

ENERGY SAVINGS REPORT - EXAMPLE 1

ENERGY ANALYSIS

FOR

HEALTH EDUCATION CENTER

EASTERN KENTUCKY UNIVERSITY

DECEMBER 2002

ENGINEERING FILE NO. PEKU 0310

**FOR: Division Of Engineering
Commonwealth of Kentucky**

**BY: Adams-Frazier-Anderson, Inc.
Consulting Engineers
715 Westland Drive
Lexington, KY 40504**

**Omni Architects
212 N. Upper St.
Lexington, KY 40507**

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EXECUTIVE SUMMARY:

The Commonwealth of Kentucky Division of Engineering commissioned Omni Architects, with Adams-Frazier-Anderson, Inc. as Mechanical Electrical Consultant, to design a new Health Education Center for Eastern Kentucky University, Richmond, Kentucky. The 42,000 square foot building will be heated with condensing hydronic boilers and cooled with air-cooled screw compressors. Building will use constant volume four-pipe air handlers with cooling coils designed to handle the full outside air load. An energy analysis for the building, as designed, shows 4,120,000 KBTU energy to operate the building for one year.

Certain elements of the proposed construction, i.e.: Wall insulation thickness, roof insulation thickness, lighting, and boiler efficiency exceed minimum building standards. A second energy analysis was performed without these elements. Energy usage for these elements. Energy usage for this building would be 4,760,000 KBTU per year.

Calculations were made using Carrier Hourly Analysis Program 4.10B

EKU HEALTH EDUCATION (As Constructed):

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Energy Budget by System Component - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	3,124,009	73.435
Heating Coil Loads	2,102,642	49.426
Grand Total	5,226,651	122.862

2. Energy Consumption by System Component

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
Air System Fans	1,051,972	24.728	3,757,043	88.316
Cooling	934,855	21.975	3,338,766	78.484
Heating	2,569,834	60.408	2,570,961	60.435
Pumps	84,331	1.982	301,184	7.080
Cooling Towers	0	0.000	0	0.000
HVAC Sub-Total	4,640,992	109.095	9,967,954	234.314
Lights	835,717	19.645	2,984,704	70.161
Electric Equipment	393,891	9.259	1,406,752	33.068
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	0	0.000	0	0.000
Non-HVAC Sub-Total	1,229,608	28.904	4,391,456	103.229
Grand Total	5,870,600	137.999	14,359,410	337.543

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
 Gross Floor Area 42541.0 ft²
 Conditioned Floor Area 42541.0 ft²

Air System Design Load Summary for Block

Project Name: EKU Health Education Standard Building
Prepared by: Adams-Frazier-Anderson

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ZONE LOADS	DESIGN COOLING			DESIGN HEATING			
	COOLING DATA AT Jul 1400			HEATING DATA AT DES HYG			
	COOLING OA DB / WB 80.4 °F / 73.9 °F			HEATING OA DB / WB 4.0 °F / 2.1 °F			
	Details	Sensible (BTU/hr)	Latent (BTU/hr)		Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	2870 ft²	149369	-		2870 ft²	-	-
Wall Transmission	16721 ft²	48975	-		16721 ft²	208335	-
Roof Transmission	41200 ft²	1143901	-		41200 ft²	1040800	-
Window Transmission	2070 ft²	14068	-		2070 ft²	62411	-
Skylight Transmission	800 ft²	5437	-		800 ft²	24120	-
Door Loads	216 ft²	3105	-		216 ft²	7429	-
Floor Transmission	42541 ft²	0	-		42541 ft²	6415	-
Partitions	0 ft²	0	-		0 ft²	0	-
Ceiling	0 ft²	0	-		0 ft²	0	-
Overhead Lighting	80862 W	211462	-		0	0	-
Task Lighting	7657 W	22737	-		0	0	-
Electric Equipment	25525 W	80403	-		0	0	-
People	432	70091	51840		0	0	0
Infiltration	-	29229	46241		-	212311	0
Miscellaneous	-	0	0		-	0	0
Safety Factor	5% / 5%	88939	4904		5%	78091	0
>> Total Zone Loads	-	1867716	102985		-	1639913	0
Zone Conditioning	-	1113725	102985		-	1570844	0
Plenum Wall Load	0%	0	-		0	0	-
Plenum Roof Load	0%	0	-		0	0	-
Plenum Lighting Load	0%	0	-		0	0	-
Return Fan Load	36000 CFM	0	-		36000 CFM	0	-
Ventilation Load	6000 CFM	35999	182460		6000 CFM	400900	0
Supply Fan Load	36000 CFM	120093	-		36000 CFM	-120093	-
Space Fan Coil Fans	-	0	-		-	0	-
Duct Heat Gain / Loss	0%	0	-		0%	0	-
>> Total System Loads	-	1269817	285445		-	1851651	0
Central Cooling Coil	-	1269817	285461		-	0	0
Central Heating Coil	-	0	-		-	1851651	-
>> Total Conditioning	-	1269817	285461		-	1851651	0
Key:	Positive values are ckg loads Negative values are htg loads				Positive values are htg loads Negative values are ckg loads		

Air System Sizing Summary for Block

Project Name: ECU Health Education Standard Building
Prepared by: Adams-Frazier-Anderson

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Air System Information

Air System Name **Block**
Equipment Class **CW AHU**
Air System Type **SZCAV**

Number of zones **1**
Floor Area **42541.0** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM **Peak zone sensible load**
Space CFM **Coincident space loads**

Calculation Months **Jan to Dec**
Sizing Data **User-Modified**

Central Cooling Coil Sizing Data

Total coil load **129.6** Tons
Total coil load **1555.3** MBH
Sensible coil load **1269.8** MBH
Coil CFM at Jul 1400 **36000** CFM
Max block CFM **36000** CFM
Sum of peak zone CFM **36000** CFM
Sensible heat ratio **0.816**
ft²/Ton **328.2**
BTU/(hr-ft²) **36.6**
Water flow @ 12.0 °F rise **259.37** gpm

