Consumption		Peak(thm)	1,793	1,692	1,745	1,531	1,674	1,580	1,407	1,525	1,329	1,487	1,506	1,488	18,757
Gas Demand		Peak (thm/hr)	12	8	6	6	6	6	6	6	6	6	6	6	12
Water Consumption		(kgals)	1,051	892	1,723	1,819	2,111	2,509	2,517	2,834	2,338	1,971	1,586	1,328	22,680

Equipment Energy Consumption Report

FAU RCx

Alternative - 4

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Base utility		Gas(thm)	107	97	117	102	112	112	102	117	102	112	107	102	1,289
Lights		Elec(kWh)	338,893	306,417	358,756	324,757	348,824	344,620	328,961	358,756	324,757	348,824	334,688	328,961	4,047,214
MISC LD		Elec(kWh)	36,782	33,279	40,285	35,031	38,534	38,534	35,031	40,285	35,031	38,534	36,782	35,031	443,138
Fans:															
System 1		Elec(kWh)	89,986	85,392	128,741	126,552	141,151	149,238	139,682	162,774	129,851	123,801	104,776	91,625	1,473,568
Cooling:															
P1	Centrifugal 2-Stage	Elec(kWh)	85,630	79,193	127,080	124,419	143,025	161,733	163,470	180,067	149,257	134,283	120,021	103,596	1,571,774
	Cooling tower for Cent. Chillers	Elec(kWh)	66,024	71,473	100,608	104,146	107,683	103,752	110,827	106,896	103,163	103,163	91,766	81,941	1,151,441
	Cooling accessories	Elec(kWh)	31,025	32,008	50,155	53,979	59,559	67,090	71,729	75,655	65,077	55,373	46,024	39,686	647,361
	Centrifugal 2-Stage	Elec(kWh)	48,078	33,553	109,382	102,829	121,372	139,536	130,541	155,881	124,387	118,461	100,496	75,331	1,259,845
	Cooling accessories	Elec(kWh)	13,194	9,108	23,374	21,431	23,574	23,574	21,431	24,646	21,431	23,574	20,226	16,274	241,839
	Centrifugal 2-Stage	Elec(kWh)	0	0	0	30,863	40,829	80,851	100,462	109,942	86,400	29,772	0	0	479,119
	Cooling accessories	Elec(kWh)	0	0	0	6,697	7,903	13,796	16,408	17,212	14,935	6,228	0	0	83,180
Heating:															
P1	Gas Fired Hot Water Boiler	Gas(thm)	1,686	1,595	1,628	1,429	1,562	1,468	1,305	1,408	1,227	1,375	1,399	1,387	17,468
	Heating accessories	Elec(kWh)	6,674	6,038	7,230	6,277	6,555	6,555	5,959	6,853	5,959	6,892	6,594	6,356	77,941
Utility Summary:			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Electrical Consumption		Peak(kWh)	250,842	216,526	316,461	437,525	502,416	559,603	533,050	629,798	511,680	481,510	286,237	262,175	4,987,822
		Off Peak(kWh)	465,443	439,935	629,149	499,456	536,593	569,677	591,450	609,170	548,569	507,396	575,136	516,626	6,488,601
Electrical Demand		Peak (kW)	2,632	2,367	2,793	3,665	3,796	4,100	4,226	4,337	4,082	3,620	2,803	2,933	4,337
		Off Peak (kW)	2,818	2,953	3,451	3,298	3,434	3,707	3,885	3,900	3,650	3,215	3,396	3,159	3,900
Gas Consumption		Peak(thm)	1,793	1,692	1,745	1,531	1,674	1,580	1,407	1,525	1,329	1,487	1,506	1,488	18,757
Gas Demand		Peak (thm/hr)	12	8	6	6	6	6	6	6	6	6	6	6	12
Water Consumption		(kgals)	1,051	892	1,723	1,819	2,111	2,509	2,517	2,834	2,338	1,971	1,586	1,328	22,680

Utility Cost Summary Report

Monthly Utility Costs

Alternative - 1

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	19,622	17,262	24,442	32,510	37,118	40,861	38,719	45,599	37,278	35,741	22,278	20,272	371,703
	Off Pk ($)	29,044	25,783	33,418	29,723	31,607	34,396	38,309	37,772	35,474	31,016	32,526	31,509	390,577
	Sub Total($)	**48,666**	**43,045**	**57,860**	**62,233**	**68,725**	**75,256**	**77,028**	**83,371**	**72,752**	**66,757**	**54,804**	**51,782**	**762,279**
Electric Demand	On Pk ($)	37,358	36,087	43,516	57,138	58,871	62,922	64,615	66,094	62,703	56,464	42,547	42,281	630,596
	Sub Total($)	**37,358**	**36,087**	**43,516**	**57,138**	**58,871**	**62,922**	**64,615**	**66,094**	**62,703**	**56,464**	**42,547**	**42,281**	**630,596**
Gas	On Pk ($)	8,159	6,739	4,972	4,240	4,131	3,502	3,300	3,029	3,495	4,603	5,557	6,726	58,454
	Sub Total($)	**8,159**	**6,739**	**4,972**	**4,240**	**4,131**	**3,502**	**3,300**	**3,029**	**3,495**	**4,603**	**5,557**	**6,726**	**58,454**
Monthly Total ($)		**94,183**	**85,872**	**106,348**	**123,611**	**131,726**	**141,680**	**144,943**	**152,494**	**138,951**	**127,824**	**102,908**	**100,789**	**1,451,329**

Alternative - 2

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	19,670	17,091	24,370	32,776	37,398	41,038	38,847	45,746	37,480	36,032	22,055	20,284	372,788
	Off Pk ($)	17,867	17,334	24,680	20,195	21,466	22,370	23,491	23,743	21,754	20,299	22,563	20,262	256,023
	Sub Total($)	**37,537**	**34,425**	**49,049**	**52,971**	**58,863**	**63,408**	**62,338**	**69,489**	**59,235**	**56,332**	**44,619**	**40,546**	**628,811**
Electric Demand	On Pk ($)	42,378	38,550	44,654	57,025	58,757	62,795	64,481	65,934	62,530	56,342	44,796	46,586	644,827
	Sub Total($)	**42,378**	**38,550**	**44,654**	**57,025**	**58,757**	**62,795**	**64,481**	**65,934**	**62,530**	**56,342**	**44,796**	**46,586**	**644,827**
Gas	On Pk ($)	1,574	1,488	1,533	1,352	1,473	1,393	1,246	1,346	1,180	1,314	1,330	1,315	16,544
	Sub Total($)	**1,574**	**1,488**	**1,533**	**1,352**	**1,473**	**1,393**	**1,246**	**1,346**	**1,180**	**1,314**	**1,330**	**1,315**	**16,544**
Monthly Total ($)		**81,489**	**74,463**	**95,236**	**111,348**	**119,094**	**127,596**	**128,065**	**136,769**	**122,944**	**113,987**	**90,744**	**88,447**	**1,290,181**

