

ASU Health Services Expansion and Renovations

Tempe, Arizona

LEED-NC v3 Energy Analysis Report

Provided by



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I. Introduction

Design is underway for the expansion and renovation of the ASU Health services building in Tempe, Arizona. This two story health clinic will consist of exam areas and administration areas. The project is seeking certification under the United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED version 3) program. This document is provided in support of these guidelines, specifically with respect to Energy and Atmosphere Prerequisite 2 (EAp2), Minimum Energy Performance, and Energy and Atmosphere Credit 1 (EAc1), Optimize Energy Performance.

The purpose of this preliminary report is to assess the current building design and gauge the annual energy performance in comparison with ASHRAE 2007. The intent is that the results from this preliminary study will help guide design decisions for the envelope, lighting, and mechanical systems in the building.

II. Background

Leadership in Energy & Environmental Design (LEED) is an internationally recognized green building certification system, providing third-party verification that a building was designed and built using strategies intended to improve performance in metrics such as energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

Developed by the U.S. Green Building Council (USGBC), LEED is intended to provide building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.

Points are distributed across major credit categories such as Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. Prerequisites in each category receive no points and are mandatory for all projects.¹

III. Methodology

Under LEED guidelines, there are two approaches to calculating a building's energy score, *Prescriptive* and *Energy Performance*:

The Prescriptive Compliance Path requires that individual building components (envelope, lighting, and HVAC systems), exceed the minimum requirements prescribed by either the *ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004* (1 point) or the *Advanced Buildings™ Core Performance™ Guide* (1-3 points), depending on the building type, size, usage, etc..

¹ Source: http://en.wikipedia.org/wiki/Leadership_in_Energy_and_Environmental_Design



The Energy Performance Path (*Whole Building Energy Simulation*) requires an improvement in energy usage be demonstrated with an energy model of the building that follows the *Building Performance Rating Method* found in Appendix G of ASHRAE 90.1-2007.

Using the Energy Performance Path, an hourly building simulation model was developed using the *eQUEST* (DOE2.2) computer software. The features of the baseline building model are minimally compliant with ASHRAE 90.1-2007 Appendix G. Improvements to this model are then made to reflect design improvements to the building's envelope, lighting, and HVAC systems that have been incorporated into the as-proposed building. The energy cost savings between the ASHRAE 90.1 benchmark building and the as-designed building are then used to determine the number of Energy Optimization Credits. Long term hourly weather data (TMY 3) was used for the analysis.

IV. Building Description

The ASU Health Services building is a two-story facility consisting primarily of exam rooms and administration areas. The project totals approximately 34,300 sqft.

Figure 1 below shows the 3D schematic of the model, while the zoning/floorplan can be seen in Figure 2. Additional building information is found in the following sections.



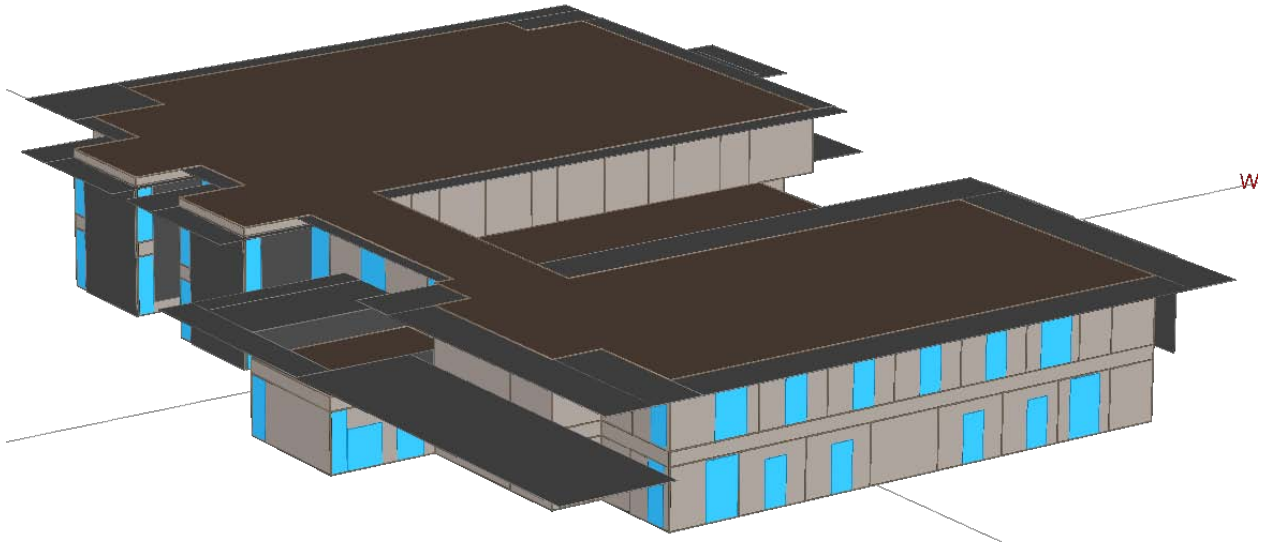


Figure 1 – 3D representation eQUEST model



Figure 2 – 1st Floor zoning/floorplan of eQUEST model



A. Operation

This building is operated on a year round basis, 7am to 6pm Monday through Friday, except federal holidays.

