ASHRAE Standard 140-2020

Test Results Comparison
for
Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

Results for TRNSYS 18.05.0001
(TRNSYS18)
vs.
Example Results

Prepared By
Thermal Energy System Specialists, LLC
(TESS)

Results Developed
22-Mar-2023

ASHRAE Standard 140-2020
Computer Programs, Program Authors, and Producers of Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

The programs used to generate the example results for Sections 5.2.1, 5.2.2, and 5.2.3 are described in Table B11-1. Under the "Computer Program" column, the first entry in each cell is the proper program name and version number. The entries in parentheses are the abbreviations for the programs used in the tables and charts of this workbook.

The second column ("Authoring Organization") indicates the national research facility, university, or industry organization with expertise in building science that wrote the simulation software.

The third column ("Example Results Produced By") indicates the national research facility, university, or industry organization with expertise in building science that performed the simulations. Most of the organizations that performed simulations are members of the development team for the simulation model that they ran.

See Standard 140, Annex B11 for further details.

TABLE B11-1

Computer Programs, Program Authors, and Producers of Example Results

Computer Program (Abbrev.)	Authoring Organization	Example Results Produced by
BSIMAC 9, Version 9.0.74 (BSIMAC)	Alec Johannsen Consulting Engineers, South Africa	Alec Johannsen Consulting Engineers, South Africa
California Simulation Engine, Version 0.861.1 (CSE)	J.R. Barnaby/C.S. Barnaby/Big Ladder Software LLC/Wrightsoft Corp., United States	Big Ladder Software LLC, United States
DeST 2.0, Version 20190401 (DeST)	Tsinghua University, China	Southeast University, China Tsinghua University, China
EnergyPlus, Version 9.0.1 (EnergyPlus)	U.S. Department of Energy, Building Technologies Office, United States	GARD Analytics, Inc., United States
ESP-r, Version 13.3 (ESP-r)	University of Strathclyde, United Kingdom	University of Strathclyde, United Kingdom
TRNSYS, Version 18.01.0001 (TRNSYS)	Transsolar Energietechnik GmbH, Germany; Thermal Energy System Specialists, United States	Transsolar Energietechnik GmbH, Germany
TRNSYS, Versions 17.02.0005 and 18.00.0017 (N/A)	Transsolar Energietechnik GmbH, Germany; Thermal Energy System Specialists, United States	Ecole Polytechnique Montréal, Canada[a,b]

[a] Ecole Polytechnique and GARD also worked on simulations for developing alternative constant interior and exterior surface coefficients, applying TRNSYS and EnergyPlus, respectively.

[b] Also checking input files versus the Transsolar participant's files and vice versa.

Note: Results for "TestSpec-Alt" are shown in Table B8-16 and in Figures B8-6, B8-H10, and B8-H11; contents of tables and figures are further described in sheet tabs labeled "Table List" and "Figure List". "TestSpec-Alt" results are alternative values resulting from optional alternative inputs for sky temperature provided in the test specification (see Section 5.2.1.1.1.2 and Annex A1, Section A1.1.1.2).

ASHRAE Standard 140-2010 Section 5.2 - Building Thermal Envelope and Fabric Load Tests
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

List of Tables

ASHRAE Standard 140-2010 Section 5.2 - Building Thermal Envelope and Fabric Load Tests
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

List of Figures

ASHRAE Standard 140-2010 Section 5.2 - Building Thermal Envelope and Fabric Load Tests
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

List of Figures

ASHRAE Standard 140-2010 Section 5.2 - Building Thermal Envelope and Fabric Load Tests
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

List of Figures

ASHRAE Standard 140-2010 Section 5.2 - Building Thermal Envelope and Fabric Load Tests
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

List of Figures

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-1. Annual Heating Loads (MWh)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
Case							Min	Max	Mean	(Max-Min)/ Mean** (%)	
600 Base Case, South Windows	4.050	3.993	4.047	4.324	4.362	4.504	3.993	4.504	4.213	12.1%	4.500
610 S. Windows + Overhang	4.163	4.066	4.144	4.375	4.527	4.592	4.066	4.592	4.311	12.2%	4.589
620 East & West Windows	4.370	4.094	4.297	4.485	4.514	4.719	4.094	4.719	4.413	14.2%	4.715
630 E&W Windows + Overhang & Fins	4.923	4.356	4.677	4.784	5.051	5.139	4.356	5.139	4.821	16.2%	5.137
640 Case 600 with Htg Temp. Setback	2.682	2.403	2.619	2.662	2.654	2.653	2.403	2.682	2.612	10.7%	2.648
650 Case 600 with Night Ventilation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	----	0.000
660 Low-E Windows	3.574	3.602	3.821	3.707	3.787	3.790	3.574	3.821	3.713	6.7%	3.786
670 Single-Pane Windows	5.484	5.300	5.573	5.616	5.975	6.140	5.300	6.140	5.681	14.8%	6.136
680 Case 600 with Increased Insulation	2.219	1.786	1.732	2.180	2.132	2.286	1.732	2.286	2.056	27.0%	2.284
685 Case 600 with "20/20" Thermostat	4.532	4.574	4.646	4.877	4.904	5.042	4.532	5.042	4.763	10.7%	5.038
695 Case 685 with Increased Insulation	2.709	2.415	2.385	2.802	2.732	2.892	2.385	2.892	2.656	19.1%	2.889
900 South Windows	1.726	1.379	1.591	1.664	1.585	1.814	1.379	1.814	1.626	26.8%	1.803
910 S. Windows + Overhang	2.163	1.648	1.860	1.956	2.067	2.132	1.648	2.163	1.971	26.1%	2.127
920 East & West Windows	3.500	2.956	3.259	3.337	3.300	3.607	2.956	3.607	3.326	19.6%	3.589
930 E&W Windows + Overhang & Fins	4.270	3.524	3.933	3.994	4.278	4.384	3.524	4.384	4.064	21.2%	4.369
940 Case 900 with Htg Temp. Setback	1.389	0.863	1.149	1.067	1.015	1.169	0.863	1.389	1.109	47.4%	1.157
950 Case 900 with Night Ventilation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	----	0.000
960 Sunspace		2.522	2.771	2.689	2.624	2.860	2.522	2.860	2.693	12.5%	2.850
980 Case 900 with Increased Insulation	0.720	0.246	0.266	0.411	0.351	0.450	0.246	0.720	0.407	116.4%	0.450
985 Case 900 with "20/20" Thermostat	2.801	2.120	2.279	2.369	2.283	2.536	2.120	2.801	2.398	28.4%	2.526
995 Case 985 with Increased Insulation	1.330	0.755	0.770	1.006	0.905	1.077	0.755	1.330	0.974	59.0%	1.076
195 Solid Conduction	4.217	3.990	4.157	4.070	3.951	4.094	3.951	4.217	4.080	6.5%	4.091
200 Surface Convection (Int & Ext IR="off")	5.041	4.813	5.226	5.105	4.920	5.143	4.813	5.226	5.042	8.2%	5.156
210 Infrared Radiation (Int IR="off", Ext IR="on")	5.627	5.966	6.531	6.047	6.317	6.429	5.627	6.531	6.153	14.7%	6.449
215 Infrared Radiation (Int IR="on", Ext IR="off")	5.652	5.307	5.697	5.405	5.181	5.443	5.181	5.697	5.448	9.5%	5.463
220 In-Depth Base Case	6.377	6.666	7.178	6.455	6.726	6.868	6.377	7.178	6.712	11.9%	6.899
230 Infiltration	9.851	9.812	10.417	9.930	9.939	10.234	9.812	10.417	10.031	6.0%	10.265
240 Internal Gains	5.116	5.443	5.944	5.279	5.539	5.657	5.116	5.944	5.496	15.1%	5.688
250 Exterior Shortwave Absorptance	4.733	5.044	5.373	4.899	4.935	5.105	4.733	5.373	5.015	12.8%	5.126
270 South Solar Windows		4.346	4.273	4.385	4.576	4.631	4.273	4.631	4.442	8.1%	4.627
280 Cavity Albedo		4.525	4.619	4.570	4.738	4.870	4.525	4.870	4.664	7.4%	4.866
290 South Shading		4.424	4.381	4.424	4.745	4.725	4.381	4.745	4.540	8.0%	4.722
300 East/West Window		4.318	4.460	4.425	4.668	4.726	4.318	4.726	4.519	9.0%	4.722
310 East/West Shading		4.580	4.846	4.691	5.240	5.163	4.580	5.240	4.904	13.4%	5.161
320 Thermostat		3.677	3.599	3.771	3.970	4.031	3.599	4.031	3.810	11.3%	4.027
395 Low Mass Solid Conduction	4.565	4.855	5.145	4.641	4.866	4.908	4.565	5.145	4.830	12.0%	4.904
400 Low Mass High Cond. Wall Elements	5.906	6.536	7.047	6.348	6.610	6.769	5.906	7.047	6.536	17.5%	6.800
410 Low Mass Infiltration	7.630	8.045	8.661	8.080	8.212	8.445	7.630	8.661	8.179	12.6%	8.476
420 Low Mass Internal Gains	6.399	6.834	7.433	6.906	7.027	7.236	6.399	7.433	6.973	14.8%	7.268
430 Low Mass Ext. Shortwave Absorptance	5.171	5.454	5.954	5.620	5.545	5.851	5.171	5.954	5.599	14.0%	5.872
440 Low Mass Cavity Albedo		4.156	4.330	4.500	4.504	4.721	4.156	4.721	4.442	12.7%	4.717
450 Constant Interior and Exterior Surf Coeffs	3.743	3.990	3.375	3.962	3.850	3.871	3.375	3.990	3.799	16.2%	3.869
460 Constant Interior Surface Coefficients	3.828	4.056	3.873	4.194	4.263	4.290	3.828	4.290	4.084	11.3%	4.287
470 Constant Exterior Surface Coefficients	4.042	3.899	3.540	4.094	3.960	4.075	3.540	4.094	3.935	14.1%	4.072
800 High Mass High Cond. Wall Elements	5.141	4.906	5.403	5.116	4.980	5.369	4.906	5.403	5.152	9.7%	5.370
810 High Mass Cavity Albedo		2.038	2.454	2.342	2.185	2.610	2.038	2.610	2.326	24.6%	2.595

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-2. Annual Sensible Cooling Loads (MWh)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
Case							Min	Max	Mean	(Max-Min)/ Mean** (%)	
600 Base Case, South Windows	5.822	5.913	5.432	6.027	6.162	5.780	5.432	6.162	5.856	12.5%	5.779
610 S. Windows + Overhang	4.299	4.382	4.173	4.333	4.233	4.117	4.117	4.382	4.256	6.2%	4.105
620 East & West Windows	4.404	4.079	3.909	4.060	4.246	3.841	3.841	4.404	4.090	13.8%	3.839
630 E&W Windows + Overhang & Fins	3.074	3.020	2.787	2.836	2.595	2.573	2.573	3.074	2.814	17.8%	2.568
640 Case 600 with Htg Temp. Setback	5.804	5.644	5.237	5.763	5.893	5.477	5.237	5.893	5.636	11.6%	5.477
650 Case 600 with Night Ventilation	4.629	4.654	4.186	4.817	4.945	4.632	4.186	4.945	4.644	16.3%	4.632
660 Low-E Windows	3.014	3.340	3.260	3.232	3.219	2.966	2.966	3.340	3.172	11.8%	2.966
670 Single-Pane Windows	6.539	6.578	5.954	6.623	6.520	6.198	5.954	6.623	6.402	10.4%	6.198
680 Case 600 with Increased Insulation	5.938	6.430	5.932	6.444	6.529	6.310	5.932	6.529	6.264	9.5%	6.310
685 Case 600 with "20/20" Thermostat	9.130	8.859	8.238	9.119	9.121	8.851	8.238	9.130	8.886	10.0%	8.851
695 Case 685 with Increased Insulation	8.755	8.974	8.386	9.172	9.149	9.039	8.386	9.172	8.912	8.8%	9.039
900 South Windows	2.714	2.464	2.383	2.489	2.488	2.267	2.267	2.714	2.467	18.1%	2.267
910 S. Windows + Overhang	1.484	1.415	1.490	1.383	1.283	1.191	1.191	1.490	1.374	21.8%	1.187
920 East & West Windows	3.128	2.789	2.706	2.731	2.814	2.549	2.549	3.128	2.786	20.8%	2.547
930 E&W Windows + Overhang & Fins	2.161	2.075	1.908	1.919	1.654	1.672	1.654	2.161	1.898	26.7%	1.668
940 Case 900 with Htg. Temp. Setback	2.613	2.397	2.343	2.424	2.428	2.203	2.203	2.613	2.401	17.1%	2.203
950 Case 900 with Night Ventilation	0.586	0.598	0.618	0.707	0.656	0.642	0.586	0.707	0.634	19.1%	0.642
960 Sunspace		0.926	0.909	0.907	0.950	0.789	0.789	0.950	0.896	17.9%	0.789
980 Case 900 with Increased Insulation	3.501	3.995	3.758	3.712	3.775	3.519	3.501	3.995	3.710	13.3%	3.518
985 Case 900 with "20/20" Thermostat	7.273	6.234	5.880	6.359	6.249	6.113	5.880	7.273	6.351	21.9%	6.115
995 Case 985 with Increased Insulation	7.482	7.202	6.771	7.203	7.149	7.064	6.771	7.482	7.145	10.0%	7.064
195 Solid Conduction	0.712	0.606	0.628	0.612	0.611	0.592	0.592	0.712	0.627	19.2%	0.592
200 Surface Convection (Int & Ext IR="off")	0.839	0.800	0.835	0.814	0.800	0.788	0.788	0.839	0.813	6.2%	0.791
210 Infrared Radiation (Int IR="off", Ext IR="on")	0.688	0.503	0.496	0.560	0.519	0.459	0.459	0.688	0.537	42.6%	0.461
215 Infrared Radiation (Int IR="on", Ext IR="off")	0.952	0.946	0.922	0.877	0.895	0.850	0.850	0.952	0.907	11.2%	0.855
220 In-Depth Base Case	0.803	0.611	0.550	0.610	0.576	0.498	0.498	0.803	0.608	50.2%	0.500
230 Infiltration	1.184	0.991	0.929	0.991	0.955	0.897	0.897	1.184	0.991	29.0%	0.900
240 Internal Gains	1.287	0.982	0.876	0.979	0.922	0.834	0.834	1.287	0.980	46.2%	0.836
250 Exterior Shortwave Absorptance	3.612	3.429	3.471	3.182	3.467	2.904	2.904	3.612	3.344	21.2%	2.930
270 South Solar Windows		7.271	6.698	7.522	7.309	7.289	6.698	7.522	7.217	11.4%	7.288
280 Cavity Albedo		4.996	4.215	5.183	5.206	4.808	4.215	5.206	4.882	20.3%	4.808
290 South Shading		5.610	5.310	5.743	5.321	5.461	5.310	5.743	5.489	7.9%	5.447
300 East/West Window		5.055	4.805	5.152	5.038	4.913	4.805	5.152	4.993	7.0%	4.911
310 East/West Shading		3.752	3.402	3.669	3.128	3.324	3.128	3.752	3.455	18.1%	3.317
320 Thermostat		4.859	4.420	4.986	4.913	4.788	4.420	4.986	4.793	11.8%	4.787
395 Low Mass Solid Conduction	0.021	0.008	0.006	0.010	0.006	0.004	0.004	0.021	0.009	193.7%	0.004
400 Low Mass High Cond. Wall Elements	0.063	0.023	0.017	0.031	0.024	0.013	0.013	0.063	0.028	176.6%	0.013
410 Low Mass Infiltration	0.096	0.048	0.041	0.057	0.052	0.035	0.035	0.096	0.055	110.6%	0.036
420 Low Mass Internal Gains	0.228	0.141	0.119	0.153	0.142	0.109	0.109	0.228	0.149	79.8%	0.110
430 Low Mass Ext. Shortwave Absorptance	1.084	0.906	0.944	0.856	0.953	0.739	0.739	1.084	0.914	37.8%	0.744
440 Low Mass Cavity Albedo		3.985	3.458	4.085	4.414	3.741	3.458	4.414	3.937	24.3%	3.741
450 Constant Interior and Exterior Surf Coeffs	6.172	5.689	6.161	6.507	6.613	6.531	5.689	6.613	6.279	14.7%	6.529
460 Constant Interior Surface Coefficients	6.260	5.940	5.929	6.475	6.729	6.243	5.929	6.729	6.263	12.8%	6.242
470 Constant Exterior Surface Coefficients	5.987	5.644	5.649	6.029	6.005	6.056	5.644	6.056	5.895	7.0%	6.056
800 High Mass High Cond. Wall Elements	0.473	0.380	0.362	0.374	0.391	0.282	0.282	0.473	0.377	50.6%	0.284
810 High Mass Cavity Albedo		1.481	1.357	1.508	1.606	1.295	1.295	1.606	1.449	21.5%	1.294

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-3. Annual Hourly Integrated Peak Heating Loads

Simulation Model:	BSIMAC				CSE				DeST				EnergyPlus				ESP-r				TRNSYS				Example Result Statistics				TRNSYS18			
																									Min	Max	Mean	(Max-Min)/				
Case	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	kW	kW	Mean** (%)	kW	Mo.	Day	Hr
600 Base Case, South Windows	3.255	Nov	26	8	3.020	Jan	1	1	3.035	Jan	1	0	3.204	Dec	31	24	3.228	Jan	1	1	3.359	Jan	1	1	3.020	3.359	3.184	10.6%	3.278	Dec	31	24
610 S. Windows + Overhang	3.166	Nov	26	8	3.021	Jan	1	1	3.039	Jan	1	0	3.192	Dec	31	24	3.233	Jan	1	1	3.360	Jan	1	1	3.021	3.360	3.168	10.7%	3.280	Dec	31	24
620 East & West Windows	3.145	Dec	31	24	3.038	Jan	1	1	3.068	Jan	1	0	3.229	Dec	31	24	3.253	Jan	1	1	3.385	Jan	1	1	3.038	3.385	3.186	10.9%	3.326	Dec	31	24
630 E&W Windows + Overhang & Fins	3.252	Dec	31	24	3.039	Jan	1	1	3.072	Jan	1	0	3.207	Dec	31	24	3.259	Jan	1	1	3.388	Jan	1	1	3.039	3.388	3.203	10.9%	3.331	Dec	31	24
640 Case 600 with Htg. Temp. Setback	4.633	Feb	8	9	4.222	Nov	26	8	4.658	Nov	26	7	4.559	Nov	26	8	4.101	Nov	26	8	4.039	Nov	26	8	4.039	4.658	4.369	14.2%	4.039	Nov	26	8
650 Case 600 with Night Ventilation	0.000				0.000	Jan	1	1	0.000				0.000	Jan	1	1	0.000	Jan	1	1	0.000	Dec	31	0	0.000	0.000	0.000	----	0.000	Jan	1	1
660 Low-E Windows	2.620	Nov	26	8	2.758	Jan	1	1	2.798	Jan	1	0	2.831	Dec	31	24	2.846	Jan	1	1	2.955	Jan	1	1	2.620	2.955	2.801	12.0%	2.869	Dec	31	24
670 Single-Pane Windows	4.122	Nov	26	8	3.655	Jan	1	1	3.812	Jan	1	0	3.854	Nov	26	7	3.992	Nov	26	7	4.221	Nov	26	8	3.655	4.221	3.943	14.3%	4.221	Nov	26	8
680 Case 600 with Increased Insulation	2.126	Nov	26	8	1.778	Feb	9	6	1.811	Jan	1	1	2.052	Nov	26	7	2.022	Feb	9	7	2.115	Nov	26	8	1.778	2.126	1.984	17.6%	2.115	Nov	26	8
685 Case 600 with "20/20" Thermostat	3.169	Nov	26	8	3.032	Jan	1	1	3.054	Jan	1	0	3.223	Dec	31	24	3.247	Jan	1	1	3.374	Jan	1	1	3.032	3.374	3.183	10.8%	3.306	Dec	31	24
695 Case 685 with Increased Insulation	2.138	Nov	26	8	1.795	Jan	1	1	1.855	Jan	1	1	2.072	Dec	31	24	2.025	Nov	26	7	2.118	Nov	26	8	1.795	2.138	2.000	17.1%	2.118	Nov	26	8
900 South Windows	2.551	Feb	8	24	2.443	Feb	9	6	2.453	Feb	9	5	2.687	Feb	9	6	2.633	Feb	9	7	2.778	Feb	9	7	2.443	2.778	2.591	12.9%	2.779	Feb	9	7
910 S. Windows + Overhang	2.761	Feb	8	24	2.469	Feb	9	6	2.474	Feb	9	5	2.699	Feb	9	6	2.684	Feb	9	7	2.799	Feb	9	6	2.469	2.799	2.648	12.5%	2.800	Feb	9	6
920 East & West Windows	2.895	Nov	26	8	2.512	Feb	9	6	2.513	Feb	9	5	2.770	Feb	9	6	2.706	Feb	9	7	2.864	Feb	9	6	2.512	2.895	2.710	14.1%	2.864	Feb	9	6
930 E&W Windows + Overhang & Fins	2.968	Dec	31	24	2.537	Feb	9	6	2.549	Feb	9	5	2.785	Feb	9	6	2.765	Feb	9	6	2.900	Feb	9	6	2.537	2.968	2.751	15.7%	2.901	Feb	9	6
940 Case 900 with Htg. Temp. Setback	3.882	Feb	8	9	3.052	Jan	1	9	3.659	Feb	9	7	3.143	Dec	31	9	3.122	Feb	9	9	3.405	Jan	1	9	3.052	3.882	3.377	24.6%	3.196	Nov	3	9
950 Case 900 with Night Ventilation	0.000				0.000	Jan	1	1	0.000				0.000	Jan	1	1	0.000	Jan	1	1	0.000	Dec	31	0	0.000	0.000	0.000	----	0.000	Jan	1	1
960 Sunspace					2.132	Feb	9	6	2.085	Jan	1	0	2.259	Feb	9	6	2.201	Feb	9	6	2.300	Feb	9	6	2.085	2.300	2.196	9.8%	2.300	Feb	9	6
980 Case 900 with Increased Insulation	1.693	Feb	8	24	1.254	Feb	9	6	1.382	Feb	9	5	1.538	Feb	9	6	1.473	Feb	9	7	1.592	Feb	9	7	1.254	1.693	1.489	29.5%	1.592	Feb	9	7
985 Case 900 with "20/20" Thermostat	2.754	Feb	8	24	2.452	Feb	9	6	2.458	Feb	9	5	2.695	Feb	9	6	2.642	Feb	9	7	2.785	Feb	9	6	2.452	2.785	2.631	12.7%	2.786	Feb	9	6
995 Case 985 with Increased Insulation	1.711	Nov	26	8	1.370	Feb	9	6	1.462	Feb	9	5	1.622	Feb	9	6	1.560	Feb	9	7	1.662	Feb	9	6	1.370	1.711	1.564	21.8%	1.662	Feb	9	6
195 Solid Conduction	1.802	Dec	31	24	1.791	Jan	1	1	1.799	Jan	1	0	1.794	Dec	31	24	1.802	Jan	1	1	1.796	Jan	1	1	1.791	1.802	1.797	0.6%	1.792	Dec	31	24
200 Surface Convection (Int & Ext IR="off")	2.272	Nov	26	8	2.226	Nov	26	8	2.308	Jan	1	0	2.341	Nov	26	8	2.275	Dec	31	24	2.353	Nov	26	8	2.226	2.353	2.296	5.5%	2.362	Nov	26	8
210 Infrared Radiation (Int IR="off", Ext IR="on")	2.374	Dec	31	24	2.629	Jan	1	2	2.605	Jan	1	0	2.565	Dec	31	24	2.671	Jan	1	1	2.750	Jan	1	1	2.374	2.750	2.599	14.5%	2.705	Dec	31	24
215 Infrared Radiation (Int IR="on", Ext IR="off")	2.521	Nov	26	8	2.420	Nov	26	8	2.520	Jan	1	0	2.478	Nov	26	8	2.390	Nov	26	8	2.489	Nov	26	8	2.390	2.521	2.470	5.3%	2.503	Nov	26	8
220 In-Depth Base Case	2.631	Nov	26	8	2.839	Jan	1	1	2.863	Jan	1	0	2.692	Dec	31	24	2.788	Jan	1	1	2.879	Jan	1	1	2.631	2.879	2.782	8.9%	2.835	Dec	31	24
230 Infiltration	4.219	Dec	31	24	4.133	Jan	1	1	4.223	Jan	1	0	4.316	Dec	31	24	4.160	Jan	1	1	4.315	Jan	1	1	4.133	4.316	4.228	4.3%	4.277	Dec	31	24
240 Internal Gains	2.431	Nov	26	8	2.651	Jan	1	1	2.685	Jan	1	0	2.507	Dec	31	24	2.605	Jan	1	1	2.693	Jan	1	1	2.431	2.693	2.595	10.1%	2.650	Dec	31	24
250 Exterior Shortwave Absorptance	2.631	Nov	26	8	2.837	Jan	1	1	2.855	Jan	1	0	2.687	Dec	31	24	2.780	Jan	1	1	2.874	Jan	1	1	2.631	2.874	2.777	8.8%	2.828	Dec	31	24
270 South Solar Windows					2.611	Jan	1	2	2.560	Jan	1	1	2.597	Dec	31	24	2.748	Jan	1	1	2.843	Jan	1	2	2.560	2.843	2.672	10.6%	2.772	Dec	31	24
280 Cavity Albedo					2.612	Jan	1	2	2.568	Jan	1	1	2.602	Dec	31	24	2.752	Jan	1	1	2.849	Jan	1	1	2.568	2.849	2.677	10.5%	2.783	Dec	31	24
290 South Shading					2.611	Jan	1	2	2.561	Jan	1	1	2.583	Dec	31	24	2.750	Jan	1	1	2.843	Jan	1	2	2.561	2.843	2.670	10.6%	2.773	Dec	31	24
300 East/West Window					2.614	Jan	1	1	2.589	Jan	1	0	2.603	Dec	31	24	2.766	Jan	1	1	2.854	Jan	1	1	2.589	2.854	2.685	9.9%	2.794	Dec	31	24
310 East/West Shading					2.615	Jan	1	1	2.592	Jan	1	0	2.580	Dec	31	24	2.771	Jan	1	1	2.856	Jan	1	1	2.580	2.856	2.683	10.3%	2.798	Dec	31	24
320 Thermostat					2.609	Jan	1	1	2.546	Jan	1	1	2.573	Dec	31	24	2.733	Jan	1	2	2.834	Jan	1	2	2.546	2.834	2.659	10.8%	2.749	Feb	9	6
395 Low Mass Solid Conduction	1.948	Dec	31	24	2.157	Jan	1	2	2.085	Jan	1	1	1.952	Dec	31	24	2.090	Jan	1	2	2.161	Jan	1	2	1.948	2.161	2.066	10.3%	2.041	Dec	31	24
400 Low Mass High Cond. Wall Elements	2.559	Nov	26	8	2.839	Jan	1	1	2.863	Jan	1	0	2.692	Dec	31	24	2.788	Jan	1	1	2.879	Jan	1	1	2.559	2.879	2.770	11.5%	2.835	Dec	31	24
410 Low Mass Infiltration	3.338	Dec	31	24	3.441	Jan	1	1	3.543	Jan	1	0	3.504	Dec	31	24	3.473	Jan	1	1	3.597	Jan	1	1	3.338	3.597	3.483	7.4%	3.556	Dec	31	24
420 Low Mass Internal Gains	3.138	Dec	31	24	3.256	Jan	1	1	3.365	Jan	1	0	3.319	Dec	31	24	3.290	Jan	1	1	3.411	Jan	1	1	3.138	3.411	3.297	8.3%	3.371	Dec	31	24
430 Low Mass Ext. Shortwave Absorptance	3.300	Dec	31	24	3.254	Jan	1	1	3.360	Jan	1	0	3.316	Dec	31	24	3.285	Jan	1	1	3.409	Jan	1	1	3.254	3.409	3.321	4.7%	3.366	Dec	31	24
440 Low Mass Cavity Albedo					3.027	Jan	1	1	3.060	Jan	1	0	3.219	Dec	31	24	3.237	Jan	1	1	3.374	Jan	1	1	3.027	3.374	3.183	10.9%	3.306	Dec	31	24
450 Constant Interior and Exterior Surf Coeffs	2.989	Nov	26	8	2.978	Jan	1	1	2.753	Jan	1	0	3.100	Dec	31	24	3.042	Jan	1	1	3.037	Jan	1	1	2.753	3.100	2.983	11.6%	2.978	Dec	31	24
460 Constant Interior Surface Coefficients	3.055	Nov	26	8	2.971	Jan	1	1	2.980	Jan	1	0	3.091	Dec	31	24	3.101	Jan	1	1	3.160	Jan	1	1	2.971	3.160	3.060	6.2%	3.092	Dec	31	24
470 Constant Exterior Surface Coefficients	3.118	Nov	26	8	3.001	Jan	1	1	2.807	Jan	1	0	3.207	Dec	31	24	3.169	Jan	1	1	3.231	Jan	1	1	2.807	3.231	3.089	13.7%	3.163	Dec	31	24
800 High Mass High Cond. Wall Elements	2.957	Dec	31	24	2.778	Feb	9	6	2.864	Feb	9	5	2.924	Feb	9	6	2.840	Feb	9	7	2.967	Feb	9	6	2.778	2.967	2.888	6.6%	2.980	Feb	9	6
810 High Mass Cavity Albedo					2.500	Feb	9	6	2.512	Feb	9	5	2.749	Feb	9	6	2.695	Feb	9	7	2.845	Feb	9	6	2.500	2.845	2.660	13.0%	2.845	Feb	9	6

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-4. Annual Hourly Integrated Peak Sensible Cooling Loads

