The Unico System ®

ENERGYGUIDE

This guide will help you compare the annual operating costs of the ***UNICOSYSTEM*** and a conventional system. The Unico Energy Guide is based on the *ARI Guide for Estimating Annual Operating Cost of a Central Air Conditioner or Heat Pump* in the printed forward of the ARI Unitary Directory. The ARI Guide estimates the equipment operating cost based on geographical location and local utility rates. It is a good method for comparing similar systems. Unfortunately, the ARI procedure does not include the type of duct used, installation quality, or comfort level. These additional factors are extremely important when comparing two dissimilar systems such as the ***UNICOSYSTEM*** and a conventional system. The Unico Energy Guide follows the same methodology but also accounts for the type of distribution system and the comfort of the occupants.

In most cases, when comfort and duct design is included in the operating cost, the Unico cooling system will cost marginally more to operate on an annual basis — on the order of less than $10 per year. This makes the benefits of the ***UNICOSYSTEM*** very attractive. The Unico heat pump, on the other hand, will cost less to operate than a conventional system when comfort is included as part of the analysis. The Unico heat pump can cost as much as 10% less to operate, depending on which region you are in.

STEP-BY-STEP PROCEDURE

The following is a step-by-step procedure for estimating the annual operating costs of your ***UNICOSYSTEM*** and for comparing this cost to a conventional system designed to deliver you the same level of comfort you expect from your ***UNICOSYSTEM***. This procedure is based on the ARI Energy Guide and requires the efficiency and capacity ratings listed in the ARI Unitary Directory in addition to your local heating and cooling load hours and utility rates.

Completed Sample Worksheet

A. The Building

1. Location

2. Outdoor Design Temperature °F

3. Local Power Rates $/kW-hr
   $/kW-hr

4. Load Hours (Fig. 1 and 2) Hour
   Hour

St. Louis, Missouri (Region IV)	
a) Summer	**94°F DB / 75°F WB**
b) Winter	**8°F**
a) Summer	**0.0831**
b) Winter	**0.0750**
a) Summer	**1100**
b) Winter	**2000**

Type of System

B. Summer (Cooling) Load
1. Indoor Design Temperature °F
2. Building Heat Gain Btu/hr
3. Duct Loss %
4. Duct Heat Gain Btu/hr
5. Total Heat Gain Btu/hr

	Conventional System	Unico System
Indoor Design Temperature	**75**	**78**
Building Heat Gain	**40,000**	**34,000**
Duct Loss	**15**[1]	**8**[2]
Duct Heat Gain	**6,000**	**2,720**
Total Heat Gain	**46,000**	**36,720**

C. Winter (Heating) Load
1. Indoor Design Temperature °F
2. Building Heat Loss Btu/hr
3. Duct Loss %
4. Duct Heat Loss Btu/hr
5. Total Heat Loss Btu/hr

	Conventional System	Unico System
Indoor Design Temperature	**72**	
Building Heat Loss	**60,000**	
Duct Loss	**20**	**12**
Duct Heat Loss	**12,000**	**7,200**
Total Heat Loss	**72,000**	**67,200**

D. Equipment Data from ARI Directory
1. Outdoor Equipment
2. Indoor Equipment
3. Rated Unit Cooling Capacity Btu/hr
4. Rated Cooling Efficiency, SEER Btuh/W
5. Rated Unit Heating Capacity Btu/hr
6. Rated Heating Efficiency, HSPF Btuh/W
7. Average Heating Annual Operating Cost $

	Trane 4TWX4048A1	
Indoor Equipment	**4TTE3F49A**	**MB4860L + MC4860HX**
Rated Unit Cooling Capacity	**50,500**	**42,000**
Rated Cooling Efficiency, SEER	**14.0**	**11.0**
Rated Unit Heating Capacity	**45,000**	**42,000**
Rated Heating Efficiency, HSPF	**8.45**	**7.0**
Average Heating Annual Operating Cost	**815**	**787**