Load occurs at **Jul 1400**
OA DB / WB **90.4 / 73.9** °F
Entering DB / WB **85.6 / 65.5** °F
Leaving DB / WB **51.8 / 50.1** °F
Coil ADP **48.0** °F
Bypass Factor **0.100**
Resulting RH **31** %
Design supply temp. **55.0** °F
Zone T-stat Check **0 of 1** OK
Max zone temperature deviation **10.7** °F

Central Heating Coil Sizing Data

Max coil load **1851.7** MBH
Coil CFM at Des Htg **36000** CFM
Max coil CFM **36000** CFM
Water flow @ 20.0 °F drop **185.28** gpm

Load occurs at **Des Htg**
BTU/(hr-ft²) **43.5**
Ent. DB / Lvg DB **57.4 / 106.8** °F

Supply Fan Sizing Data

Actual max CFM **36000** CFM
Standard CFM **34733** CFM
Actual max CFM/ft² **0.85** CFM/ft²

Fan motor BHP **47.20** BHP
Fan motor kW **35.20** kW
Fan static **4.50** in wg

Outdoor Ventilation Air Data

Design airflow CFM **6000** CFM
CFM/ft² **0.14** CFM/ft²

CFM/person **13.89** CFM/person

Zone Sizing Summary for Block

Project Name: ECU Health Education Standard Building
Prepared by: Adams-Frazier-Anderson

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Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM Peak zone sensible load
Space CFM Coincident space loads

Calculation Months Jan to Dec
Sizing Data User-Modified

Zone Sizing Data

Zone Name	Maximum Cooling Sensible (MBH)	Design Air Flow (CFM)	Minimum Air Flow (CFM)	Time of Peak Load	Maximum Heating Load (MBH)	Zone Floor Area (ft²)	Zone CFM/ft²
Zone 1	1867.7	36000	36000	Jul 1400	1639.9	42541.0	0.85

Zone Terminal Sizing Data

No Zone Terminal Sizing Data required for this system.

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
Block	1	1867.7	Jul 1400	36000	1639.9	42541.0	0.85

Annual Cost Summary

EKU Health Education Standard Building
Adams-Frazier-Anderson

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Table 1. Annual Costs

Component	EKU Health Services Standard Bid (\$)
Air System Fans	13,240
Cooling	11,757
Heating	18,237
Pumps	1,062
Cooling Tower Fans	0
HVAC Sub-Total	44,296
Lights	10,518
Electric Equipment	4,957
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	15,475
Grand Total	59,770

Table 2. Annual Cost per Unit Floor Area

Component	EKU Health Services Standard Bid (\$/ft²)
Air System Fans	0.311
Cooling	0.276
Heating	0.429
Pumps	0.025
Cooling Tower Fans	0.000
HVAC Sub-Total	1.041
Lights	0.247
Electric Equipment	0.117
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	0.364
Grand Total	1.405
Gross Floor Area (ft²)	42541.0
Conditioned Floor Area (ft²)	42541.0

Note: Values in this table are calculated using the Gross Floor Area.

Annual Cost Summary

EKU Health Education Standard Building
Adams-Frazier-Anderson

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Table 3. Component Cost as a Percentage of Total Cost

Component	EKU Health Services Standard Bid (%)
Air System Fans	22.2
Cooling	19.7
Heating	30.5
Pumps	1.8
Cooling Tower Fans	0.0
HVAC Sub-Total	74.1
Lights	17.6
Electric Equipment	8.3
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	25.9
Grand Total	100.0

Annual Energy and Emissions Summary

EKU Health Education Standard Building
Adams-Frazier-Anderson

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Table 1. Annual Costs

Component	EKU Health Services Standard Bid (\$)
HVAC Components	
Electric	26,063
Natural Gas	18,232
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	44,295
Non-HVAC Components	
Electric	15,475
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	15,475
Grand Total	59,770

Annual Energy and Emissions Summary

EKU Health Education Standard Building
Adams-Frazier-Anderson

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Table 2. Annual Energy Consumption

Component	EKU Health Services Standard Bld
HVAC Components	
Electric (kWh)	607,148
Natural Gas (mbtu)	2,569
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	360,375
Natural Gas (mbtu)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	967,523
Natural Gas (mbtu)	2,569
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Table 3. Annual Emissions

Component	EKU Health Services Standard Bld
CO2 (lb)	0
SO2 (kg)	0
NOx (kg)	0

Annual Energy and Emissions Summary

EKU Health Education Standard Building
Adams-Frazier-Anderson

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Table 4. Annual Cost per Unit Floor Area

Component	EKU Health Services Standard Bld (\$/ft²)
HVAC Components	
Electric	0.613
Natural Gas	0.429
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Remote CW	0.000
HVAC Sub-Total	1.041
Non-HVAC Components	
Electric	0.364
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Non-HVAC Sub-Total	0.364
Grand Total	1.405
Gross Floor Area (ft²)	42541.0
Conditioned Floor Area (ft²)	42541.0

Note: Values in this table are calculated using the Gross Floor Area.