Simulation Model:	BSIMAC				CSE				DeST				EnergyPlus				ESP-r				TRNSYS				Example Result Statistics				TRNSYS18			
																									Min	Max	Mean	(Max-Min)/				
Case	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	Mo.	Day	Hr	kW	kW	kW	Mean** (%)	kW	Mo.	Day	Hr
600 Base Case, South Windows	5.650	Jan	22	15	6.481	Jan	22	14	5.422	Jan	22	14	6.352	Jan	22	14	6.193	Jan	22	14	6.046	Jan	22	14	5.422	6.481	6.024	17.6%	6.045	Jan	22	14
610 S. Windows + Overhang	5.466	Jan	22	15	6.432	Dec	1	14	5.331	Jan	22	14	6.135	Dec	1	14	5.934	Jan	22	14	5.868	Dec	1	14	5.331	6.432	5.861	18.8%	5.812	Dec	1	14
620 East & West Windows	4.704	Jun	26	18	4.493	Jun	26	17	3.955	Jun	26	17	4.797	Jun	26	17	4.622	Jun	26	17	4.588	Jun	26	17	3.955	4.797	4.527	18.6%	4.588	Jun	26	17
630 E&W Windows + Overhang & Fins	4.121	Jun	26	18	3.998	Jun	26	18	3.526	Jun	26	17	4.212	Jun	26	17	3.971	Jun	26	17	3.949	Jun	26	17	3.526	4.212	3.963	17.3%	3.944	Jun	26	17
640 Case 600 with Htg. Temp. Setback	5.650	Jan	22	15	6.429	Jan	22	14	5.365	Jan	22	14	6.297	Jan	22	14	6.127	Jan	22	14	5.967	Jan	22	14	5.365	6.429	5.973	17.8%	5.967	Jan	22	14
650 Case 600 with Night Ventilation	5.648	Jan	22	15	6.290	Dec	1	14	5.045	Oct	18	14	6.138	Oct	18	14	5.961	Oct	18	14	5.797	Oct	18	14	5.045	6.290	5.813	21.4%	5.797	Oct	18	14
660 Low-E Windows	3.343	Oct	18	15	3.933	Oct	1	13	3.355	Oct	11	14	3.770	Oct	18	14	3.530	Oct	1	14	3.457	Oct	18	14	3.343	3.933	3.565	16.6%	3.457	Oct	18	14
670 Single-Pane Windows	6.217	Oct	18	14	6.925	Oct	1	13	5.839	Oct	10	13	6.806	Jan	22	14	6.482	Oct	18	14	6.401	Oct	18	14	5.839	6.925	6.445	16.9%	6.401	Oct	18	14
680 Case 600 with Increased Insulation	5.761	Jan	22	15	7.051	Jan	22	14	5.861	Jan	22	14	6.770	Jan	22	14	6.676	Jan	22	14	6.557	Jan	22	14	5.761	7.051	6.446	20.0%	6.556	Jan	22	14
685 Case 600 with "20/20" Thermostat	6.318	Jan	22	15	7.159	Jan	22	14	6.071	Jan	22	14	7.107	Jan	22	14	6.934	Jan	22	14	6.867	Jan	22	14	6.071	7.159	6.743	16.1%	6.867	Jan	22	14
695 Case 685 with Increased Insulation	6.232	Jan	22	15	7.541	Jan	22	14	6.355	Jan	22	14	7.334	Jan	22	14	7.239	Jan	22	14	7.175	Jan	22	14	6.232	7.541	6.979	18.8%	7.175	Jan	22	14
900 South Windows	3.039	Oct	1	15	3.376	Oct	1	14	2.556	Sep	11	14	3.040	Oct	1	14	2.896	Oct	12	15	2.940	Oct	1	14	2.556	3.376	2.975	27.6%	2.940	Oct	1	14
910 S. Windows + Overhang	2.493	Oct	18	14	2.722	Oct	2	15	2.103	Oct	12	14	2.222	Oct	18	15	2.212	Oct	2	15	2.081	Oct	12	15	2.081	2.722	2.306	27.8%	2.075	Oct	12	15
920 East & West Windows	3.481	Jun	26	18	3.057	Jun	26	18	2.710	Jun	26	17	3.260	Jun	26	18	3.099	Jun	26	18	3.154	Jun	26	18	2.710	3.481	3.127	24.7%	3.154	Jun	26	18
930 E&W Windows + Overhang & Fins	3.052	Jun	26	18	2.662	Jun	26	18	2.335	Jun	26	17	2.782	Jun	26	18	2.494	Jun	26	18	2.613	Jun	26	18	2.335	3.052	2.656	27.0%	2.612	Jun	26	18
940 Case 900 with Htg. Temp. Setback	3.158	Oct	1	15	3.376	Oct	1	14	2.556	Sep	11	14	3.040	Oct	1	14	2.891	Oct	12	15	2.938	Oct	1	14	2.556	3.376	2.993	27.4%	2.937	Oct	1	14
950 Case 900 with Night Ventilation	2.366	Sep	10	15	2.364	Sep	4	15	2.054	Sep	11	14	2.388	Sep	11	15	2.202	Sep	10	15	2.236	Sep	11	15	2.054	2.388	2.268	14.7%	2.236	Sep	11	15
960 Sunspace					1.377	Jun	26	17	1.367	Jun	26	16	1.480	Jun	26	17	1.403	Jun	26	17	1.338	Jun	26	17	1.338	1.480	1.393	10.2%	1.338	Jun	26	17
980 Case 900 with Increased Insulation	3.384	Oct	18	14	3.668	Oct	2	14	2.930	Oct	18	14	3.450	Oct	18	15	3.341	Oct	12	15	3.313	Oct	12	14	2.930	3.668	3.348	22.0%	3.312	Oct	12	14
985 Case 900 with "20/20" Thermostat	3.977	Oct	18	14	4.225	Oct	1	14	3.208	Oct	11	14	3.915	Oct	18	15	3.736	Oct	12	15	3.885	Oct	1	14	3.208	4.225	3.824	26.6%	3.885	Oct	1	14
995 Case 985 with Increased Insulation	4.129	Jan	22	14	4.224	Jan	22	15	3.315	Jan	22	14	4.177	Jan	22	15	3.954	Jan	22	15	4.115	Jan	22	15	3.315	4.224	3.986	22.8%	4.114	Jan	22	15
195 Solid Conduction	1.118	Jun	26	17	0.994	Jun	26	17	0.973	Jun	26	16	1.041	Jun	26	17	0.944	Jun	26	17	0.994	Jun	26	17	0.944	1.118	1.011	17.2%	0.994	Jun	26	17
200 Surface Convection (Int & Ext IR="off")	1.271	Jun	26	17	1.215	Jun	26	17	1.239	Jun	26	16	1.307	Jun	26	17	1.198	Jun	26	17	1.259	Jun	26	17	1.198	1.307	1.248	8.8%	1.263	Jun	26	17
210 Infrared Radiation (Int IR="off", Ext IR="on")	1.193	Jun	26	17	0.946	Jun	13	15	0.937	Jun	26	16	1.084	Jun	26	17	0.877	Jun	14	14	0.884	Jun	26	18	0.877	1.193	0.987	32.0%	0.887	Jun	26	18
215 Infrared Radiation (Int IR="on", Ext IR="off")	1.393	Jun	26	17	1.369	Jun	26	17	1.386	Jun	26	16	1.400	Jun	26	17	1.366	Jun	26	17	1.352	Jun	26	17	1.352	1.400	1.378	3.5%	1.358	Jun	26	17
220 In-Depth Base Case	1.336	Jun	26	18	1.108	Jun	13	15	1.040	Jun	26	16	1.184	Jun	26	18	1.012	Jun	14	15	0.968	Jun	26	18	0.968	1.336	1.108	33.2%	0.973	Jun	26	18
230 Infiltration	1.994	Jun	26	17	1.728	Jun	26	17	1.734	Jun	26	16	1.841	Jun	26	17	1.701	Jun	26	17	1.694	Jun	26	17	1.694	1.994	1.782	16.9%	1.699	Jun	26	17
240 Internal Gains	1.534	Jun	26	18	1.295	Jun	13	15	1.218	Jun	26	16	1.366	Jun	26	18	1.192	Jun	14	15	1.150	Jun	26	18	1.150	1.534	1.292	29.7%	1.155	Jun	26	18
250 Exterior Shortwave Absorptance	2.913	Sep	12	14	2.790	Sep	12	14	2.751	Sep	3	14	2.867	Sep	12	14	3.034	Sept	12	14	2.688	Sep	12	14	2.688	3.034	2.840	12.2%	2.711	Sep	12	14
270 South Solar Windows					7.011	Jan	22	14	5.832	Jan	22	14	6.839	Jan	22	14	6.613	Jan	22	14	6.637	Jan	22	14	5.832	7.011	6.586	17.9%	6.637	Jan	22	14
280 Cavity Albedo					4.765	Jan	22	14	3.768	Dec	1	13	4.727	Jan	22	14	4.676	Jan	22	14	4.400	Jan	22	14	3.768	4.765	4.467	22.3%	4.400	Jan	22	14
290 South Shading					6.872	Jan	22	14	5.739	Jan	22	14	6.595	Jan	22	14	6.411	Jan	22	14	6.402	Jan	22	14	5.739	6.872	6.404	17.7%	6.375	Jan	22	14
300 East/West Window					4.163	Jun	26	17	3.695	Jun	26	17	4.475	Jun	26	17	4.221	Jun	26	17	4.278	Jun	26	17	3.695	4.475	4.167	18.7%	4.278	Jun	26	17
310 East/West Shading					3.796	Jun	26	18	3.252	Jun	26	17	3.970	Jun	26	18	3.618	Jun	26	18	3.701	Jun	26	18	3.252	3.970	3.667	19.6%	3.699	Jun	26	18
320 Thermostat					6.473	Jan	22	14	5.304	Jan	22	14	6.209	Jan	22	14	5.993	Jan	22	14	5.949	Jan	22	14	5.304	6.473	5.986	19.5%	5.949	Jan	22	14
395 Low Mass Solid Conduction	0.547	Jun	26	18	0.357	Jun	14	18	0.308	Jun	14	16	0.377	Jun	26	19	0.294	Aug	5	18	0.265	Jun	14	18	0.265	0.547	0.358	78.7%	0.265	Jun	14	18
400 Low Mass High Cond. Wall Elements	0.798	Jun	26	18	0.494	Jun	14	15	0.457	Jun	26	17	0.607	Jun	26	18	0.456	Aug	5	17	0.372	Jun	14	17	0.372	0.798	0.531	80.3%	0.374	Jun	14	17
410 Low Mass Infiltration	1.011	Jun	26	17	0.700	Jun	26	18	0.709	Jun	26	16	0.828	Jun	26	18	0.624	Jun	26	18	0.604	Jun	26	18	0.604	1.011	0.746	54.6%	0.607	Jun	26	18
420 Low Mass Internal Gains	1.208	Jun	26	17	0.909	Jun	26	18	0.917	Jun	26	16	1.033	Jun	26	18	0.836	Jun	26	17	0.814	Jun	26	18	0.814	1.208	0.953	41.3%	0.816	Jun	26	18
430 Low Mass Ext. Shortwave Absorptance	2.167	Jun	26	16	1.840	Jun	26	15	1.840	Jun	26	15	1.929	Jun	26	16	1.874	Jul	17	14	1.704	Jun	26	15	1.704	2.167	1.892	24.5%	1.712	Jun	26	15
440 Low Mass Cavity Albedo					4.666	Oct	1	13	3.766	Oct	11	13	4.686	Oct	18	14	4.679	Oct	18	14	4.308	Oct	18	14	3.766	4.686	4.421	20.8%	4.308	Oct	18	14
450 Constant Interior and Exterior Surf Coeffs	5.812	Jan	22	15	6.180	Jan	22	14	6.063	Jan	22	13	6.466	Jan	22	14	6.501	Jan	22	14	6.313	Jan	22	14	5.812	6.501	6.223	11.1%	6.312	Jan	22	14
460 Constant Interior Surface Coefficients	5.804	Jan	22	15	6.243	Jan	22	14	5.902	Jan	22	13	6.374	Jan	22	14	6.304	Jan	22	14	6.069	Jan	22	14	5.804	6.374	6.116	9.3%	6.068	Jan	22	14
470 Constant Exterior Surface Coefficients	5.695	Jan	22	15	6.388	Jan	22	14	5.570	Jan	22	14	6.444	Jan	22	14	6.407	Jan	22	14	6.320	Jan	22	14	5.570	6.444	6.137	14.2%	6.320	Jan	22	14
800 High Mass High Cond. Wall Elements	1.286	Jun	26	16	1.102	Aug	5	15	1.157	Aug	5	14	1.046	Jun	26	16	1.052	Aug	5	15	0.936	Aug	5	15	0.936	1.286	1.096	32.0%	0.942	Aug	5	15
810 High Mass Cavity Albedo					2.410	Sep	4	15	1.940	Sep	11	14	2.270	Sep	11	15	2.179	Sep	4	15	2.113	Sep	11	15	1.940	2.410	2.183	21.6%	2.113	Sep	11	15

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-5. Free-Float Temperature Output

MAXIMUM ANNUAL HOURLY INTEGRATED ZONE TEMPERATURE																								Example Result Statistics				TRNSYS18			
Simulation Model:	BSIMAC				CSE				DeST				EnergyPlus				ESP-r				TRNSYS				Min	Max	Mean	(Max-Min)/				
Case	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	T (°C)	T (°C)	Mean** (%)	T (°C)	Mo.	Day	Hr
600FF - Low Mass with S. Windows	63.4	Oct	18	17	68.4	Oct	1	16	65.0	Oct	11	15	63.8	Oct	18	16	64.6	Oct	1	16	62.4	Oct	1	15	62.4	68.4	64.6	9.3%	62.4	Oct	1	15
900FF - High Mass with S. Windows	46.0	Oct	1	17	45.1	Sep	4	15	44.5	Sep	11	15	44.3	Sep	12	15	44.3	Sep	12	16	43.3	Sep	12	15	43.3	46.0	44.6	6.2%	43.3	Sep	12	15
650FF Case 600FF with Night Ventilation	62.1	Oct	18	17	66.8	Oct	1	16	62.6	Oct	11	15	62.5	Oct	18	16	63.3	Oct	1	16	61.1	Oct	1	15	61.1	66.8	63.1	9.1%	61.1	Oct	1	15
950FF Case 900FF with Night Ventilation	37.1	Oct	1	17	36.8	Sep	11	15	36.4	Sep	11	15	36.7	Sep	11	16	36.4	Aug	5	16	36.1	Sep	11	16	36.1	37.1	36.6	2.7%	36.1	Sep	11	16
680FF Case 600FF with Increased Insulation	72.5	Jan	22	17	78.5	Jan	22	16	75.0	Oct	12	15	70.1	Jan	22	16	72.2	Oct	12	16	69.8	Jan	22	16	69.8	78.5	73.0	12.0%	69.8	Jan	22	16
980FF Case 900FF with Increased Insulation	49.7	Oct	1	17	52.2	Sep	12	15	52.8	Oct	21	14	49.6	Sep	12	16	50.2	Sep	12	15	48.5	Sep	12	15	48.5	52.8	50.5	8.5%	48.5	Sep	12	15
960 Sunspace					48.9	Oct	2	16	53.2	Oct	20	14	49.9	Oct	12	15	49.5	Oct	12	15	48.1	Oct	12	15	48.1	53.2	49.9	10.2%	48.1	Oct	12	15
MINIMUM ANNUAL HOURLY INTEGRATED ZONE TEMPERATURE																								Example Result Statistics				TRNSYS18			
Simulation Model:	BSIMAC				CSE				DeST				EnergyPlus				ESP-r				TRNSYS				Min	Max	Mean	(Max-Min)/				
Case	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	T (°C)	T (°C)	Mean** (%)	T (°C)	Mo.	Day	Hr
600FF - Low Mass with S. Windows	-9.9	Nov	26	8	-12.9	Feb	9	7	-13.5	Feb	9	6	-12.6	Feb	9	7	-13.5	Feb	9	7	-13.8	Feb	9	7	-13.8	-9.9	-12.7	31.1%	-13.8	Feb	9	7
900FF - High Mass with S. Windows	0.6	Feb	8	11	2.2	Feb	9	7	1.3	Feb	9	7	1.2	Feb	9	7	1.6	Feb	9	7	0.6	Feb	9	7	0.6	2.2	1.3	124.2%	0.6	Feb	9	7
650FF Case 600FF with Night Ventilation	-16.7	Dec	31	24	-17.8	Jan	1	1	-17.4	Dec	30	23	-17.1	Dec	31	24	-17.5	Jan	1	1	-17.5	Dec	31	24	-17.8	-16.7	-17.3	6.1%	-17.5	Dec	31	24
950FF Case 900FF with Night Ventilation	-13.2	Dec	31	24	-13.2	Jan	1	1	-13.4	Dec	30	23	-12.8	Feb	9	7	-12.5	Feb	9	6	-12.8	Feb	9	6	-13.4	-12.5	-13.0	6.6%	-12.8	Feb	9	6
680FF Case 600FF with Increased Insulation	-5.7	Feb	8	11	-6.2	Feb	9	7	-6.9	Feb	9	7	-7.1	Feb	9	7	-7.2	Feb	9	7	-8.1	Feb	9	7	-8.1	-5.7	-6.9	34.6%	-8.1	Feb	9	7
980FF Case 900FF with Increased Insulation	7.3	Feb	8	11	12.5	Nov	4	7	12.4	Nov	5	6	9.9	Nov	4	7	10.5	Nov	4	8	9.5	Nov	4	7	7.3	12.5	10.4	50.6%	9.5	Nov	4	7
960 Sunspace					8.0	Feb	9	8	6.7	Feb	9	6	5.1	Feb	9	7	5.0	Feb	9	7	4.2	Feb	9	7	4.2	8.0	5.8	65.0%	4.2	Feb	9	7
AVERAGE ANNUAL HOURLY INTEGRATED ZONE TEMPERATURE																								Example Result Statistics				TRNSYS18			
Simulation Model:	BSIMAC				CSE				DeST				EnergyPlus				ESP-r				TRNSYS				Min	Max	Mean	(Max-Min)/				
Case	T (°C)				T (°C)				T (°C)				T (°C)				T (°C)				T (°C)				T (°C)	T (°C)	T (°C)	Mean** (%)	T (°C)			
600FF - Low Mass with S. Windows	26.1				25.6				25.3				24.9				25.3				24.3				24.3	26.1	25.2	7.3%	24.3			
900FF - High Mass with S. Windows	25.5				25.7				25.3				25.1				25.3				24.5				24.5	25.7	25.2	4.9%	24.5			
650FF Case 600FF with Night Ventilation	17.6				18.5				18.0				18.4				18.9				18.4				17.6	18.9	18.3	7.3%	18.4			
950FF Case 900FF with Night Ventilation	15.0				14.7				14.4				14.8				14.8				14.7				14.4	15.0	14.7	4.4%	14.7			
680FF Case 600FF with Increased Insulation	31.8				33.1				33.3				31.0				31.7				30.2				30.2	33.3	31.8	9.8%	30.2			
980FF Case 900FF with Increased Insulation	30.7				33.3				33.3				31.2				31.8				30.5				30.5	33.3	31.8	8.8%	30.5			
960 Sunspace					28.6				29.5				27.7				27.7				26.8				26.8	29.5	28.1	9.5%	26.8			

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-6. Low Mass Basic Sensitivity Tests

ANNUAL HEATING [MWh]							Statistics for Example Results				
Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
610-600 Heat, S. Shade	0.113	0.074	0.097	0.050	0.165	0.089	0.050	0.165	0.098	117.0%	0.090
620-600 Heat, E&W Orient.	0.320	0.101	0.250	0.161	0.152	0.215	0.101	0.320	0.200	109.6%	0.215
630-620 Heat, E&W Shade	0.553	0.262	0.380	0.298	0.536	0.420	0.262	0.553	0.408	71.2%	0.422
640-600 Heat, Htg. Setback	-1.368	-1.590	-1.428	-1.663	-1.708	-1.851	-1.851	-1.368	-1.601	30.2%	-1.852
660-600 Heat, Low-E Win.	-0.476	-0.391	-0.226	-0.618	-0.575	-0.714	-0.714	-0.226	-0.500	97.6%	-0.714
670-600 Heat, 1-Pane Win.	1.434	1.307	1.526	1.292	1.613	1.636	1.292	1.636	1.468	23.5%	1.636
680-600 Heat, > Ins. 20/27	-1.831	-2.207	-2.315	-2.145	-2.230	-2.217	-2.315	-1.831	-2.157	22.4%	-2.216
685-600 Heat, 20/20 tstat	0.482	0.582	0.599	0.553	0.542	0.539	0.482	0.599	0.549	21.3%	0.539
695-685 Heat, > Ins. 20/20	-1.823	-2.159	-2.261	-2.075	-2.171	-2.150	-2.261	-1.823	-2.107	20.8%	-2.149
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				
Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
610-600 Cool, S. Shade	-1.523	-1.531	-1.259	-1.694	-1.929	-1.663	-1.929	-1.259	-1.600	41.9%	-1.675
620-600 Cool, E&W Orient.	-1.418	-1.834	-1.523	-1.968	-1.916	-1.939	-1.968	-1.418	-1.766	31.1%	-1.940
630-620 Cool, E&W Shade	-1.330	-1.059	-1.122	-1.223	-1.650	-1.268	-1.650	-1.059	-1.275	46.4%	-1.271
640-600 Cool, Htg. Setback	-0.018	-0.269	-0.195	-0.264	-0.269	-0.302	-0.302	-0.018	-0.220	129.5%	-0.302
650-600 Cool, Night Vent	-1.193	-1.259	-1.246	-1.210	-1.217	-1.147	-1.259	-1.147	-1.212	9.2%	-1.147
660-600 Heat, Low-E Win.	-2.808	-2.573	-2.172	-2.796	-2.943	-2.813	-2.943	-2.172	-2.684	28.7%	-2.813
670-600 Heat, 1-Pane Win.	0.717	0.665	0.522	0.596	0.358	0.418	0.358	0.717	0.546	65.7%	0.418
680-600 Heat, > Ins. 20/27	0.116	0.517	0.500	0.417	0.368	0.530	0.116	0.530	0.408	101.6%	0.530
685-600 Heat, 20/20 tstat	3.308	2.946	2.806	3.092	2.960	3.072	2.806	3.308	3.031	16.6%	3.072
695-685 Heat, > Ins. 20/20	-0.375	0.115	0.148	0.053	0.028	0.188	-0.375	0.188	0.026	2164.0%	0.188
PEAK HEATING [kW]							Statistics for Example Results				
Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
610-600 Heat, S. Shade	-0.089	0.001	0.004	-0.013	0.005	0.001	-0.089	0.005	-0.015	616.7%	0.001
620-600 Heat, E&W Orient.	-0.110	0.018	0.033	0.025	0.025	0.026	-0.110	0.033	0.003	5355.3%	0.048
630-620 Heat, E&W Shade	0.107	0.002	0.004	-0.023	0.006	0.003	-0.023	0.107	0.016	786.0%	0.005
640-600 Heat, Htg. Setback	1.378	1.202	1.623	1.354	0.873	0.680	0.680	1.623	1.185	79.6%	0.760
660-600 Heat, Low-E Win.	-0.635	-0.262	-0.237	-0.373	-0.382	-0.404	-0.635	-0.237	-0.382	104.1%	-0.409
670-600 Heat, 1-Pane Win.	0.867	0.635	0.777	0.649	0.764	0.862	0.635	0.867	0.759	30.5%	0.943
680-600 Heat, > Ins. 20/27	-1.129	-1.243	-1.224	-1.152	-1.206	-1.244	-1.244	-1.129	-1.200	9.6%	-1.163
685-600 Heat, 20/20 tstat	-0.086	0.012	0.019	0.019	0.019	0.016	-0.086	0.019	0.000	29982.6%	0.028
695-685 Heat, > Ins. 20/20	-1.031	-1.237	-1.199	-1.151	-1.222	-1.257	-1.257	-1.031	-1.183	19.1%	-1.188
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				
Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
610-600 Cool, S. Shade	-0.184	-0.049	-0.091	-0.217	-0.259	-0.178	-0.259	-0.049	-0.163	129.0%	-0.233
620-600 Cool, E&W Orient.	-0.946	-1.988	-1.467	-1.554	-1.571	-1.457	-1.988	-0.946	-1.497	69.6%	-1.457
630-620 Cool, E&W Shade	-0.583	-0.495	-0.429	-0.585	-0.651	-0.639	-0.651	-0.429	-0.564	39.4%	-0.644
640-600 Cool, Htg. Setback	0.000	-0.052	-0.057	-0.054	-0.066	-0.079	-0.079	0.000	-0.051	153.3%	-0.079
650-600 Cool, Night Vent	-0.002	-0.191	-0.377	-0.213	-0.232	-0.248	-0.377	-0.002	-0.211	178.0%	-0.248
660-600 Heat, Low-E Win.	-2.307	-2.548	-2.067	-2.581	-2.663	-2.588	-2.663	-2.067	-2.459	24.2%	-2.588
670-600 Heat, 1-Pane Win.	0.567	0.444	0.417	0.455	0.289	0.356	0.289	0.567	0.421	66.0%	0.356
680-600 Heat, > Ins. 20/27	0.111	0.570	0.439	0.419	0.483	0.511	0.111	0.570	0.422	108.8%	0.511
685-600 Heat, 20/20 tstat	0.668	0.678	0.649	0.755	0.741	0.822	0.649	0.822	0.719	24.0%	0.822
695-685 Heat, > Ins. 20/20	-0.086	0.381	0.284	0.228	0.305	0.308	-0.086	0.381	0.237	197.5%	0.308

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-7. High Mass Basic Sensitivity Tests

ANNUAL HEATING [MWh]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
900-600 Mass, Heat	-2.324	-2.614	-2.456	-2.661	-2.777	-2.690	-2.777	-2.324	-2.587	17.5%	-2.697
910-900 Heat, S. Shade	0.437	0.269	0.269	0.292	0.483	0.318	0.269	0.483	0.345	62.0%	0.325
920-900 Heat, E&W Orient.	1.774	1.577	1.668	1.673	1.715	1.793	1.577	1.793	1.700	12.7%	1.787
930-920 Heat, E&W Shade	0.770	0.568	0.674	0.657	0.978	0.777	0.568	0.978	0.737	55.6%	0.780
940-900 Heat, Htg. Setback	-0.337	-0.516	-0.442	-0.596	-0.570	-0.645	-0.645	-0.337	-0.518	59.5%	-0.646
960-900 Heat, Sunspace		1.143	1.180	1.025	1.039	1.046	1.025	1.180	1.087	14.2%	1.047
980-900 Heat, > Ins. 20/27	-1.006	-1.133	-1.325	-1.253	-1.234	-1.364	-1.364	-1.006	-1.219	29.3%	-1.352
985-900 Heat, 20/20 tstat	1.075	0.741	0.688	0.706	0.699	0.722	0.688	1.075	0.772	50.1%	0.724
995-985 Heat, > Ins. 20/20	-1.471	-1.365	-1.509	-1.363	-1.379	-1.459	-1.509	-1.363	-1.424	10.3%	-1.450
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
900-600 Mass, Cool	-3.108	-3.449	-3.049	-3.538	-3.674	-3.512	-3.674	-3.049	-3.389	18.4%	-3.513
910-900 Cool, S. Shade	-1.230	-1.049	-0.893	-1.105	-1.205	-1.076	-1.230	-0.893	-1.093	30.8%	-1.079
920-900 Cool, E&W Orient.	0.414	0.325	0.323	0.242	0.327	0.282	0.242	0.414	0.319	53.9%	0.281
930-920 Cool, E&W Shade	-0.967	-0.714	-0.798	-0.812	-1.161	-0.877	-1.161	-0.714	-0.888	50.3%	-0.879
940-900 Cool, Htg. Setback	-0.101	-0.067	-0.040	-0.064	-0.060	-0.064	-0.101	-0.040	-0.066	92.3%	-0.064
950-900 Cool, Night Vent	-2.128	-1.866	-1.765	-1.782	-1.832	-1.626	-2.128	-1.626	-1.833	27.4%	-1.625
960-900 Cool, Sunspace		-1.538	-1.474	-1.582	-1.538	-1.478	-1.582	-1.474	-1.522	7.1%	-1.478
980-900 Heat, > Ins. 20/27	0.787	1.531	1.375	1.223	1.287	1.251	0.787	1.531	1.242	59.9%	1.251
985-900 Heat, 20/20 tstat	4.559	3.770	3.497	3.870	3.762	3.846	3.497	4.559	3.884	27.3%	3.848
995-985 Heat, > Ins. 20/20	0.209	0.969	0.891	0.844	0.900	0.950	0.209	0.969	0.794	95.7%	0.949
PEAK HEATING [kW]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
900-600 Mass, Heat	-0.704	-0.577	-0.582	-0.517	-0.595	-0.580	-0.704	-0.517	-0.593	31.6%	-0.499
910-900 Heat, S. Shade	0.210	0.026	0.021	0.011	0.051	0.021	0.011	0.210	0.057	350.6%	0.021
920-900 Heat, E&W Orient.	0.344	0.069	0.060	0.083	0.073	0.086	0.060	0.344	0.119	238.5%	0.086
930-920 Heat, E&W Shade	0.073	0.025	0.036	0.015	0.059	0.036	0.015	0.073	0.041	143.7%	0.036
940-900 Heat, Htg. Setback	1.331	0.609	1.206	0.455	0.489	0.626	0.455	1.331	0.786	111.4%	0.417
960-900 Heat, Sunspace		-0.311	-0.368	-0.428	-0.432	-0.478	-0.478	-0.311	-0.404	41.3%	-0.478
980-900 Heat, > Ins. 20/27	-0.858	-1.190	-1.071	-1.150	-1.160	-1.186	-1.190	-0.858	-1.102	30.1%	-1.186
985-900 Heat, 20/20 tstat	0.203	0.009	0.005	0.008	0.009	0.007	0.005	0.203	0.040	493.6%	0.007
995-985 Heat, > Ins. 20/20	-1.043	-1.083	-0.996	-1.073	-1.082	-1.123	-1.123	-0.996	-1.067	11.9%	-1.123
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
900-600 Mass, Cool	-2.611	-3.105	-2.866	-3.311	-3.297	-3.106	-3.311	-2.611	-3.049	23.0%	-3.106
910-900 Cool, S. Shade	-0.546	-0.654	-0.453	-0.818	-0.684	-0.859	-0.859	-0.453	-0.669	60.7%	-0.865
920-900 Cool, E&W Orient.	0.442	-0.320	0.154	0.220	0.203	0.214	-0.320	0.442	0.152	500.5%	0.214
930-920 Cool, E&W Shade	-0.429	-0.395	-0.375	-0.479	-0.605	-0.541	-0.605	-0.375	-0.471	48.9%	-0.542
940-900 Cool, Htg. Setback	0.119	0.000	0.000	0.000	-0.005	-0.002	-0.005	0.119	0.019	669.9%	-0.002
950-900 Cool, Night Vent	-0.673	-1.013	-0.502	-0.653	-0.694	-0.704	-1.013	-0.502	-0.706	72.3%	-0.704
960-900 Cool, Sunspace		-1.999	-1.189	-1.561	-1.493	-1.602	-1.999	-1.189	-1.569	51.7%	-1.601
980-900 Heat, > Ins. 20/27	0.345	0.292	0.374	0.410	0.445	0.372	0.292	0.445	0.373	41.1%	0.373
985-900 Heat, 20/20 tstat	0.938	0.849	0.652	0.874	0.840	0.945	0.652	0.945	0.850	34.4%	0.945