B. Envelope

The building is located in Tempe, Arizona, which is in ASHRAE Climate Zone 2B. The ASHRAE climate zone dictates which envelope table is used, and subsequently the minimum insulation required. A summary of all the envelope components of the Proposed and Baseline buildings is provided below:

1. Exterior Walls

Baseline

The baseline Appendix G construction is a steel-framed exterior wall with R-13 batt insulation (U-0.124 Btu/h-ft²-°F).

Proposed

The proposed exterior wall construction utilizes 1.5" rigid insulation on steel studs 16" on center with R-19 batt insulation, and finished with gyp board (U-value 0.074). On existing areas of the building the walls will be block furred out with R-13 batt insulation (U-value 0.115).

2. Roofs

Baseline

The baseline Appendix G LEED Construction is built-up roof with R-20 continuous insulation above deck (U-0.048 Btu/h-ft²-°F).

Proposed

The proposed roof construction utilizes a build up roof with R-30 insulation (U-0.037 Btu/h-ft²-°F).

3. Glass

Baseline

The baseline Appendix G LEED glazing has an assembly U-value of 0.75 and a SHGC of 0.25.

Proposed

A high performance Low-E glass is utilized in the proposed glazing system. This glazing has center of glass (CoG) U-value of 0.29 and a solar heat gain coefficient (SHGC) of 0.31. The overall window-to-wall ratio for the building is approximately 18%. Frames were modeled explicitly in eQUEST.



C. Interior Lighting

Baseline

The ASHRAE 90.-2007 lighting budget was determined using the “Space-by-Space” method which assigns a maximum allowable lighting power density (LPD) based on the space type or function. The overall baseline LPD is 1.12 W/sqft.

Proposed

The proposed lighting design utilizes high efficiency T-8 fixtures in an optimized layout, yielding an overall building LPD of 0.88 W/sqft (a 21% improvement over ASHRAE 90.1-2007).

The proposed lighting design also includes occupancy sensors. For these sensors, a ten percent lighting power credit is allowed by Appendix G and applied to all lighting connected to occupancy sensors. Occupancy sensors are required in all conference rooms and must be modeled with occupancy sensors in both the baseline and as design models.

Figure below shows the comparison of the Baseline and Proposed lighting power densities.

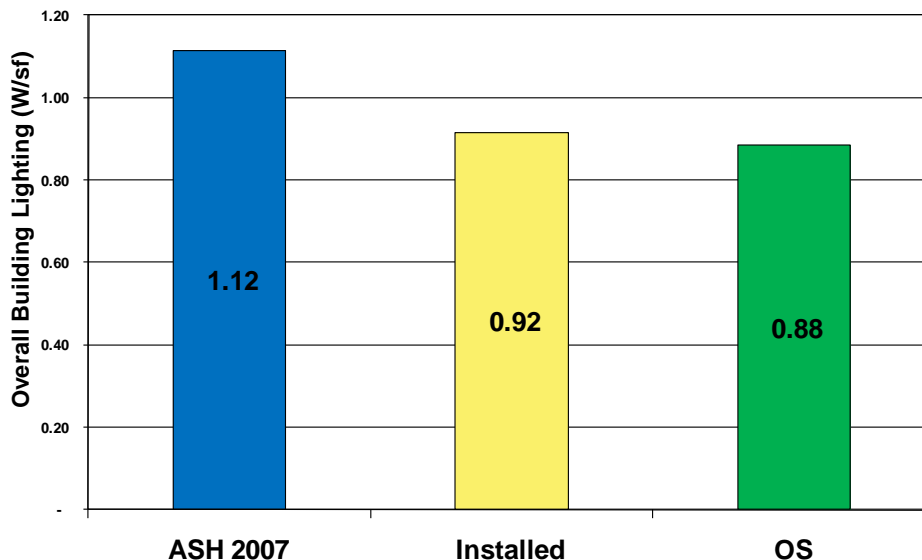


Figure 3 – Baseline vs. Proposed lighting power density



D. Exterior Lighting

This project can take credit for efficient exterior lighting within ASHRAE 90.1 Appendix G. Credit is only taken for the tradable surfaces listed in ASHRAE 90.1-2007 Table 9.4.5. All other exterior lighting is modeled identically in the Baseline and Proposed case. The Baseline case exterior lighting power allowance is calculated using the methodology outline in Section 9.4.5.