Table 5. Component Cost as a Percentage of Total Cost

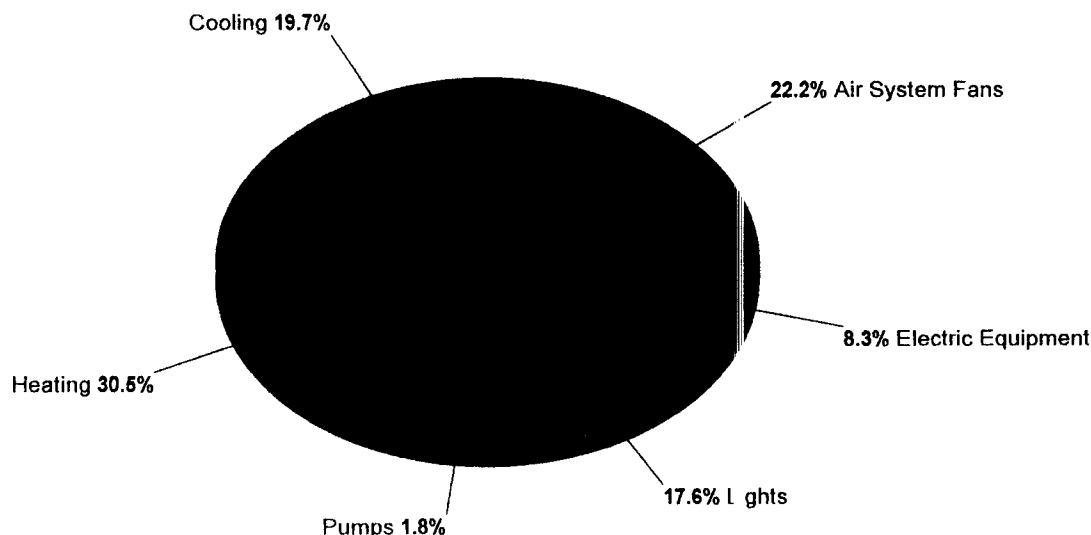
Component	EKU Health Services Standard Bld (%)
HVAC Components	
Electric	43.6
Natural Gas	30.5
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Remote CW	0.0
HVAC Sub-Total	74.1
Non-HVAC Components	
Electric	25.9
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Non-HVAC Sub-Total	25.9
Grand Total	100.0

Annual Component Costs - ECU Health Services Standard Bld

EKU Health Education Standard Building
Adams-Frazier-Anderson

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1. Annual Costs

Component	Annual Cost (\$)	(\$/ft²)	Percent of Total (%)
Air System Fans	13,240	0.311	22.2
Cooling	11,757	0.276	19.7
Heating	18,237	0.429	30.5
Pumps	1,062	0.025	1.8
Cooling Tower Fans	0	0.000	0.0
HVAC Sub-Total	44,295	1.041	74.1
Lights	10,518	0.247	17.6
Electric Equipment	4,957	0.117	8.3
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	15,475	0.364	25.9
Grand Total	59,770	1.405	100.0

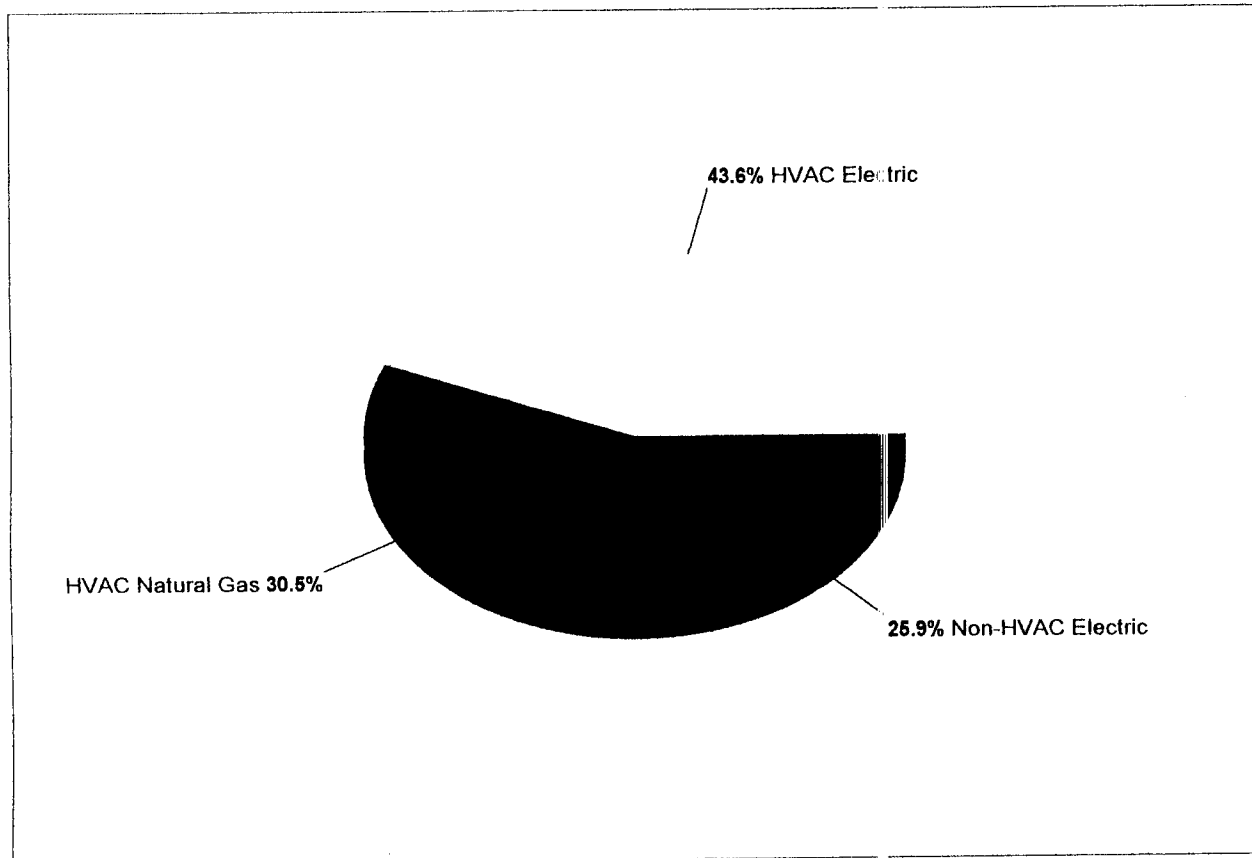
Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area 42541.0 ft²
Conditioned Floor Area 42541.0 ft²