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

995-985 Heat, > Ins. 20/20	0.152	-0.001	0.107	0.263	0.218	0.230	-0.001	0.263	0.161	163.7%	0.230

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-8. Low Mass In-Depth (Cases 195 thru 320) Sensitivity Tests

ANNUAL HEATING [MWh]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
200-195 Surface Convection	0.824	0.823	1.069	1.036	0.970	1.049	0.823	1.069	0.962	25.5%	1.065
210-200 Ext IR (Int IR "off")	0.586	1.153	1.305	0.941	1.397	1.287	0.586	1.397	1.111	72.9%	1.294
220-215 Ext IR (Int IR "on")	0.725	1.360	1.481	1.050	1.545	1.424	0.725	1.545	1.264	64.8%	1.436
215-200 Int IR (Ext IR "off")	0.611	0.493	0.471	0.300	0.261	0.301	0.261	0.611	0.406	86.3%	0.307
220-210 Int IR (Ext IR "on")	0.750	0.700	0.647	0.409	0.409	0.438	0.409	0.750	0.559	61.1%	0.449
230-220 Infiltration	3.474	3.146	3.239	3.475	3.213	3.366	3.146	3.475	3.319	9.9%	3.366
240-220 Internal Gains	-1.261	-1.224	-1.234	-1.176	-1.186	-1.211	-1.261	-1.176	-1.215	7.0%	-1.210
250-220 Ext Solar Abs.	-1.644	-1.622	-1.805	-1.556	-1.791	-1.763	-1.805	-1.556	-1.697	14.7%	-1.772
270-220 South Windows		-2.320	-2.905	-2.070	-2.149	-2.237	-2.905	-2.070	-2.336	35.8%	-2.271
280-270 Cavity Albedo		0.178	0.346	0.185	0.162	0.239	0.162	0.346	0.222	83.0%	0.239
320-270 Thermostat		-0.669	-0.674	-0.614	-0.607	-0.600	-0.674	-0.600	-0.633	11.7%	-0.600
290-270 South Shading		0.078	0.108	0.039	0.168	0.094	0.039	0.168	0.097	132.8%	0.095
300-270 E&W Windows		-0.028	0.187	0.039	0.092	0.094	-0.028	0.187	0.077	280.1%	0.094
310-300 E&W Shading		0.262	0.386	0.267	0.572	0.437	0.262	0.572	0.385	80.5%	0.439
ANNUAL SENSIBLE COOLING [MWh]											
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
200-195 Surface Convection	0.127	0.195	0.207	0.203	0.189	0.197	0.127	0.207	0.186	42.9%	0.200
210-200 Ext IR (Int IR "off")	-0.151	-0.297	-0.339	-0.254	-0.282	-0.329	-0.339	-0.151	-0.275	68.3%	-0.330
220-215 Ext IR (Int IR "on")	-0.149	-0.335	-0.372	-0.268	-0.319	-0.353	-0.372	-0.149	-0.299	74.5%	-0.354
215-200 Int IR (Ext IR "off")	0.113	0.146	0.087	0.063	0.094	0.062	0.062	0.146	0.094	88.6%	0.064
220-210 Int IR (Ext IR "on")	0.115	0.108	0.054	0.050	0.058	0.038	0.038	0.115	0.070	108.6%	0.040
230-220 Infiltration	0.381	0.381	0.379	0.381	0.379	0.399	0.379	0.399	0.383	5.3%	0.399
240-220 Internal Gains	0.484	0.372	0.326	0.369	0.346	0.336	0.326	0.484	0.372	42.5%	0.336
250-220 Ext Solar Abs.	2.809	2.818	2.921	2.572	2.891	2.406	2.406	2.921	2.736	18.8%	2.429
270-220 South Windows		6.660	6.148	6.912	6.732	6.791	6.148	6.912	6.649	11.5%	6.787
280-270 Cavity Albedo		-2.274	-2.483	-2.339	-2.103	-2.480	-2.483	-2.103	-2.336	16.3%	-2.480
320-270 Thermostat		-2.412	-2.278	-2.536	-2.396	-2.501	-2.536	-2.278	-2.424	10.6%	-2.501
290-270 South Shading		-1.661	-1.388	-1.779	-1.988	-1.827	-1.988	-1.388	-1.729	34.7%	-1.840
300-270 E&W Windows		-2.216	-1.893	-2.370	-2.271	-2.376	-2.376	-1.893	-2.225	21.7%	-2.377
310-300 E&W Shading		-1.303	-1.403	-1.483	-1.910	-1.589	-1.910	-1.303	-1.538	39.5%	-1.594
PEAK HEATING [kW]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
200-195 Surface Convection	0.470	0.435	0.509	0.547	0.473	0.557	0.435	0.557	0.499	24.4%	0.570
210-200 Ext IR (Int IR "off")	0.102	0.403	0.297	0.223	0.396	0.397	0.102	0.403	0.303	99.3%	0.343
220-215 Ext IR (Int IR "on")	0.110	0.419	0.343	0.214	0.398	0.389	0.110	0.419	0.312	99.1%	0.333
215-200 Int IR (Ext IR "off")	0.249	0.194	0.212	0.136	0.115	0.137	0.115	0.249	0.174	77.1%	0.140
220-210 Int IR (Ext IR "on")	0.257	0.210	0.258	0.127	0.117	0.129	0.117	0.258	0.183	77.0%	0.130
230-220 Infiltration	1.588	1.294	1.360	1.624	1.372	1.437	1.294	1.624	1.446	22.9%	1.442
240-220 Internal Gains	-0.200	-0.188	-0.178	-0.185	-0.183	-0.185	-0.200	-0.178	-0.187	11.8%	-0.185
250-220 Ext Solar Abs.	0.000	-0.002	-0.008	-0.005	-0.008	-0.004	-0.008	0.000	-0.005	176.8%	-0.007
270-220 South Windows		-0.228	-0.303	-0.095	-0.040	-0.035	-0.303	-0.035	-0.140	190.7%	-0.063
280-270 Cavity Albedo		0.001	0.008	0.005	0.004	0.005	0.001	0.008	0.005	150.6%	0.010
320-270 Thermostat		-0.002	-0.014	-0.023	-0.015	-0.010	-0.023	-0.002	-0.013	161.1%	-0.023
290-270 South Shading		0.000	0.001	-0.013	0.002	0.000	-0.013	0.002	-0.002	763.1%	0.001
300-270 E&W Windows		0.003	0.029	0.007	0.018	0.010	0.003	0.029	0.013	197.7%	0.022
310-300 E&W Shading		0.001	0.003	-0.023	0.005	0.003	-0.023	0.005	-0.002	1211.6%	0.005
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
200-195 Surface Convection	0.153	0.221	0.266	0.266	0.254	0.265	0.153	0.266	0.238	47.8%	0.269
210-200 Ext IR (Int IR "off")	-0.078	-0.270	-0.302	-0.223	-0.321	-0.375	-0.375	-0.078	-0.261	113.5%	-0.376
220-215 Ext IR (Int IR "on")	-0.057	-0.261	-0.346	-0.216	-0.354	-0.384	-0.384	-0.057	-0.270	121.3%	-0.385
215-200 Int IR (Ext IR "off")	0.122	0.154	0.147	0.093	0.168	0.093	0.093	0.168	0.130	58.0%	0.095
220-210 Int IR (Ext IR "on")	0.143	0.163	0.103	0.100	0.135	0.084	0.084	0.163	0.121	65.1%	0.086
230-220 Infiltration	0.658	0.620	0.694	0.656	0.689	0.726	0.620	0.726	0.674	15.7%	0.726
240-220 Internal Gains	0.198	0.186	0.178	0.181	0.180	0.182	0.178	0.198	0.184	10.9%	0.181
250-220 Ext Solar Abs.	1.577	1.682	1.711	1.682	2.022	1.720	1.577	2.022	1.732	25.7%	1.738
270-220 South Windows		5.903	4.792	5.654	5.601	5.669	4.792	5.903	5.524	20.1%	5.664
280-270 Cavity Albedo		-2.246	-2.064	-2.112	-1.937	-2.238	-2.246	-1.937	-2.119	14.6%	-2.237
320-270 Thermostat		-0.538	-0.528	-0.630	-0.620	-0.688	-0.688	-0.528	-0.601	26.6%	-0.688
290-270 South Shading		-0.139	-0.093	-0.244	-0.202	-0.236	-0.244	-0.093	-0.183	82.8%	-0.261
300-270 E&W Windows		-2.848	-2.137	-2.363	-2.392	-2.359	-2.848	-2.137	-2.420	29.4%	-2.359

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
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310-300 E&W Shading		-0.367	-0.443	-0.506	-0.603	-0.577	-0.603	-0.367	-0.499	47.2%	-0.579

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
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Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-9. Low Mass In-Depth (Cases 395 thru 440) Sensitivity Tests

ANNUAL HEATING [MWh]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
400-395 Surf. Conv. & IR	1.341	1.681	1.902	1.707	1.744	1.861	1.341	1.902	1.706	32.9%	1.896
410-400 Infiltration	1.724	1.509	1.614	1.733	1.602	1.676	1.509	1.733	1.643	13.6%	1.676
420-410 Internal Gains	-1.231	-1.211	-1.228	-1.175	-1.185	-1.209	-1.231	-1.175	-1.206	4.7%	-1.208
430-420 Ext Solar Abs.	-1.228	-1.380	-1.479	-1.286	-1.482	-1.386	-1.482	-1.228	-1.374	18.5%	-1.395
600-430 South Windows	-1.121	-1.461	-1.907	-1.296	-1.183	-1.347	-1.907	-1.121	-1.386	56.7%	-1.372
440-600 Cavity Albedo		0.163	0.283	0.176	0.142	0.217	0.142	0.283	0.196	71.9%	0.217
450-600 Const Int&Ext Surf Coefs	-0.307	-0.002	-0.672	-0.362	-0.512	-0.633	-0.672	-0.002	-0.415	161.5%	-0.631
460-600 Const Int Surf Coefs	-0.222	0.063	-0.174	-0.131	-0.099	-0.214	-0.222	0.063	-0.130	219.8%	-0.213
460-450 Auto Ext Surf Heat Transf	0.085	0.065	0.498	0.231	0.412	0.419	0.065	0.498	0.285	151.9%	0.418
470-600 Const Ext Surf Coefs	-0.008	-0.093	-0.507	-0.231	-0.402	-0.429	-0.507	-0.008	-0.278	179.3%	-0.428
470-450 Auto Int Surf Heat Transf	0.299	-0.091	0.165	0.131	0.109	0.204	-0.091	0.299	0.136	286.2%	0.203
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
400-395 Surf. Conv. & IR	0.042	0.016	0.011	0.020	0.019	0.009	0.009	0.042	0.019	168.7%	0.009
410-400 Infiltration	0.033	0.025	0.024	0.027	0.028	0.022	0.022	0.033	0.027	39.8%	0.023
420-410 Internal Gains	0.132	0.092	0.078	0.095	0.090	0.074	0.074	0.132	0.094	61.7%	0.074
430-420 Ext Solar Abs.	0.856	0.766	0.825	0.703	0.811	0.630	0.630	0.856	0.765	29.6%	0.635
600-430 South Windows	4.738	5.007	4.488	5.171	5.209	5.040	4.488	5.209	4.942	14.6%	5.035
440-600 Cavity Albedo		-1.928	-1.974	-1.942	-1.748	-2.038	-2.038	-1.748	-1.926	15.1%	-2.038
450-600 Const Int&Ext Surf Coefs	0.350	-0.224	0.729	0.480	0.451	0.751	-0.224	0.751	0.423	230.6%	0.750
460-600 Const Int Surf Coefs	0.438	0.027	0.497	0.448	0.567	0.464	0.027	0.567	0.407	132.9%	0.463
460-450 Auto Ext Surf Heat Transf	0.088	0.251	-0.232	-0.033	0.116	-0.287	-0.287	0.251	-0.016	3319.8%	-0.287
470-600 Const Ext Surf Coefs	0.165	-0.269	0.217	0.002	-0.156	0.276	-0.269	0.276	0.039	1392.5%	0.276
470-450 Auto Int Surf Heat Transf	-0.185	-0.045	-0.512	-0.478	-0.608	-0.475	-0.608	-0.045	-0.384	146.6%	-0.474
PEAK HEATING [kW]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
400-395 Surf. Conv. & IR	0.611	0.682	0.778	0.740	0.698	0.717	0.611	0.778	0.704	23.7%	0.794
410-400 Infiltration	0.779	0.601	0.680	0.812	0.685	0.718	0.601	0.812	0.713	29.6%	0.721
420-410 Internal Gains	-0.200	-0.184	-0.178	-0.185	-0.183	-0.185	-0.200	-0.178	-0.186	11.8%	-0.185
430-420 Ext Solar Abs.	0.162	-0.002	-0.005	-0.003	-0.005	-0.003	-0.005	0.162	0.024	695.2%	-0.005
600-430 South Windows	-0.045	-0.234	-0.325	-0.112	-0.057	-0.050	-0.325	-0.045	-0.137	204.3%	-0.088
440-600 Cavity Albedo		0.007	0.025	0.014	0.009	0.015	0.007	0.025	0.014	127.7%	0.027
450-600 Const Int&Ext Surf Coefs	-0.266	-0.042	-0.282	-0.105	-0.186	-0.322	-0.322	-0.042	-0.200	139.6%	-0.300
460-600 Const Int Surf Coefs	-0.200	-0.049	-0.055	-0.113	-0.127	-0.199	-0.200	-0.049	-0.124	122.0%	-0.186
460-450 Auto Ext Surf Heat Transf	0.066	-0.007	0.227	-0.009	0.059	0.122	-0.009	0.227	0.076	308.4%	0.113
470-600 Const Ext Surf Coefs	-0.137	-0.020	-0.228	0.002	-0.059	-0.127	-0.228	0.002	-0.095	243.0%	-0.115
470-450 Auto Int Surf Heat Transf	0.129	0.022	0.054	0.107	0.127	0.194	0.022	0.194	0.106	162.7%	0.185
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
400-395 Surf. Conv. & IR	0.251	0.136	0.149	0.229	0.162	0.107	0.107	0.251	0.172	83.7%	0.109
410-400 Infiltration	0.213	0.206	0.252	0.221	0.168	0.232	0.168	0.252	0.215	39.0%	0.233
420-410 Internal Gains	0.197	0.209	0.208	0.205	0.212	0.210	0.197	0.212	0.207	7.3%	0.210
430-420 Ext Solar Abs.	0.959	0.931	0.923	0.897	1.038	0.890	0.890	1.038	0.940	15.7%	0.896
600-430 South Windows	3.483	4.641	3.582	4.422	4.319	4.342	3.483	4.641	4.132	28.0%	4.333
440-600 Cavity Albedo		-1.815	-1.656	-1.666	-1.514	-1.738	-1.815	-1.514	-1.678	18.0%	-1.738
450-600 Const Int&Ext Surf Coefs	0.162	-0.301	0.641	0.115	0.308	0.268	-0.301	0.641	0.199	474.2%	0.267
460-600 Const Int Surf Coefs	0.154	-0.238	0.480	0.023	0.111	0.023	-0.238	0.480	0.092	779.6%	0.022
460-450 Auto Ext Surf Heat Transf	-0.008	0.063	-0.161	-0.092	-0.197	-0.244	-0.244	0.063	-0.107	288.5%	-0.244
470-600 Const Ext Surf Coefs	0.045	-0.093	0.148	0.092	0.214	0.274	-0.093	0.274	0.113	324.3%	0.274
470-450 Auto Int Surf Heat Transf	-0.117	0.208	-0.493	-0.023	-0.094	0.007	-0.493	0.208	-0.085	821.0%	0.008

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
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Note: The statistics in the tables below are based on the listed example results.
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Note: The statistics in the tables below are based on the listed example results.
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Table B8-10. High Mass Basic and In-Depth Sensitivity Tests

ANNUAL HEATING [MWh]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
800-430 Mass, w/ High Cond. Wall	-0.030	-0.548	-0.551	-0.505	-0.565	-0.481	-0.565	-0.030	-0.447	119.8%	-0.502
900-800 Himass, S. Win.	-3.415	-3.527	-3.812	-3.452	-3.395	-3.555	-3.812	-3.395	-3.526	11.8%	-3.567
900-810 Himass, Int. Sol. Abs.		-0.659	-0.863	-0.678	-0.600	-0.796	-0.863	-0.600	-0.719	36.5%	-0.793
910-610 Mass, w/ S. Shade	-2.000	-2.419	-2.284	-2.419	-2.460	-2.460	-2.460	-2.000	-2.340	19.7%	-2.462
920-620 Mass, w/ E&W Win.	-0.870	-1.138	-1.038	-1.149	-1.215	-1.112	-1.215	-0.870	-1.087	31.7%	-1.126
930-630 Mass w/ E&W Shade	-0.653	-0.832	-0.744	-0.790	-0.773	-0.754	-0.832	-0.653	-0.758	23.7%	-0.768
940-640 Mass, w/ Htg. Setback	-1.293	-1.540	-1.470	-1.594	-1.640	-1.484	-1.640	-1.293	-1.503	23.1%	-1.492
980-680 Mass, w/ Insulation 20/27	-1.499	-1.540	-1.466	-1.769	-1.781	-1.836	-1.836	-1.466	-1.648	22.4%	-1.833
985-685 Mass, w/ 20/20 Tstat	-1.731	-2.454	-2.367	-2.508	-2.620	-2.506	-2.620	-1.731	-2.364	37.6%	-2.512
995-695 Mass, w/ Insulation 20/20	-1.379	-1.660	-1.615	-1.795	-1.827	-1.815	-1.827	-1.379	-1.682	26.7%	-1.813
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
800-430 Mass, w/ High Cond. Wall	-0.611	-0.526	-0.582	-0.482	-0.561	-0.457	-0.611	-0.457	-0.537	28.7%	-0.461
900-800 Himass, S. Win.	2.241	2.084	2.021	2.115	2.096	1.985	1.985	2.241	2.090	12.2%	1.983
900-810 Himass, Int. Sol. Abs.		0.983	1.026	0.981	0.882	0.973	0.882	1.026	0.969	14.9%	0.972
910-610 Mass, w/ S. Shade	-2.815	-2.967	-2.683	-2.949	-2.950	-2.926	-2.967	-2.683	-2.882	9.9%	-2.917
920-620 Mass, w/ E&W Win.	-1.276	-1.290	-1.203	-1.329	-1.431	-1.292	-1.431	-1.203	-1.303	17.5%	-1.292
930-630 Mass w/ E&W Shade	-0.913	-0.945	-0.879	-0.917	-0.942	-0.901	-0.945	-0.879	-0.916	7.2%	-0.900
940-640 Mass, w/ Htg. Setback	-3.191	-3.247	-2.894	-3.339	-3.465	-3.274	-3.465	-2.894	-3.235	17.7%	-3.274
950-650 Mass, w/ Night Vent	-4.043	-4.056	-3.568	-4.110	-4.289	-3.991	-4.289	-3.568	-4.009	18.0%	-3.991
980-680 Mass, w/ Insulation 20/27	-2.437	-2.435	-2.174	-2.732	-2.755	-2.791	-2.791	-2.174	-2.554	24.2%	-2.792
985-685 Mass, w/ 20/20 Tstat	-1.857	-2.626	-2.358	-2.760	-2.872	-2.738	-2.872	-1.857	-2.535	40.0%	-2.736
995-695 Mass, w/ Insulation 20/20	-1.273	-1.772	-1.615	-1.969	-2.000	-1.975	-2.000	-1.273	-1.767	41.1%	-1.975
PEAK HEATING [kW]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
800-430 Mass, w/ High Cond. Wall	-0.343	-0.476	-0.496	-0.393	-0.445	-0.442	-0.496	-0.343	-0.432	35.4%	-0.386
900-800 Himass, S. Win.	-0.406	-0.334	-0.411	-0.236	-0.207	-0.188	-0.411	-0.188	-0.297	74.9%	-0.202
900-810 Himass, Int. Sol. Abs.		-0.057	-0.059	-0.062	-0.062	-0.066	-0.066	-0.057	-0.061	15.4%	-0.066
910-610 Mass, w/ S. Shade	-0.405	-0.552	-0.565	-0.493	-0.549	-0.560	-0.565	-0.405	-0.521	30.7%	-0.480
920-620 Mass, w/ E&W Win.	-0.250	-0.525	-0.555	-0.459	-0.547	-0.520	-0.555	-0.250	-0.476	64.1%	-0.462
930-630 Mass w/ E&W Shade	-0.284	-0.502	-0.523	-0.422	-0.494	-0.487	-0.523	-0.284	-0.452	52.9%	-0.431
940-640 Mass, w/ Htg. Setback	-0.751	-1.171	-0.999	-1.416	-0.979	-0.634	-1.416	-0.634	-0.992	78.9%	-0.843
980-680 Mass, w/ Insulation 20/27	-0.433	-0.524	-0.429	-0.515	-0.549	-0.523	-0.549	-0.429	-0.495	24.2%	-0.522
985-685 Mass, w/ 20/20 Tstat	-0.415	-0.580	-0.596	-0.528	-0.605	-0.589	-0.605	-0.415	-0.552	34.4%	-0.520
995-695 Mass, w/ Insulation 20/20	-0.427	-0.426	-0.393	-0.450	-0.465	-0.456	-0.465	-0.393	-0.436	16.5%	-0.456
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
800-430 Mass, w/ High Cond. Wall	-0.881	-0.738	-0.683	-0.884	-0.822	-0.768	-0.884	-0.683	-0.796	25.2%	-0.770
900-800 Himass, S. Win.	1.753	2.275	1.399	1.995	1.844	2.004	1.399	2.275	1.878	46.6%	1.998
900-810 Himass, Int. Sol. Abs.		0.966	0.616	0.770	0.717	0.827	0.616	0.966	0.779	44.9%	0.827
910-610 Mass, w/ S. Shade	-2.973	-3.710	-3.228	-3.912	-3.722	-3.787	-3.912	-2.973	-3.555	26.4%	-3.738
920-620 Mass, w/ E&W Win.	-1.223	-1.436	-1.245	-1.537	-1.523	-1.434	-1.537	-1.223	-1.400	22.4%	-1.434
930-630 Mass w/ E&W Shade	-1.069	-1.336	-1.191	-1.431	-1.477	-1.336	-1.477	-1.069	-1.307	31.2%	-1.332
940-640 Mass, w/ Htg. Setback	-2.492	-3.053	-2.809	-3.257	-3.236	-3.029	-3.257	-2.492	-2.979	25.7%	-3.029
950-650 Mass, w/ Night Vent	-3.282	-3.926	-2.991	-3.751	-3.759	-3.561	-3.926	-2.991	-3.545	26.4%	-3.561
980-680 Mass, w/ Insulation 20/27	-2.377	-3.383	-2.931	-3.320	-3.335	-3.244	-3.383	-2.377	-3.098	32.5%	-3.244
985-685 Mass, w/ 20/20 Tstat	-2.341	-2.934	-2.863	-3.192	-3.198	-2.983	-3.198	-2.341	-2.918	29.4%	-2.982
995-695 Mass, w/ Insulation 20/20	-2.103	-3.317	-3.040	-3.157	-3.285	-3.060	-3.317	-2.103	-2.994	40.6%	-3.061

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-11. Annual Transmissivity Coefficient of Windows

(ANNUAL UNSHADED TRANSMITTED SOLAR RADIATION)/(ANNUAL UNSHADED INCIDENT SOLAR RADIATION)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
Case							Min	Max	Mean	(Max-Min)/ Mean* (%)	
600 South	0.591	0.627	0.624	0.587	0.597	0.594	0.587	0.627	0.603	6.7%	0.594
620 West	0.600		0.629	0.601	0.616	0.640	0.600	0.640	0.617	6.5%	0.640
660 South, Low-E	0.322	0.381	0.392	0.318	0.325	0.324	0.318	0.392	0.344	21.6%	0.324
670 South, Single-Pane	0.748	0.750	0.770	0.747	0.754	0.751	0.747	0.770	0.753	3.1%	0.751

* ABS[(Max-Min) / (Mean of Example Simulation Results)]

Table B8-12. Annual Shading Coefficient of Window Shading Devices: Overhangs & Fins

(1-(ANNUAL SHADED TRANSMITTED SOLAR RADIATION)/(ANNUAL UNSHADED TRANSMITTED SOLAR RADIATION))

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
Case							Min	Max	Mean	(Max-Min)/ Mean* (%)	
610/600 South	0.218	0.194	0.176	0.196	0.224	0.195	0.176	0.224	0.201	24.0%	0.197
630/620 West	0.268		0.299	0.278	0.342	0.286	0.268	0.342	0.294	25.2%	0.287

* ABS[(Max-Min) / (Mean of Example Simulation Results)]

Table B8-13. Case 600 Annual Incident Solar Radiation (kWh/m^2)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
Case							Min	Max	Mean	(Max-Min)/ Mean* (%)	
Horizontal	1670	1663	1667	1664	1665	1669	1663	1670	1666	0.4%	1669
North	453	399	477	438	432	440	399	477	440	17.8%	440
East	1061	1027	1017	1062	1054	1068	1017	1068	1048	4.9%	1068
South	1387	1317	1291	1370	1363	1384	1291	1387	1352	7.1%	1384
West	997	903	906	967	961	974	903	997	951	9.9%	974

* ABS[(Max-Min) / (Mean of Example Simulation Results)]

Table B8-14. Annual Transmitted Solar Radiation - Unshaded (kWh/m^2)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
Case							Min	Max	Mean	(Max-Min)/ Mean* (%)	
600 South	820	826	805	804	814	823	804	826	815	2.6%	823
620 West	598		569	581	592	624	569	624	593	9.2%	624
660 South	447	501	506	436	443	448	436	506	464	15.2%	448
670 South	1037	988	994	1024	1028	1039	988	1039	1018	5.0%	1039

* ABS[(Max-Min) / (Mean of Example Simulation Results)]

Table B8-15. Annual Transmitted Solar Radiation - Shaded (kWh/m^2)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
Case							Min	Max	Mean	(Max-Min)/ Mean* (%)	
610 South	641	665	663	646	631	662	631	665	651	5.2%	661
630 West	438		399	419	390	446	390	446	418	13.4%	445

* ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-16. Sky Temperature Output, Case 600

MAXIMUM ANNUAL HOURLY INTEGRATED SKY TEMPERATURE																																
Simulation Model:	BSIMAC				CSE				DeST				EnergyPlus				ESP-r				TRNSYS				TestSpec-Alt Alternative Values				Example Result Statistics				TRNSYS18			
																													Min	Max	Mean	(Max-Min)/				
Case	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	Mo.	Day	Hr	T (°C)	T (°C)	T (°C)	Mean** (%)	T (°C)	Mo.	Day	Hr
Average Annual Hourly Integrated					-3.9				-5.9				-2.0				-5.2				-5.1				-5.9				-5.9	-2.0	-4.7	83.2%	-5.1			
Minimum Annual Hourly Integrated					-46.2	Dec	31	24	-46.9	Dec	31	23	-38.0	Dec	31	24	-46.9	Dec	31	23	-46.2	Dec	31	24	-46.9				-46.9	-38.0	-45.2	19.8%	-46.2	Dec	31	24
Maximum Annual Hourly Integrated					30.1	Jun	13	15	24.6	Aug	4	15	24.7	Aug	4	16	26.7	Aug	4	15	26.0	Jun	13	18	24.6				24.6	30.1	26.1	20.9%	26.0	Jun	13	18