	Baseline	Proposed
Tradable	7,999 W	2,856 W
Non-Tradable	0 W	0 W
Total	7,999 W	2,856 W

E. HVAC

Baseline

The ASHRAE 90.1 Appendix G Baseline system for the building is packaged variable air volume with hot water reheat. The PVAV units are auto sized in the baseline with efficiencies and fan powers from ASHRAE 90.1 Appendix G.

Proposed

The Proposed mechanical design includes new rooftop VAV unit with electric reheat to provide space heating and cooling for new section of the building. Heating for the existing building and cooling for both new and existing areas are supplied by ASU's district plant. The existing multi-zone air handler will be converted to a VAV system with temperature control from the existing hot deck and cold deck for each zone. The existing air handler will keep the existing steam coil in place for the hot deck. Per LEED requirements, the overall plant was modeled with an overall COP of 4.4 and the heating was modeled with an overall efficiency of 70%. Demand Control Ventilation is not utilized. No credit can be taken for DCV. See the HVAC Summary Table below for further details.

Unit	Baseline								Proposed							
	Total Supply Flow (cfm)	Cooling / Heating Sizing Ratio	Fan Power (W/cfm)	Total Fan kW	Cooling Capacity (kBtu/hr)	Heating Capacity (kBtu/hr)	Cooling Efficiency (EER)	Heating Efficiency (COP)	Total Supply Flow (cfm)	Cooling / Heating Sizing Ratio	Fan Power (W/cfm)	Total Fan kW	Cooling Capacity (kBtu/hr)	Heating Capacity (kBtu/hr)	Cooling Efficiency (EER)	Heating Efficiency (COP)
RTU-1	20,297	1.15 / 1.25	1.217	24.70	658.6	-390.3	9.8	(Boiler)	30,000	1.0 / 1.0	1.067	32.01	962.2	-290.2	(Chiller)	(Boiler)
RTU-2	15,912	1.15 / 1.25	1.225	19.49	527.9	-338.2	9.8	(Boiler)	21,360	1.0 / 1.0	0.850	18.16	484.0	-137.4	(Chiller)	(Boiler)
AC-1	338	1.15 / 1.25	1.166	0.39	9.0	0.5	SEER 13	80%	425	1.0 / 1.0	0.198	0.08	12.0	0.5	SEER 15.2	(Boiler)
AC-2	375	1.15 / 1.25	0.923	0.35	9.7	0.5	SEER 13	80%	425	1.0 / 1.0	0.198	0.08	12.0	0.5	SEER 15.2	(Boiler)
AC-3	692	1.15 / 1.25	0.909	0.63	18.5	0.5	SEER 13	80%	920	1.0 / 1.0	0.182	0.17	34.2	0.5	SEER 14	(Boiler)
DFC-1	826	1.15 / 1.25	0.849	0.70	20.9	0.5	SEER 13	80%	900	1.0 / 1.0	0.181	0.16	26.8	0.5	(Chiller)	(Boiler)
Total	38,440			46	1,245	-727			54,030			51	1,531	-426		

*Per Appendix G

*Per DWGs



F. Renewable Energy Sources

A 69.3 kW system has been proposed for this project. This system is estimated to produce 103,229 kWh annually.

G. Utility Rates

State average utility rates from DOE's Energy Information Administration (EIA) were used in the analysis. A summary of the utility rates can be seen below.

EIA Average Electric Commercial Rate (Arizona, Nov. 2011):

Average Energy Charge: \$0.08860 per kWh

EIA Average Natural Gas Commercial Rate (Arizona, Nov. 2011):

Average Energy Charge: \$0.92500 per therm



V. Modeling Summary

A total of five simulations were done beginning with the minimum ASHRAE 90.1-2007 baseline model (blue background). Each run was done incrementally incorporating the features of the previous run. The final run (green background) represents the as-designed building. Note that the intermediate runs are provided for information purposes to assess the relative impact of each building system. LEED credit calculations are done only between the ASHRAE base and the final HVAC run.