Annual Energy Costs - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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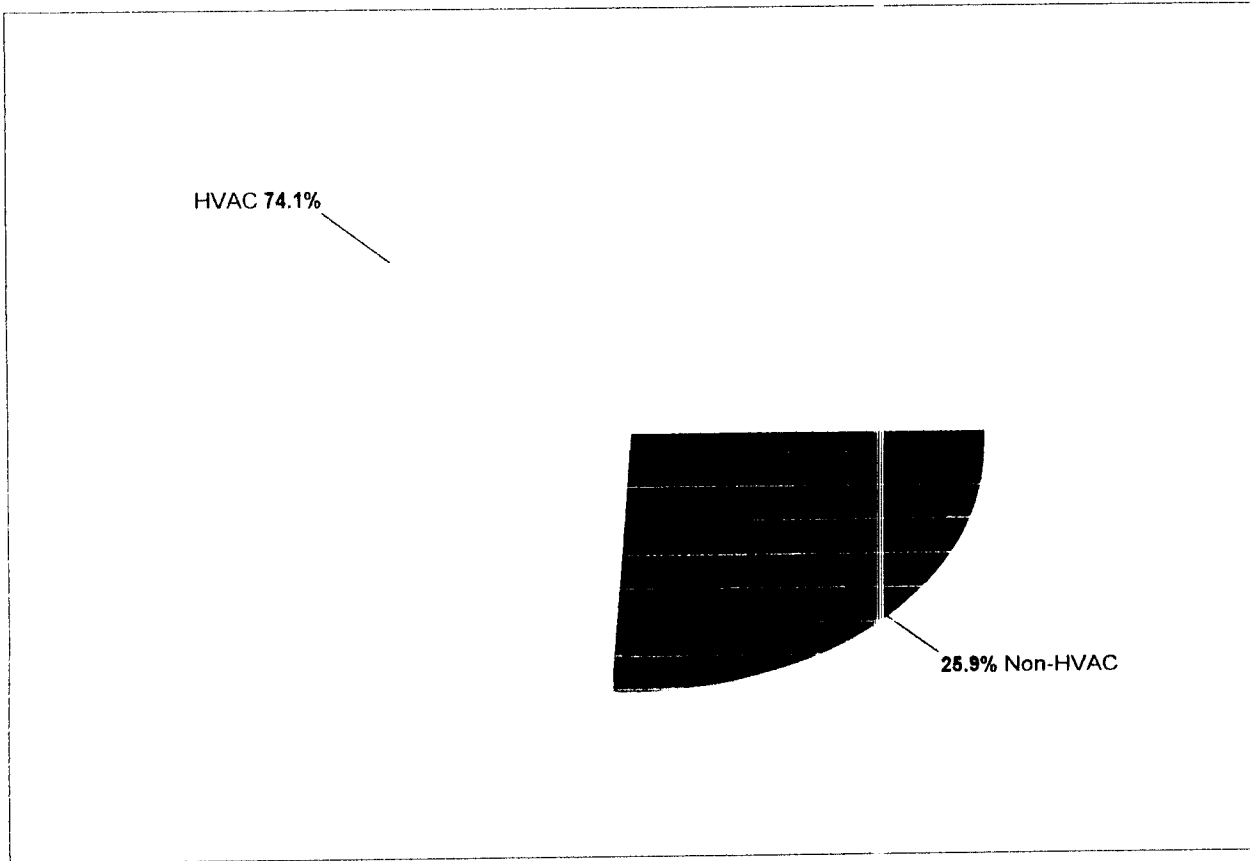


1. Annual Costs

Component	Annual Cost (\$/yr)	(\$/ft ²)	Percent of Total (%)
HVAC Components			
Electric	26,063	0.613	43.6
Natural Gas	18,232	0.429	30.5
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	44,295	1.041	74.1
Non-HVAC Components			
Electric	15,475	0.364	25.9
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	15,475	0.364	25.9
Grand Total	59,770	1.405	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area 42541.0 ft²
Conditioned Floor Area 42541.0 ft²



1. Annual Costs

Component	Annual Cost (\$/yr)	(\$/ft²)	Percent of Total (%)
HVAC	44,295	1.041	74.1
Non-HVAC	15,475	0.364	25.9
Grand Total	59,770	1.405	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area 42541.0 ft²
 Conditioned Floor Area 42541.0 ft²

Energy Budget by Energy Source - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	3,124,009	73.435
Heating Coil Loads	2,102,642	49.426
Grand Total	5,226,651	122.862

2. Energy Consumption by Energy Source

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
HVAC Components				
Electric	2,071,590	48.696	7,398,534	173.915
Natural Gas	2,569,396	60.398	2,569,396	60.398
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Remote Chilled Water	0	0.000	0	0.000
HVAC Sub-Total	4,640,986	109.094	9,967,930	234.314
Non-HVAC Components				
Electric	1,229,600	28.904	4,391,429	103.228
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Non-HVAC Sub-Total	1,229,600	28.904	4,391,429	103.228
Grand Total	5,870,586	137.998	14,359,359	337.542

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.

Gross Floor Area **42541.0** ft²
 Conditioned Floor Area **42541.0** ft²

Billing Details - Natural Gas - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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1. Component Charges

Billing Period	Energy Charges (\$)	Demand Charges (\$)	Customer Charges (\$)	Taxes (\$)	Total Charge (\$)
Jan	4,650	0	15	373	5,038
Feb	3,405	0	15	274	3,694
Mar	2,098	0	15	169	2,282
Apr	425	0	15	35	476
May	134	0	15	12	161
Jun	0	0	15	1	16
Jul	0	0	15	1	16
Aug	0	0	15	1	16
Sep	0	0	15	1	16
Oct	449	0	15	37	501
Nov	2,083	0	15	168	2,266
Dec	3,457	0	15	278	3,750
Totals	16,701	0	180	1,350	18,232

2. Totals

Billing Period	Total Charges (\$)	Total Consumption (mbtu)	Avg Price (\$/mbtu)
Jan	5,038	715	7.0615
Feb	3,694	524	7.0698
Mar	2,282	323	7.0891
Apr	476	65	7.2870
May	161	21	7.8262
Jun	16	0	0.0000
Jul	16	0	0.0000
Aug	16	0	0.0000
Sep	16	0	637.4081
Oct	501	69	7.2740
Nov	2,266	321	7.0894
Dec	3,750	532	7.0693
Totals	18,232	2,569	7.0957