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

SHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980F
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-M1. Monthly Heating Loads (kWh)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
							Min	Max	Mean	(Max-Min)/ Mean** (%)	
Case 600											
Jan	664.0	655.6	672.7	711.9	732.0	734.9	655.6	734.9	695.2	11.4%	731.2
Feb	653.3	626.3	635.3	682.6	682.0	702.1	626.3	702.1	663.6	11.4%	702.1
Mar	433.5	435.7	450.5	472.2	481.0	495.0	433.5	495.0	461.3	13.3%	495.0
Apr	511.0	457.0	448.0	510.1	479.0	517.3	448.0	517.3	487.1	14.2%	517.3
May	112.8	127.8	128.0	136.8	139.0	150.7	112.8	150.7	132.5	28.6%	150.7
Jun	2.7	11.7	11.2	10.1	14.0	16.0	2.7	16.0	10.9	120.7%	16.0
Jul	4.8	11.5	10.1	12.0	14.0	16.7	4.8	16.7	11.5	103.0%	16.7
Aug	1.4	6.9	8.4	6.6	9.0	9.6	1.4	9.6	7.0	118.1%	9.6
Sep	51.8	74.3	76.7	73.3	81.0	84.8	51.8	84.8	73.7	44.9%	84.8
Oct	317.0	328.4	324.1	347.7	354.0	367.1	317.0	367.1	339.7	14.7%	367.1
Nov	598.7	575.6	585.8	625.3	629.0	645.8	575.6	645.8	610.0	11.5%	645.8
Dec	698.7	682.0	697.8	735.7	750.0	763.5	682.0	763.5	721.3	11.3%	763.6
Case 900											
Jan	277.8	206.1	275.3	255.8	266.0	291.9	206.1	291.9	262.2	32.7%	280.2
Feb	307.4	243.2	292.9	294.2	283.0	322.1	243.2	322.1	290.5	27.2%	322.2
Mar	134.4	102.4	120.0	125.5	115.0	143.8	102.4	143.8	123.5	33.5%	143.9
Apr	275.7	222.4	214.2	268.7	228.0	275.5	214.2	275.7	247.4	24.9%	275.5
May	20.1	33.3	26.8	33.4	29.0	37.5	20.1	37.5	30.0	58.0%	37.5
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!	0.0
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!	0.0
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!	0.0
Sep	2.1	0.0	0.0	0.1	0.0	0.5	0.0	2.1	0.5	458.3%	0.5
Oct	80.5	65.1	63.6	81.1	70.0	85.0	63.6	85.0	74.2	28.9%	85.0
Nov	298.2	251.6	283.9	297.0	286.0	318.2	251.6	318.2	289.2	23.0%	318.3
Dec	329.8	254.7	314.3	307.9	308.0	339.4	254.7	339.4	309.0	27.4%	339.4

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

Table B8-M2. Monthly Sensible Cooling Loads (kWh)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRNSYS18
							Min	Max	Mean	(Max-Min)/ Mean** (%)	
Case 600											
Jan	475.4	554.0	417.9	521.8	523.0	495.0	417.9	554.0	497.9	27.3%	495.0
Feb	349.2	394.3	315.4	387.5	398.0	367.4	315.4	398.0	368.6	22.4%	367.4
Mar	450.3	474.4	410.7	484.4	489.0	457.4	410.7	489.0	461.0	17.0%	457.4
Apr	218.7	220.1	230.2	240.5	263.0	235.4	218.7	263.0	234.6	18.9%	235.4
May	342.7	321.2	338.6	339.9	364.0	325.2	321.2	364.0	338.6	12.7%	325.2
Jun	578.3	497.4	526.4	539.6	550.0	516.1	497.4	578.3	534.6	15.1%	516.1
Jul	568.4	505.9	525.1	536.4	556.0	514.4	505.9	568.4	534.4	11.7%	514.4
Aug	658.2	606.5	621.1	648.5	674.0	634.1	606.5	674.0	640.4	10.5%	634.1
Sep	724.8	705.2	672.1	733.7	743.0	710.5	672.1	743.0	714.9	9.9%	710.5
Oct	628.4	676.1	611.1	675.3	681.0	649.5	611.1	681.0	653.6	10.7%	649.5
Nov	394.3	454.7	377.1	437.7	444.0	418.6	377.1	454.7	421.1	18.4%	418.5
Dec	433.3	503.3	386.2	481.9	476.0	456.1	386.2	503.3	456.1	25.7%	456.0
Case 900											
Jan	73.3	67.8	33.5	53.3	42.0	44.6	33.5	73.3	52.4	76.0%	44.5
Feb	24.0	15.1	4.7	12.3	11.0	9.2	4.7	24.0	12.7	151.4%	9.2
Mar	86.4	68.5	40.9	65.4	56.0	50.6	40.9	86.4	61.3	74.2%	50.5
Apr	29.3	12.3	18.3	18.5	22.0	16.1	12.3	29.3	19.4	87.8%	16.0
May	131.1	117.8	128.6	114.5	125.0	98.4	98.4	131.1	119.2	27.5%	98.3
Jun	447.5	372.3	408.5	401.3	404.0	365.8	365.8	447.5	399.9	20.4%	365.8
Jul	440.9	380.4	408.1	398.7	410.0	365.5	365.5	440.9	400.6	18.8%	365.5
Aug	532.6	485.7	510.2	510.3	531.0	487.6	485.7	532.6	509.6	9.2%	487.5
Sep	517.9	484.0	466.1	492.8	492.0	458.9	458.9	517.9	485.3	12.2%	458.8
Oct	296.2	305.6	269.6	292.7	281.0	260.9	260.9	305.6	284.3	15.7%	260.8
Nov	72.7	80.5	56.2	68.0	63.0	60.2	56.2	80.5	66.8	36.4%	60.1
Dec	62.1	73.7	38.1	60.9	48.0	49.5	38.1	73.7	55.4	64.4%	49.3

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
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By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
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Table B8-M3. Monthly Hourly Integrated Peak Heating Loads

Simulation Model:	BSIMAC			CSE			DeST			EnergyPlus			ESP-r			TRNSYS			Example Result Statistics				TRNSYS18		
																			Min	Max	Mean	(Max-Min)/			
Case 600	kW	Day	Hr	kW	Day	Hr	kW	Day	Hr	kW	Day	Hr	kW	Day	Hr	kW	Day	Hr	kW	kW	kW	Mean** (%)	kW	Day	Hr
Jan	3.100	29	7	3.020	1	1	3.036	1	0	2.978	1	3	3.230	1	1	3.359	1	1	2.978	3.359	3.120	12.2%	2.991	4	6
Feb	3.041	9	7	2.900	9	6	2.922	9	5	3.067	9	6	3.140	9	6	3.225	9	6	2.900	3.225	3.049	10.7%	3.225	9	6
Mar	2.275	2	7	2.034	17	6	2.065	17	5	2.115	17	6	2.230	17	6	2.287	17	6	2.034	2.287	2.168	11.7%	2.287	17	6
Apr	2.446	3	6	2.207	11	6	2.238	11	5	2.322	11	5	2.380	11	6	2.457	11	6	2.207	2.457	2.342	10.7%	2.457	11	6
May	1.645	3	5	1.592	1	5	1.569	1	4	1.624	1	5	1.750	1	5	1.778	1	5	1.569	1.778	1.660	12.6%	1.778	1	5
Jun	0.805	9	5	0.778	9	5	0.748	9	4	0.732	9	5	0.760	10	5	0.853	9	5	0.732	0.853	0.779	15.4%	0.853	9	5
Jul	0.599	25	6	0.540	26	5	0.512	26	4	0.514	26	5	0.570	26	5	0.619	26	5	0.512	0.619	0.559	19.1%	0.619	26	5
Aug	0.572	10	7	0.553	17	6	0.532	17	5	0.479	17	6	0.560	17	6	0.591	17	6	0.479	0.591	0.548	20.5%	0.591	17	6
Sep	1.229	28	24	1.120	29	1	1.114	29	2	1.130	28	24	1.190	29	1	1.212	28	24	1.114	1.229	1.166	9.9%	1.212	28	24
Oct	1.702	6	7	1.624	15	6	1.619	9	5	1.682	15	5	1.770	9	6	1.813	15	6	1.619	1.813	1.702	11.4%	1.813	15	6
Nov	3.255	26	8	2.850	26	8	2.931	26	7	3.106	26	7	3.110	26	7	3.207	26	8	2.850	3.255	3.076	13.2%	3.207	26	8
Dec	3.171	31	24	2.941	31	24	2.972	31	23	3.204	31	24	3.170	31	24	3.278	31	24	2.941	3.278	3.123	10.8%	3.278	31	24
Case 900																									
Jan	2.322	7	7	2.077	1	5	2.178	1	4	1.903	29	7	2.200	1	5	2.379	1	5	1.903	2.379	2.176	21.9%	1.915	29	7
Feb	2.551	8	24	2.443	9	6	2.453	9	5	2.687	9	6	2.630	9	7	2.778	9	7	2.443	2.778	2.591	12.9%	2.779	9	7
Mar	1.774	16	7	1.613	17	6	1.646	17	5	1.744	17	6	1.760	17	7	1.858	17	6	1.613	1.858	1.733	14.2%	1.858	17	6
Apr	1.997	2	7	1.771	3	4	1.725	3	3	2.004	3	4	1.930	3	4	2.036	3	4	1.725	2.036	1.910	16.3%	2.036	3	4
May	1.295	4	6	1.142	1	5	1.124	1	5	1.268	1	5	1.230	1	5	1.324	1	5	1.124	1.324	1.231	16.3%	1.324	1	5
Jun	0.000			0.000	1	1				0.000	1	1	0.000	1	1	0.000	31	0	0.000	0.000	0.000	----	0.000	1	1
Jul	0.000			0.000	1	1				0.000	1	1	0.000	1	1	0.000	31	0	0.000	0.000	0.000	----	0.000	1	1
Aug	0.000			0.000	1	1				0.000	1	1	0.000	1	1	0.000	31	0	0.000	0.000	0.000	----	0.000	1	1
Sep	0.113	28	6	0.000	1	1				0.064	29	7	0.000	1	1	0.194	29	7	0.000	0.194	0.074	261.6%	0.195	29	7
Oct	1.201	6	7	1.188	7	7	1.158	7	6	1.326	7	7	1.210	7	7	1.331	7	7	1.158	1.331	1.236	14.0%	1.331	7	7
Nov	2.427	1	7	2.086	26	8	2.201	26	7	2.316	26	7	2.280	26	8	2.463	26	8	2.086	2.463	2.296	16.4%	2.463	26	8
Dec	2.120	31	8	1.927	31	8	1.981	9	6	2.175	31	7	2.040	9	7	2.180	9	7	1.927	2.180	2.070	12.2%	2.180	9	7

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

Table B8-M4. Monthly Hourly Integrated Peak Sensible Cooling Loads

Simulation Model:	BSIMAC			CSE			DeST			EnergyPlus			ESP-r			TRNSYS			Example Result Statistics				TRNSYS18		
																			Min	Max	Mean	(Max-Min)/			
Case 600	kW	Day	Hr	kW	Day	Hr	kW	Day	Hr	kW	Day	Hr	kW	Day	Hr	kW	Day	Hr	kW	kW	kW	Mean** (%)	kW	Day	Hr
Jan	5.650	22	15	6.481	22	14	5.422	22	14	6.352	22	14	6.190	22	14	6.046	22	14	5.422	6.481	6.023	17.6%	6.045	22	14
Feb	4.921	15	15	5.393	15	14	4.444	15	14	5.537	2	14	5.420	2	14	5.155	2	14	4.444	5.537	5.145	21.2%	5.155	2	14
Mar	4.458	24	14	5.148	24	13	4.252	9	14	5.009	9	14	5.040	9	14	4.740	9	14	4.252	5.148	4.774	18.8%	4.740	9	14
Apr	3.473	12	14	4.015	27	14	3.600	7	14	3.931	12	14	4.040	12	14	3.803	12	14	3.473	4.040	3.810	14.9%	3.803	12	14
May	2.774	10	14	3.080	21	14	2.894	10	14	3.086	10	13	3.100	10	14	3.040	21	14	2.774	3.100	2.996	10.9%	3.040	21	14
Jun	3.253	26	15	3.249	13	13	3.067	14	14	3.449	13	13	3.430	13	14	3.379	13	13	3.067	3.449	3.304	11.6%	3.379	13	13
Jul	3.319	17	14	3.290	17	14	3.155	29	13	3.628	17	14	3.640	17	14	3.497	17	14	3.155	3.640	3.422	14.2%	3.497	17	14
Aug	4.192	26	14	4.120	8	14	4.038	29	13	4.672	26	14	4.700	29	14	4.651	27	13	4.038	4.700	4.395	15.1%	4.651	27	13
Sep	5.086	30	14	5.450	2	14	4.911	30	13	5.715	30	13	5.580	30	14	5.420	30	14	4.911	5.715	5.360	15.0%	5.420	30	14
Oct	5.577	18	14	6.270	1	13	5.278	10	13	6.222	18	14	6.070	18	14	5.923	18	14	5.278	6.270	5.890	16.8%	5.922	18	14
Nov	5.476	28	14	6.149	28	13	5.229	29	13	6.194	28	13	6.030	28	14	5.824	28	14	5.229	6.194	5.817	16.6%	5.824	28	14
Dec	5.537	1	14	6.450	1	14	5.294	1	13	6.251	1	14	6.120	1	14	5.942	1	14	5.294	6.450	5.932	19.5%	5.942	1	14
Case 900																									
Jan	1.982	22	16	2.242	22	15	1.637	22	15	2.078	22	15	1.810	22	16	1.878	22	15	1.637	2.242	1.938	31.2%	1.877	22	15
Feb	1.096	15	16	0.996	15	15	0.588	15	15	0.979	15	15	0.850	15	16	0.829	15	15	0.588	1.096	0.890	57.1%	0.829	15	15
Mar	1.508	10	15	1.434	24	15	1.143	10	14	1.493	11	14	1.270	10	15	1.426	11	14	1.143	1.508	1.379	26.5%	1.425	11	14
Apr	1.093	7	15	0.631	19	14	1.032	8	14	0.953	7	15	0.950	8	15	0.837	8	15	0.631	1.093	0.916	50.4%	0.837	8	15
May	1.555	11	15	1.427	21	14	1.446	11	14	1.534	11	14	1.460	11	15	1.465	11	14	1.427	1.555	1.481	8.6%	1.464	11	14
Jun	2.101	26	15	1.897	14	14	1.873	14	14	1.966	14	14	1.890	14	15	1.974	14	14	1.873	2.101	1.950	11.7%	1.974	14	14
Jul	2.140	17	15	1.943	17	14	1.830	17	14	2.068	17	15	1.970	17	15	1.975	17	15	1.830	2.140	1.988	15.6%	1.975	17	15
Aug	2.632	26	15	2.485	5	14	2.212	29	14	2.526	29	15	2.510	29	15	2.534	29	15	2.212	2.632	2.483	16.9%	2.534	29	15
Sep	2.961	30	15	3.137	4	14	2.556	11	14	2.989	11	15	2.810	11	15	2.871	11	15	2.556	3.137	2.887	20.1%	2.871	11	15
Oct	3.039	1	15	3.376	1	14	2.549	12	14	3.040	1	14	2.900	12	15	2.940	1	14	2.549	3.376	2.974	27.8%	2.940	1	14
Nov	1.982	6	15	2.233	20	15	1.683	20	14	2.002	20	15	1.940	20	15	1.941	22	14	1.683	2.233	1.963	28.0%	1.940	22	14
Dec	2.069	1	15	2.105	1	15	1.595	2	14	1.968	2	15	1.670	2	15	1.690	2	15	1.595	2.105	1.850	27.6%	1.689	2	15

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-9
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results
By Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Note: The statistics in the tables below are based on the listed example results.
These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B8-M5. Monthly Load 600-900 Sensitivity Tests

ANNUAL HEATING [MWh]							Statistics for Example Results				
Month	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
Jan	386.2	449.5	397.4	456.0	466.0	443.0	386.2	466.0	433.0	18.4%	451.1
Feb	345.9	383.0	342.4	388.5	399.0	379.9	342.4	399.0	373.1	15.2%	379.9
Mar	299.1	333.3	330.5	346.7	366.0	351.2	299.1	366.0	337.8	19.8%	351.1
Apr	235.3	234.6	233.8	241.5	251.0	241.8	233.8	251.0	239.7	7.2%	241.8
May	92.7	94.4	101.2	103.4	110.0	113.2	92.7	113.2	102.5	20.1%	113.2
Jun	2.7	11.7	11.2	10.1	14.0	16.0	2.7	16.0	10.9	120.7%	16.0
Jul	4.8	11.5	10.1	12.0	14.0	16.7	4.8	16.7	11.5	103.0%	16.7
Aug	1.4	6.9	8.4	6.6	9.0	9.6	1.4	9.6	7.0	118.1%	9.6
Sep	49.7	74.3	76.7	73.2	81.0	84.3	49.7	84.3	73.2	47.3%	84.3
Oct	236.5	263.3	260.6	266.6	284.0	282.0	236.5	284.0	265.5	17.9%	282.0
Nov	300.5	324.0	301.9	328.3	343.0	327.6	300.5	343.0	320.9	13.3%	327.5
Dec	368.9	427.3	383.5	427.9	442.0	424.2	368.9	442.0	412.3	17.7%	424.2

ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				
Month	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
Jan	402.1	486.2	384.4	468.5	481.0	450.4	384.4	486.2	445.4	22.8%	450.4
Feb	325.2	379.2	310.7	375.2	387.0	358.2	310.7	387.0	355.9	21.4%	358.2
Mar	363.9	405.8	369.8	419.0	433.0	406.8	363.9	433.0	399.7	17.3%	406.9
Apr	189.4	207.8	211.9	222.0	241.0	219.3	189.4	241.0	215.2	24.0%	219.3
May	211.6	203.3	210.0	225.4	239.0	226.8	203.3	239.0	219.4	16.3%	226.8
Jun	130.8	125.2	118.0	138.3	146.0	150.2	118.0	150.2	134.7	24.0%	150.3
Jul	127.5	125.4	117.0	137.7	146.0	148.9	117.0	148.9	133.7	23.8%	148.9
Aug	125.6	120.8	110.9	138.2	143.0	146.6	110.9	146.6	130.8	27.2%	146.6
Sep	206.9	221.2	206.0	240.9	251.0	251.6	206.0	251.6	229.6	19.9%	251.7
Oct	332.2	370.6	341.6	382.6	400.0	388.6	332.2	400.0	369.3	18.4%	388.7
Nov	321.6	374.3	320.9	369.7	381.0	358.4	320.9	381.0	354.3	17.0%	358.4
Dec	371.2	429.5	348.2	420.9	428.0	406.6	348.2	429.5	400.7	20.3%	406.7

PEAK HEATING [kW]							Statistics for Example Results				
Month	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
Jan	0.778	0.943	0.858	1.075	1.030	0.980	0.778	1.075	0.944	31.4%	1.075
Feb	0.490	0.456	0.469	0.379	0.510	0.447	0.379	0.510	0.459	28.5%	0.446
Mar	0.501	0.422	0.419	0.370	0.470	0.429	0.370	0.501	0.435	30.1%	0.429
Apr	0.449	0.437	0.513	0.319	0.450	0.421	0.319	0.513	0.431	45.0%	0.421
May	0.350	0.450	0.445	0.356	0.520	0.454	0.350	0.520	0.429	39.6%	0.454
Jun	0.805	0.778	0.748	0.732	0.760	0.853	0.732	0.853	0.779	15.4%	0.853
Jul	0.599	0.540	0.512	0.514	0.570	0.619	0.512	0.619	0.559	19.1%	0.619
Aug	0.572	0.553	0.532	0.479	0.560	0.591	0.479	0.591	0.548	20.5%	0.591
Sep	1.116	1.120	1.114	1.065	1.190	1.017	1.017	1.190	1.104	15.7%	1.017
Oct	0.501	0.435	0.461	0.356	0.560	0.482	0.356	0.560	0.466	43.7%	0.482
Nov	0.828	0.764	0.730	0.790	0.830	0.744	0.730	0.830	0.781	12.8%	0.744
Dec	1.051	1.014	0.991	1.030	1.130	1.098	0.991	1.130	1.052	13.2%	1.098

PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				
Month	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	TRNSYS18
Jan	3.668	4.239	3.785	4.274	4.380	4.168	3.668	4.380	4.086	17.4%	4.168
Feb	3.825	4.397	3.856	4.558	4.570	4.326	3.825	4.570	4.255	17.5%	4.326
Mar	2.950	3.714	3.109	3.515	3.770	3.314	2.950	3.770	3.395	24.2%	3.314
Apr	2.380	3.384	2.568	2.978	3.090	2.966	2.380	3.384	2.894	34.7%	2.966
May	1.219	1.652	1.448	1.553	1.640	1.576	1.219	1.652	1.515	28.6%	1.576
Jun	1.152	1.352	1.194	1.483	1.540	1.405	1.152	1.540	1.354	28.7%	1.405
Jul	1.179	1.347	1.325	1.560	1.670	1.522	1.179	1.670	1.434	34.3%	1.522
Aug	1.560	1.634	1.826	2.146	2.190	2.117	1.560	2.190	1.912	32.9%	2.117
Sep	2.125	2.313	2.355	2.726	2.770	2.549	2.125	2.770	2.473	26.1%	2.549
Oct	2.538	2.894	2.729	3.182	3.170	2.983	2.538	3.182	2.916	22.1%	2.983
Nov	3.494	3.916	3.546	4.192	4.090	3.883	3.494	4.192	3.854	18.1%	3.884
Dec	3.468	4.345	3.699	4.283	4.450	4.252	3.468	4.450	4.083	24.1%	4.253

** ABS[(Max-Min) / (Mean of Example Simulation Results)]

Figure B8-1.
Annual Incident Solar Radiation

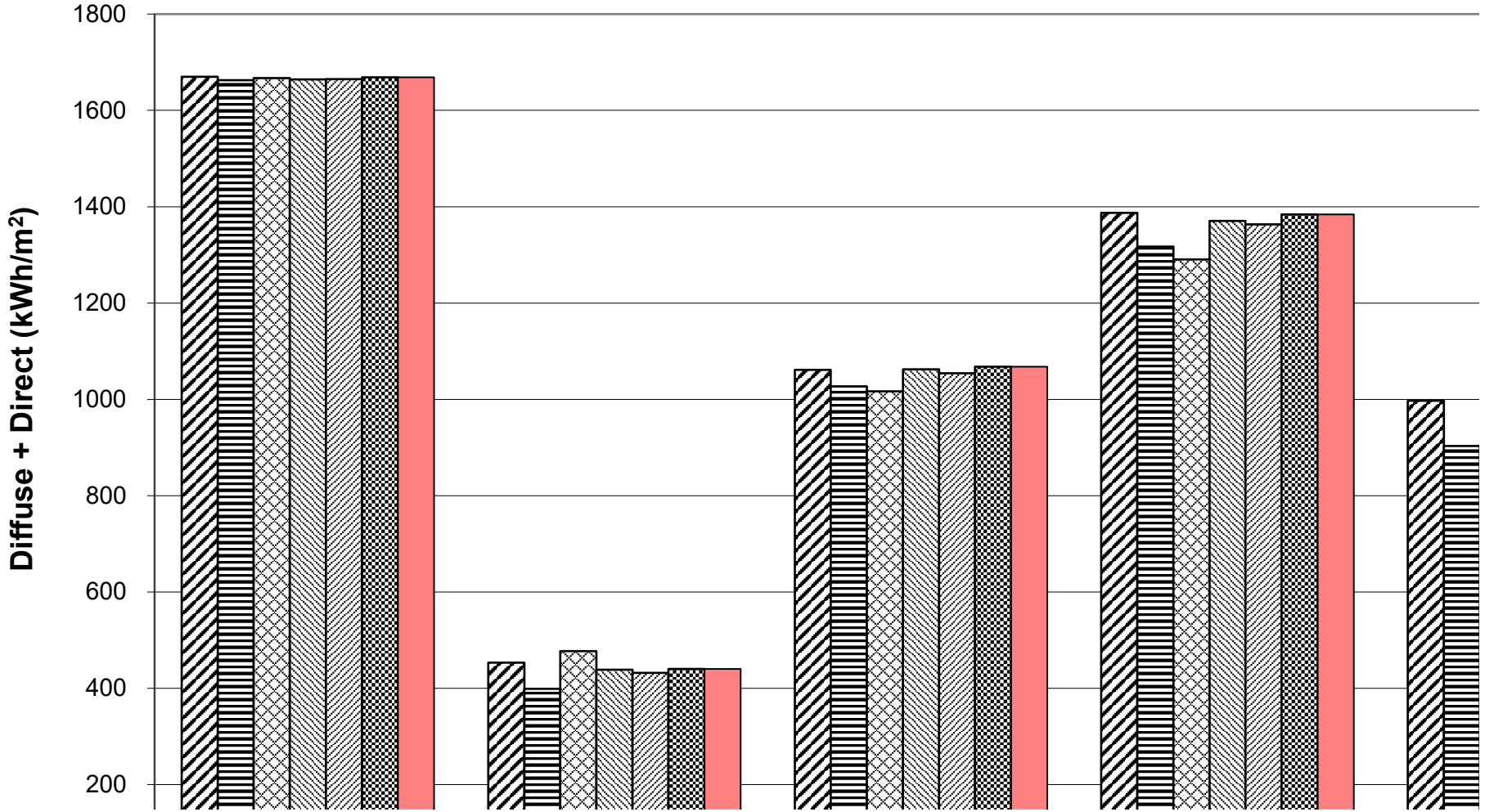


Figure B8-2.
Annual Transmitted Solar Radiation - Unshaded

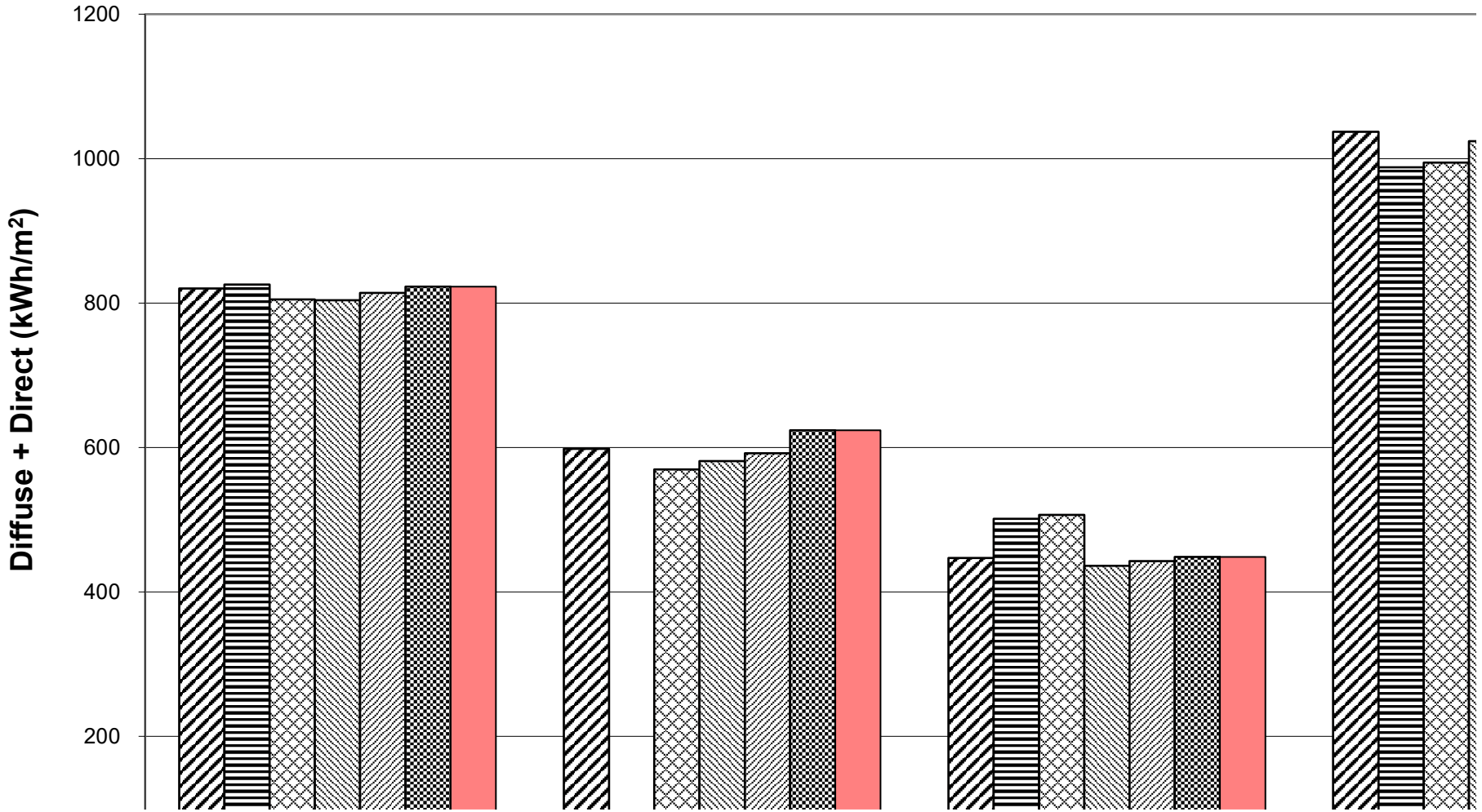


Figure B8-3.
Annual Transmitted Solar Radiation - Shaded

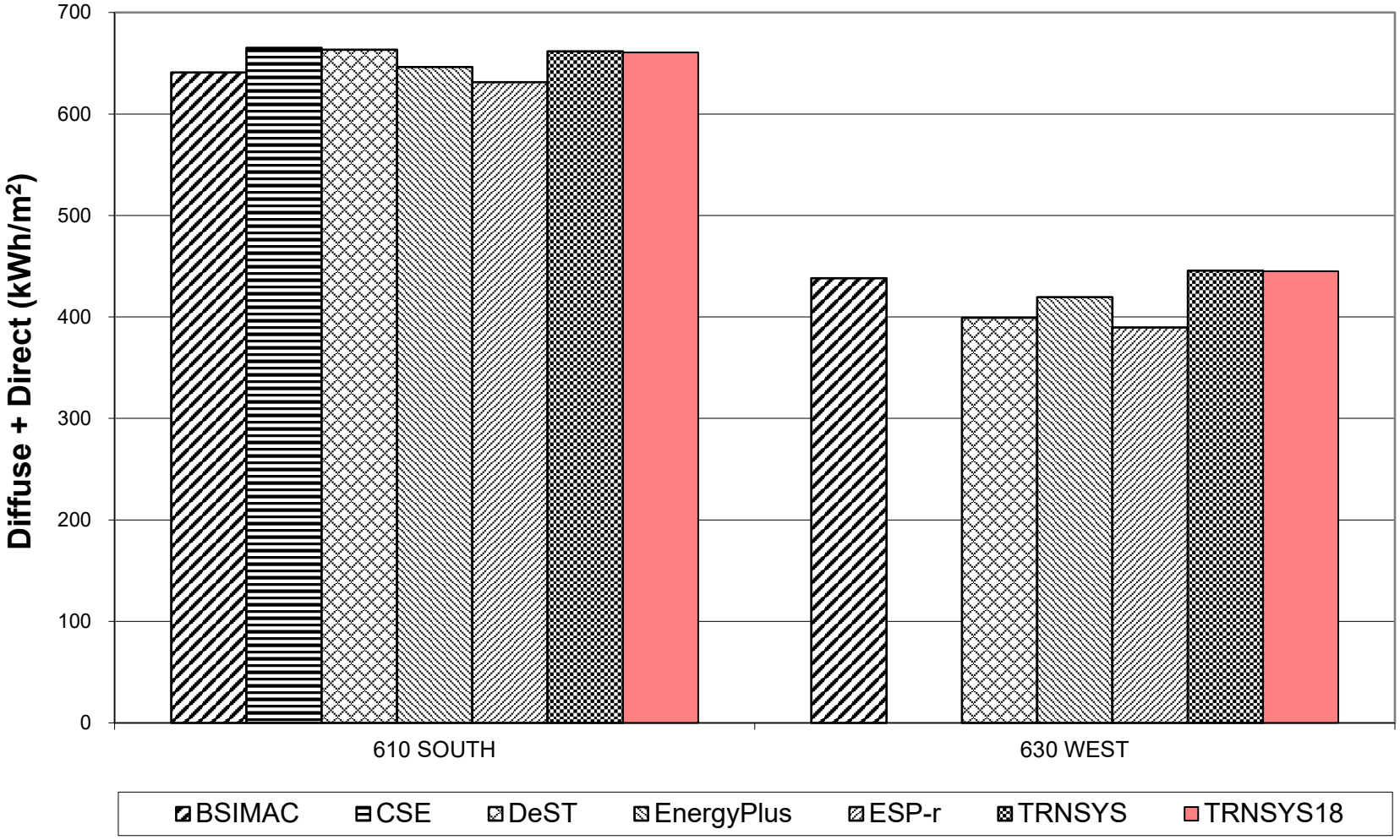


Figure B8-4.
Annual Transmissivity Coefficient of Windows
(Unshaded Transmitted)/(Incident Solar Radiation)