The inputs and assumptions of the simulation order described below can be found in Table 2:

ASHRAE:	Minimum ASHRAE 90.1-2007 model
E-1:	ASHRAE 90.1 plus Envelope
L-1:	E-1 plus Lighting
M-1:	L-1 plus Mechanical
R-1:	M-1 plus PV System



ASHRAE Baseline vs. Proposed Design							
		B-0*	E-1	L-1	M-1	R-1	
		ASHRAE 90.1 2007 CZ 2B	Envelope	Lighting	Mechanical	PV System	
Envelope	Roof	U-Value / R-Value	0.048 / 20ci	0.037 / 30	0.037 / 30	0.037 / 30	0.037 / 30
		Framing	Above Deck	Above Deck	Above Deck	Above Deck	Above Deck
	New Walls	U-Value / R-Value	0.124 / 13	0.074 / 19+5ci	0.074 / 19+5ci	0.074 / 19+5ci	0.074 / 19+5ci
		Framing	Steel Stud	Steel Stud	Steel Stud	Steel Stud	Steel Stud
	Existing Walls	U-Value / R-Value	0.124 / 13	0.115 / 13	0.115 / 13	0.115 / 13	0.115 / 13
		Framing	Steel Stud	Steel Stud	Steel Stud	Steel Stud	Steel Stud
	Windows	U-Value	0.57	0.29	0.29	0.29	0.29
		SHGC / SC	0.25 / 0.29	0.31/0.36	0.31/0.36	0.31/0.36	0.31/0.36
Frames		n/a	Yes	Yes	Yes	Yes	
Shading	Exterior (Fixed)	No	Yes	Yes	Yes	Yes	
Lighting	Overall LPD	Watts / sqft	1.12	1.12	0.88	0.88	0.88
	Controls	Occupancy	n/a	n/a	Yes	Yes	Yes
	Exterior	Tradable KW	7.99	7.99	2.86	2.86	2.86
		Non Tradable kW	0	0	0	0	0
Airside System	New AHU	System Type	Package VAV w/ Electric Reheat	Package VAV w/ Electric Reheat	Package VAV w/ Electric Reheat	VAV w/ Electric Reheat	VAV w/ Electric Reheat
		Fan Control	VFD	VFD	VFD	VFD	VFD
		OA Economizer	Yes	Yes	Yes	Yes	Yes
		Fan Power	1.217 W/CFM	1.217 W/CFM	1.217 W/CFM	1.067 W/CFM	1.067 W/CFM
		EER	10 EER	10 EER	10 EER	(Chiller)	(Chiller)
	Existing AHU	System Type	Package VAV w/ HW Reheat	Package VAV w/ HW Reheat	Package VAV w/ HW Reheat	VAV w/ HW Reheat	VAV w/ HW Reheat
		Fan Control	VFD	VFD	VFD	VFD	VFD
		OA Economizer	Yes	Yes	Yes	Yes	Yes
		Fan Power	1.225 W/CFM	1.225 W/CFM	1.225 W/CFM	0.856 W/CFM	0.856 W/CFM
		EER	9.8 EER	9.8 EER	9.8 EER	(Chiller)	(Chiller)
Cooling	Chillers / Chilled Water System	Compressor Type	n/a	n/a	n/a	(District)	(District)
		Condensor	n/a	n/a	n/a	(District)	(District)
		COP	n/a	n/a	n/a	4.40	4.40
		CHW ST (deg F)	n/a	n/a	n/a	44	44
		CHW ΔT (deg F)	n/a	n/a	n/a	12	12
		Pump Motor Class	n/a	n/a	n/a	High Efficiency	High Efficiency
		Pump Drive Type	n/a	n/a	n/a	VFD	VFD
Heating	Boilers / Hot Water System	No. of Boilers	2	2	2	(District)	(District)
		Efficiency (%)	80%	80%	80%	70%	70%
		HW ST (deg F)	180	180	180	180	180
		HW ΔT (deg F)	50	50	50	40	40
		Pump Motor Class	High Efficiency	High Efficiency	High Efficiency	High Efficiency	High Efficiency
Renewables	Photovoltaic	kW	n/a	n/a	n/a	n/a	69
		Annual kWh	n/a	n/a	n/a	n/a	103,229
		Fixed/Tracking	n/a	n/a	n/a	n/a	Fixed

* Average of four runs (building rotated 90 deg each run)

Table 2 – Modeling Summary Table



VI. Analysis Results

Results of the analysis are summarized in the Table below. The building has the potential to achieve approximately \$19,594 (48.9%) in annual utility savings per year compared to a minimally compliant ASHRAE 90.1-2007 building. More detailed results are shown in the Table and Figure below.