3. Consumption Totals

Billing Period	Peak (mbtu)	Mid-Peak (mbtu)	Normal Peak (mbtu)	Off-Peak (mbtu)	Overall (mbtu)
Jan	0	0	0	0	715
Feb	0	0	0	0	524
Mar	0	0	0	0	323
Apr	0	0	0	0	65
May	0	0	0	0	21
Jun	0	0	0	0	0
Jul	0	0	0	0	0
Aug	0	0	0	0	0
Sep	0	0	0	0	0
Oct	0	0	0	0	69
Nov	0	0	0	0	321
Dec	0	0	0	0	532
Totals	0	0	0	0	2,569

Billing Details - Natural Gas - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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4. Billing Demands

Billing Period	Peak (mbtu)	Mid-Peak (mbtu)	Normal Peak (mbtu)	Off-Peak (mbtu)	Overall (mbtu)
Jan	0.0	0.0	0.0	0.0	2.3
Feb	0.0	0.0	0.0	0.0	2.2
Mar	0.0	0.0	0.0	0.0	1.4
Apr	0.0	0.0	0.0	0.0	1.0
May	0.0	0.0	0.0	0.0	1.1
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	1.0
Nov	0.0	0.0	0.0	0.0	1.5
Dec	0.0	0.0	0.0	0.0	2.2

5. Maximum Demands

Billing Period	Peak (mbtu)	Mid-Peak (mbtu)	Normal Peak (mbtu)	Off-Peak (mbtu)	Overall (mbtu)
Jan	0.0	0.0	0.0	0.0	2.3
Feb	0.0	0.0	0.0	0.0	2.2
Mar	0.0	0.0	0.0	0.0	1.4
Apr	0.0	0.0	0.0	0.0	1.0
May	0.0	0.0	0.0	0.0	1.1
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	1.0
Nov	0.0	0.0	0.0	0.0	1.5
Dec	0.0	0.0	0.0	0.0	2.2

6. Time Of Maximum Demands

Billing Period	Peak (m/d/h)	Mid-Peak (m/d/h)	Normal Peak (m/d/h)	Off-Peak (m/d/h)	Overall (m/d/h)
Jan	n/a	n/a	n/a	n/a	5/0500
Feb	n/a	n/a	n/a	n/a	2/1/0400
Mar	n/a	n/a	n/a	n/a	3/3/0500
Apr	n/a	n/a	n/a	n/a	4/10/0500
May	n/a	n/a	n/a	n/a	5/1/0500
Jun	n/a	n/a	n/a	n/a	n/a
Jul	n/a	n/a	n/a	n/a	n/a
Aug	n/a	n/a	n/a	n/a	n/a
Sep	n/a	n/a	n/a	n/a	9/12/0500
Oct	n/a	n/a	n/a	n/a	10/27/0500
Nov	n/a	n/a	n/a	n/a	11/26/0600
Dec	n/a	n/a	n/a	n/a	12/18/0500

**EKU HEALTH EDUCATION STANDARD BUILDING WITH STANDARD
BLDG COMPONENTS:**

Air System Design Load Summary for Block	1 Page
Zone Sizing Summary for Block	1 Page
Air System Sizing Summary for Block	1 Page
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Energy Budget by System Component - Eku Health Services Standard Bld

EKU Health Education Standard Building
Adams-Frazier-Anderson

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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	3,342,416	78.569
Heating Coil Loads	2,439,388	57.342
Grand Total	5,781,804	135.911

2. Energy Consumption by System Component

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
Air System Fans	1,051,972	24.728	3,757,043	88.316
Cooling	984,182	23.135	3,514,938	82.625
Heating	2,954,863	69.459	2,967,803	69.763
Pumps	86,619	2.036	309,352	7.272
Cooling Towers	0	0.000	0	0.000
HVAC Sub-Total	5,077,636	119.359	10,549,136	147.976
Lights	939,819	22.092	3,356,495	78.900
Electric Equipment	393,891	9.259	1,406,752	33.068
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	0	0.000	0	0.000
Non-HVAC Sub-Total	1,333,709	31.351	4,763,247	11.968
Grand Total	6,411,345	150.710	15,312,383	159.944

Notes:

- 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
- 'Heating Coil Loads' is the sum of all air system heating coil loads.
- Site Energy is the actual energy consumed.
- Source Energy is the site energy divided by the electric generating efficiency (28.0%).
- Source Energy for fuels equals the site energy value.
- Energy per unit floor area is based on the gross building floor area.
Gross Floor Area **42541.0** ft²
Conditioned Floor Area .. **42541.0** ft²

Air System Design Load Summary for Block

Project Name: Eku Health Education Standard Building
Prepared by: Adams-Frazier-Anderson

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	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1400			HEATING DATA AT DES HTG		
	COOLING OA DB / WB 90.4 °F / 73.9 °F			HEATING OA DB / WB 4.0 °F / 2.1 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	2870 ft²	149369	-	2870 ft²	-	-
Wall Transmission	16721 ft²	48975	-	16721 ft²	208335	-
Roof Transmission	41200 ft²	1143901	-	41200 ft²	1040800	-
Window Transmission	2070 ft²	34388	-	2070 ft²	152559	-
Skylight Transmission	800 ft²	13290	-	800 ft²	58960	-
Door Loads	216 ft²	3105	-	216 ft²	7429	-
Floor Transmission	42541 ft²	0	-	42541 ft²	6415	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	91889 W	240298	-	0	0	-
Task Lighting	7657 W	22737	-	0	0	-
Electric Equipment	25525 W	80403	-	0	0	-
People	432	70091	51840	0	0	0
Infiltration	-	58459	88565	-	424623	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	5% / 5%	93251	7020	5%	94956	0
>> Total Zone Loads	-	1958266	147425	-	1994077	0
Zone Conditioning	-	1132677	147425	-	1770227	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	36000 CFM	0	-	36000 CFM	0	-
Ventilation Load	6000 CFM	32840	174732	6000 CFM	367670	0
Supply Fan Load	36000 CFM	120093	-	36000 CFM	-120093	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	1285610	322157	-	2017804	0
Central Cooling Coil	-	1285610	322172	-	0	0
Central Heating Coil	-	0	-	-	2017804	-
>> Total Conditioning	-	1285610	322172	-	2017804	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