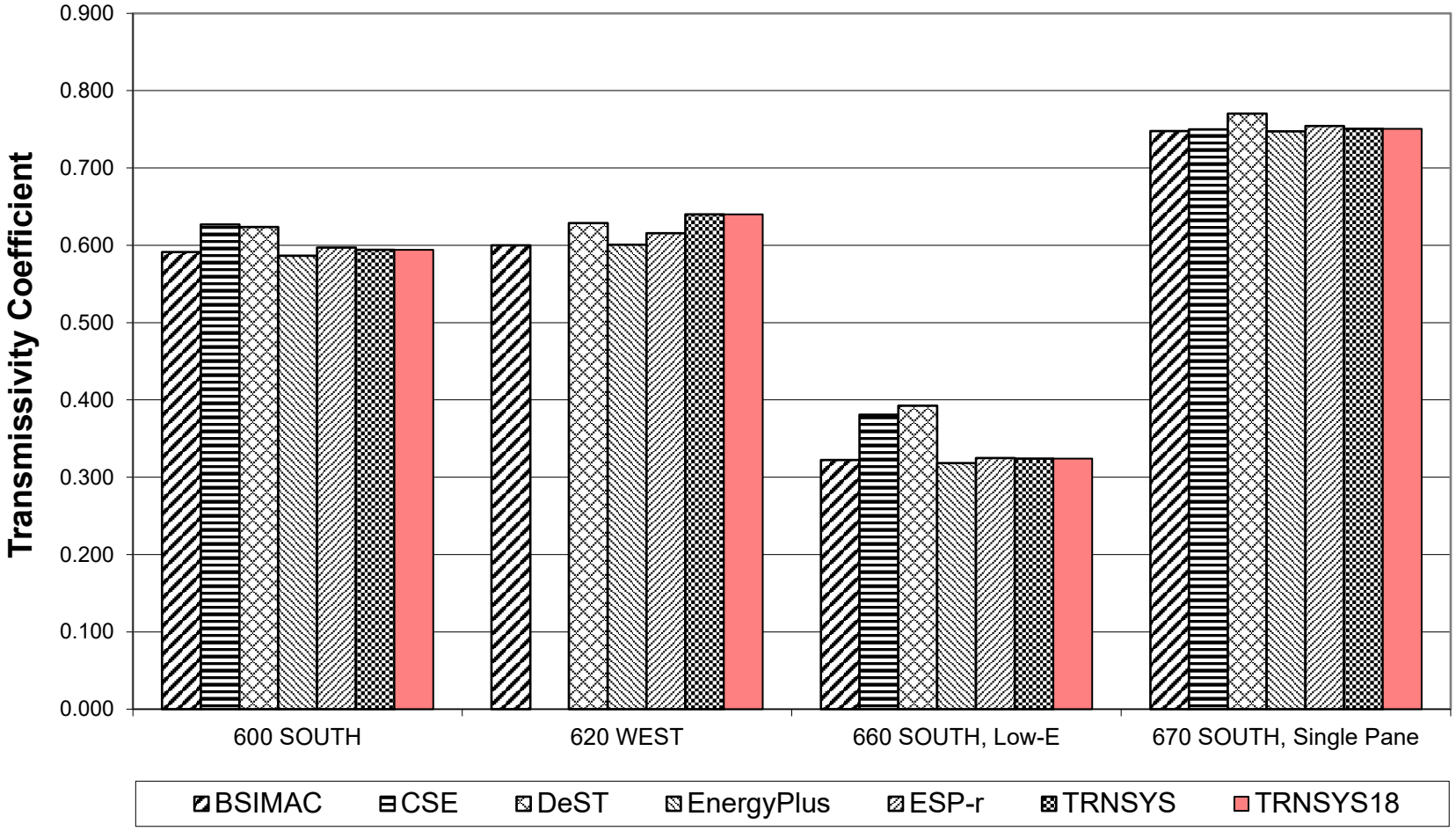


Figure B8-5.
Annual Overhang and Fin Shading Coefficients
(1-(Shaded)/(Unshaded)) Transmitted Solar Radiation

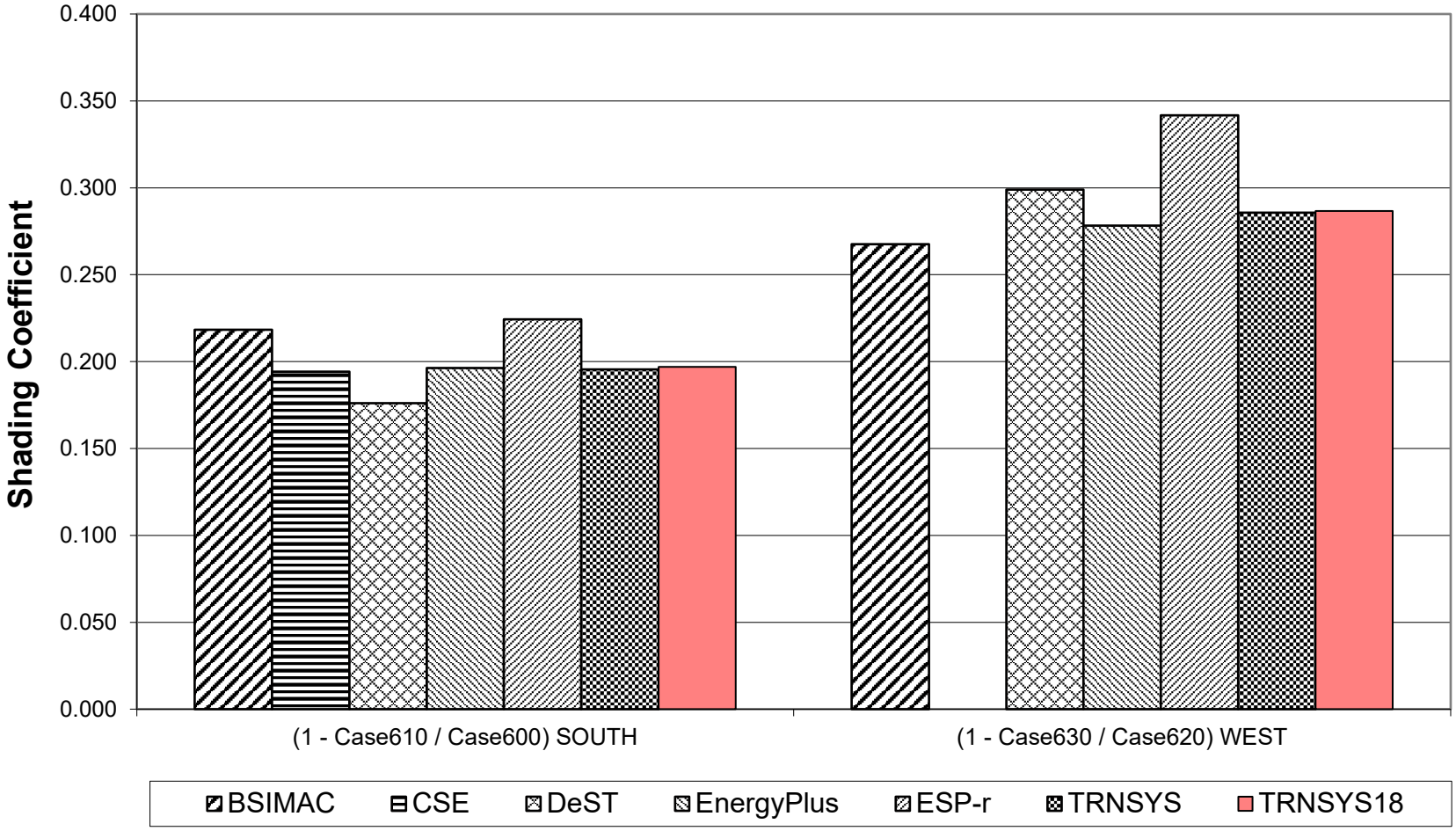


Figure B8-6.
Average, Minimum and Maximum Sky Temperature
Case 600

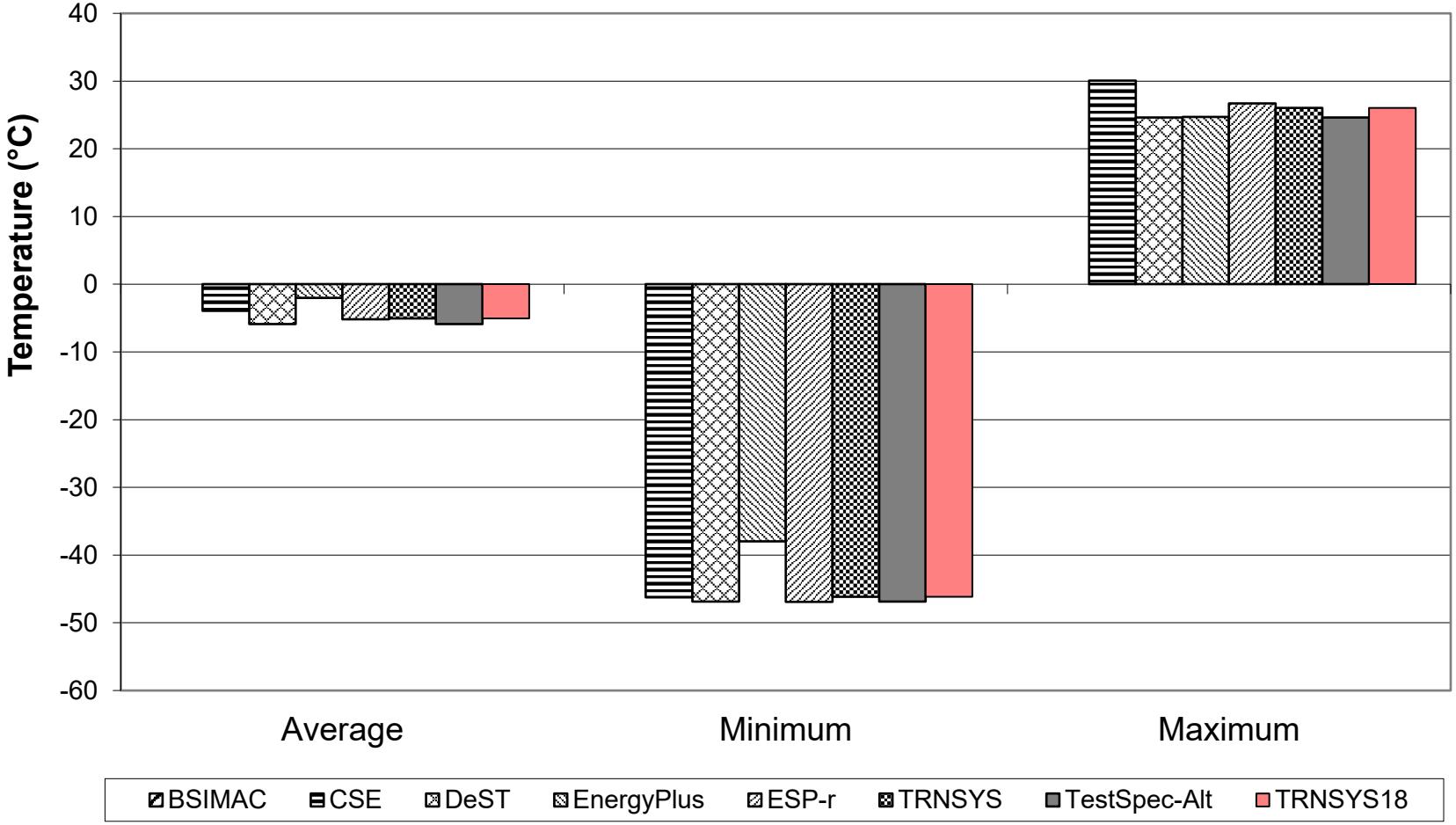


Figure B8-7. Basic: Low Mass Annual Heating

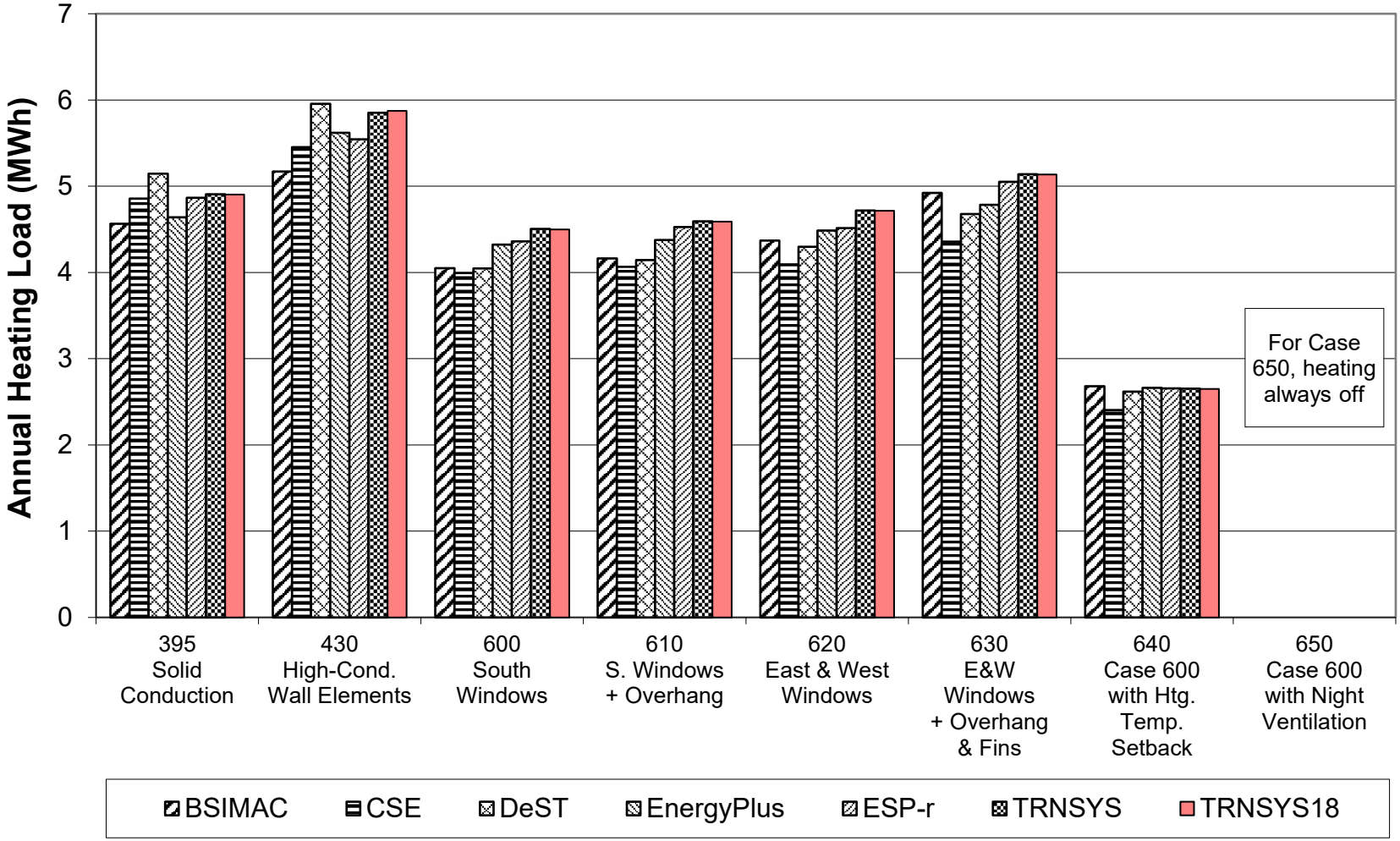


Figure B8-8. Basic: Low Mass Annual Sensible Cooling

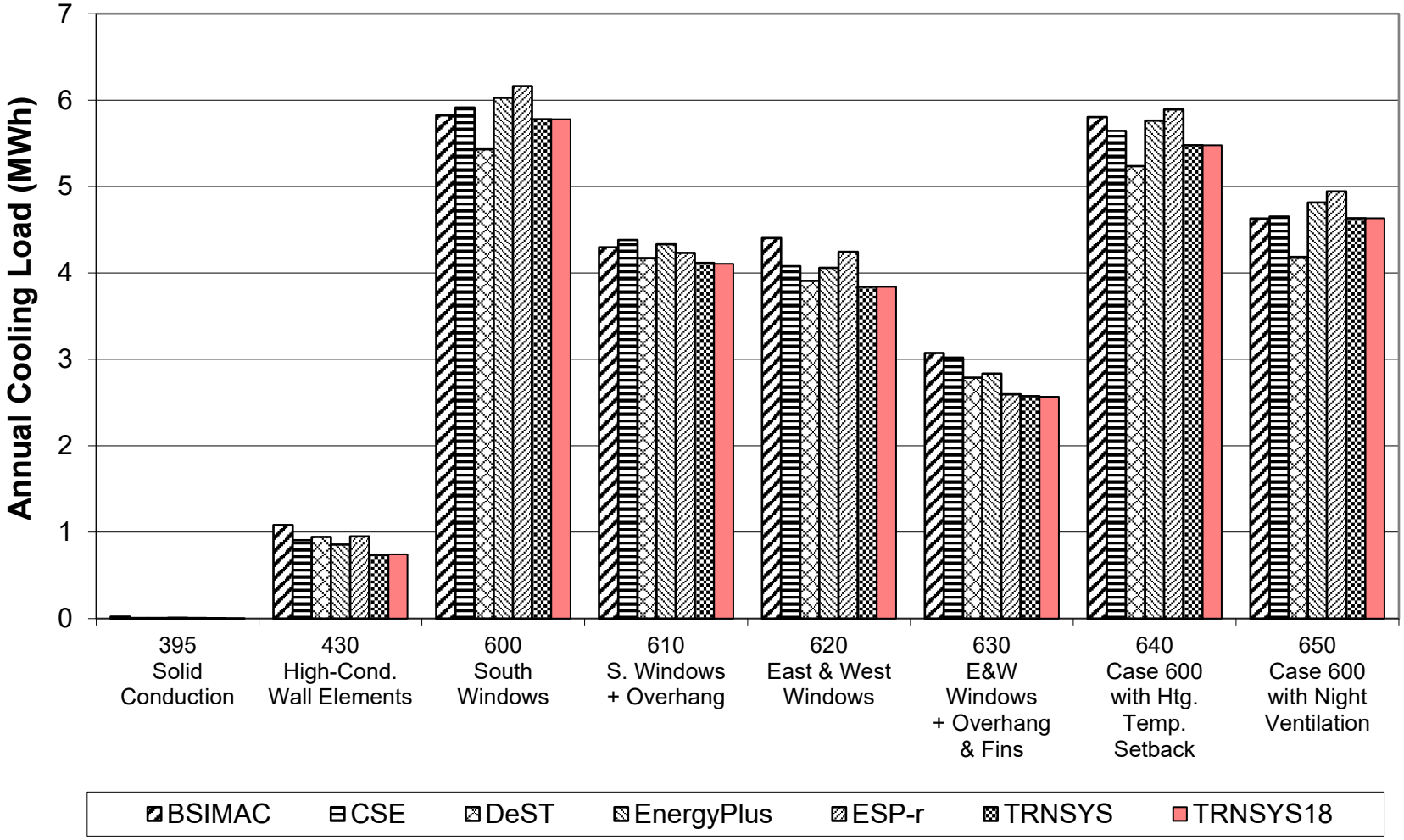
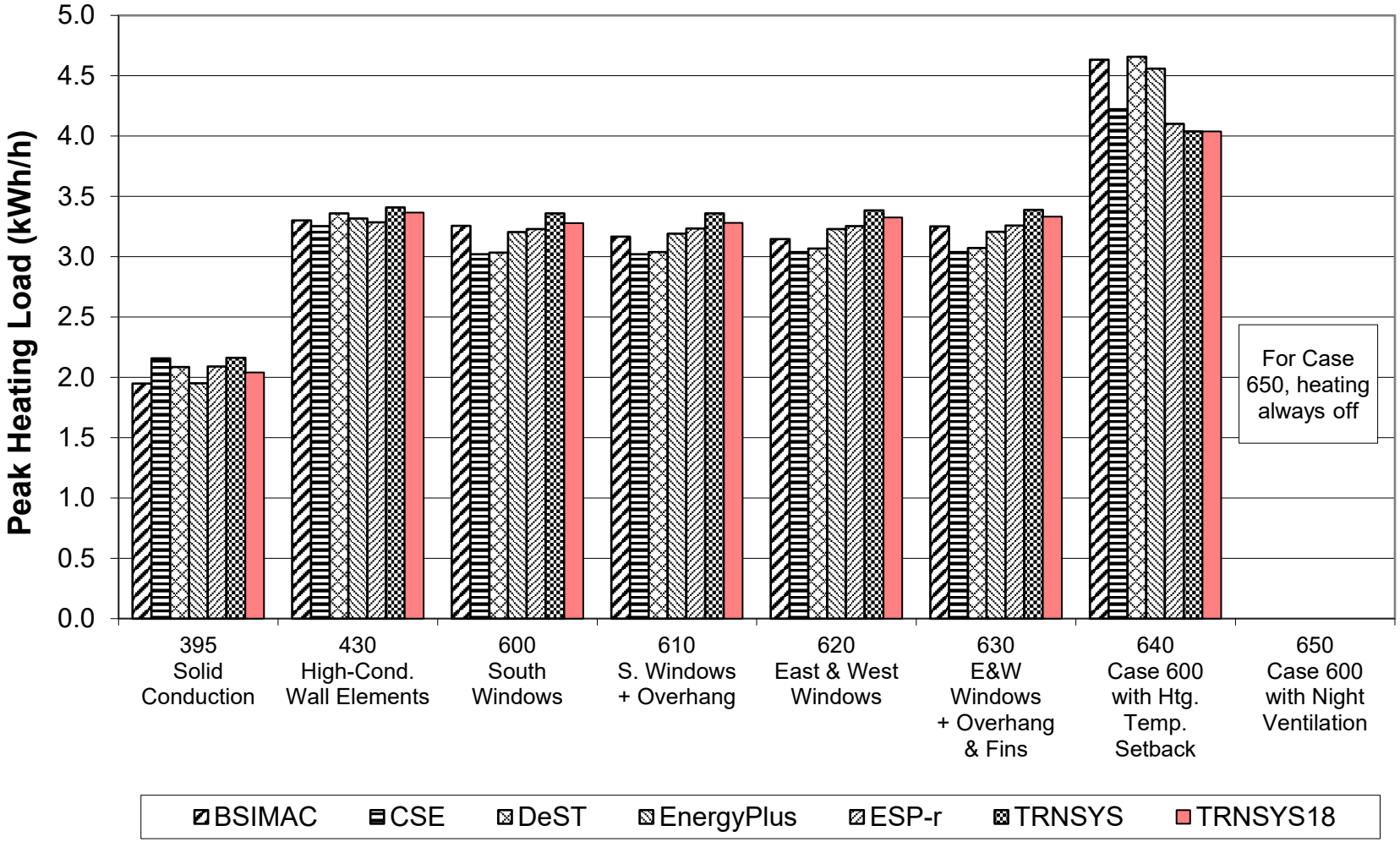


Figure B8-9. Basic: Low Mass Peak Heating



ASHRAE Standard 140-2020, Test Results Comparison for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF
(TRNSYS18) vs. Annex B8, Section B8.1 Example Results, by Thermal Energy System Specialists, LLC (TESS), 22-Mar-2023