E. Calculate Estimated Cooling Cost
1. Cooling Cost = (B.5)(A.3a)(A.4a)/((1000)(D.4)) $

	Conventional	Unico
	300	**305**

F. Calculate Estimated Heating Cost
1. Conventional Heating Cost Factor[3] (Table 1)
2. UnicoSystem Heating Cost Factor (Table 2)
3. Heating Cost = (A.3b)(A.4b)(D.7)(F.1)/((2080)(0.0831[4])) $
4. Heating Cost = (A.3b)(A.4b)(D.7)(F.2)/((2080)(0.0831[4])) $

	Conventional	Unico
F.1	**2.291**	
F.2		**1.804**
F.3	**1620**	
F.4		**1232**

In this example, the Unico System will cost approximately $5 dollars more per year to cool the residence but will save $388 to heat per year for a total energy savings of $383.

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[1] Ref: Florida Energy Report average home thermal losses for duct in non-conditioned air space, 1985.
[2] Ref: Dunham-Bush internal company test report, 1976.
[3] With a comfort controller added to maintain a constant discharge temperature of 100°F

Location (not shown) — Hours
Alaska — 0
Canal Zone — 6,000
Guam — 6,600
Hawaii — 2,300
Puerto Rico — 6,000
Samoa — 6,600
Virgin Islands — 6,000