Air System Sizing Summary for Block

Project Name: ECU Health Education Standard Building
Prepared by: Adams-Frazier-Anderson

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Air System Information

Air System Name **Block**
Equipment Class **CW AHU**
Air System Type **SZCAV**

Number of zones **1**
Floor Area **42541.0** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM **Peak zone sensible load**
Space CFM **Coincident space loads**

Calculation Months **Jan to Dec**
Sizing Data **User-Modified**

Central Cooling Coil Sizing Data

Total coil load **134.0** Tons
Total coil load **1607.8** MBH
Sensible coil load **1285.6** MBH
Coil CFM at Jul 1400 **36000** CFM
Max block CFM **36000** CFM
Sum of peak zone CFM **36000** CFM
Sensible heat ratio **0.800**
ft²/Ton **317.5**
BTU/(hr-ft²) **37.8**
Water flow @ 12.0 °F rise **268.13** gpm

Load occurs at **Jul 1400**
OA DB / WB **90.4 / 73.9** °F
Entering DB / WB **86.1 / 65.9** °F
Leaving DB / WB **51.8 / 50.1** °F
Coil ADP **48.0** °F
Bypass Factor **0.100**
Resulting RH **32** %
Design supply temp. **55.0** °F
Zone T-stat Check **0 of 1** OK
Max zone temperature deviation **11.2** °F

Central Heating Coil Sizing Data

Max coil load **2017.8** MBH
Coil CFM at Des Htg **36000** CFM
Max coil CFM **36000** CFM
Water flow @ 20.0 °F drop **201.90** gpm

Load occurs at **Des Htg**
BTU/(hr-ft²) **47.4**
Ent. DB / Lvg DB **53.0 / 106.8** °F

Supply Fan Sizing Data

Actual max CFM **36000** CFM
Standard CFM **34733** CFM
Actual max CFM/ft² **0.85** CFM/ft²

Fan motor BHP **47.20** BHP
Fan motor kW **35.20** kW
Fan static **4.50** in wg

Outdoor Ventilation Air Data

Design airflow CFM **6000** CFM
CFM/ft² **0.14** CFM/ft²

CFM/person **13.89** CFM/person

Zone Sizing Summary for Block

Project Name: ECU Health Education Standard Building
Prepared by: Adams-Frazier-Anderson

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Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM Peak zone sensible load
Space CFM Coincident space loads

Calculation Months Jan to Dec
Sizing Data User-Modified

Zone Sizing Data

Zone Name	Maximum Cooling Sensible (MBH)	Design Air Flow (CFM)	Minimum Air Flow (CFM)	Time of Peak Load	Maximum Heating Load (MBH)	Zone Floor Area (ft²)	Zone CFM/ft²
Zone 1	1958.3	36000	36000	Jul 1400	1994.1	42541.0	0.85

Zone Terminal Sizing Data

No Zone Terminal Sizing Data required for this system.

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
Block	1	1958.3	Jul 1400	36000	1994.1	42541.0	0.85

Annual Energy and Emissions Summary

EKU Health Education Standard Building
Adams-Frazier-Anderson

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Table 1. Annual Costs

Component	EKU Health Services Standard Bid (\$)
HVAC Components	
Electric	26,766
Natural Gas	20,902
Fuel Oil	0
Propane	0
Remote H-W	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	47,669
Non-HVAC Components	
Electric	16,783
Natural Gas	0
Fuel Oil	0
Propane	0
Remote H-W	0
Remote Steam	0
Non-HVAC Sub-Total	16,783
Grand Total	64,451

Annual Energy and Emissions Summary

EKU Health Education Standard Building
Adams-Frazier-Anderson

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Table 2. Annual Energy Consumption

Component	EKU Health Services Standard Bid
HVAC Components	
Electric (kWh)	623,619
Natural Gas (mbtu)	2,950
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	390,886
Natural Gas (mbtu)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	1,014,505
Natural Gas (mbtu)	2,950
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Table 3. Annual Emissions

Component	EKU Health Services Standard Bid
CO2 (lb)	0
SO2 (kg)	0
NOx (kg)	0

Annual Energy and Emissions Summary

EKU Health Education Standard Building
Adams-Frazier-Anderson

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Table 4. Annual Cost per Unit Floor Area

Component	EKU Health Services Standard Bid (\$/ft ²)
HVAC Components	
Electric	0.629
Natural Gas	0.491
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Remote CW	0.000
HVAC Sub-Total	1.121
Non-HVAC Components	
Electric	0.395
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Non-HVAC Sub-Total	0.395
Grand Total	1.515
Gross Floor Area (ft ²)	42541.0
Conditioned Floor Area (ft ²)	42541.0

Note: Values in this table are calculated using the Gross Floor Area.