Description		Total			Electric			Cost				LEED	
#	Name	Elec kW	Electric kWh	Gas Therms	Lighting kWh	HVAC kWh	Equip kWh	Electric \$	Gas \$	Total \$	Total \$/sqft	LEED %	EAc1 Points
B-0	ASHRAE 90.1-2007	202	433,128	1,825	99,652	190,355	108,209	\$38,375	\$1,688	\$40,063	\$1.16		0
E-1	O+Envelope	189	418,170	1,482	99,652	175,397	108,209	\$37,050	\$1,371	\$38,421	\$1.12	4.1%	0
L-1	E-1+Lighting	177	365,528	1,599	77,242	167,598	108,209	\$32,386	\$1,479	\$33,865	\$0.98	15.5%	2
M-1	L-1+Mechanical	129	321,684	1,205	77,242	123,753	108,209	\$28,501	\$1,114	\$29,615	\$0.86	26.1%	8
R-1	M-1+PV System	129	218,455	1,205	77,242	123,753	108,209	\$19,355	\$1,114	\$20,469	\$0.60	48.9%	19

Table 3 – Estimated Annual Utility and Energy Costs

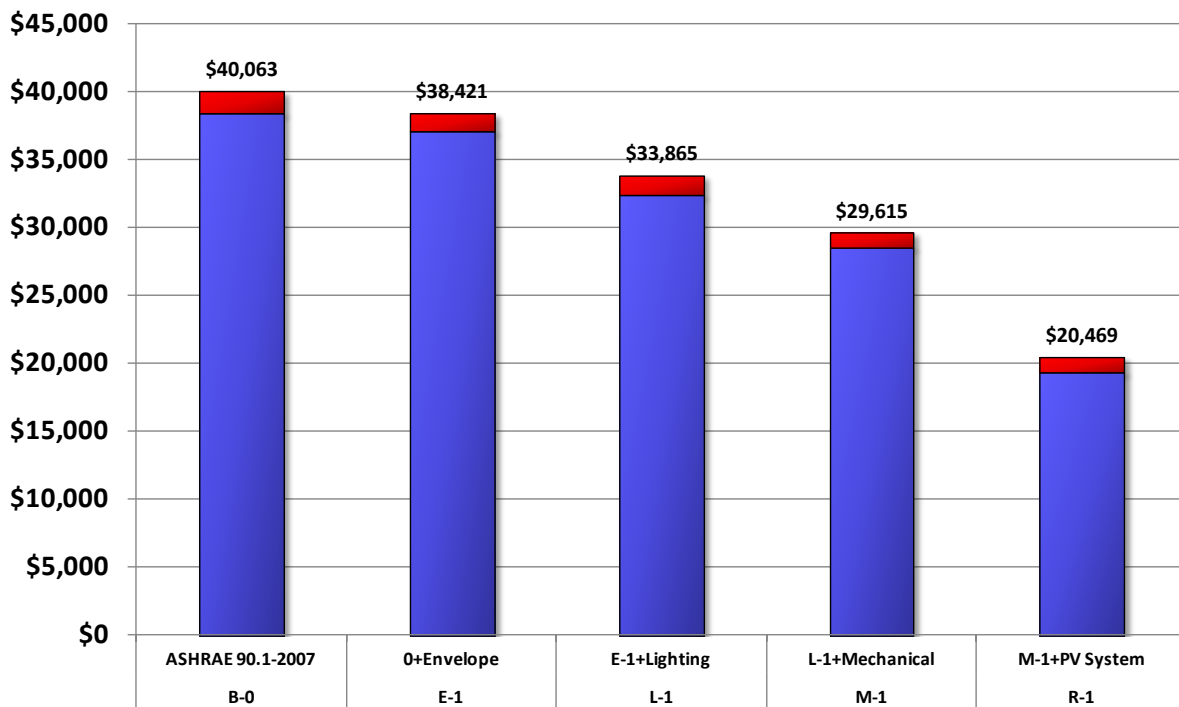


Figure 4 – Estimated Annual Utility Costs



VII. LEED Calculations

From a LEED perspective, the building is 48.9% below ASHRAE and is eligible for 19 points according to Option 1 under EA Credit 1. The renewable energy generated by the PV System accounts for 30.9% of the overall energy usage and is eligible for 7 points under EA Credit 2. Calculations are provided in this section in the format prescribed by the USGBC.

Energy & Cost Summary

End-Use	Energy Type	Baseline (ECB')				Proposed (DEC'')		
		Electric kWh	Gas Therms	Energy Use kBtu/sf/yr	Energy Cost %	Electric kWh	Gas Therms	Energy Use kBtu/sf/yr
Lighting	Electric	99,652	-	9.9	22%	77,242	-	7.7
Misc Equipment	Electric	108,209	-	10.7	24%	108,209	-	10.7
Space Heating	Electric/Gas	-	776	2.3	2%	4,544	156	0.9
Space Cooling	Electric	135,161	-	13.4	30%	83,434	-	8.3
Fans	Electric	54,364	-	5.4	12%	31,494	-	3.1
Pumps/Aux	Electric	830	-	0.1	0%	4,281	-	0.4
Exterior	Electric/Gas	34,912	-	3.5	8%	12,479	-	1.2
Domestic Hot Water	Electric/Gas	-	1,049	3.0	2%	-	1,048	3.0
Subtotal Regulated		433,128	1,825	48.3	100%	321,683	1,204	35.4
Regulated Cost \$		\$38,375	\$1,688	\$40,063		\$28,501	\$1,114	\$29,615
Total Building Energy Cost		433,128	1,825	48.3		321,683	1,204	35.4
		\$38,375	\$1,688	\$1.16		\$28,501	\$1,114	\$0.86