Figure 1. Cooling Load Hours

Location (not shown) — Hours
Alaska — 3,500
Hawaii and — 0
  Territories
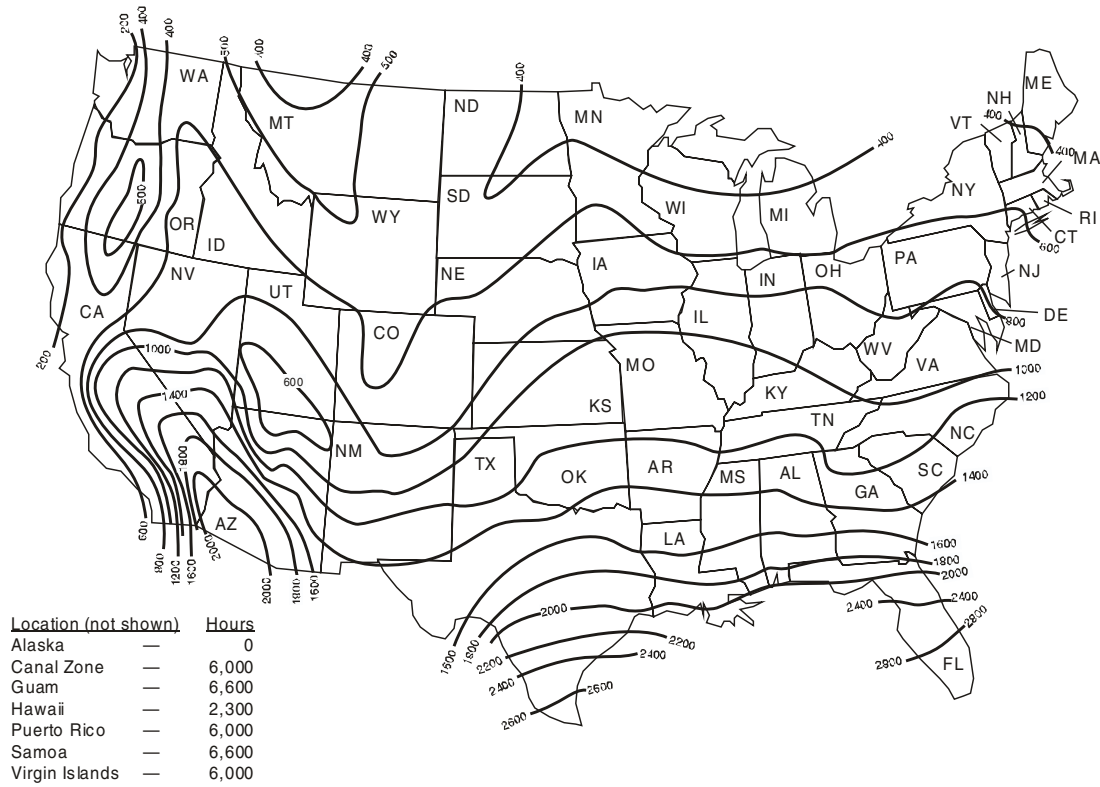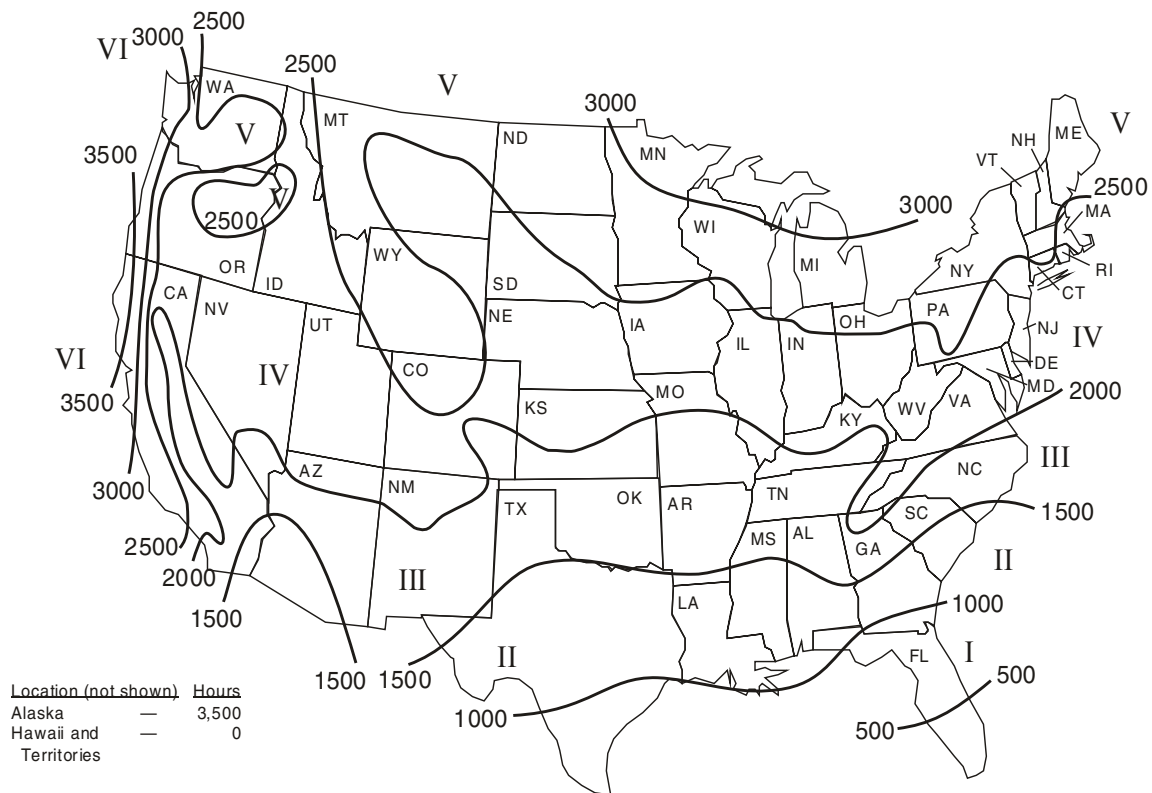
Figure 2. Heating Load Hours

Table 1. Heating Cost Factor for Conventional System with Electric Comfort Controller
(Maintains 100°F air temperature)