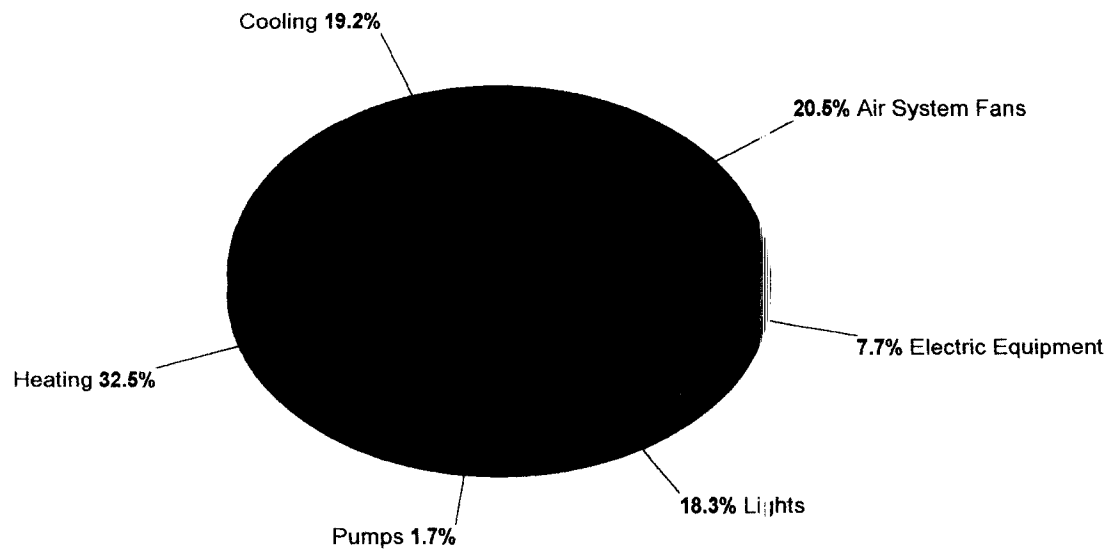
Table 5. Component Cost as a Percentage of Total Cost

Component	EKU Health Services Standard Bid (%)
HVAC Components	
Electric	41.5
Natural Gas	32.4
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Remote CW	0.0
HVAC Sub-Total	74.0
Non-HVAC Components	
Electric	26.0
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Non-HVAC Sub-Total	26.0
Grand Total	100.0

Annual Component Costs - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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1. Annual Costs

Component	Annual Cost (\$)	(\$/ft²)	Percent of Total (%)
Air System Fans	13,238	0.311	20.5
Cooling	12,375	0.291	19.2
Heating	20,966	0.493	32.5
Pumps	1,090	0.026	1.7
Cooling Tower Fans	0	0.000	0.0
HVAC Sub-Total	47,669	1.121	74.0
Lights	11,826	0.278	18.3
Electric Equipment	4,957	0.117	7.7
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	16,783	0.395	26.0
Grand Total	64,452	1.515	100.0

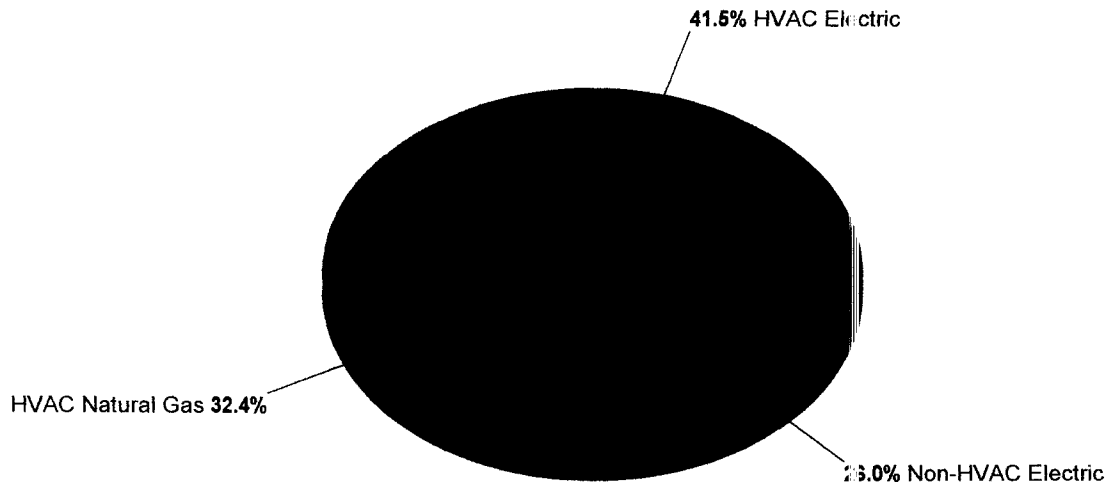
Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area 42541.0 ft²
Conditioned Floor Area 42541.0 ft²

Annual Energy Costs - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

12/05/2002
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1. Annual Costs

Component	Annual Cost (\$/yr)	(\$/ft²)	Percent of Total (%)
HVAC Components			
Electric	26,766	0.629	41.5
Natural Gas	20,902	0.491	32.4
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	47,668	1.121	74.0
Non-HVAC Components			
Electric	16,783	0.395	26.0
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	16,783	0.395	26.0
Grand Total	64,451	1.515	100.0

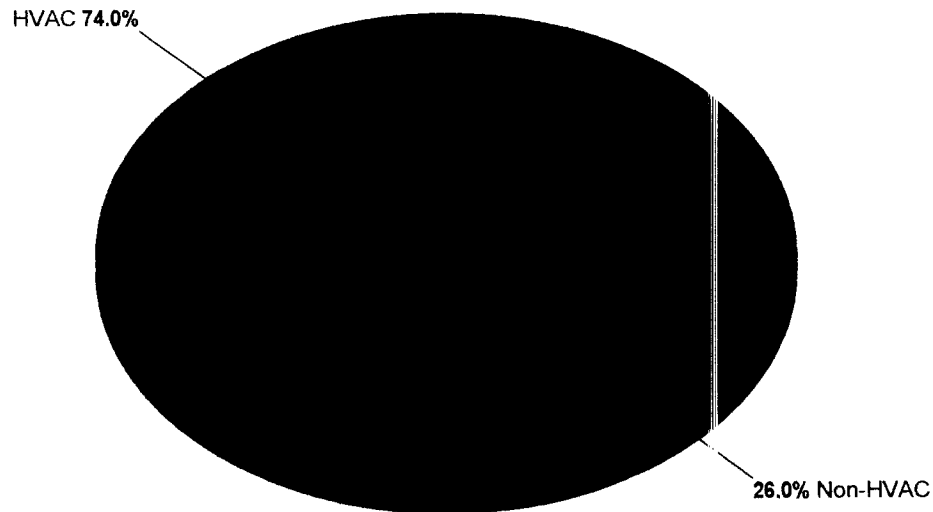
Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area 42541.0 ft²
Conditioned Floor Area 42541.0 ft²