Alternative - 3

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	17,684	15,265	22,311	30,845	35,420	39,452	37,580	44,401	36,073	33,946	20,180	18,483	351,642
	Off Pk ($)	16,656	15,753	22,451	17,860	19,174	20,346	21,116	21,744	19,598	18,141	20,539	18,468	231,844
	Sub Total($)	**34,340**	**31,018**	**44,761**	**48,705**	**54,595**	**59,798**	**58,696**	**66,144**	**55,672**	**52,087**	**40,719**	**36,951**	**583,486**
Electric Demand	On Pk ($)	39,667	35,669	42,088	55,234	57,212	61,786	63,686	65,353	61,510	54,558	42,242	44,204	623,208
	Sub Total($)	**39,667**	**35,669**	**42,088**	**55,234**	**57,212**	**61,786**	**63,686**	**65,353**	**61,510**	**54,558**	**42,242**	**44,204**	**623,208**
Gas	On Pk ($)	1,574	1,488	1,533	1,352	1,473	1,393	1,246	1,346	1,180	1,314	1,330	1,315	16,544
	Sub Total($)	**1,574**	**1,488**	**1,533**	**1,352**	**1,473**	**1,393**	**1,246**	**1,346**	**1,180**	**1,314**	**1,330**	**1,315**	**16,544**
Monthly Total ($)		**75,582**	**68,174**	**88,382**	**105,291**	**113,280**	**122,976**	**123,628**	**132,843**	**118,361**	**107,959**	**84,291**	**82,470**	**1,223,238**

Utility Cost Summary Report

Monthly Utility Costs

Alternative - 4

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	16,832	14,529	21,235	29,358	33,712	37,549	35,768	42,259	34,334	32,309	19,207	17,592	334,683
	Off Pk ($)	23,893	22,661	31,800	25,536	27,329	28,927	29,979	30,835	27,908	25,919	29,191	26,365	330,343
	Sub Total($)	**40,724**	**37,190**	**53,034**	**54,894**	**61,042**	**66,477**	**65,747**	**73,094**	**62,242**	**58,229**	**48,398**	**43,957**	**665,026**
Electric Demand	On Pk ($)	29,876	26,864	31,699	41,600	43,090	46,534	47,965	49,221	46,326	41,090	31,815	33,292	469,370
	Sub Total($)	**29,876**	**26,864**	**31,699**	**41,600**	**43,090**	**46,534**	**47,965**	**49,221**	**46,326**	**41,090**	**31,815**	**33,292**	**469,370**
Gas	On Pk ($)	1,574	1,488	1,533	1,352	1,473	1,393	1,246	1,346	1,180	1,314	1,330	1,315	16,544
	Sub Total($)	**1,574**	**1,488**	**1,533**	**1,352**	**1,473**	**1,393**	**1,246**	**1,346**	**1,180**	**1,314**	**1,330**	**1,315**	**16,544**
Monthly Total ($)		**72,174**	**65,542**	**86,266**	**97,845**	**105,604**	**114,404**	**114,957**	**123,661**	**109,747**	**100,633**	**81,542**	**78,564**	**1,150,940**

Title / Summary Report

FAU Solar ESCO

Location: West Palm Beach, Florida

	Alternative - 1	Alternative - 2
Alternative Description	Alternative - 1	Rx Schedule and VAV Minimums
Building Template	College/University	College/University
Building Floor Area	59,400 ft²	59,400 ft²
System #1	Variable Volume Reheat (30% Min Flow Default)	Variable Volume Reheat (30% Min Flow Default)
Max Clg Load	220.4 ton	219.9 ton
Max Htg Load	1,011.4 MBh	719.0 MBh
System #2		
Max Clg Load		
Max Htg Load		
Opt Ventilation Clg Load		
Opt Ventilation Htg Load		
Total Building Clg Load	220.4 ton	219.9 ton
Total Building Htg Load	1,011.4 MBh	719.0 MBh
Plant #1		
Clg Equipment Type #1	Centrifugal 2-Stage	Centrifugal 2-Stage
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type	Gas Fired Hot Water Boiler	Gas Fired Hot Water Boiler
Plant #2		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
MAU Plant #3		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
Building Clg Coil Load	945,925 ton·hrs/year	578,936 ton·hrs/year
Building Htg Coil Load	-1,978,710 kBtu/year	-1,532 kBtu/year
Building Energy Usage	120,039 Btu/ft²·year	60,279 Btu/ft²·year
Building Energy Cost	2.326 $/ft²·year	1.824 $/ft²·year

	Alternative - 3	Alternative - 4
Alternative Description	Variable Flow Pumping	GSLDT-3
Building Template	College/University	College/University
Building Floor Area	59,400 ft²	59,400 ft²
System #1	Same as Alt - 2	Same as Alt - 2
Max Clg Load		
Max Htg Load		
System #2	Same as Alt - 2	Same as Alt - 2
Max Clg Load		
Max Htg Load		
Opt Ventilation Clg Load		
Opt Ventilation Htg Load		
Total Building Clg Load		
Total Building Htg Load		
Plant #1		
Clg Equipment Type #1	Centrifugal 2-Stage	Centrifugal 2-Stage
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type	Gas Fired Hot Water Boiler	Gas Fired Hot Water Boiler
Plant #2		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
MAU Plant #3		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
Building Clg Coil Load	578,936 ton·hrs/year	578,936 ton·hrs/year
Building Htg Coil Load	-1,532 kBtu/year	-1,532 kBtu/year
Building Energy Usage	57,356 Btu/ft²·year	57,356 Btu/ft²·year
Building Energy Cost	1.774 $/ft²·year	1.905 $/ft²·year