Range of Comparability, Btu/hr		Building Heat Loss, MBtu/hr (MBtu/hr times 1000 = Btu/hr)															
		5	10	15	20	25	30	35	40	50	60	70	80	90	100	110	130
Up to 12,499	Region I	0.598	1.118	1.607													
	Region II	0.694	1.302	1.850	2.444												
	Region III	0.771	1.452	2.066	2.677												
	Region IV		1.646	2.336	3.015	3.773											
	Region V		1.860	2.639	3.386	4.193											
	Region VI	0.656	1.234	1.753	2.304												
12,500-17,499	Region I	0.408	0.779	1.118	1.442												
	Region II	0.473	0.905	1.302	1.670	2.037											
	Region III		1.007	1.452	1.866	2.264	2.677										
	Region IV		1.141	1.646	2.113	2.557	3.015	3.503	4.045								
	Region V		1.291	1.860	2.388	2.886	3.386	3.913	4.479								
	Region VI	0.447	0.856	1.234	1.583	1.927	2.304	2.726									
17,500-22,499	Region I		0.598	0.867	1.118	1.359											
	Region II		0.694	1.007	1.302	1.580	1.850										
	Region III			1.122	1.452	1.765	2.066	2.366	2.677								
	Region IV			1.271	1.646	1.999	2.336	2.670	3.015	3.772							
	Region V			1.437	1.860	2.260	2.639	3.009	3.386	4.193	5.081						
	Region VI		0.656	0.954	1.233	1.498	1.753	2.016	2.304								
22,500-27,499	Region I		0.485	0.708	0.918	1.118	1.312										
	Region II			0.822	1.068	1.302	1.525	1.742	1.962								
	Region III			0.914	1.189	1.452	1.704	1.947	2.185	2.677							
	Region IV				1.348	1.646	1.930	2.203	2.469	3.015	3.608						
	Region V				1.524	1.860	2.182	2.489	2.787	3.386	4.025	4.718	5.466				
	Region VI			0.777	1.011	1.233	1.446	1.651	1.855								
27,500-32,499	Region I			0.598	0.779	0.952	1.118										
	Region II			0.694	0.905	1.108	1.302	1.489	1.670								
	Region III			0.771	1.007	1.234	1.452	1.663	1.866	2.264							
	Region IV				1.141	1.398	1.646	1.883	2.113	2.557	3.015						
	Region V				1.291	1.581	1.860	2.129	2.388	2.886	3.386	3.913	4.479				
	Region VI			0.656	0.856	1.049	1.233	1.411	1.583	1.927	2.304						
32,500-37,499	Region I			0.518	0.677	0.829	0.976	1.118									
	Region II				0.785	0.964	1.136	1.302	1.463	1.773							
	Region III				0.873	1.073	1.266	1.452	1.633	1.981	2.322						
	Region IV					1.216	1.434	1.646	1.850	2.241	2.621	3.015	3.433	3.889			
	Region V					1.375	1.622	1.860	2.091	2.532	2.956	3.386	3.837	4.313			
	Region VI				0.743	0.912	1.076	1.233	1.386	1.681	1.978						
37,500-44,999	Region I			0.445	0.583	0.716	0.845	0.970	1.091								
	Region II					0.831	0.982	1.128	1.270	1.543	1.806						
	Region III						1.093	1.257	1.417	1.723	2.017						
	Region IV							1.425	1.605	1.952	2.281	2.604	2.937	3.286	3.657		
	Region V							1.611	1.815	2.206	2.578	2.938	3.300	3.680	4.076	4.490	
	Region VI				0.786	0.930	1.069	1.203	1.462	1.712	1.965	2.235					
45,000-49,999	Region I				0.507	0.624	0.738	0.849	0.957								
	Region II					0.724	0.857	0.987	1.113	1.356	1.587						
	Region III						0.954	1.099	1.240	1.513	1.773	2.025	2.275				
	Region IV								1.405	1.714	2.008	**2.291**	2.569	2.853	3.149	3.461	
	Region V								1.589	1.938	2.270	2.588	2.898	3.211	3.532	3.867	4.584
	Region VI					0.685	0.811	0.934	1.054	1.284	1.505	1.719	1.937	2.164	2.422	2.687	3.317
50,000-54,999	Region I						0.678	0.781	0.881	1.074							
	Region II						0.787	0.907	1.024	1.250	1.466	1.674					
	Region III							1.009	1.140	1.394	1.637	1.870	2.099	2.327			
	Region IV									1.579	1.854	2.117	2.373	2.627	2.887	3.155	
	Region V									1.786	2.096	2.393	2.680	2.963	3.247	3.540	4.162
	Region VI						0.745	0.858	0.969	1.184	1.389	1.587	1.781	1.982	2.191	2.426	2.948
55,000-59,999	Region I					0.523	0.620	0.714	0.807	0.985							
	Region II							0.829	0.937	1.146	1.346	1.539					
	Region III								1.043	1.277	1.502	1.719	1.929	2.136			
	Region IV									1.447	1.702	1.947	2.183	2.413	2.645	2.881	
	Region V									1.636	1.924	2.201	2.467	2.725	2.981	3.240	3.783
	Region VI							0.785	0.887	1.085	1.276	1.458	1.636	1.812	1.997		
60,000-64,999	Region I					0.486	0.577	0.666	0.752	0.920	1.082						
	Region II							0.773	0.874	1.070	1.259	1.441	1.616				
	Region III								1.192	1.404	1.608	1.806	1.999	2.191			
	Region IV									1.591	1.822	2.045	2.261	2.475	2.689	3.133	
	Region V									1.799	2.060	2.312	2.555	2.794	3.030	3.517	
	Region VI							0.731	0.827	1.013	1.193	1.365	1.532	1.696	1.859		