Annual Energy & Utility Cost

Energy Type	Baseline		Proposed		Savings		
	kBtu/sqft	Cost \$	kBtu/sqft	Cost \$	Energy%	Cost%	
Electricity	43.0	\$38,375	31.9	\$28,501	25.7%	25.7%	
Natural Gas	5.3	\$1,688	3.5	\$1,114	34.0%	34.0%	
Subtotal	48.3	\$40,063	35.4	\$29,615	26.6%	26.1%	
Renewable							
Photovoltaics	0	\$0	10.2	\$9,146	28.9%	30.9%	
Solar Hot Water	0	\$0	0.00	\$0	0.0%	0.0%	
Exceptional Calculation	0	\$0	0.0	\$0	0.0%	0.0%	
Total	48.3	\$40,063	25.2	20,469	47.9%	48.9%	
					%	Credits	
					Energy Optimization EAc1	48.9%	19
					Renewable Energy EAc2	30.9%	7
					EA Credit 1 & 2 Points =		26

Table 4 – LEED Calculations



VIII. Appendices

A. Envelope Requirements

TABLE 5.5-2 Building Envelope Requirements for Climate Zone 2 (A, B)*

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
<i>Roofs</i>						
Insulation Entirely above Deck	U-0.048	R-20.0 c.i.	U-0.048	R-20.0 c.i.	U-0.218	R-3.8 c.i.
Metal Building	U-0.065	R-19.0	U-0.065	R-19.0	U-0.167	R-6.0
Attic and Other	U-0.027	R-38.0	U-0.027	R-38.0	U-0.081	R-13.0
<i>Walls, Above-Grade</i>						
Mass	U-0.151 ^a	R-5.7 c.i. ^a	U-0.123	R-7.6 c.i.	U-0.580	NR
Metal Building	U-0.113	R-13.0	U-0.113	R-13.0	U-0.184	R-6.0
Steel-Framed	U-0.124	R-13.0	U-0.064	R-13.0 + R-7.5 c.i.	U-0.124	R-13.0
Wood-Framed and Other	U-0.089	R-13.0	U-0.089	R-13.0	U-0.089	R-13.0
<i>Walls, Below-Grade</i>						
Below-Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
<i>Floors</i>						
Mass	U-0.107	R-6.3 c.i.	U-0.087	R-8.3 c.i.	U-0.322	NR
Steel-Joist	U-0.052	R-19.0	U-0.052	R-19.0	U-0.069	R-13.0
Wood-Framed and Other	U-0.051	R-19.0	U-0.033	R-30.0	U-0.066	R-13.0
<i>Slab-On-Grade Floors</i>						
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
Heated	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.
<i>Opaque Doors</i>						
Swinging	U-0.700		U-0.700		U-0.700	
Nonswinging	U-1.450		U-0.500		U-1.450	
Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
<i>Vertical Glazing, 0%–40% of Wall</i>						
Nonmetal framing (all) ^b	U-0.75		U-0.75		U-1.20	
Metal framing (curtainwall/storefront) ^c	U-0.70	SHGC-0.25 all	U-0.70	SHGC-0.25 all	U-1.20	SHGC-NR all
Metal framing (entrance door) ^c	U-1.10		U-1.10		U-1.20	
Metal framing (all other) ^c	U-0.75		U-0.75		U-1.20	
<i>Skylight with Curb, Glass, % of Roof</i>						
0%–2.0%	U _{all} -1.98	SHGC _{all} -0.36	U _{all} -1.98	SHGC _{all} -0.19	U _{all} -1.98	SHGC _{all} -NR
2.1%–5.0%	U _{all} -1.98	SHGC _{all} -0.19	U _{all} -1.98	SHGC _{all} -0.19	U _{all} -1.98	SHGC _{all} -NR
<i>Skylight with Curb, Plastic, % of Roof</i>						
0%–2.0%	U _{all} -1.90	SHGC _{all} -0.39	U _{all} -1.90	SHGC _{all} -0.27	U _{all} -1.90	SHGC _{all} -NR
2.1%–5.0%	U _{all} -1.90	SHGC _{all} -0.34	U _{all} -1.90	SHGC _{all} -0.27	U _{all} -1.90	SHGC _{all} -NR
<i>Skylight without Curb, All, % of Roof</i>						
0%–2.0%	U _{all} -1.36	SHGC _{all} -0.36	U _{all} -1.36	SHGC _{all} -0.19	U _{all} -1.36	SHGC _{all} -NR
2.1%–5.0%	U _{all} -1.36	SHGC _{all} -0.19	U _{all} -1.36	SHGC _{all} -0.19	U _{all} -1.36	SHGC _{all} -NR

*The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.