Annual HVAC & Non-HVAC Cost Totals - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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1. Annual Costs

Component	Annual Cost (\$/yr)	(\$/ft²)	Percent of Total (%)
HVAC	47,669	1.121	74.0
Non-HVAC	16,783	0.395	26.0
Grand Total	64,452	1.515	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area 42541.0 ft²
Conditioned Floor Area 42541.0 ft²

Energy Budget by Energy Source - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

12/05/2002
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1. Annual Coil Loads

Component	Load (kBtu)	(kBtu/ft²)
Cooling Coil Loads	3,342,416	78.569
Heating Coil Loads	2,439,388	57.342
Grand Total	5,781,804	135.911

2. Energy Consumption by Energy Source

Component	Site Energy (kBtu)	Site Energy (kBtu/ft²)	Source Energy (kBtu)	Source Energy (kBtu/ft²)
HVAC Components				
Electric	2,127,789	50.017	7,599,246	78.633
Natural Gas	2,949,830	69.341	2,949,830	69.341
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Remote Chilled Water	0	0.000	0	0.000
HVAC Sub-Total	5,077,619	119.358	10,549,076	147.974
Non-HVAC Components				
Electric	1,333,702	31.351	4,763,223	11.968
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Non-HVAC Sub-Total	1,333,702	31.351	4,763,223	11.968
Grand Total	6,411,321	150.709	15,312,298	159.942

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
 Gross Floor Area 42541.0 ft²
 Conditioned Floor Area 42541.0 ft²

Billing Details - Natural Gas - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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1. Component Charges

Billing Period	Energy Charges (\$)	Demand Charges (\$)	Customer Charges (\$)	Taxes (\$)	Total Charge (\$)
Jan	5,231	0	15	420	5,666
Feb	3,916	0	15	314	4,246
Mar	2,473	0	15	199	2,687
Apr	528	0	15	43	586
May	166	0	15	14	195
Jun	0	0	15	1	16
Jul	0	0	15	1	16
Aug	0	0	15	1	16
Sep	1	0	15	1	17
Oct	553	0	15	45	613
Nov	2,389	0	15	192	2,596
Dec	3,918	0	15	315	4,248
Totals	19,174	0	180	1,548	20,902

2. Totals

Billing Period	Total Charges (\$)	Total Consumption (mbtu)	Avg Price (\$/mbtu)
Jan	5,666	805	7.0565
Feb	4,246	602	7.0633
Mar	2,687	380	7.0790
Apr	586	81	7.2364
May	195	26	7.6731
Jun	16	0	0.0000
Jul	16	0	0.0000
Aug	16	0	0.0000
Sep	17	0	208.6478
Oct	613	85	7.2273
Nov	2,596	367	7.0805
Dec	4,248	603	7.0633
Totals	20,902	2,950	7.0859

3. Consumption Totals

Billing Period	Peak (mbtu)	Mid-Peak (mbtu)	Normal Peak (mbtu)	Off-Peak (mbtu)	Overall (mbtu)
Jan	0	0	0	0	805
Feb	0	0	0	0	602
Mar	0	0	0	0	380
Apr	0	0	0	0	81
May	0	0	0	0	26
Jun	0	0	0	0	0
Jul	0	0	0	0	0
Aug	0	0	0	0	0
Sep	0	0	0	0	0
Oct	0	0	0	0	85
Nov	0	0	0	0	367
Dec	0	0	0	0	603
Totals	0	0	0	0	2,950

Billing Details - Natural Gas - ECU Health Services Standard Bld

ECU Health Education Standard Building
Adams-Frazier-Anderson

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4. Billing Demands

Billing Period	Peak (mbtu)	Mid-Peak (mbtu)	Normal Peak (mbtu)	Off-Peak (mbtu)	Overall (mbtu)
Jan	0.0	0.0	0.0	0.0	2.0
Feb	0.0	0.0	0.0	0.0	2.0
Mar	0.0	0.0	0.0	0.0	1.7
Apr	0.0	0.0	0.0	0.0	1.1
May	0.0	0.0	0.0	0.0	1.2
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	1.2
Nov	0.0	0.0	0.0	0.0	1.7
Dec	0.0	0.0	0.0	0.0	2.0

5. Maximum Demands

Billing Period	Peak (mbtu)	Mid-Peak (mbtu)	Normal Peak (mbtu)	Off-Peak (mbtu)	Overall (mbtu)
Jan	0.0	0.0	0.0	0.0	2.0
Feb	0.0	0.0	0.0	0.0	2.0
Mar	0.0	0.0	0.0	0.0	1.7
Apr	0.0	0.0	0.0	0.0	1.1
May	0.0	0.0	0.0	0.0	1.2
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	0.0	0.0	1.2
Nov	0.0	0.0	0.0	0.0	1.7
Dec	0.0	0.0	0.0	0.0	2.0

6. Time Of Maximum Demands

Billing Period	Peak (m/d/h)	Mid-Peak (m/d/h)	Normal Peak (m/d/h)	Off-Peak (m/d/h)	Overall (m/d/h)
Jan	n/a	n/a	n/a	n/a	1 4/0600
Feb	n/a	n/a	n/a	n/a	2 1/0100
Mar	n/a	n/a	n/a	n/a	3 3/0500
Apr	n/a	n/a	n/a	n/a	4 10/0500
May	n/a	n/a	n/a	n/a	5 1/0500
Jun	n/a	n/a	n/a	n/a	n/a
Jul	n/a	n/a	n/a	n/a	n/a
Aug	n/a	n/a	n/a	n/a	n/a
Sep	n/a	n/a	n/a	n/a	9 12/0600
Oct	n/a	n/a	n/a	n/a	10 7/0600
Nov	n/a	n/a	n/a	n/a	11 6/0600
Dec	n/a	n/a	n/a	n/a	12 1/0400