Table 2. Heating Cost Factor for Unico System

Range of Comparability, Btu/hr	Region	Building Heat Loss, MBtu/hr (MBtu/hr times 1000 = Btu/hr)															
		5	10	15	20	25	30	35	40	50	60	70	80	90	100	110	130
Up to 12,499	Region I	0.440	0.842	1.352													
	Region II	0.463	0.876	1.388	2.038												
	Region III	0.486	0.920	1.419	2.063												
	Region IV		1.000	1.555	2.250	3.050											
	Region V		1.145	1.767	2.495	3.308											
	Region VI	0.454	0.852	1.315	1.922												
12,500-17,499	Region I	0.302	0.573	0.842	1.164												
	Region II	0.318	0.601	0.876	1.194	1.585											
	Region III		0.633	0.920	1.232	1.612	2.063										
	Region IV		0.682	1.000	1.355	1.766	2.250	2.776	3.323								
	Region V		0.774	1.145	1.551	1.998	2.495	3.030	3.585								
	Region VI	0.311	0.590	0.852	1.149	1.500	1.922	2.339									
17,500-22,499	Region I		0.440	0.638	0.842	1.075											
	Region II		0.463	0.669	0.876	1.112	1.388										
	Region III			0.704	0.920	1.152	1.419	1.718	2.063								
	Region IV			0.76	1.000	1.262	1.555	1.879	2.250	3.049							
	Region V			0.864	1.145	1.445	1.767	2.113	2.495	3.308	4.175						
	Region VI		0.454	0.657	0.852	1.064	1.315	1.606	1.922								
22,500-27,499	Region I		0.358	0.520	0.677	0.842	1.029										
	Region II			0.547	0.709	0.876	1.063	1.269	1.507								
	Region III			0.575	0.747	0.920	1.103	1.303	1.535	2.063							
	Region IV				0.807	1.000	1.206	1.428	1.682	2.25	2.885						
	Region V				0.919	1.145	1.383	1.635	1.906	2.495	3.141	3.821	4.529				
	Region VI			0.537	0.696	0.852	1.022	1.216	1.415								
27,500-32,499	Region I			0.440	0.573	0.705	0.842										
	Region II			0.463	0.601	0.736	0.876	1.030	1.194								
	Region III			0.486	0.633	0.775	0.920	1.070	1.232	1.612							
	Region IV				0.682	0.839	1.000	1.169	1.355	1.766	2.250						
	Region V				0.774	0.957	1.145	1.344	1.551	1.998	2.495	3.030	3.585				
	Region VI			0.454	0.590	0.722	0.852	0.994	1.149	1.500	1.922						
32,500-37,499	Region I			0.382	0.498	0.610	0.725	0.842									
	Region II				0.523	0.640	0.755	0.876	1.006	1.303							
	Region III				0.550	0.674	0.796	0.920	1.047	1.336	1.668						
	Region IV					0.727	0.862	1.000	1.145	1.464	1.826	2.250	2.697	3.167			
	Region V					0.826	0.984	1.145	1.315	1.671	2.064	2.495	2.951	3.426			
	Region VI				0.514	0.628	0.741	0.852	0.974	1.244	1.561						
37,500-44,999	Region I			0.328	0.428	0.525	0.621	0.718	0.818								
	Region II					0.552	0.65	0.749	0.851	1.075	1.335						
	Region III						0.685	0.789	0.893	1.115	1.367						
	Region IV							0.854	0.970	1.221	1.498	**1.804**	2.161	2.527	2.926		
	Region V							0.975	1.110	1.398	1.705	2.041	2.403	2.779	3.183	3.586	
	Region VI					0.542	0.639	0.734	0.829	1.032	1.271	1.539	1.847				
45,000-49,999	Region I				0.375	0.461	0.544	0.627	0.711								
	Region II					0.485	0.572	0.657	0.743	0.920	1.124						
	Region III						0.601	0.692	0.782	0.965	1.163	1.387	1.630				
	Region IV								0.847	1.053	1.276	1.52	1.786	2.092	2.402	2.744	
	Region V								0.966	1.207	1.460	1.729	2.020	2.332	2.652	2.998	3.705
	Region VI					0.476	0.562	0.646	0.728	0.896	1.076	1.288	1.521	1.788	2.052	2.315	2.907
50,000-54,999	Region I						0.497	0.572	0.647	0.803							
	Region II						0.523	0.601	0.678	0.835	1.006	1.193					
	Region III							0.632	0.714	0.877	1.046	1.231	1.446	1.667			
	Region IV									0.952	1.144	1.354	1.584	1.825	2.108	2.389	
	Region V									1.09	1.315	1.55	1.799	2.062	2.348	2.638	3.266
	Region VI						0.513	0.59	0.666	0.815	0.973	1.148	1.338	1.56	1.801	2.041	2.514
55,000-59,999	Region I					0.387	0.457	0.527	0.595	0.734							
	Region II							0.553	0.624	0.765	0.912	1.079					
	Region III								0.657	0.806	0.957	1.119	1.291	1.494			
	Region IV									0.873	1.043	1.225	1.417	1.636	1.861	2.119	
	Region V									0.997	1.196	1.402	1.623	1.856	2.096	2.360	2.907
	Region VI							0.543	0.613	0.750	0.889	1.035	1.206	1.378	1.591		
60,000-64,999	Region I					0.358	0.424	0.488	0.552	0.677	0.809						
	Region II							0.514	0.58	0.709	0.842	0.983	1.141				
	Region III								0.747	0.884	1.024	1.181	1.349	1.535			
	Region IV									0.960	1.122	1.295	1.479	1.681	1.894	2.367	
	Region V									1.099	1.288	1.483	1.685	1.906	2.128	2.616	
	Region VI							0.504	0.569	0.696	0.821	0.954	1.094	1.255	1.414		

Table 3. Heating Cost Factor for Conventional System (Reference ONLY. Compares to Table in ARI Unitary Directory)