Figure B8-10. Basic: Low Mass Peak Sensible Cooling

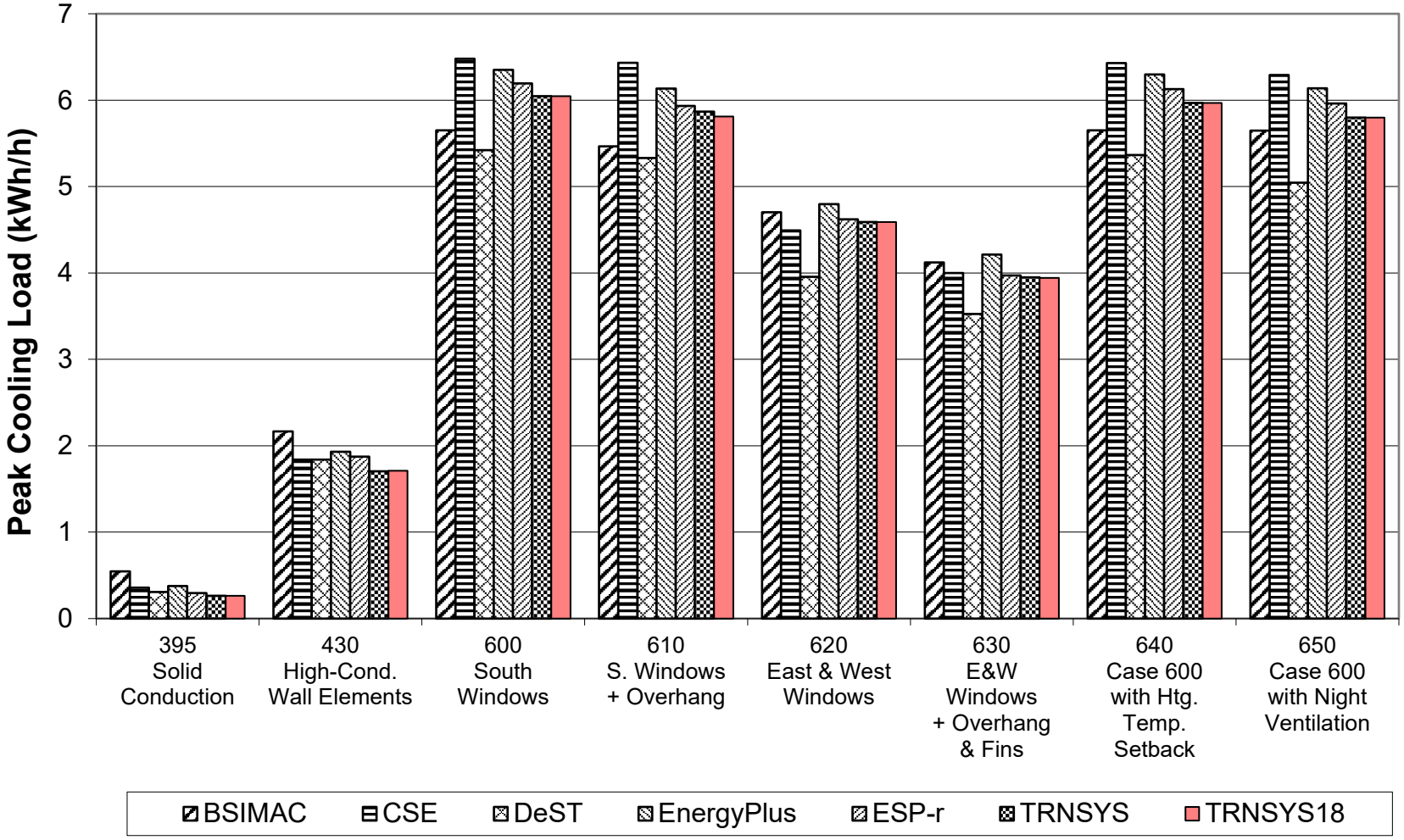


Figure B8-11. Basic: High Mass Annual Heating

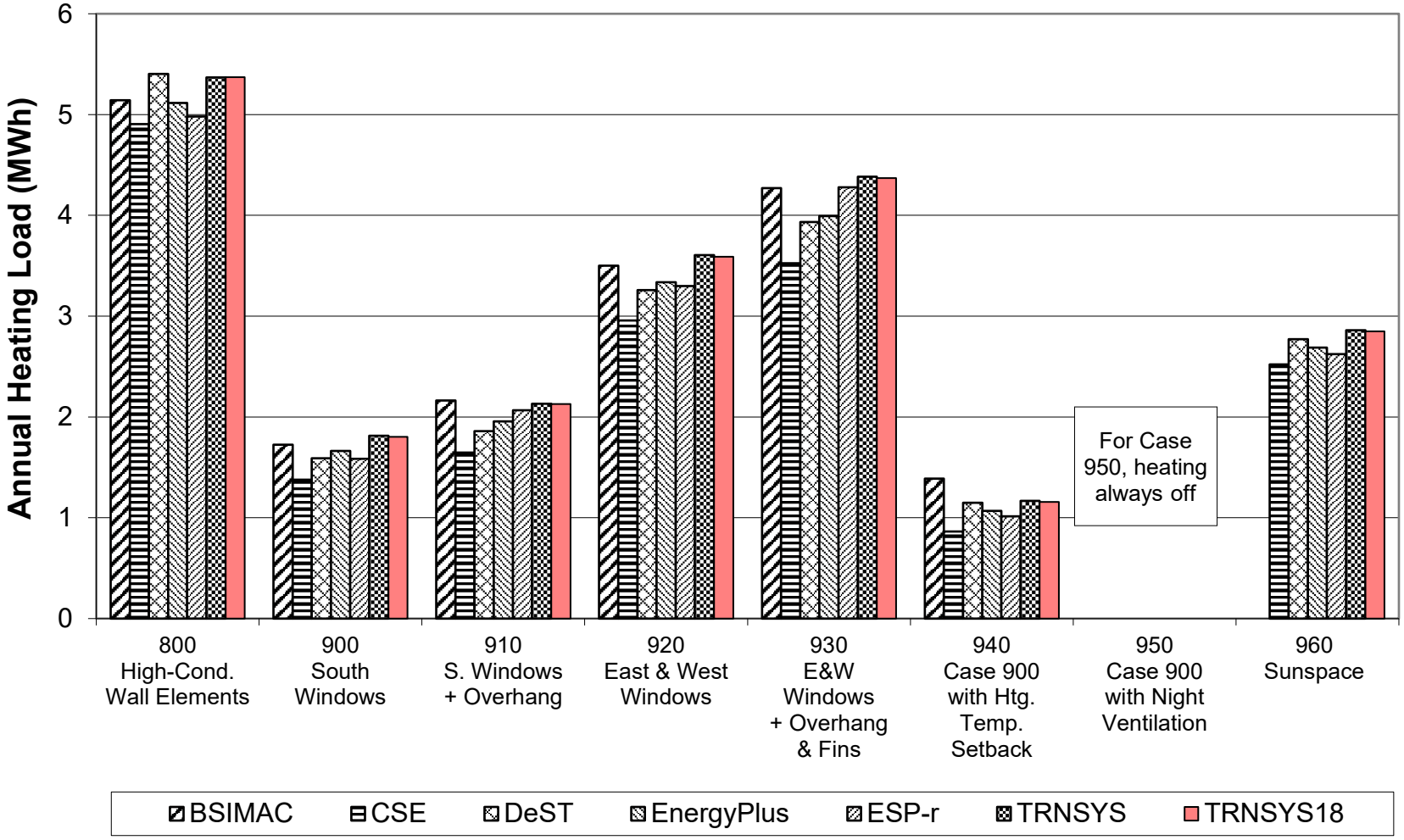


Figure B8-12. Basic: High Mass Annual Sensible Cooling

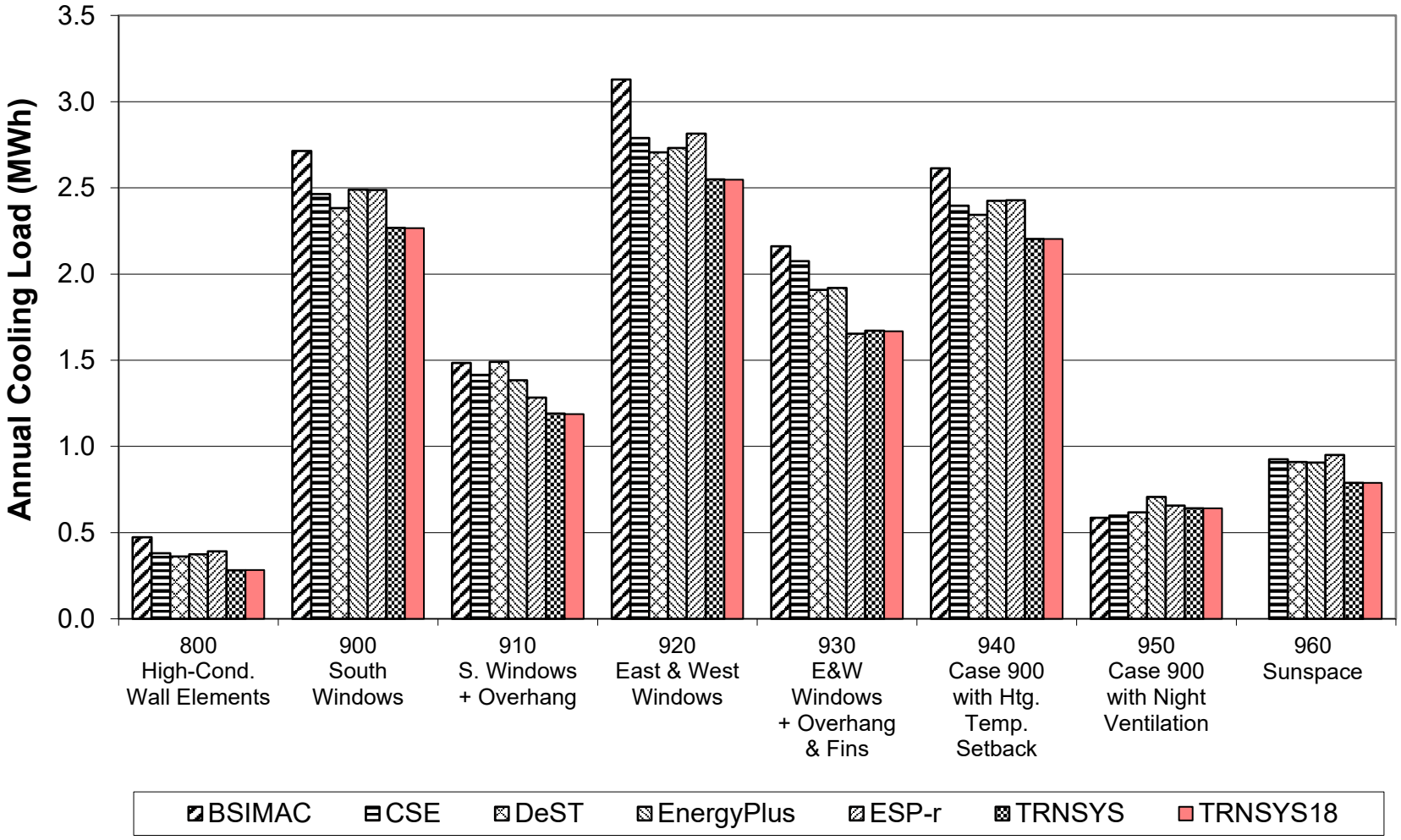


Figure B8-13. Basic: High Mass Peak Heating

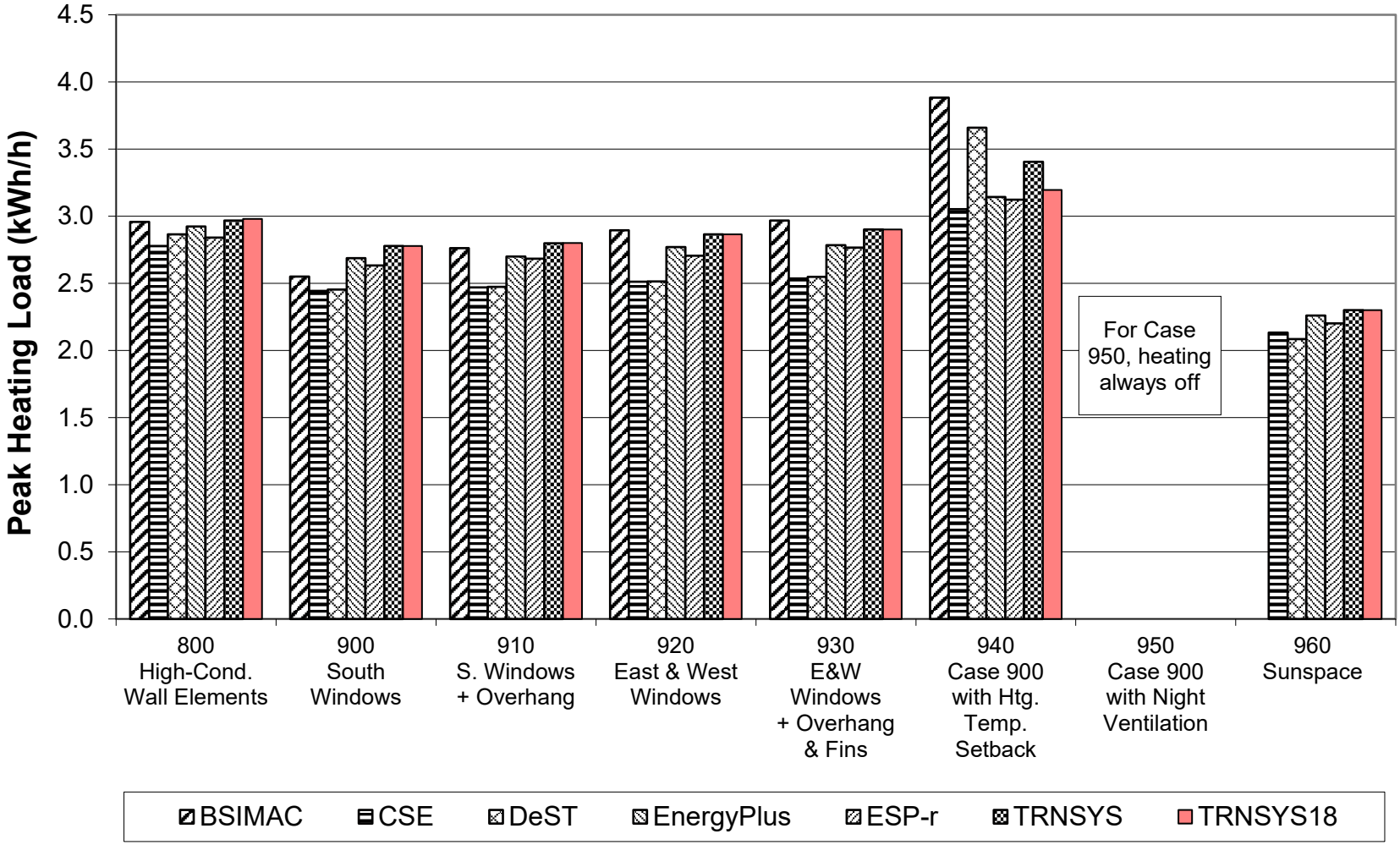


Figure B8-14. Basic: High Mass Peak Sensible Cooling

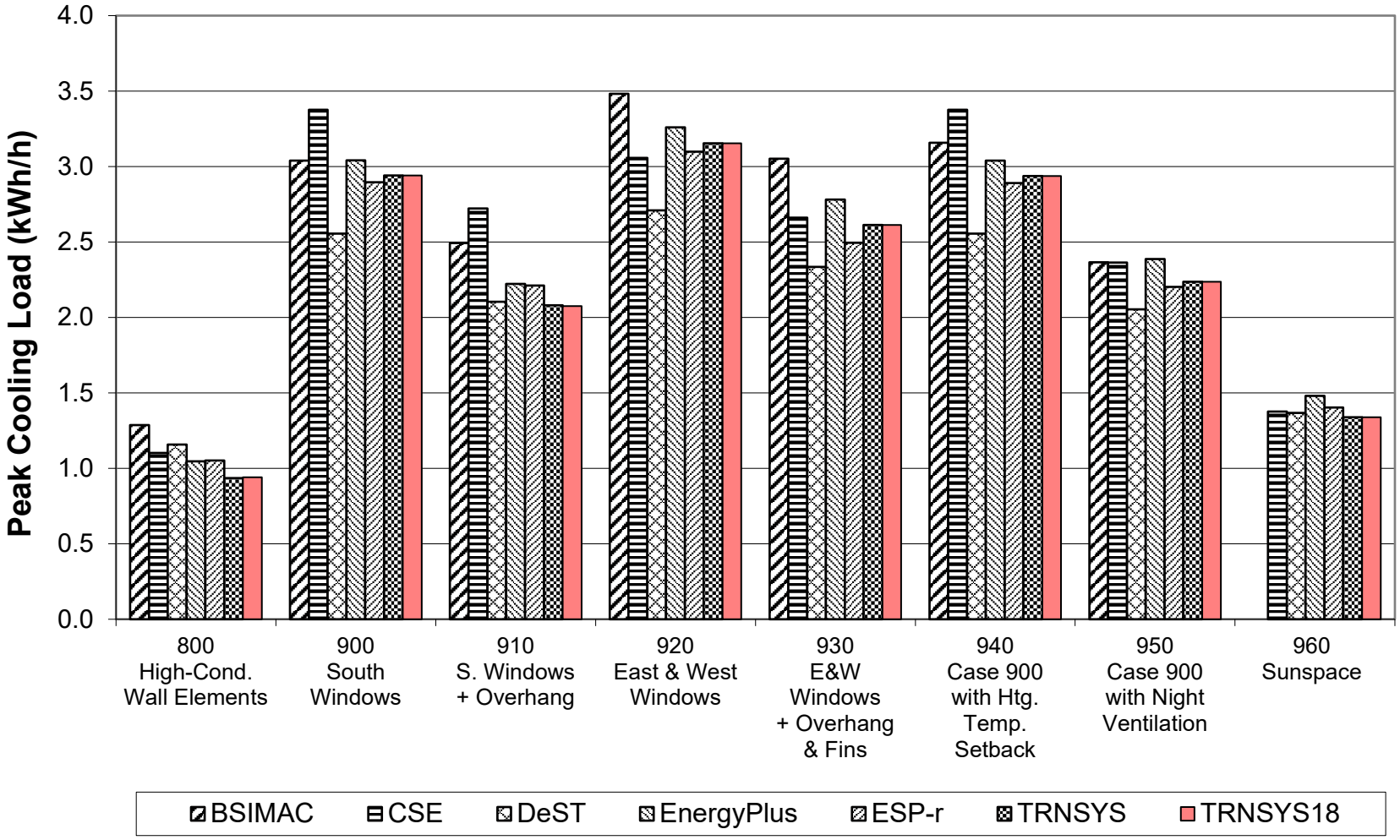


Figure B8-15. Basic and In-Depth: South Window (Delta) Annual Heating and Sensible Cooling

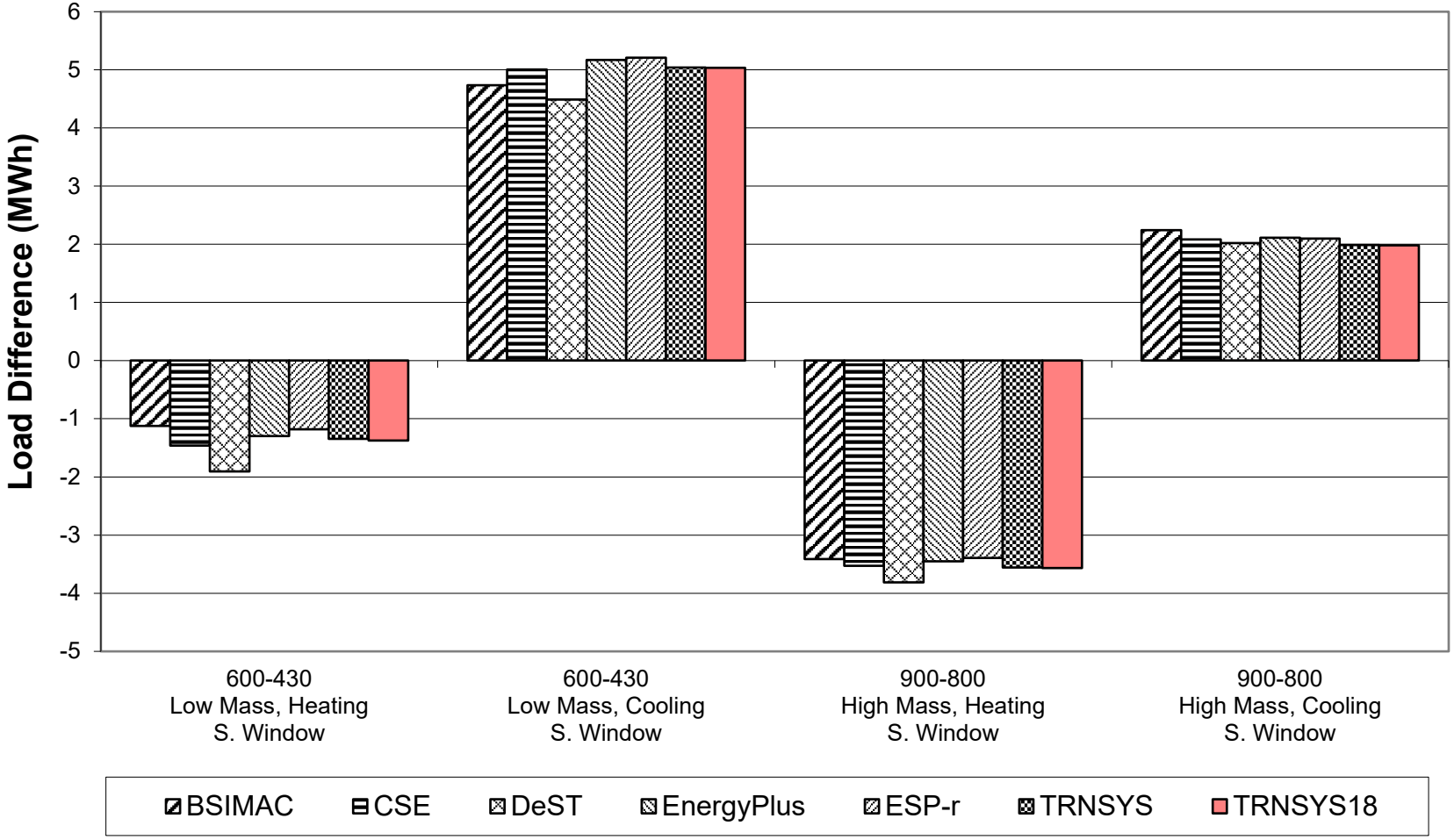


Figure B8-16. Basic and In-Depth: South Window (Delta) Peak Heating and Sensible Cooling

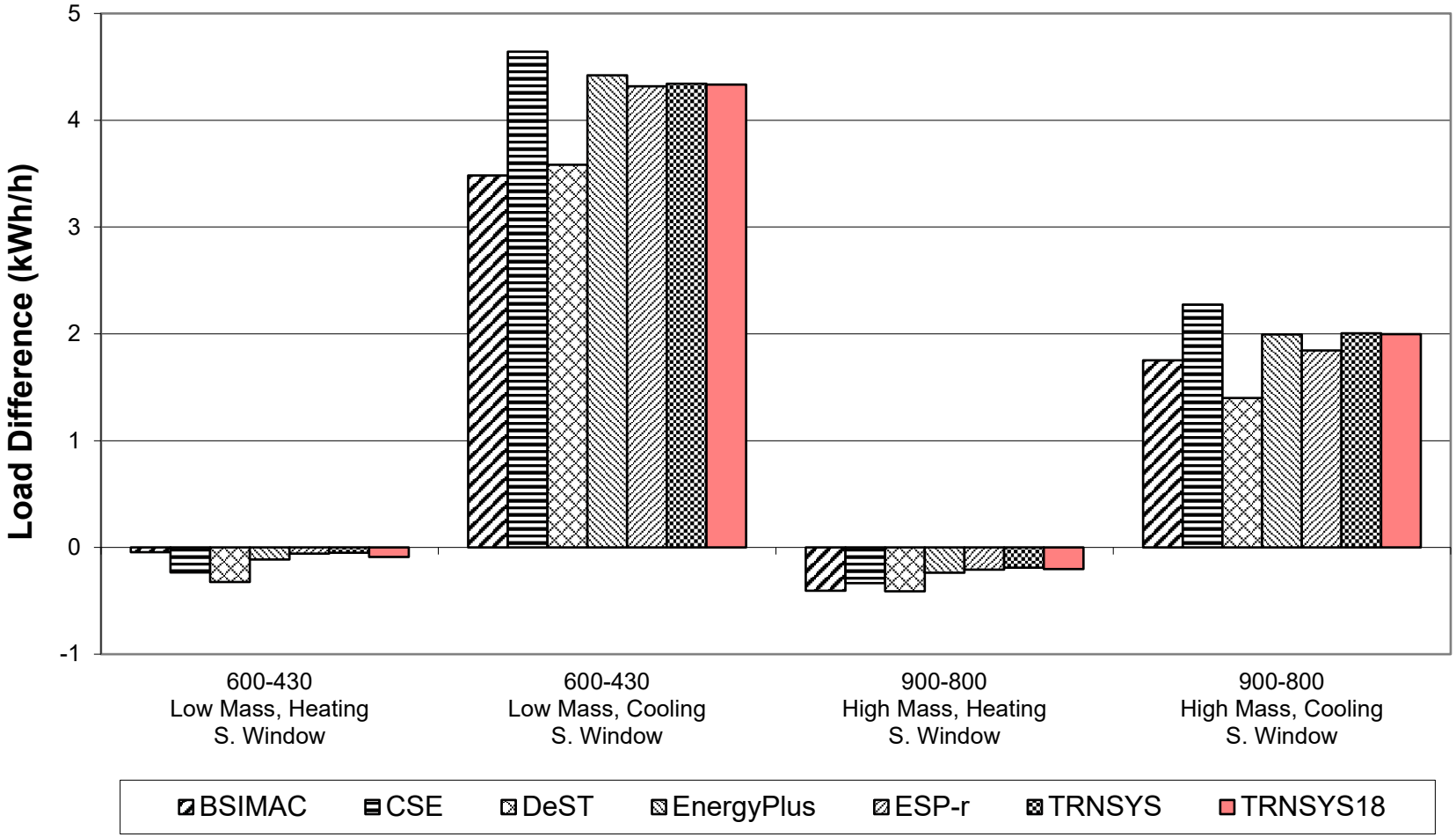


Figure B8-17. Basic: Window Shading and Orientation (Delta) Annual Heating and Sensible Cooling

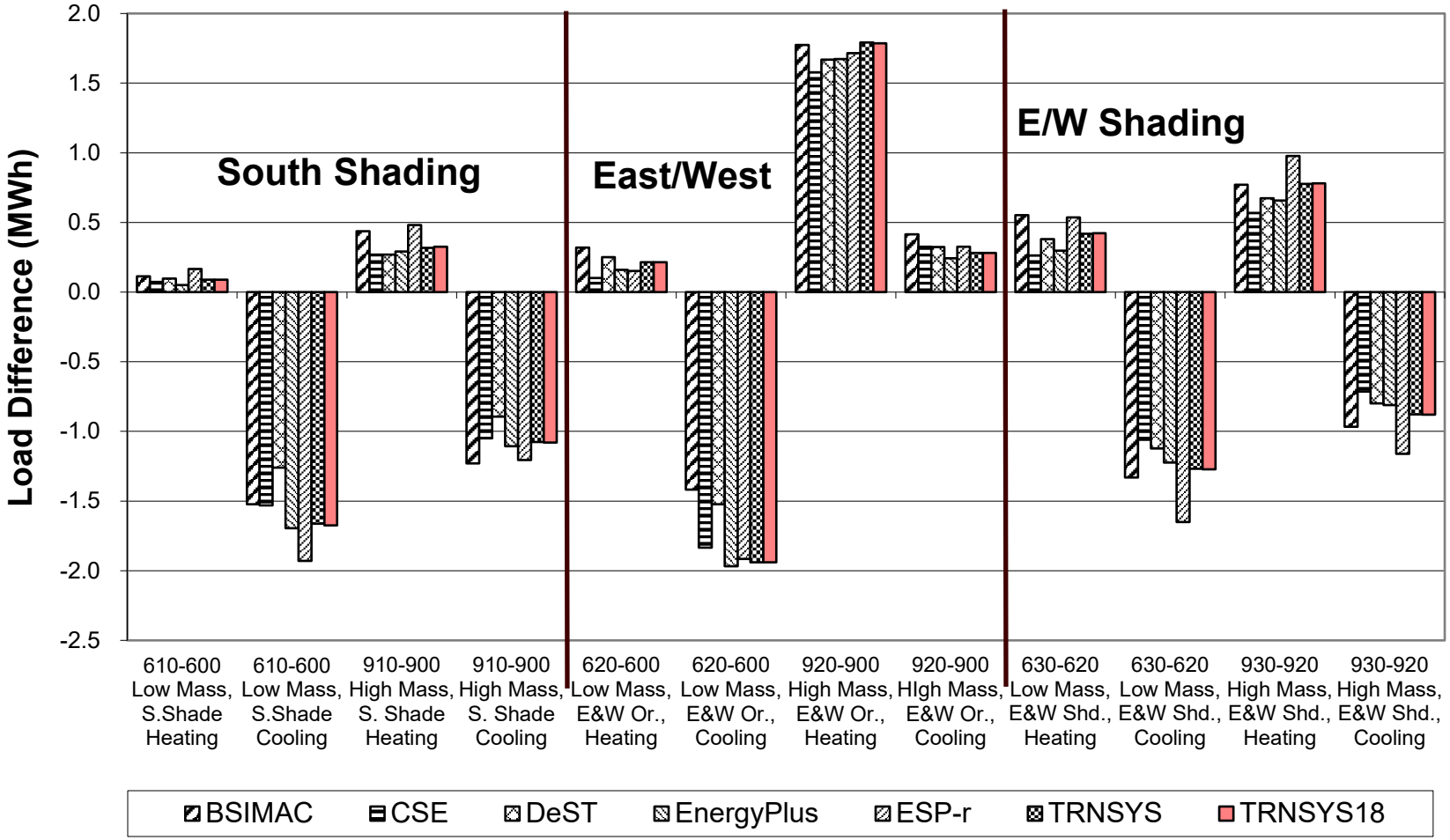


Figure B8-18. Basic: Window Shading and Orientation (Delta) Peak Heating and Sensible Cooling

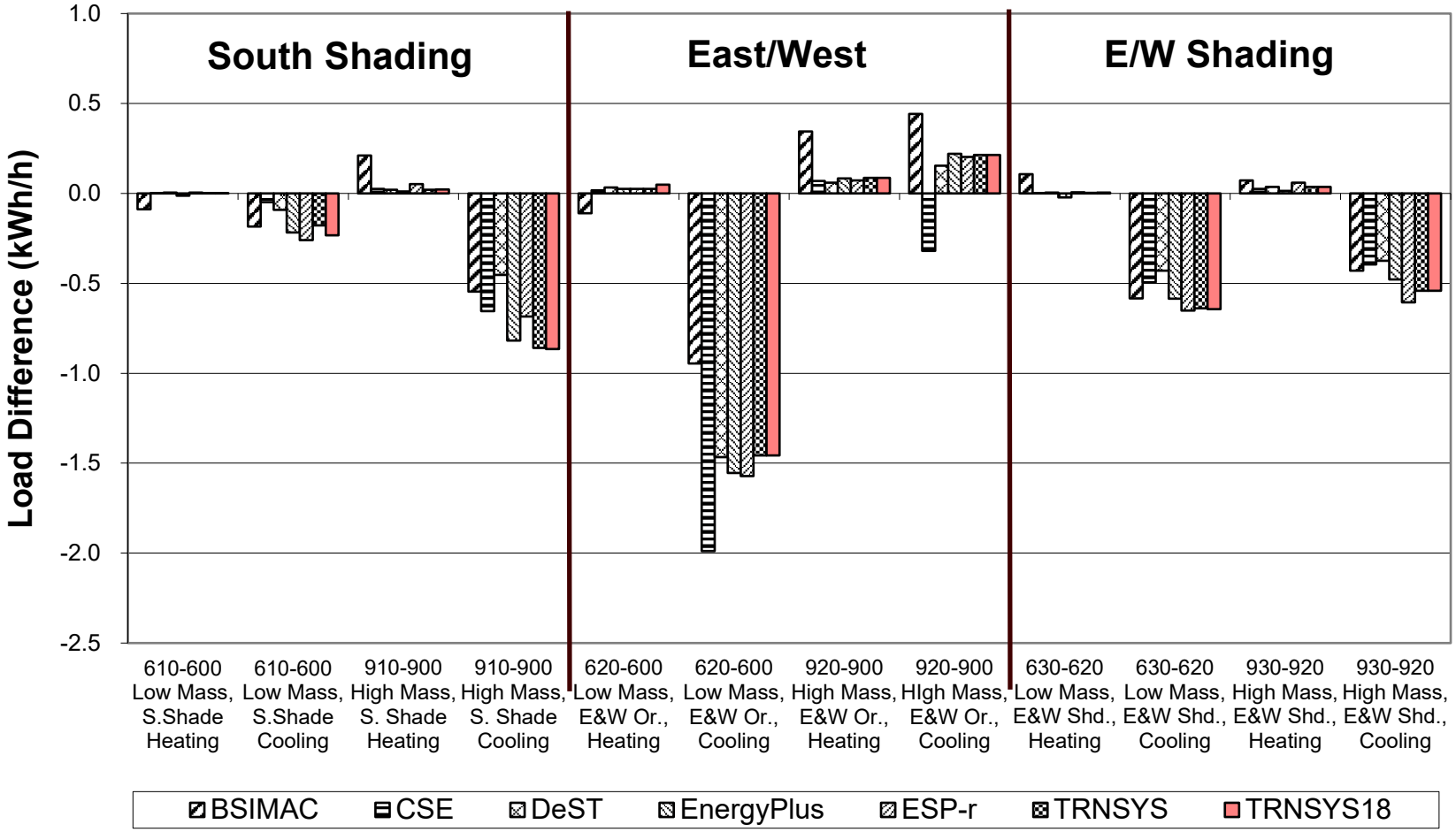


Figure B8-19. Basic: Thermostat Setback, Vent Cooling, and Sunspace (Delta) Annual Heating and Sensible Cooling