Title / Summary Report

FAU Solar ESCO

Location: West Palm Beach, Florida

Life Cycle Payback on Investment

	Alt 1 vs 2	Alt 1 vs 3	Alt 1 vs 4	Alt 2 vs 3
Internal Rate of Return	0.0 %	0.0 %	0.0 %	0.0 %
Life Cycle Cost Difference	-$361,015	-$397,347	-$303,215	-$36,331
Net Present Value of Cash Flow	-$361,015	-$397,347	-$303,215	-$36,331
Life Cycle Payback on Invest.	NA	NA	NA	NA
Simple Payback on Invest.	NA	NA	NA	NA

	Alt 2 vs 4	Alt 3 vs 4
Internal Rate of Return	1,000.0 %	1,000.0 %
Life Cycle Cost Difference	$57,800	$94,132
Net Present Value of Cash Flow	$57,800	$94,132
Life Cycle Payback on Invest.	NA	NA
Simple Payback on Invest.	NA	NA

Environmental Impact Analysis

	Alt 1	Alt 2	Alt 3	Alt 4
CO2 Impact	6,873,481 lbm/year	4,364,958 lbm/year	4,148,192 lbm/year	4,148,192 lbm/year
SO2 Impact	29,231 gm/year	18,563 gm/year	17,641 gm/year	17,641 gm/year
NOX Impact	16,280 gm/year	10,338 gm/year	9,825 gm/year	9,825 gm/year

Energy Star Building Label Benchmarking Tool

	Alt - 1	Alt - 2	Alt - 3	Alt - 4
Building Floor Area	59,400 ft²	59,400 ft²	59,400 ft²	59,400 ft²
Weekly Operating Hours	168 hrs	73 hrs	73 hrs	73 hrs
Number of Occupants	2,970 People	2,970 People	2,970 People	2,970 People
Annual Electric Consumption	1,355,407 kWh	1,010,782 kWh	959,918 kWh	959,918 kWh
Annual Gas Consumption	25,043 therms	1,308 therms	1,308 therms	1,308 therms
Annual Oil Consumption	0 therms	0 therms	0 therms	0 therms
Annual Steam Consumption	0 therms	0 therms	0 therms	0 therms

Design Load Summary Report

FAU Solar ESCO

Location: West Palm Beach, Florida
Summer Design DB: 92.3 °F
Summer Design WB: 79.2 °F
Winter Design DB: 45.0 °F

	Alternative - 1				Alternative - 2			
	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)
Envelope Loads								
Skylight Solar	0	0.0	0	0.0	0	0.0	0	0.0
Skylight Conduction	0	0.0	0	0.0	0	0.0	0	0.0
Roof Conduction	121,054	4.6	-88,290	8.7	121,033	4.6	-86,261	12.0
Glass Solar	287,923	10.9	0	0.0	287,923	10.9	0	0.0
Glass Conduction	77,295	2.9	-137,513	13.6	77,295	2.9	-137,513	19.1
Wall Conduction	49,146	1.9	-48,813	4.8	49,143	1.9	-48,559	6.8
Infiltration	0	0.0	0	0.0	0	0.0	0	0.0
Sub Total:	**535,417**	**20.2**	**-274,616**	**27.15**	**535,394**	**20.3**	**-272,332**	**37.88**
Internal Loads								
Lights	254,649	9.6	0	0.0	254,649	9.7	0	0.0
People	1,284,924	48.6	0	0.0	1,279,454	48.5	0	0.0
Miscellaneous	41,705	1.6	0	0.0	41,705	1.6	0	0.0
Sub Total:	**1,581,277**	**59.8**	**0**	**0.0**	**1,575,807**	**59.7**	**0**	**0.0**
Ventilation Load **	342,635	13.0	-164,785	16.3	342,387	13.0	-164,785	22.9
Exhaust Heat	-18,721	-0.7	10,271	-1.0	-18,757	-0.7	13,823	-1.9
Reheat	0	0.0	0	0.0	0	0.0	0	0.0
Fan Heat	204,258	7.7	0	0.0	203,463	7.7	0	0.0
User Oversizing	0	0.0	0	0.0	0	0.0	0	0.0
Grand Total:	**2,644,866**	**100.0**	**-1,011,433**	**100.0**	**2,638,294**	**100.0**	**-719,001**	**100.0**
Main Coil Capacities:	**220.4 tons**		**-1,011 MBh**		**219.9 tons**		**-719 MBh**	
MAU Capacity:	**N/A**		**N/A**		**N/A**		**N/A**	

	Alternative - 3				Alternative - 4			
	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)
Envelope Loads								
Skylight Solar								
Skylight Conduction								
Roof Conduction								
Glass Solar								
Glass Conduction								
Wall Conduction								
Infiltration								
Sub Total:	Same As Alt - 2				Same As Alt - 2			
Internal Loads								
Lights								
People								
Miscellaneous								
Sub Total:								
Ventilation Load **								
Exhaust Heat								
Reheat								
Fan Heat								
User Oversizing								
Grand Total:								
Main Coil Capacities:			**-719 MBh**				**-719 MBh**	
MAU Capacity:	**N/A**		**N/A**		**N/A**		**N/A**	

** Includes the impact of optional ventilation

System Report

FAU Solar ESCO

Monthly Coil Loads

	Alternative - 1		Alternative - 2		Alternative - 3		Alternative - 4	
	Cooling Coil Load ton-hrs	Heating Coil Load kBtu	Cooling Coil Load ton-hrs	Heating Coil Load kBtu	Cooling Coil Load ton-hrs	Heating Coil Load kBtu	Cooling Coil Load ton-hrs	Heating Coil Load kBtu
January	66,043	-236,009	36,253	-840	36,253	-840	36,253	-840
February	58,494	-200,709	33,069	-692	33,069	-692	33,069	-692
March	76,827	-161,416	49,109	0	49,109	0	49,109	0
April	77,400	-153,406	48,126	0	48,126	0	48,126	0
May	83,038	-148,058	53,046	0	53,046	0	53,046	0
June	87,001	-124,898	57,052	0	57,052	0	57,052	0
July	90,906	-138,120	55,674	0	55,674	0	55,674	0
August	94,018	-120,455	61,404	0	61,404	0	61,404	0
September	85,982	-135,747	52,705	0	52,705	0	52,705	0
October	81,033	-160,543	50,155	0	50,155	0	50,155	0
November	73,652	-183,375	43,047	0	43,047	0	43,047	0
December	71,532	-215,974	39,295	0	39,295	0	39,295	0
Total:	**945,925**	**-1,978,710**	**578,936**	**-1,532**	**578,936**	**-1,532**	**578,936**	**-1,532**