Range of Comparability, Btu/hr		Building Heat Loss, MBtu/hr (MBtu/hr times 1000 = Btu/hr															
		5	10	15	20	25	30	35	40	50	60	70	80	90	100	110	130
Up to 12,499	Region I	0.428	0.827	1.383													
	Region II	0.453	0.863	1.421	2.169												
	Region III	0.477	0.91	1.449	2.189												
	Region IV		1	1.612	2.42	3.372											
	Region V		1.171	1.87	2.721	3.69											
	Region VI	0.443	0.834	1.327	2.019												
12,500-17,499	Region I	0.293	0.557	0.827	1.173												
	Region II	0.311	0.587	0.863	1.202	1.644											
	Region III		0.621	0.91	1.241	1.666	2.189										
	Region IV		0.672	1	1.386	1.853	2.42	3.045	3.698								
	Region V		0.774	1.171	1.624	2.138	2.721	3.358	4.021								
	Region VI	0.303	0.575	0.834	1.145	1.533	2.019	2.498									
17,500-22,499	Region I		0.428	0.621	0.827	1.075											
	Region II		0.453	0.653	0.863	1.114	1.421										
	Region III			0.692	0.91	1.154	1.449	1.788	2.189								
	Region IV			0.751	1	1.284	1.612	1.984	2.42	3.372							
	Region V			0.869	1.171	1.503	1.87	2.27	2.721	3.689	4.733						
	Region VI		0.443	0.64	0.834	1.053	1.327	1.655	2.019								
22,500-27,499	Region I		0.348	0.505	0.659	0.827	1.026										
	Region II			0.534	0.694	0.863	1.061	1.287	1.555								
	Region III			0.563	0.734	0.91	1.102	1.318	1.58	2.189							
	Region IV				0.798	1	1.222	1.467	1.757	2.42	3.175						
	Region V				0.927	1.171	1.434	1.719	2.031	2.721	3.49	4.306	5.159				
	Region VI			0.523	0.679	0.834	1.009	1.218	1.436								
27,500-32,499	Region I			0.428	0.557	0.687	0.827										
	Region II			0.453	0.587	0.721	0.863	1.025	1.202								
	Region III			0.477	0.621	0.763	0.91	1.067	1.241	1.666							
	Region IV				0.672	0.832	1	1.181	1.386	1.853	2.42						
	Region V				0.774	0.967	1.171	1.39	1.624	2.138	2.721	3.358	4.021				
	Region VI			0.443	0.575	0.704	0.834	0.98	1.145	1.533	2.019						
32,500-37,499	Region I			0.371	0.483	0.594	0.708	0.827									
	Region II				0.511	0.625	0.739	0.863	0.999	1.325							
	Region III			0.539	0.661	0.783	0.91	1.042	1.356	1.73							
	Region IV					0.717	0.856	1	1.155	1.508	1.922	2.42	2.951	3.511			
	Region V					0.828	0.996	1.171	1.359	1.76	2.214	2.721	3.263	3.831			
	Region VI				0.501	0.613	0.723	0.834	0.959	1.249	1.603						
37,500-44,999	Region I			0.319	0.417	0.511	0.605	0.702	0.804								
	Region II					0.54	0.637	0.734	0.838	1.076	1.364						
	Region III						0.674	0.778	0.884	1.117	1.393						
	Region IV							0.849	0.97	1.24	1.55	1.901	2.321	2.754	3.231		
	Region V							0.988	1.135	1.453	1.802	2.191	2.618	3.063	3.548	4.031	
	Region VI					0.529	0.624	0.718	0.812	1.022	1.281	1.582	1.936				
45,000-49,999	Region I				0.363	0.446	0.527	0.608	0.692								
	Region II					0.472	0.557	0.64	0.724	0.905	1.123						
	Region III						0.588	0.677	0.767	0.953	1.163	1.408	1.681				
	Region IV								0.837	1.053	1.294	1.567	1.87	2.227	2.591	2.996	
	Region V								0.974	1.235	1.516	1.82	2.156	2.52	2.896	3.307	4.152
	Region VI					0.462	0.546	0.627	0.708	0.876	1.063	1.292	1.552	1.858	2.161	2.462	3.155
50,000-54,999	Region I						0.484	0.558	0.631	0.789							
	Region II						0.512	0.589	0.665	0.823	1.001	1.205					
	Region III							0.622	0.703	0.868	1.044	1.243	1.484	1.734			
	Region IV									0.952	1.157	1.389	1.65	1.926	2.259	2.591	
	Region V									1.114	1.362	1.627	1.913	2.218	2.555	2.898	3.65
	Region VI						0.502	0.577	0.651	0.799	0.961	1.147	1.355	1.607	1.885	2.161	2.708
55,000-59,999	Region I					0.375	0.443	0.51	0.577	0.715							
	Region II							0.539	0.608	0.746	0.897	1.075					
	Region III								0.643	0.791	0.945	1.116	1.301	1.528			
	Region IV									0.865	1.043	1.239	1.451	1.7	1.958	2.26	
	Region V									1.008	1.224	1.451	1.7	1.968	2.245	2.554	3.201
	Region VI							0.528	0.596	0.73	0.869	1.02	1.204	1.392	1.633		
60,000-64,999	Region I					0.349	0.413	0.476	0.537	0.661	0.795						
	Region II							0.503	0.567	0.695	0.83	0.977	1.148				
	Region III									0.736	0.875	1.02	1.188	1.374	1.583		
	Region IV										0.96	1.133	1.324	1.529	1.761	2.007	2.565
	Region V										1.123	1.332	1.55	1.78	2.036	2.293	2.871
	Region VI							0.493	0.556	0.68	0.805	0.941	1.089	1.265	1.439		