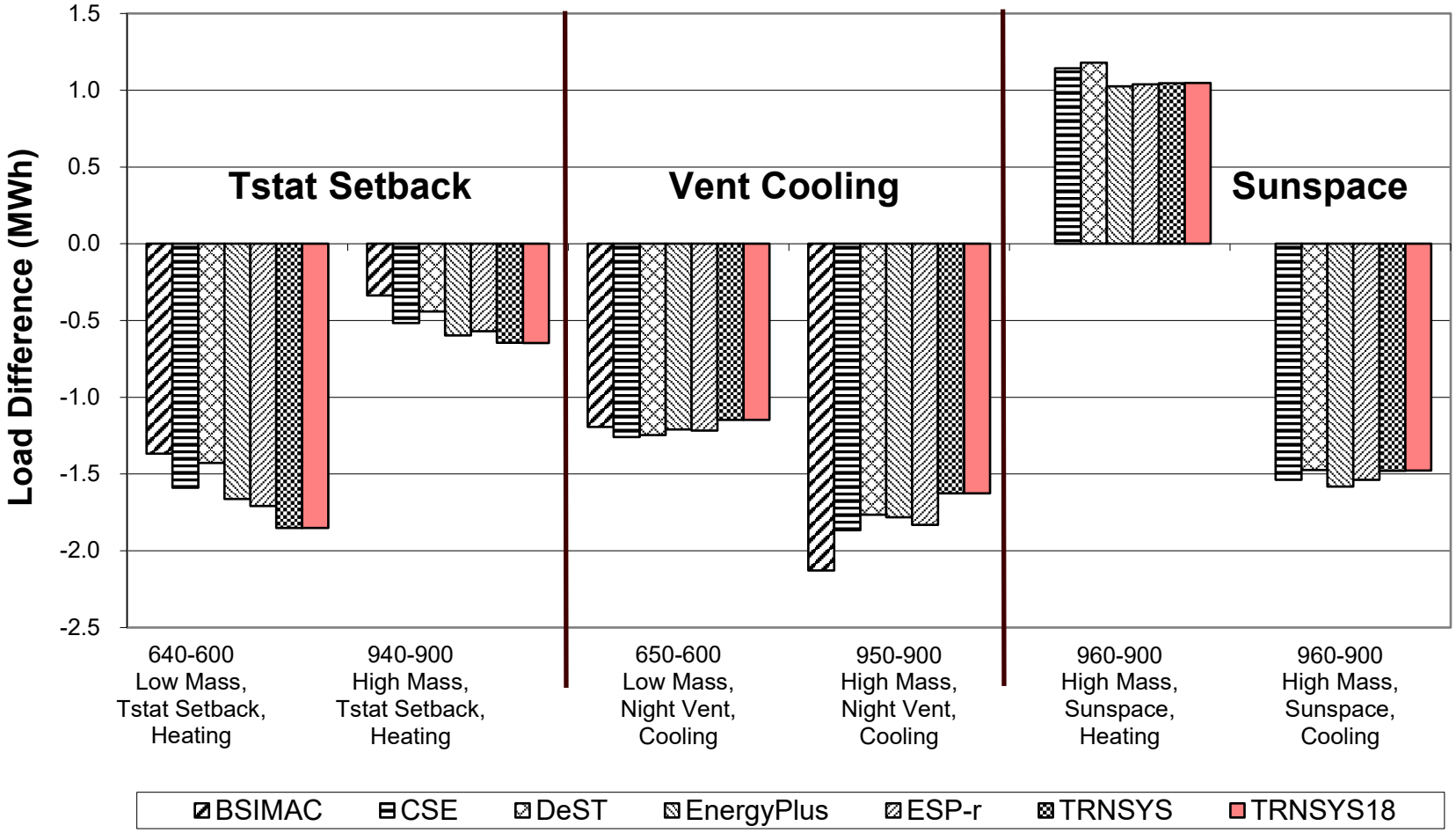


Figure B8-20. Basic: Thermostat Setback, Vent Cooling, and Sunspace (Delta) Peak Heating and Sensible Cooling

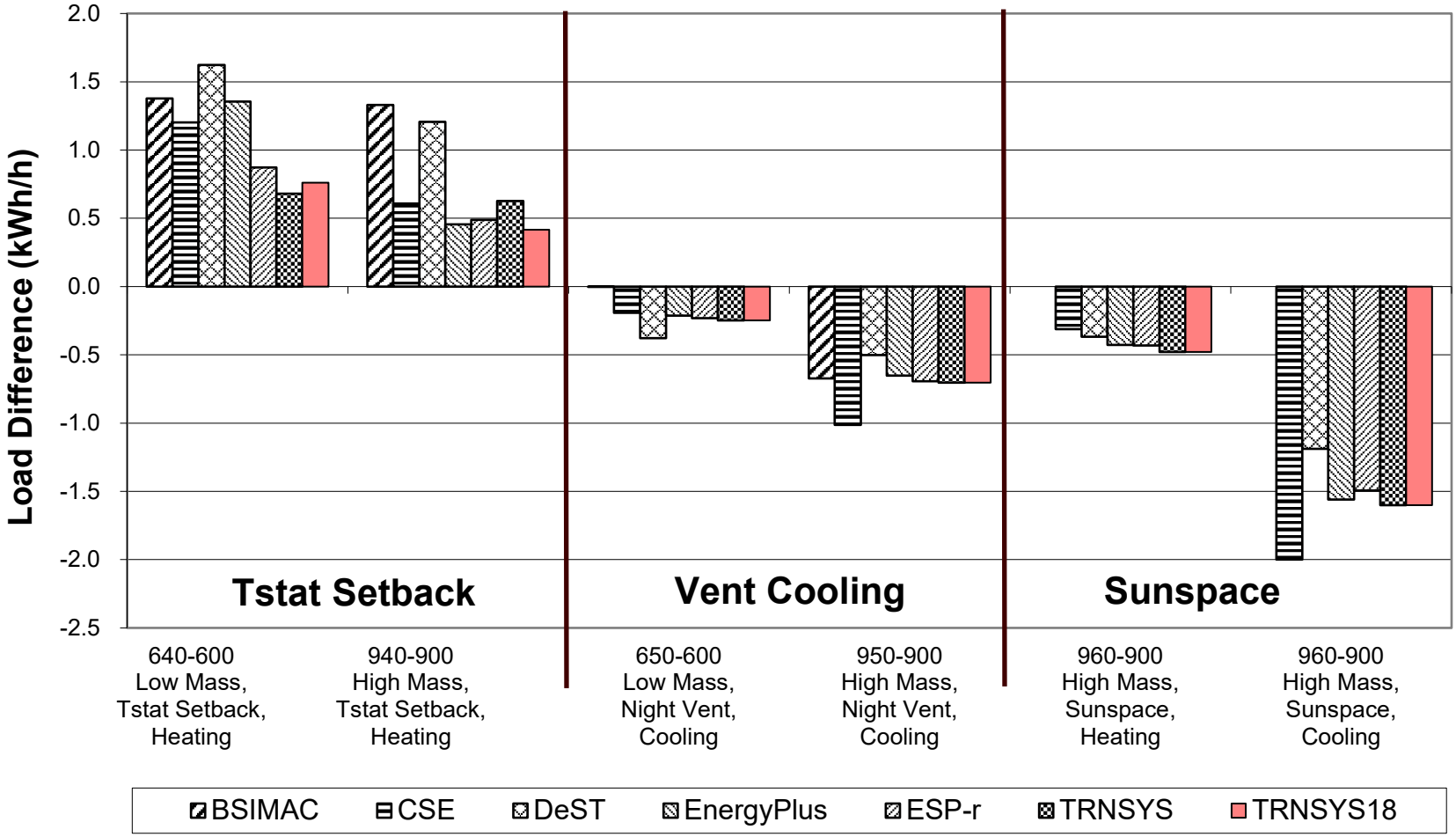


Figure B8-21. Basic and In-Depth: Mass Effect (Delta) Annual Heating and Sensible Cooling

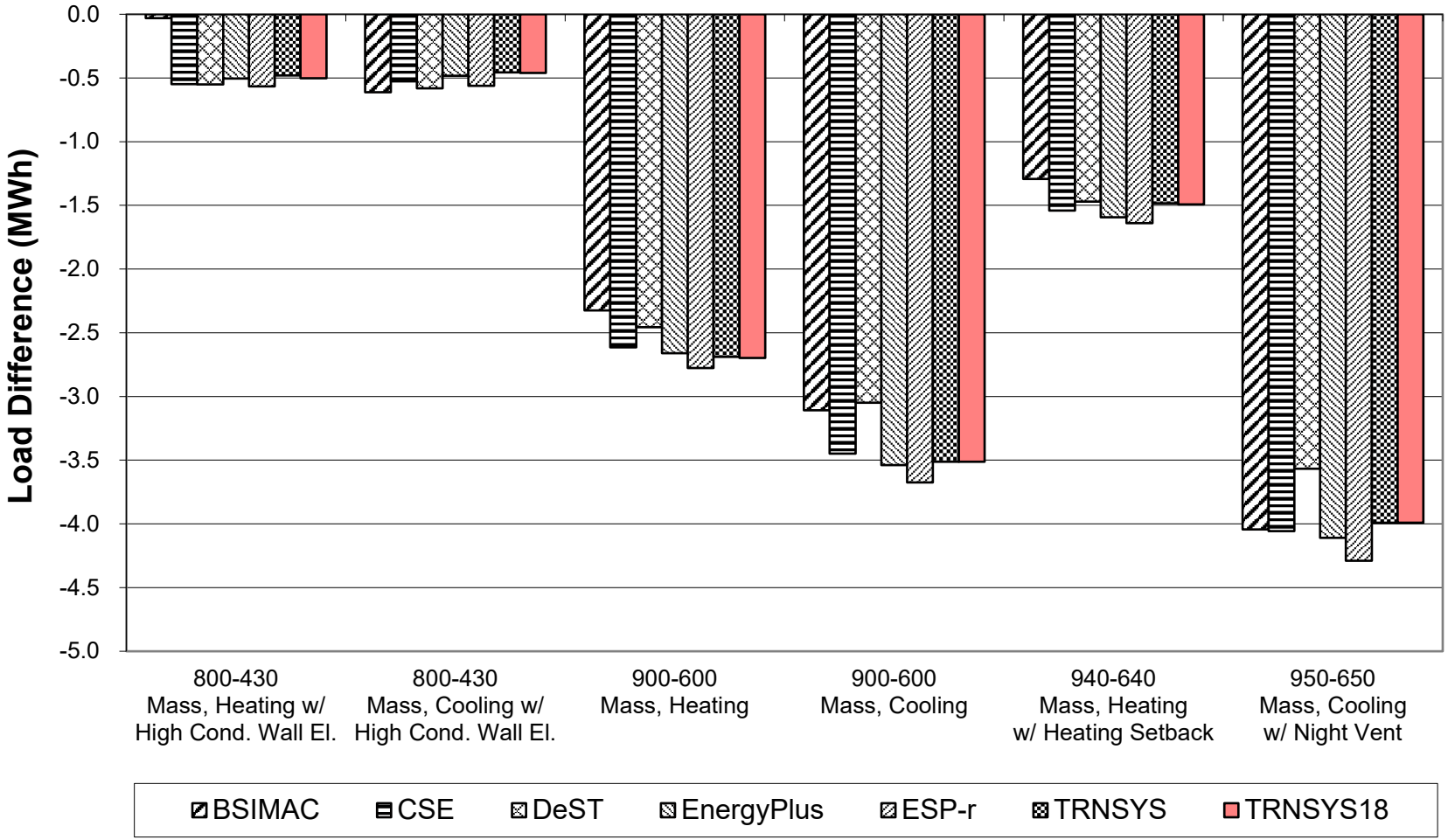


Figure B8-22. Basic and In-Depth: Mass Effect (Delta) Peak Heating and Sensible Cooling