^aException to Section A3.1.3.1 applies.

^bNonmetal framing includes framing materials other than metal with or without metal reinforcing or cladding.

^cMetal framing includes metal framing with or without thermal break. The "all other" subcategory includes operable windows, fixed windows, and non-entrance doors.



B. Lighting Calculations

Space Name	Space Type	Area (sqft)	Lighting Controls	Lighting Power Density			Fixture Name	Fixture																			
				ASH 200	Installed	OS		Watts	A	B	C	D	E	F	G	H	J	J1	K	L	M	N	P	Q	R	S	T
1st Floor								(Y/N)																			
Nurses Office 1 1F	Office	150		1.10	0.58	0.58	86	1																			
Exam 9 1F	Hospital	140		1.50	0.62	0.62	86	1																			
Exam 8 1F	Hospital	137		1.50	0.63	0.63	86	1																			
Exam 7 1F	Hospital	137		1.50	0.63	0.63	86	1																			
Exam 6 1F	Hospital	140		1.50	0.62	0.62	86	1																			
Exam 5 1F	Hospital	137		1.50	0.63	0.63	86	1																			
Mechanical 1 1F	Mechanical	23		1.50	5.18	5.18	118				2																
Exam 4 1F	Hospital	148		1.50	0.58	0.58	86	1																			
Exam 3 1F	Hospital	121		1.50	0.71	0.71	86	1																			
Exam 2 1F	Hospital	118		1.50	0.73	0.73	86	1																			
Exam 1 1F	Hospital	121		1.50	0.71	0.71	86	1																			
FT Nurse 1 1F	Hospital	450		1.50	1.66	1.66	748	2			12																
Restroom 1 1F	Restroom	56		0.90	0.57	0.57	32												1								
Office 1 1F	Office	162		1.10	0.53	0.53	86	1																			
Office 2 1F	Office	155		1.10	0.56	0.56	86	1																			
Office 3 1F	Office	162		1.10	0.89	0.89	145	1			1																
Sports Exam 1 1F	Hospital	165		1.50	0.52	0.52	86	1																			
Sports Exam 2 1F	Hospital	161		1.50	0.53	0.53	86	1																			
Imaging 1 1F	Hospital	726		1.50	0.87	0.87	632	4				1	8						1								
Central Stores 1 1F	Hospital	514		1.50	0.46	0.46	236				4																
Conference 1 1F	Conference	464	Y	1.30	0.93	0.83	430	5																			
Stairs 1 1F	Stairs	118		0.60	0.00	0.00	0																				
Office 4 1F	Office	202	Y	1.10	0.43	0.38	86	1																			
Office 5 1F	Office	118	Y	1.10	1.46	1.31	172	2																			
Office 6 1F	Office	134	Y	1.10	1.28	1.16	172	2																			
Office 7 1F	Office	139	Y	1.10	0.62	0.56	86	1																			
Office 8 1F	Office	131	Y	1.10	1.31	1.18	172	2																			
Office 9 1F	Office	134	Y	1.10	1.28	1.16	172	2																			
Office 10 1F	Office	137	Y	1.10	1.41	1.27	192				4																
Stairs 2 1F	Stairs	83		0.60	0.00	0.00	0																				
Admin Wait 1 1F	Waiting	435		0.80	0.00	0.00	0																				
Storage 2 1F	Storage-Active	72		0.80	0.82	0.82	59				1																
Stairs 3 1F	Stairs	190		0.60	0.00	0.00	0																				
Public Wait 1 1F	Waiting	431		0.80	0.53	0.53	227																4	1			
Public Wait 2 1F	Waiting	431		0.80	0.53	0.53	227																4	1			
Public Wait 3 1F	Waiting	114		0.80	0.52	0.52	59																				
Public Wait 4 1F	Waiting	124		0.80	0.48	0.48	59																				
Reception 1 1F	Waiting	401		0.80	1.14	1.14	456	2			2		1							5							
FT Exam 3 1F	Hospital	123	Y	1.50	0.70	0.63	86	1																			
FT Exam 4 1F	Hospital	115	Y	1.50	0.75	0.68	86	1																			
Lab 1 1F	Lab	653	Y	1.40	0.71	0.64	462	5													1						
Restroom 2 1F	Restroom	179	Y	0.90	2.32	2.09	416				4									7							
Restroom 3 1F	Restroom	175	Y	0.90	2.29	2.06	400				3									8							