Sample Worksheet

A. The Building

   1. Location

   2. Outdoor Design Temperature   °F

a)	Summer	
b)	Winter	

   3. Local Power Rates $/kW-hr

a)	Summer	
b)	Winter	

$/kW-hr

   4. Load Hours (Fig. 1 and 2)   Hour

a)	Summer	
b)	Winter	

Hour

Type of System

	Conventional System	Unico System

B. Summer (Cooling) Load

		Conventional System	Unico System
1. Indoor Design Temperature	°F		
2. Building Heat Gain	Btu/hr		
3. Duct Loss	%	**15**[4]	**8**[5]
4. Duct Heat Gain	Btu/hr		
5. Total Heat Gain	Btu/hr		

C. Winter (Heating) Load

		Conventional System	Unico System
1. Indoor Design Temperature	°F	**72**	
2. Building Heat Loss	Btu/hr		
3. Duct Loss	%	**20**	**12**
4. Duct Heat Loss	Btu/hr		
5. Total Heat Loss	Btu/hr		

D. Equipment Data from ARI Directory

		Conventional System	Unico System
1. Outdoor Equipment			
2. Indoor Equipment			
3. Rated Unit Cooling Capacity	Btu/hr		
4. Rated Cooling Efficiency, SEER	Btuh/W		
5. Rated Unit Heating Capacity	Btu/hr		
6. Rated Heating Efficiency, HSPF	Btuh/W		
7. Average Heating Annual Operating Cost	$		

E. Calculate Estimated Cooling Cost

   1. Cooling Cost = (B.5)(A.3a)(A.4a)/((1000)(D.4)) $

F. Calculate Estimated Heating Cost

   1. Conventional Heating Cost Factor[6] (Table 1)

   2. UnicoSystem Heating Cost Factor (Table 2)

   3. Heating Cost = $(A.3b)(A.4b)(D.7)(F.1)/((2080)(0.0831^{7}))$ $

   4. Heating Cost = $(A.3b)(A.4b)(D.7)(F.2)/((2080)(0.0831^{8}))$ $

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[4] Ref: Florida Energy Report average home thermal losses for duct in non-conditioned air space, 1985.

[5] Ref: Dunham-Bush internal company test report, 1976.

[6] With a comfort controller added to maintain a constant discharge temperature of 100°F

[7] 1997 national average.