System Airflows

	Alternative - 1	Alternative - 2	Alternative - 3	Alternative - 4
System #1				
System Type	Variable Volume Reheat (30% Min Flow Default)	Variable Volume Reheat (30% Min Flow Default)	Variable Volume Reheat (30% Min Flow Default)	Variable Volume Reheat (30% Min Flow Default)
Outside Airflow	5,475 cfm	5,475 cfm	5,475 cfm	5,475 cfm
Cooling Supply Airflow	65,161 cfm	64,907 cfm	64,907 cfm	64,907 cfm
Heating Supply Airflow	36,074 cfm	21,562 cfm	21,562 cfm	21,562 cfm
System #2				
System Type				
Outside Airflow				
Cooling Supply Airflow				
Heating Supply Airflow				
Optional Ventilation Unit				
Cooling Supply Airflow				
Heating Supply Airflow				

System Report

FAU Solar ESCO

Alternative - 1 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	11.0	0	0	-50,572	22	1,634	3,258	0	0			
5 - 10	22.0	0	0	-101,143	8	603	6,516	0	0			
10 - 15	33.1	0	0	-151,715	7	549	9,774	0	0			
15 - 20	44.1	0	0	-202,287	5	354	13,032	0	0			
20 - 25	55.1	0	0	-252,858	8	586	16,290	0	0			
25 - 30	66.1	1	130	-303,430	8	576	19,548	0	0			
30 - 35	77.1	8	721	-354,001	6	419	22,806	0	0			
35 - 40	88.2	18	1,615	-404,573	6	477	26,064	0	0			
40 - 45	99.2	23	2,032	-455,145	9	689	29,322	0	0			
45 - 50	110.2	17	1,487	-505,716	10	779	32,580	0	0			
50 - 55	121.2	9	765	-556,288	6	464	35,838	0	0			
55 - 60	132.2	4	386	-606,860	4	301	39,096	83	7,238			
60 - 65	143.3	4	354	-657,431	1	83	42,354	3	257			
65 - 70	154.3	3	250	-708,003	0	0	45,612	0	0			
70 - 75	165.3	3	272	-758,575	0	0	48,871	1	121			
75 - 80	176.3	2	157	-809,146	0	0	52,129	5	401			
80 - 85	187.3	3	275	-859,718	0	0	55,387	5	444			
85 - 90	198.4	3	247	-910,289	0	0	58,645	3	299			
90 - 95	209.4	1	69	-960,861	0	0	61,903	0	0			
95 - 100	220.4	0	0	-1,011,433	0	0	65,161	0	0			
Hours Off	0.0	0	0	0	0	1,246	0	0	0	No heating fan for selected system		

Alternative - 1 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	11.0	0	0	-50,572	22	1,634	3,258	0	0			
5 - 10	22.0	0	0	-101,143	8	603	6,516	0	0			
10 - 15	33.1	0	0	-151,715	7	549	9,774	0	0			
15 - 20	44.1	0	0	-202,287	5	354	13,032	0	0			
20 - 25	55.1	0	0	-252,858	8	586	16,290	0	0			
25 - 30	66.1	1	130	-303,430	8	576	19,548	0	0			
30 - 35	77.1	8	721	-354,001	6	419	22,806	0	0			
35 - 40	88.2	18	1,615	-404,573	6	477	26,064	0	0			
40 - 45	99.2	23	2,032	-455,145	9	689	29,322	0	0			
45 - 50	110.2	17	1,487	-505,716	10	779	32,580	0	0			
50 - 55	121.2	9	765	-556,288	6	464	35,838	0	0			
55 - 60	132.2	4	386	-606,860	4	301	39,096	83	7,238			
60 - 65	143.3	4	354	-657,431	1	83	42,354	3	257			
65 - 70	154.3	3	250	-708,003	0	0	45,612	0	0			
70 - 75	165.3	3	272	-758,575	0	0	48,871	1	121			
75 - 80	176.3	2	157	-809,146	0	0	52,129	5	401			
80 - 85	187.3	3	275	-859,718	0	0	55,387	5	444			
85 - 90	198.4	3	247	-910,289	0	0	58,645	3	299			
90 - 95	209.4	1	69	-960,861	0	0	61,903	0	0			
95 - 100	220.4	0	0	-1,011,433	0	0	65,161	0	0			
Hours Off	0.0	0	0	0	0	1,246	0	0	0	No heating fan for selected system		

System Report

FAU Solar ESCO

Alternative - 2 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	11.0	23	1,411	-35,950	65	35	3,245	26	1,683			
5 - 10	22.0	10	578	-71,900	35	19	6,491	8	482			
10 - 15	33.0	4	233	-107,850	0	0	9,736	6	385			
15 - 20	44.0	0	0	-143,800	0	0	12,981	0	16			
20 - 25	55.0	0	0	-179,750	0	0	16,227	0	0			
25 - 30	66.0	1	42	-215,700	0	0	19,472	0	0			
30 - 35	77.0	4	236	-251,650	0	0	22,718	0	13			
35 - 40	87.9	4	213	-287,600	0	0	25,963	3	198			
40 - 45	98.9	3	202	-323,550	0	0	29,208	4	277			
45 - 50	109.9	3	151	-359,500	0	0	32,454	3	208			
50 - 55	120.9	4	213	-395,450	0	0	35,699	3	197			
55 - 60	131.9	4	242	-431,400	0	0	38,944	3	165			
60 - 65	142.9	4	246	-467,350	0	0	42,190	3	215			
65 - 70	153.9	5	300	-503,300	0	0	45,435	2	96			
70 - 75	164.9	5	284	-539,250	0	0	48,681	5	297			
75 - 80	175.9	7	447	-575,200	0	0	51,926	5	314			
80 - 85	186.9	10	579	-611,150	0	0	55,171	7	476			
85 - 90	197.9	8	512	-647,100	0	0	58,417	12	735			
90 - 95	208.9	2	135	-683,050	0	0	61,662	3	198			
95 - 100	219.9	0	0	-719,000	0	0	64,907	6	413			
Hours Off	0.0	0	2,736	0	0	8,706	0	0	2,392	No heating fan for selected system		