C. Output Summary Reports

1. Baseline - BEPS

REPORT- BEPS Building Energy Performance

WEATHER FILE- Phoenix

AZ TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	340.1	0.0	369.3	0.0	460.6	0.0	2.8	184.9	0.0	0.0	0.0	119.2	1476.9
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	74.2	0.0	0.0	0.0	0.0	0.0	0.0	104.9	0.0	179.1
MBTU	340.1	0.0	369.3	74.2	460.6	0.0	2.8	184.9	0.0	0.0	104.9	119.2	1656.0

TOTAL SITE ENERGY 1655.95 MBTU 48.2 KBTU/SQFT-YR GROSS-AREA 48.2 KBTU/SQFT-YR NET-AREA
 TOTAL SOURCE ENERGY 4609.70 MBTU 134.1 KBTU/SQFT-YR GROSS-AREA 134.1 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.55
 PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
 HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 123
 HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 37

NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.

2. Baseline - BEPU

REPORT- BEPU Building Utility Performance

WEATHER FILE- Phoenix AZ TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	99652.	0.	108209.	0.	134951.	0.	816.	54183.	0.	0.	0.	34912.	432723.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	742.	0.	0.	0.	0.	0.	0.	1049.	0.	1791.

TOTAL ELECTRICITY 432723. KWH 12.587 KWH /SQFT-YR GROSS-AREA 12.587 KWH /SQFT-YR NET-AREA
 TOTAL NATURAL-GAS 1791. THERM 0.052 THERM /SQFT-YR GROSS-AREA 0.052 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.55
 PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
 HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 123
 HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 37

NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.

3. Baseline - ES-D

REPORT- ES-D Energy Cost Summary

WEATHER FILE- Phoenix AZ TMY2

UTILITY-RATE	RESOURCE	METERS	METERED ENERGY UNITS/YR	TOTAL CHARGE (\$)	VIRTUAL RATE (\$/UNIT)	RATE USED ALL YEAR?
Avg Elec Rate	ELECTRICITY	EM1	432723. KWH	38339.	0.0886	YES
Avg Gas Rate	NATURAL-GAS	FM1	1791. THERM	1656.	0.9250	YES

=====
39996.

ENERGY COST/GROSS BLDG AREA: 1.16
 ENERGY COST/NET BLDG AREA: 1.16

4. Proposed - BEPS

REPORT- BEPS Building Energy Performance

WEATHER FILE- Phoenix AZ TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY MBTU	263.6	0.0	369.3	15.5	284.8	0.0	14.6	107.5	0.0	0.0	0.0	42.6	1097.9
FM1 NATURAL-GAS MBTU	0.0	0.0	0.0	15.6	0.0	0.0	0.0	0.0	0.0	0.0	104.8	0.0	120.5
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
MBTU	263.6	0.0	369.3	31.1	284.8	0.0	14.6	107.5	0.0	0.0	104.8	42.6	1218.4

TOTAL SITE ENERGY 1218.35 MBTU 35.4 KBTU/SQFT-YR GROSS-AREA 35.4 KBTU/SQFT-YR NET-AREA
 TOTAL SOURCE ENERGY 3414.16 MBTU 99.3 KBTU/SQFT-YR GROSS-AREA 99.3 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.73
 PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
 HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
 HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 64

NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.

5. Proposed - BEPU

REPORT- BEPU Building Utility Performance

WEATHER FILE- Phoenix AZ TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	77242.	0.	108209.	4544.	83434.	0.	4281.	31494.	0.	0.	0.	12479.	321684.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	156.	0.	0.	0.	0.	0.	0.	1048.	0.	1205.

TOTAL ELECTRICITY 321684. KWH 9.357 KWH /SQFT-YR GROSS-AREA 9.357 KWH /SQFT-YR NET-AREA
 TOTAL NATURAL-GAS 1205. THERM 0.035 THERM /SQFT-YR GROSS-AREA 0.035 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.73
 PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
 HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
 HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 64

NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.

6. Proposed - ES-D

REPORT- ES-D Energy Cost Summary

WEATHER FILE- Phoenix AZ TMY2

UTILITY-RATE	RESOURCE	METERS	METERED ENERGY UNITS/YR	TOTAL CHARGE (\$)	VIRTUAL RATE (\$/UNIT)	RATE USED ALL YEAR?
Avg Elec Rate	ELECTRICITY	EM1	321684. KWH	28501.	0.0886	YES
Avg Gas Rate	NATURAL-GAS	FM1	1205. THERM	1114.	0.9250	YES

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 29615.

ENERGY COST/GROSS BLDG AREA: 0.86
 ENERGY COST/NET BLDG AREA: 0.86