Alternative - 2 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	11.0	23	1,411	-35,950	65	35	3,245	26	1,683			
5 - 10	22.0	10	578	-71,900	35	19	6,491	8	482			
10 - 15	33.0	4	233	-107,850	0	0	9,736	6	385			
15 - 20	44.0	0	0	-143,800	0	0	12,981	0	16			
20 - 25	55.0	0	0	-179,750	0	0	16,227	0	0			
25 - 30	66.0	1	42	-215,700	0	0	19,472	0	0			
30 - 35	77.0	4	236	-251,650	0	0	22,718	0	13			
35 - 40	87.9	4	213	-287,600	0	0	25,963	3	198			
40 - 45	98.9	3	202	-323,550	0	0	29,208	4	277			
45 - 50	109.9	3	151	-359,500	0	0	32,454	3	208			
50 - 55	120.9	4	213	-395,450	0	0	35,699	3	197			
55 - 60	131.9	4	242	-431,400	0	0	38,944	3	165			
60 - 65	142.9	4	246	-467,350	0	0	42,190	3	215			
65 - 70	153.9	5	300	-503,300	0	0	45,435	2	96			
70 - 75	164.9	5	284	-539,250	0	0	48,681	5	297			
75 - 80	175.9	7	447	-575,200	0	0	51,926	5	314			
80 - 85	186.9	10	579	-611,150	0	0	55,171	7	476			
85 - 90	197.9	8	512	-647,100	0	0	58,417	12	735			
90 - 95	208.9	2	135	-683,050	0	0	61,662	3	198			
95 - 100	219.9	0	0	-719,000	0	0	64,907	6	413			
Hours Off	0.0	0	2,736	0	0	8,706	0	0	2,392	No heating fan for selected system		

System Report

FAU Solar ESCO

Alternative - 3 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	11.0	23	1,411	-35,950	65	35	3,245	26	1,683			
5 - 10	22.0	10	578	-71,900	35	19	6,491	8	482			
10 - 15	33.0	4	233	-107,850	0	0	9,736	6	385			
15 - 20	44.0	0	0	-143,800	0	0	12,981	0	16			
20 - 25	55.0	0	0	-179,750	0	0	16,227	0	0			
25 - 30	66.0	1	42	-215,700	0	0	19,472	0	0			
30 - 35	77.0	4	236	-251,650	0	0	22,718	0	13			
35 - 40	87.9	4	213	-287,600	0	0	25,963	3	198			
40 - 45	98.9	3	202	-323,550	0	0	29,208	4	277			
45 - 50	109.9	3	151	-359,500	0	0	32,454	3	208			
50 - 55	120.9	4	213	-395,450	0	0	35,699	3	197			
55 - 60	131.9	4	242	-431,400	0	0	38,944	3	165			
60 - 65	142.9	4	246	-467,350	0	0	42,190	3	215			
65 - 70	153.9	5	300	-503,300	0	0	45,435	2	96			
70 - 75	164.9	5	284	-539,250	0	0	48,681	5	297			
75 - 80	175.9	7	447	-575,200	0	0	51,926	5	314			
80 - 85	186.9	10	579	-611,150	0	0	55,171	7	476			
85 - 90	197.9	8	512	-647,100	0	0	58,417	12	735			
90 - 95	208.9	2	135	-683,050	0	0	61,662	3	198			
95 - 100	219.9	0	0	-719,000	0	0	64,907	6	413			
Hours Off	0.0	0	2,736	0	0	8,706	0	0	2,392	No heating fan for selected system		

Alternative - 3 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	11.0	23	1,411	-35,950	65	35	3,245	26	1,683			
5 - 10	22.0	10	578	-71,900	35	19	6,491	8	482			
10 - 15	33.0	4	233	-107,850	0	0	9,736	6	385			
15 - 20	44.0	0	0	-143,800	0	0	12,981	0	16			
20 - 25	55.0	0	0	-179,750	0	0	16,227	0	0			
25 - 30	66.0	1	42	-215,700	0	0	19,472	0	0			
30 - 35	77.0	4	236	-251,650	0	0	22,718	0	13			
35 - 40	87.9	4	213	-287,600	0	0	25,963	3	198			
40 - 45	98.9	3	202	-323,550	0	0	29,208	4	277			
45 - 50	109.9	3	151	-359,500	0	0	32,454	3	208			
50 - 55	120.9	4	213	-395,450	0	0	35,699	3	197			
55 - 60	131.9	4	242	-431,400	0	0	38,944	3	165			
60 - 65	142.9	4	246	-467,350	0	0	42,190	3	215			
65 - 70	153.9	5	300	-503,300	0	0	45,435	2	96			
70 - 75	164.9	5	284	-539,250	0	0	48,681	5	297			
75 - 80	175.9	7	447	-575,200	0	0	51,926	5	314			
80 - 85	186.9	10	579	-611,150	0	0	55,171	7	476			
85 - 90	197.9	8	512	-647,100	0	0	58,417	12	735			
90 - 95	208.9	2	135	-683,050	0	0	61,662	3	198			
95 - 100	219.9	0	0	-719,000	0	0	64,907	6	413			
Hours Off	0.0	0	2,736	0	0	8,706	0	0	2,392	No heating fan for selected system		

System Report

FAU Solar ESCO

Alternative - 4 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	11.0	23	1,411	-35,950	65	35	3,245	26	1,683			
5 - 10	22.0	10	578	-71,900	35	19	6,491	8	482			
10 - 15	33.0	4	233	-107,850	0	0	9,736	6	385			
15 - 20	44.0	0	0	-143,800	0	0	12,981	0	16			
20 - 25	55.0	0	0	-179,750	0	0	16,227	0	0			
25 - 30	66.0	1	42	-215,700	0	0	19,472	0	0			
30 - 35	77.0	4	236	-251,650	0	0	22,718	0	13			
35 - 40	87.9	4	213	-287,600	0	0	25,963	3	198			
40 - 45	98.9	3	202	-323,550	0	0	29,208	4	277			
45 - 50	109.9	3	151	-359,500	0	0	32,454	3	208			
50 - 55	120.9	4	213	-395,450	0	0	35,699	3	197			
55 - 60	131.9	4	242	-431,400	0	0	38,944	3	165			
60 - 65	142.9	4	246	-467,350	0	0	42,190	3	215			
65 - 70	153.9	5	300	-503,300	0	0	45,435	2	96			
70 - 75	164.9	5	284	-539,250	0	0	48,681	5	297			
75 - 80	175.9	7	447	-575,200	0	0	51,926	5	314			
80 - 85	186.9	10	579	-611,150	0	0	55,171	7	476			
85 - 90	197.9	8	512	-647,100	0	0	58,417	12	735			
90 - 95	208.9	2	135	-683,050	0	0	61,662	3	198			
95 - 100	219.9	0	0	-719,000	0	0	64,907	6	413			
Hours Off	0.0	0	2,736	0	0	8,706	0	0	2,392	No heating fan for selected system		

Alternative - 4 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Cooling Load Hrs (%)	Cooling Load Hrs	Heating Load Capacity (Btuh)	Heating Load Hrs (%)	Heating Load Hrs	Cooling Airflow Capacity (cfm)	Cooling Airflow Hrs (%)	Cooling Airflow Hrs	Heating Airflow Capacity (cfm)	Heating Airflow Hrs (%)	Heating Airflow Hrs
0 - 5	11.0	23	1,411	-35,950	65	35	3,245	26	1,683			
5 - 10	22.0	10	578	-71,900	35	19	6,491	8	482			
10 - 15	33.0	4	233	-107,850	0	0	9,736	6	385			
15 - 20	44.0	0	0	-143,800	0	0	12,981	0	16			
20 - 25	55.0	0	0	-179,750	0	0	16,227	0	0			
25 - 30	66.0	1	42	-215,700	0	0	19,472	0	0			
30 - 35	77.0	4	236	-251,650	0	0	22,718	0	13			
35 - 40	87.9	4	213	-287,600	0	0	25,963	3	198			
40 - 45	98.9	3	202	-323,550	0	0	29,208	4	277			
45 - 50	109.9	3	151	-359,500	0	0	32,454	3	208			
50 - 55	120.9	4	213	-395,450	0	0	35,699	3	197			
55 - 60	131.9	4	242	-431,400	0	0	38,944	3	165			
60 - 65	142.9	4	246	-467,350	0	0	42,190	3	215			
65 - 70	153.9	5	300	-503,300	0	0	45,435	2	96			
70 - 75	164.9	5	284	-539,250	0	0	48,681	5	297			
75 - 80	175.9	7	447	-575,200	0	0	51,926	5	314			
80 - 85	186.9	10	579	-611,150	0	0	55,171	7	476			
85 - 90	197.9	8	512	-647,100	0	0	58,417	12	735			
90 - 95	208.9	2	135	-683,050	0	0	61,662	3	198			
95 - 100	219.9	0	0	-719,000	0	0	64,907	6	413			
Hours Off	0.0	0	2,736	0	0	8,706	0	0	2,392	No heating fan for selected system		

Equipment Energy Consumption Report

FAU Solar ESCO

Alternative - 1

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Base utility		Gas(thm)	107	97	117	102	112	112	102	117	102	112	107	102	1,289
Lights		Elec(kWh)	21,491	19,428	22,551	20,627	22,021	21,687	20,961	22,551	20,627	22,021	21,157	20,961	256,082
MISC LD		Elec(kWh)	2,689	2,433	2,946	2,561	2,817	2,817	2,561	2,946	2,561	2,817	2,689	2,561	32,401
Fans:															
System 1		Elec(kWh)	11,319	10,268	12,067	12,039	12,765	12,915	12,942	13,481	12,136	11,953	11,276	11,407	144,567
Cooling:															
P1	Centrifugal 2-Stage	Elec(kWh)	33,389	29,385	39,969	41,123	44,799	48,811	52,028	54,245	48,622	43,576	38,842	37,079	511,869
	Cooling tower for Cent. Chillers	Elec(kWh)	12,670	11,420	12,670	12,261	12,670	12,261	12,670	12,670	12,261	12,670	12,261	12,670	149,152
	Cooling accessories	Elec(kWh)	20,340	18,372	20,340	19,684	20,340	19,684	20,340	20,340	19,684	20,340	19,684	20,340	239,491
Heating:															
P1	Gas Fired Hot Water Boiler	Gas(thm)	2,833	2,409	1,938	1,842	1,777	1,499	1,658	1,446	1,630	1,927	2,201	2,593	23,754
	Heating accessories	Elec(kWh)	2,102	1,733	1,695	1,802	2,099	1,901	1,930	1,762	1,512	1,651	1,727	1,930	21,845
Utility Summary:			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Electrical Consumption		Peak(kWh)	23,898	21,367	27,444	35,440	40,129	42,300	39,146	45,490	37,762	38,351	25,177	23,648	400,151
		Off Peak(kWh)	80,102	71,673	84,793	74,658	77,382	77,777	84,286	82,505	79,641	76,678	82,459	83,301	955,256
Electrical Demand		Peak (kW)	209	204	212	315	328	354	362	365	354	324	214	216	365
		Off Peak (kW)	277	277	302	286	295	309	316	309	298	284	297	288	316
Gas Consumption		Peak(thm)	2,940	2,506	2,055	1,944	1,890	1,611	1,760	1,563	1,732	2,039	2,308	2,695	25,043
Gas Demand		Peak (thm/hr)	7	8	7	6	6	6	6	6	6	6	7	7	8
Water Consumption		(kgals)	242	214	282	285	306	323	338	350	319	299	271	263	3,493

Alternative - 2

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Base utility		Gas(thm)	107	97	117	102	112	112	102	117	102	112	107	102	1,289
Lights		Elec(kWh)	21,491	19,428	22,551	20,627	22,021	21,687	20,961	22,551	20,627	22,021	21,157	20,961	256,082
MISC LD		Elec(kWh)	2,689	2,433	2,946	2,561	2,817	2,817	2,561	2,946	2,561	2,817	2,689	2,561	32,401
Fans:															
System 1		Elec(kWh)	6,133	6,127	11,474	12,151	13,307	14,633	14,138	15,817	13,389	11,841	8,956	7,549	135,514
Cooling:															
P1	Centrifugal 2-Stage	Elec(kWh)	17,841	15,909	25,225	26,082	29,248	33,355	33,976	37,014	31,326	27,242	22,536	20,300	320,055
	Cooling tower for Cent. Chillers	Elec(kWh)	6,693	6,200	7,848	8,595	9,632	9,920	10,430	10,464	9,360	8,391	7,593	7,202	102,329
	Cooling accessories	Elec(kWh)	10,745	9,954	12,599	13,799	15,463	15,926	16,745	16,799	15,026	13,472	12,190	11,563	164,281
Heating:															
P1	Gas Fired Hot Water Boiler	Gas(thm)	10	8	0	0	0	0	0	0	0	0	0	0	18
	Heating accessories	Elec(kWh)	62	57	0	0	0	0	0	0	0	0	0	0	119
Utility Summary:			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Electrical Consumption		Peak(kWh)	20,992	18,873	26,959	32,939	36,861	39,089	36,418	42,479	35,570	36,000	23,793	21,938	371,912
		Off Peak(kWh)	44,662	41,236	55,684	50,877	55,626	59,250	62,393	63,112	56,720	49,784	51,328	48,199	638,870
Electrical Demand		Peak (kW)	235	231	266	332	336	352	358	365	360	341	267	250	365
		Off Peak (kW)	296	298	325	288	299	319	327	324	317	292	325	309	327
Gas Consumption		Peak(thm)	117	105	117	102	112	112	102	117	102	112	107	102	1,308
Gas Demand		Peak (thm/hr)	1	1	1	1	1	1	1	1	1	1	1	1	1
Water Consumption		(kgals)	132	120	180	178	196	213	209	230	197	185	158	144	2,144

Equipment Energy Consumption Report

FAU Solar ESCO

Alternative - 3

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Base utility		Gas(thm)	107	97	117	102	112	112	102	117	102	112	107	102	1,289
Lights		Elec(kWh)	21,491	19,428	22,551	20,627	22,021	21,687	20,961	22,551	20,627	22,021	21,157	20,961	256,082
MISC LD		Elec(kWh)	2,689	2,433	2,946	2,561	2,817	2,817	2,561	2,946	2,561	2,817	2,689	2,561	32,401
Fans:															
System 1		Elec(kWh)	6,133	6,127	11,474	12,151	13,307	14,633	14,138	15,817	13,389	11,841	8,956	7,549	135,514
Cooling:															
P1	Centrifugal 2-Stage	Elec(kWh)	17,841	15,909	25,225	26,082	29,248	33,355	33,976	37,014	31,326	27,242	22,536	20,300	320,055
	Cooling tower for Cent. Chillers	Elec(kWh)	6,693	6,200	7,848	8,595	9,632	9,920	10,430	10,464	9,360	8,391	7,593	7,202	102,329
	Cooling accessories	Elec(kWh)	7,161	6,626	8,745	9,518	10,670	11,174	11,647	11,889	10,510	9,363	8,313	7,802	113,418
Heating:															
P1	Gas Fired Hot Water Boiler	Gas(thm)	10	8	0	0	0	0	0	0	0	0	0	0	18
	Heating accessories	Elec(kWh)	62	57	0	0	0	0	0	0	0	0	0	0	119
Utility Summary:			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Electrical Consumption		Peak(kWh)	19,872	17,855	25,878	31,799	35,640	37,972	35,444	41,388	34,552	34,733	22,774	20,942	358,848
		Off Peak(kWh)	42,198	38,926	52,911	47,735	52,055	55,615	58,269	59,293	53,221	46,943	48,471	45,434	601,071
Electrical Demand		Peak (kW)	230	226	260	328	332	349	356	363	357	338	262	243	363
		Off Peak (kW)	291	292	320	282	294	315	323	320	313	286	320	304	323
Gas Consumption		Peak(thm)	117	105	117	102	112	112	102	117	102	112	107	102	1,308
Gas Demand		Peak (thm/hr)	1	1	1	1	1	1	1	1	1	1	1	1	1
Water Consumption		(kgals)	132	120	180	178	196	213	209	230	197	185	158	144	2,144

Alternative - 4

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Base utility		Gas(thm)	107	97	117	102	112	112	102	117	102	112	107	102	1,289
Lights		Elec(kWh)	21,491	19,428	22,551	20,627	22,021	21,687	20,961	22,551	20,627	22,021	21,157	20,961	256,082
MISC LD		Elec(kWh)	2,689	2,433	2,946	2,561	2,817	2,817	2,561	2,946	2,561	2,817	2,689	2,561	32,401
Fans:															
System 1		Elec(kWh)	6,133	6,127	11,474	12,151	13,307	14,633	14,138	15,817	13,389	11,841	8,956	7,549	135,514
Cooling:															
P1	Centrifugal 2-Stage	Elec(kWh)	17,841	15,909	25,225	26,082	29,248	33,355	33,976	37,014	31,326	27,242	22,536	20,300	320,055
	Cooling tower for Cent. Chillers	Elec(kWh)	6,693	6,200	7,848	8,595	9,632	9,920	10,430	10,464	9,360	8,391	7,593	7,202	102,329
	Cooling accessories	Elec(kWh)	7,161	6,626	8,745	9,518	10,670	11,174	11,647	11,889	10,510	9,363	8,313	7,802	113,418
Heating:															
P1	Gas Fired Hot Water Boiler	Gas(thm)	10	8	0	0	0	0	0	0	0	0	0	0	18
	Heating accessories	Elec(kWh)	62	57	0	0	0	0	0	0	0	0	0	0	119
Utility Summary:			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Electrical Consumption		Peak(kWh)	19,872	17,855	25,878	31,799	35,640	37,972	35,444	41,388	34,552	34,733	22,774	20,942	358,848
		Off Peak(kWh)	42,198	38,926	52,911	47,735	52,055	55,615	58,269	59,293	53,221	46,943	48,471	45,434	601,071
Electrical Demand		Peak (kW)	230	226	260	328	332	349	356	363	357	338	262	243	363
		Off Peak (kW)	291	292	320	282	294	315	323	320	313	286	320	304	323
Gas Consumption		Peak(thm)	117	105	117	102	112	112	102	117	102	112	107	102	1,308
Gas Demand		Peak (thm/hr)	1	1	1	1	1	1	1	1	1	1	1	1	1
Water Consumption		(kgals)	132	120	180	178	196	213	209	230	197	185	158	144	2,144

Utility Cost Summary Report

Monthly Utility Costs

Alternative - 1

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	1,685	1,506	1,935	2,499	2,829	2,982	2,760	3,207	2,662	2,704	1,775	1,667	28,211
	Off Pk ($)	3,015	2,716	3,181	2,822	2,918	2,932	3,163	3,100	2,998	2,893	3,098	3,128	35,964
	Sub Total($)	**4,699**	**4,223**	**5,115**	**5,320**	**5,747**	**5,914**	**5,922**	**6,307**	**5,661**	**5,597**	**4,873**	**4,795**	**64,175**
Electric Demand	On Pk ($)	3,146	3,076	3,202	4,745	4,943	5,337	5,457	5,494	5,336	4,889	3,220	3,260	52,105
	Sub Total($)	**3,146**	**3,076**	**3,202**	**4,745**	**4,943**	**5,337**	**5,457**	**5,494**	**5,336**	**4,889**	**3,220**	**3,260**	**52,105**
Gas	On Pk ($)	2,549	2,180	1,797	1,702	1,656	1,420	1,546	1,379	1,522	1,783	2,012	2,340	21,887
	Sub Total($)	**2,549**	**2,180**	**1,797**	**1,702**	**1,656**	**1,420**	**1,546**	**1,379**	**1,522**	**1,783**	**2,012**	**2,340**	**21,887**
Monthly Total ($)		**10,395**	**9,479**	**10,114**	**11,768**	**12,346**	**12,672**	**12,925**	**13,180**	**12,518**	**12,270**	**10,105**	**10,395**	**138,166**

Alternative - 2

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	1,480	1,331	1,901	2,322	2,599	2,756	2,567	2,995	2,508	2,538	1,677	1,547	26,220
	Off Pk ($)	1,760	1,639	2,150	1,980	2,148	2,276	2,388	2,413	2,187	1,941	1,996	1,885	24,764
	Sub Total($)	**3,240**	**2,969**	**4,051**	**4,302**	**4,747**	**5,032**	**4,955**	**5,408**	**4,695**	**4,479**	**3,673**	**3,432**	**50,984**
Electric Demand	On Pk ($)	3,541	3,483	4,005	5,000	5,057	5,305	5,401	5,501	5,424	5,144	4,030	3,775	55,665
	Sub Total($)	**3,541**	**3,483**	**4,005**	**5,000**	**5,057**	**5,305**	**5,401**	**5,501**	**5,424**	**5,144**	**4,030**	**3,775**	**55,665**
Gas	On Pk ($)	150	139	150	137	145	145	137	150	137	145	141	137	1,712
	Sub Total($)	**150**	**139**	**150**	**137**	**145**	**145**	**137**	**150**	**137**	**145**	**141**	**137**	**1,712**
Monthly Total ($)		**6,930**	**6,592**	**8,205**	**9,439**	**9,949**	**10,482**	**10,493**	**11,058**	**10,255**	**9,769**	**7,844**	**7,343**	**108,360**

Alternative - 3

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	1,401	1,259	1,824	2,242	2,513	2,677	2,499	2,918	2,436	2,449	1,606	1,476	25,299
	Off Pk ($)	1,673	1,557	2,052	1,869	2,022	2,148	2,242	2,278	2,063	1,841	1,895	1,787	23,426
	Sub Total($)	**3,074**	**2,816**	**3,876**	**4,111**	**4,534**	**4,825**	**4,741**	**5,196**	**4,499**	**4,289**	**3,500**	**3,264**	**48,725**
Electric Demand	On Pk ($)	3,465	3,411	3,921	4,942	5,004	5,263	5,364	5,468	5,385	5,090	3,946	3,664	54,924
	Sub Total($)	**3,465**	**3,411**	**3,921**	**4,942**	**5,004**	**5,263**	**5,364**	**5,468**	**5,385**	**5,090**	**3,946**	**3,664**	**54,924**
Gas	On Pk ($)	150	139	150	137	145	145	137	150	137	145	141	137	1,712
	Sub Total($)	**150**	**139**	**150**	**137**	**145**	**145**	**137**	**150**	**137**	**145**	**141**	**137**	**1,712**
Monthly Total ($)		**6,689**	**6,366**	**7,947**	**9,190**	**9,684**	**10,233**	**10,241**	**10,814**	**10,021**	**9,525**	**7,587**	**7,064**	**105,361**

Utility Cost Summary Report

Monthly Utility Costs

Alternative - 4

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	1,333	1,198	1,736	2,134	2,391	2,548	2,378	2,777	2,318	2,331	1,528	1,405	24,079
	Off Pk ($)	3,450	3,292	3,968	3,718	3,926	4,098	4,226	4,276	3,983	3,679	3,753	3,606	45,976
	Sub Total($)	**4,784**	**4,490**	**5,704**	**5,851**	**6,318**	**6,646**	**6,605**	**7,053**	**6,301**	**6,010**	**5,281**	**5,012**	**70,054**
Electric Demand	On Pk ($)	2,610	2,569	2,953	3,722	3,769	3,964	4,040	4,118	4,056	3,834	2,972	2,760	41,366
	Sub Total($)	**2,610**	**2,569**	**2,953**	**3,722**	**3,769**	**3,964**	**4,040**	**4,118**	**4,056**	**3,834**	**2,972**	**2,760**	**41,366**
Gas	On Pk ($)	150	139	150	137	145	145	137	150	137	145	141	137	1,712
	Sub Total($)	**150**	**139**	**150**	**137**	**145**	**145**	**137**	**150**	**137**	**145**	**141**	**137**	**1,712**
Monthly Total ($)		**7,543**	**7,199**	**8,807**	**9,710**	**10,232**	**10,756**	**10,781**	**11,321**	**10,493**	**9,989**	**8,394**	**7,908**	**113,132**