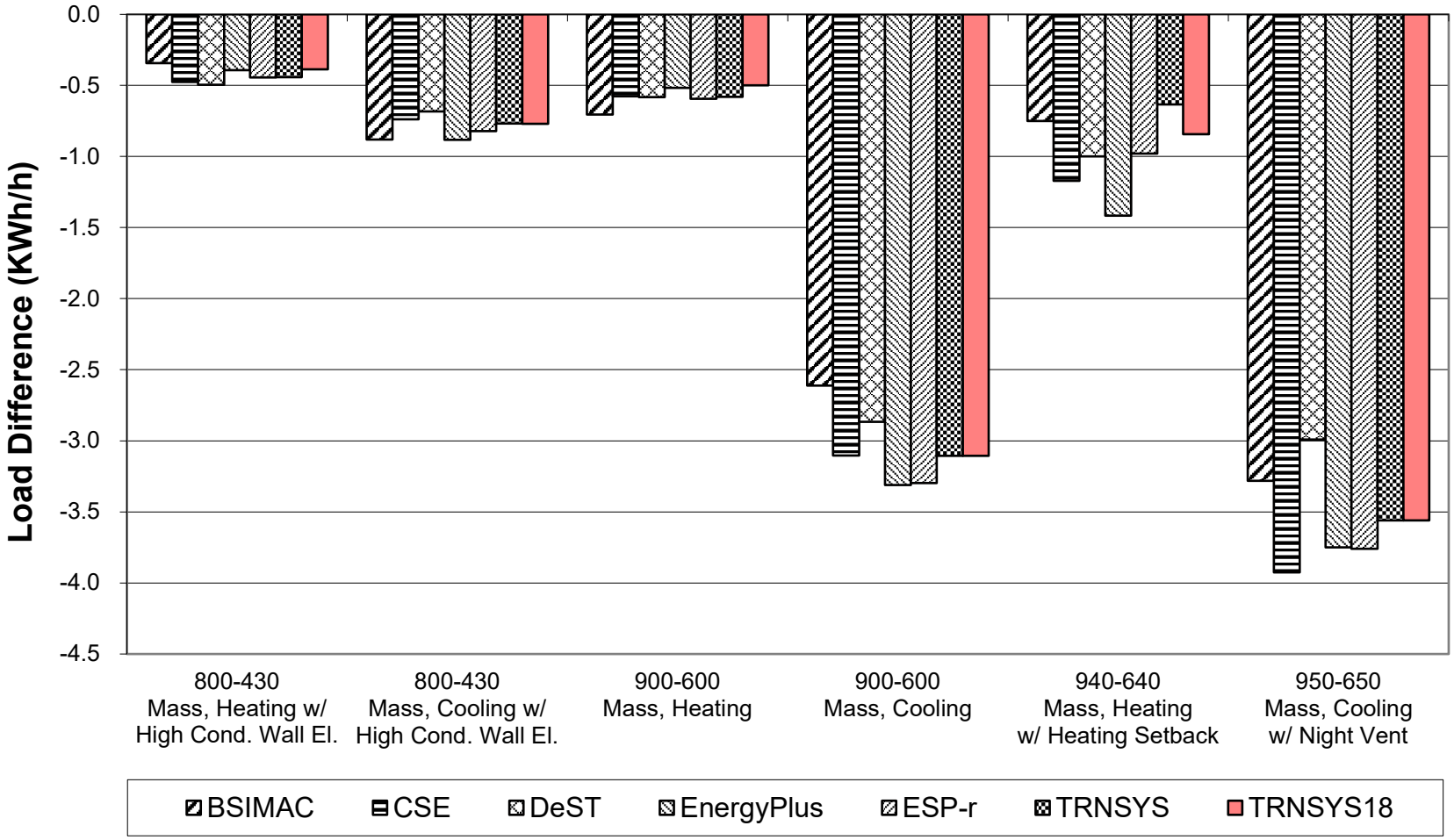


Figure B8-23. Basic: Cases 660 to 695 and 980 to 995 Annual Heating

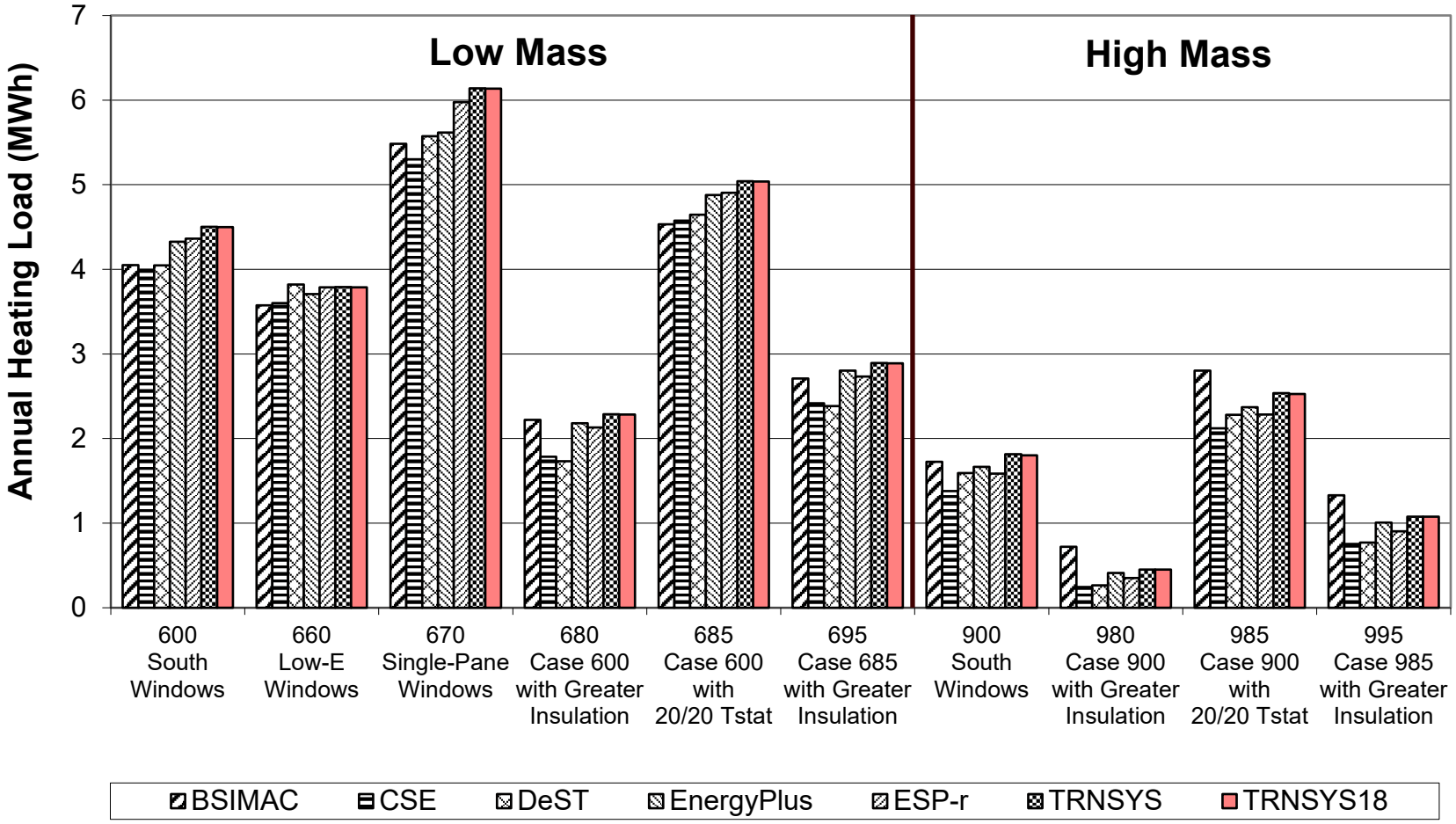


Figure B8-24. Basic: Cases 660 to 695 and 980 to 995 Annual Cooling

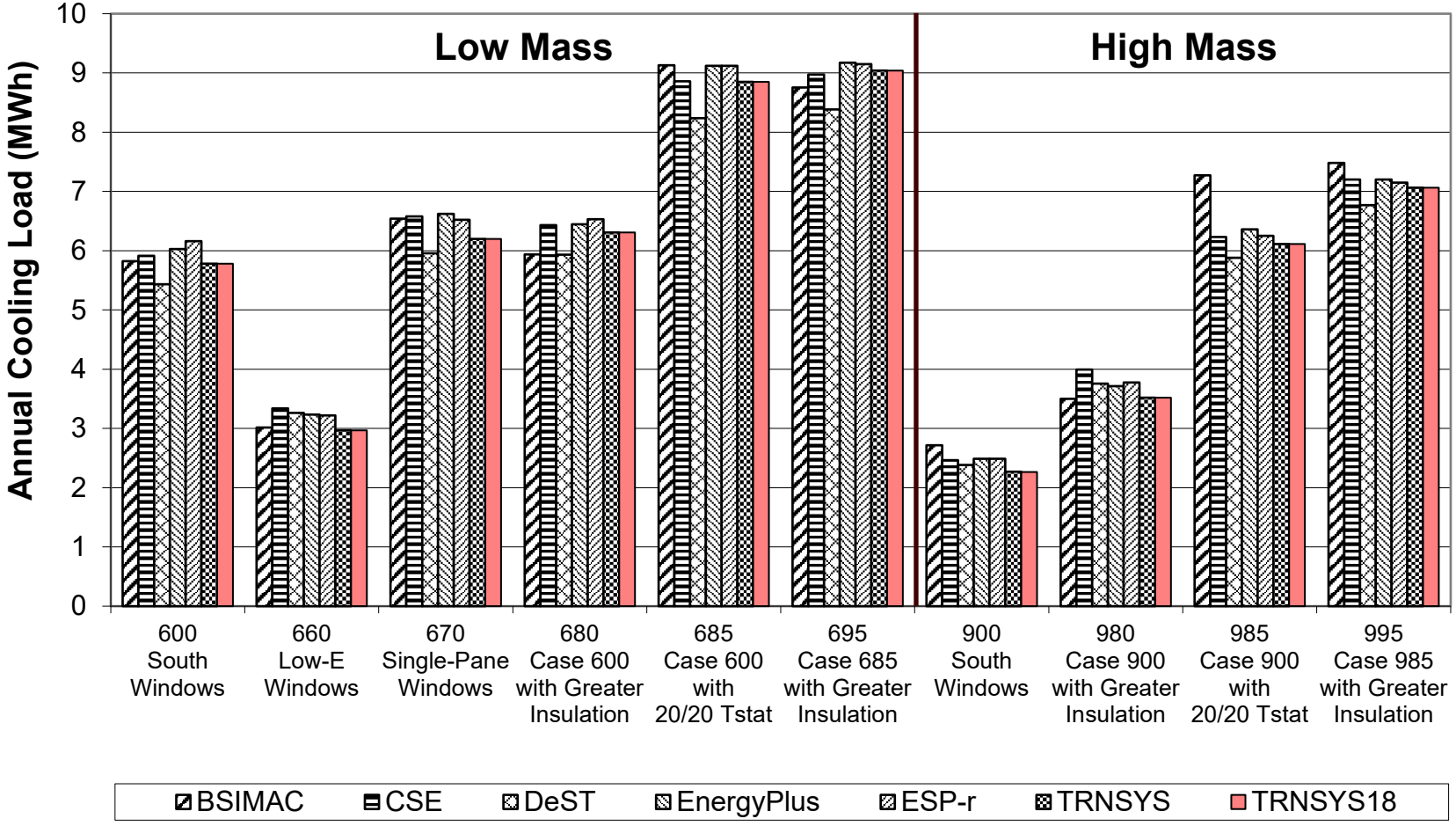


Figure B8-25. Basic: Cases 660 to 695 and 980 to 995 Peak Heating

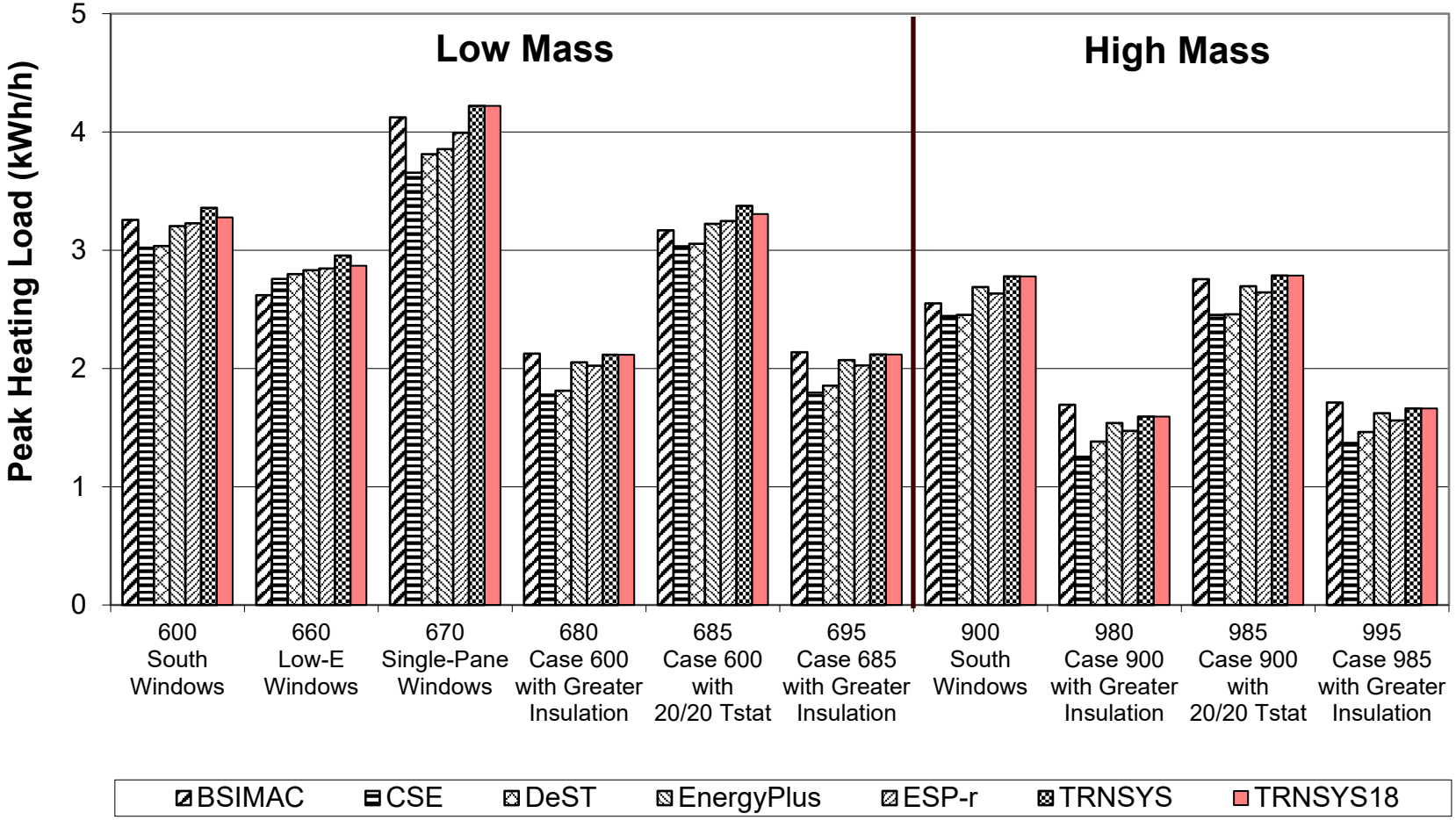


Figure B8-26. Basic: Cases 660 to 695 and 980 to 995 Peak Cooling

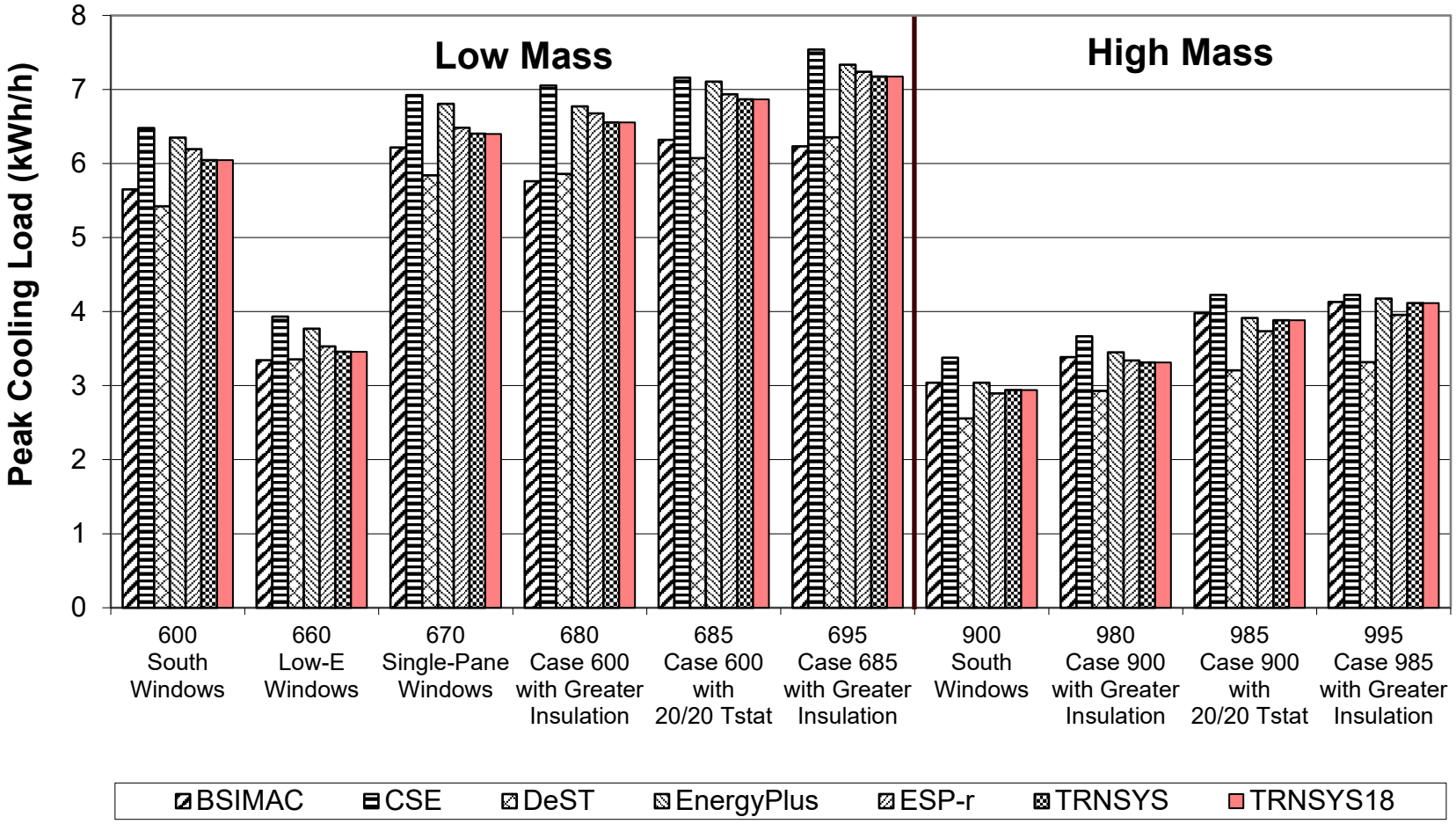


Figure B8-27. Basic: Window Types (Delta) Annual Heating and Sensible Cooling

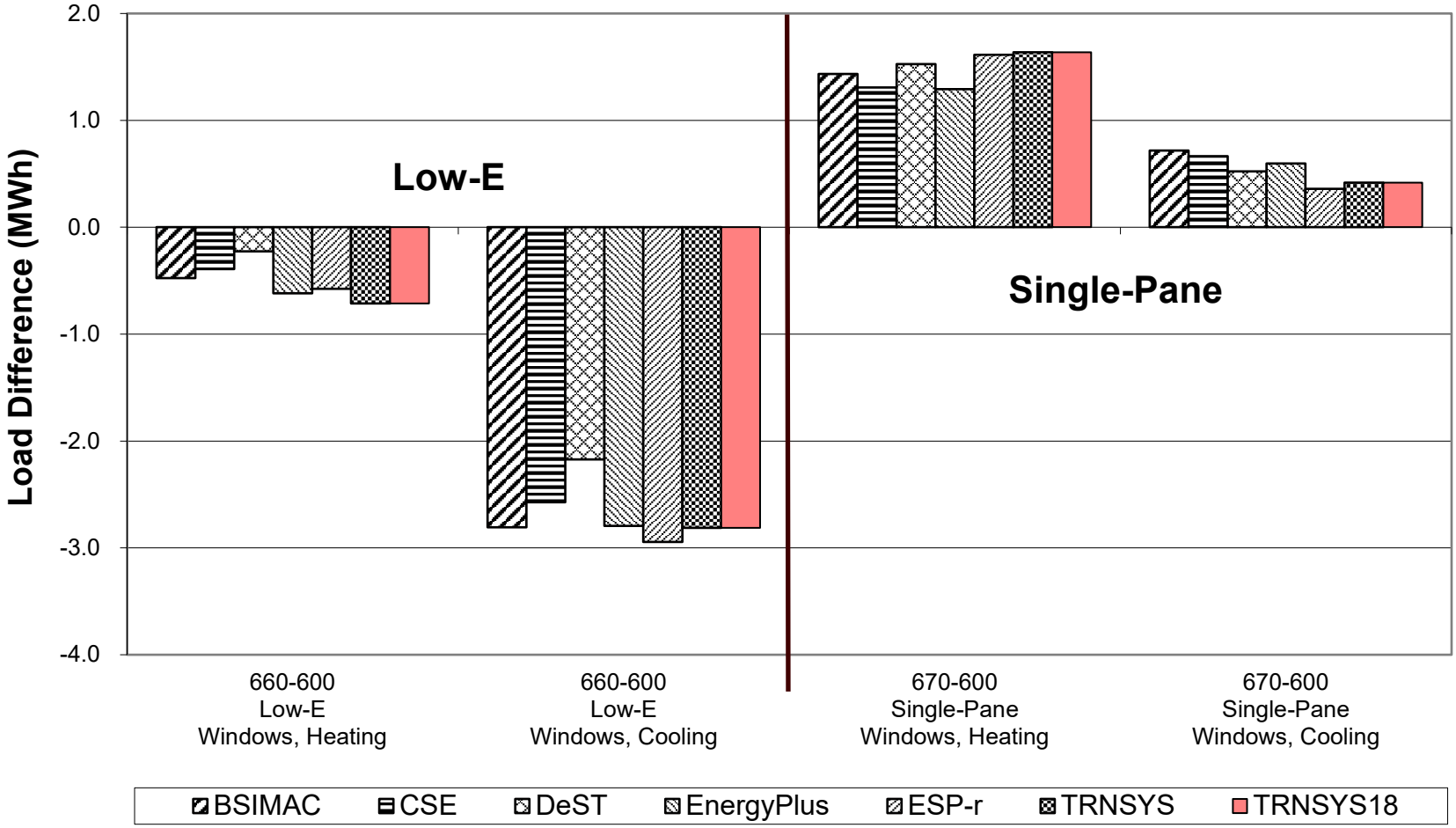


Figure B8-28. Basic: Window Types (Delta) Peak Heating and Sensible Cooling

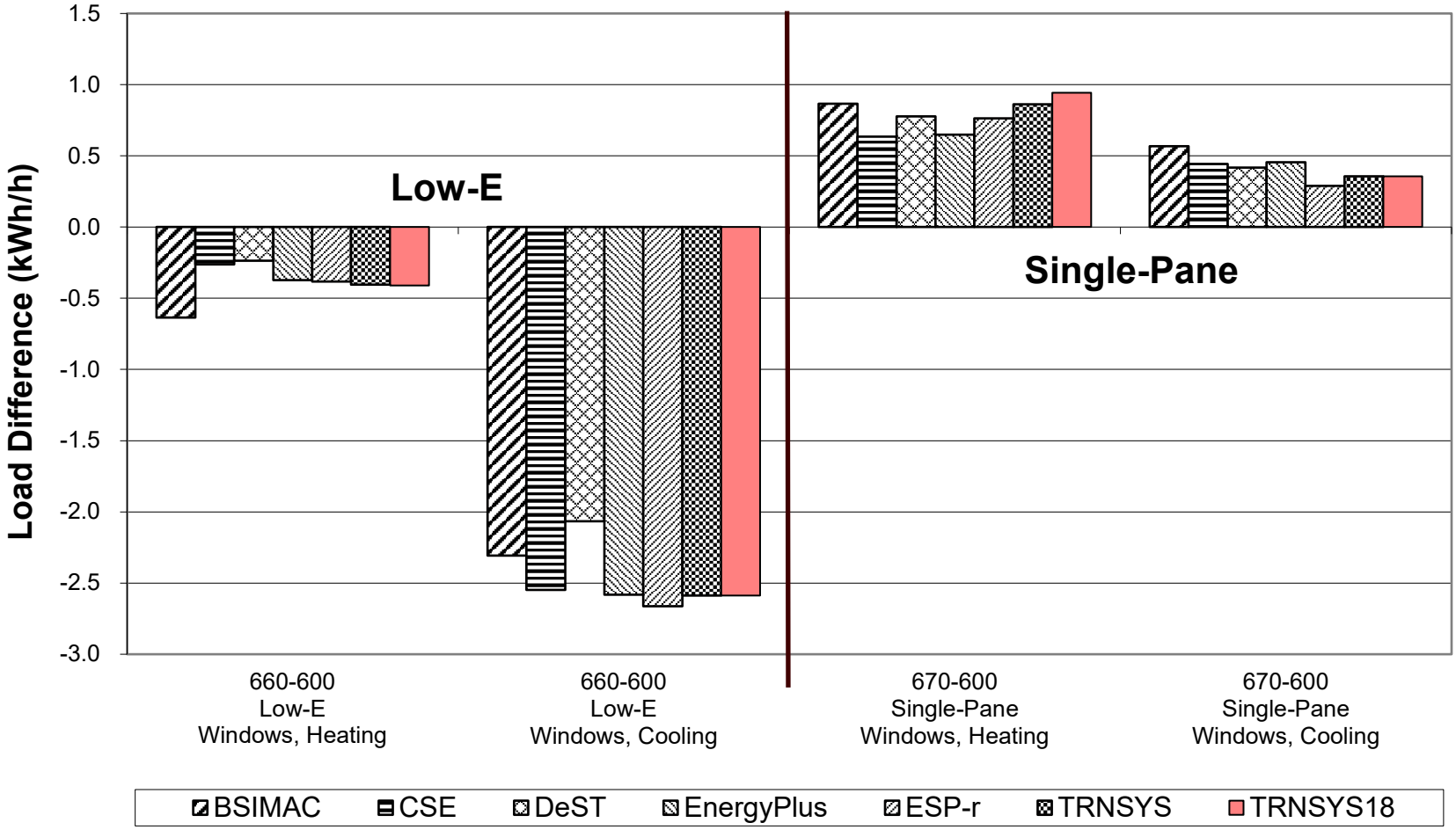


Figure B8-29. Basic: Insulation (Delta) Annual Heating and Sensible Cooling

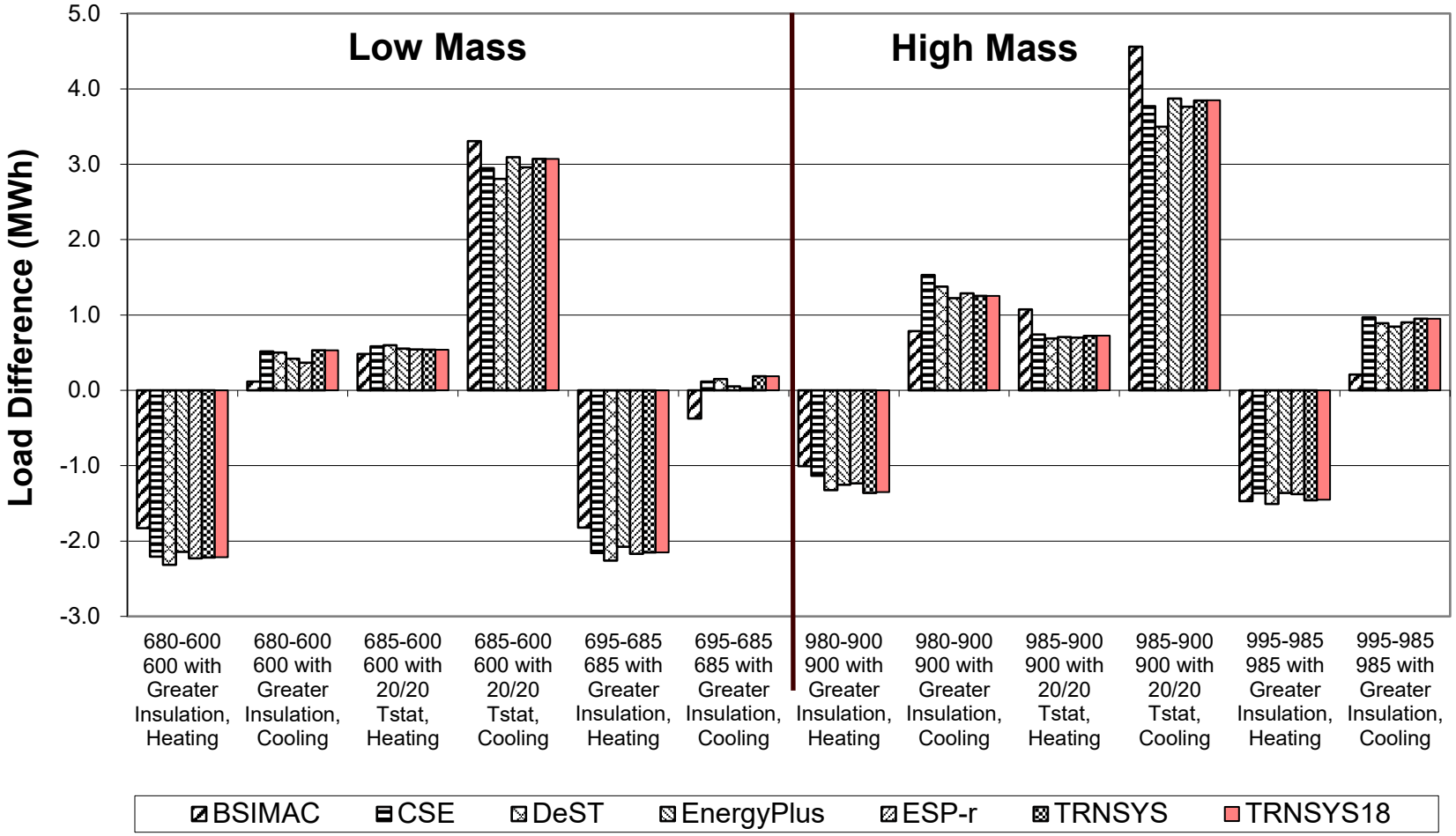


Figure B8-30. Basic: Insulation (Delta) Peak Heating and Sensible Cooling

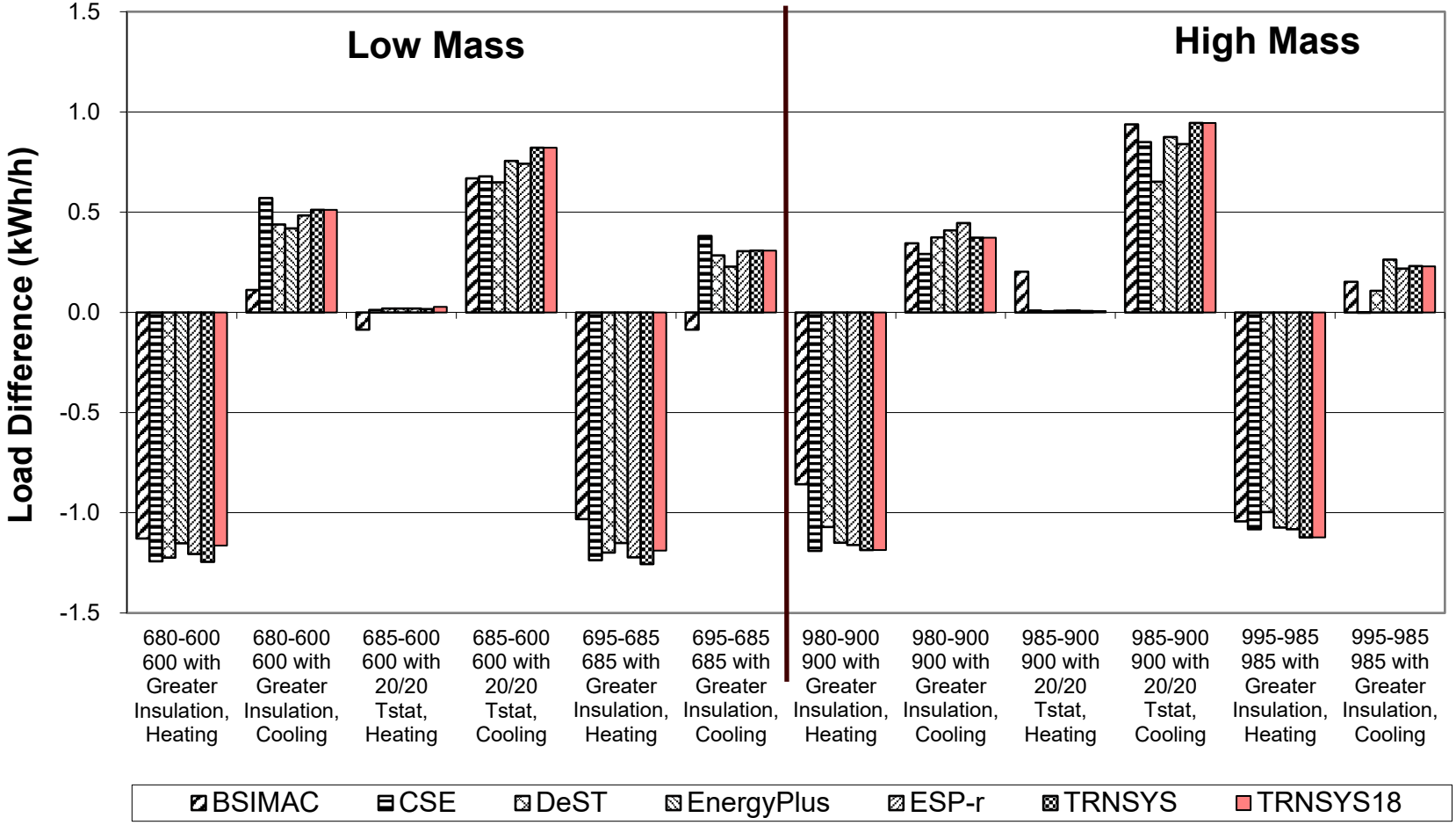


Figure B8-31. Basic: Insulation, Mass Effect (Delta) Annual Heating and Sensible Cooling

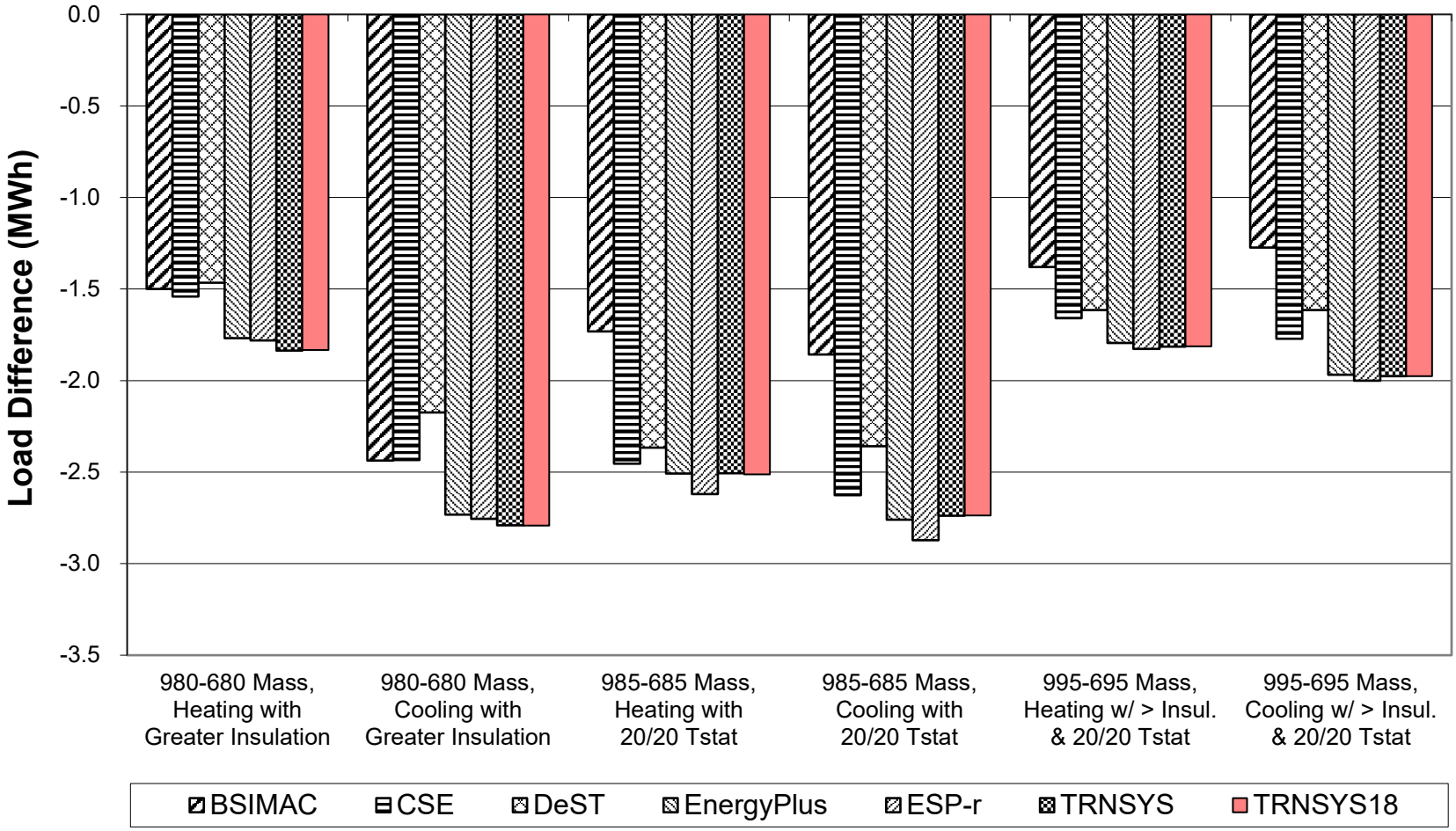


Figure B8-32. Basic: Insulation, Mass Effect (Delta) Peak Heating and Sensible Cooling

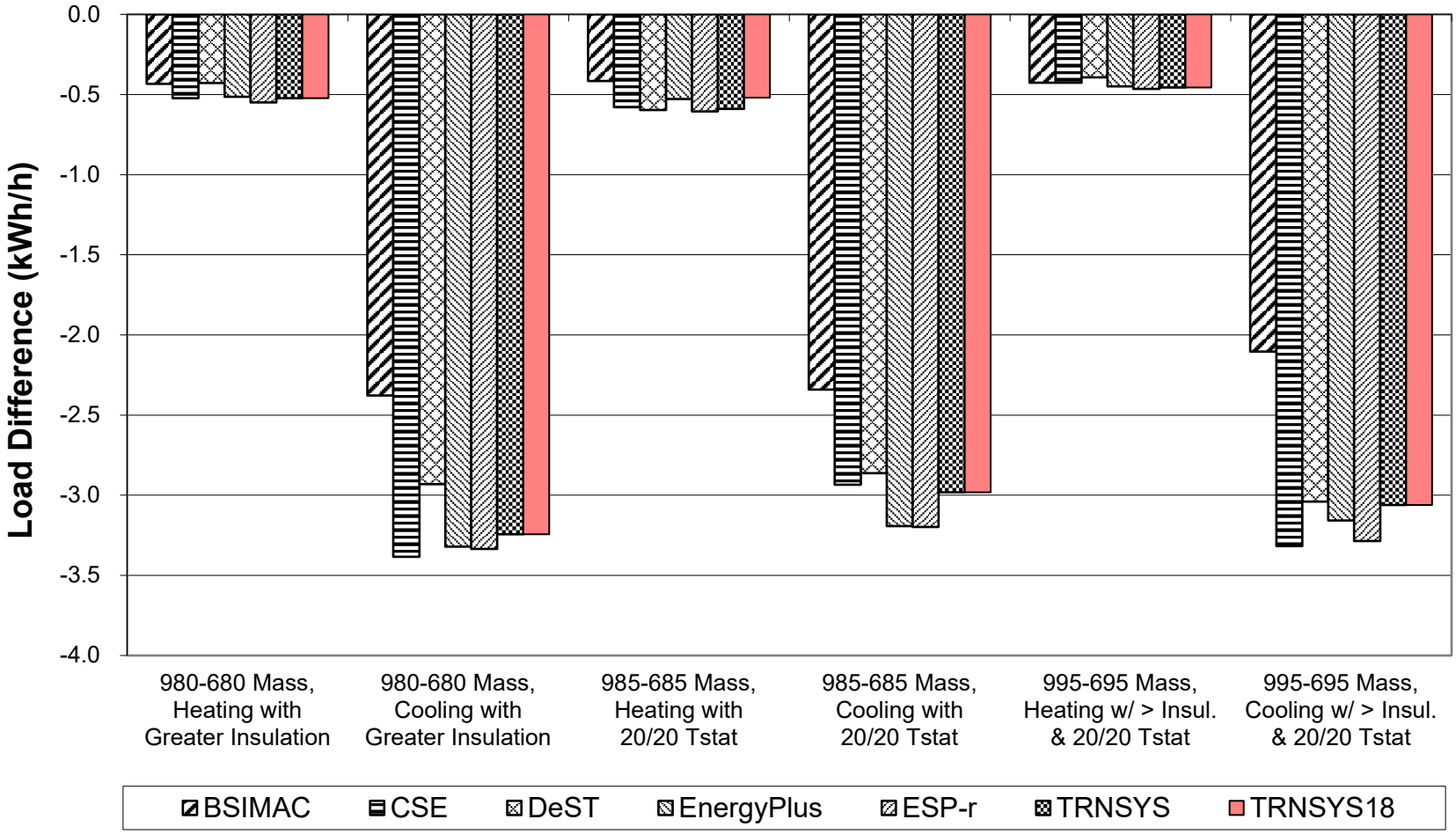


Figure B8-33. Basic: Average Hourly Annual Temperature Free-Float Cases

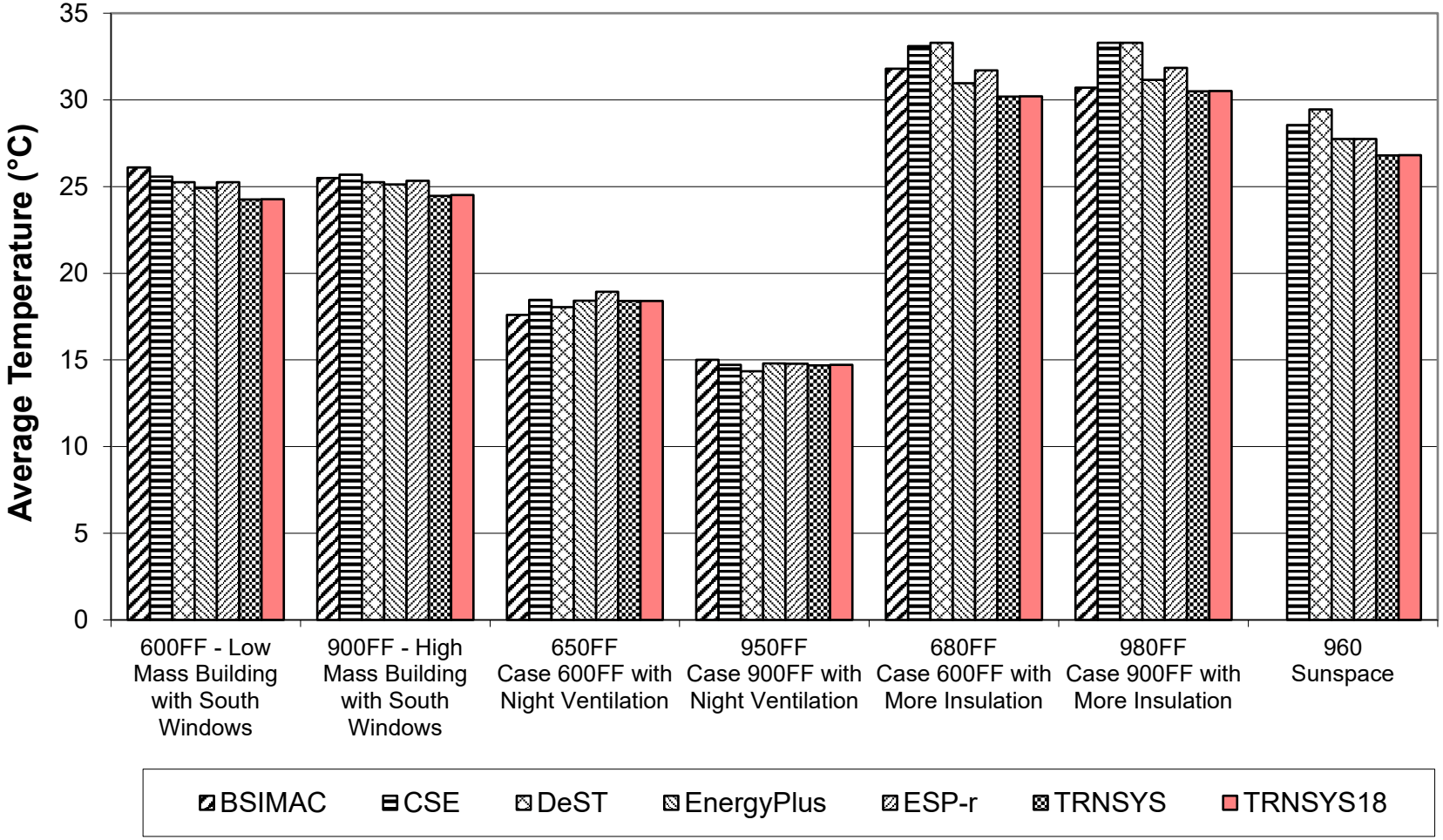


Figure B8-34. Basic: Maximum Hourly Annual Temperature Free-Float Cases

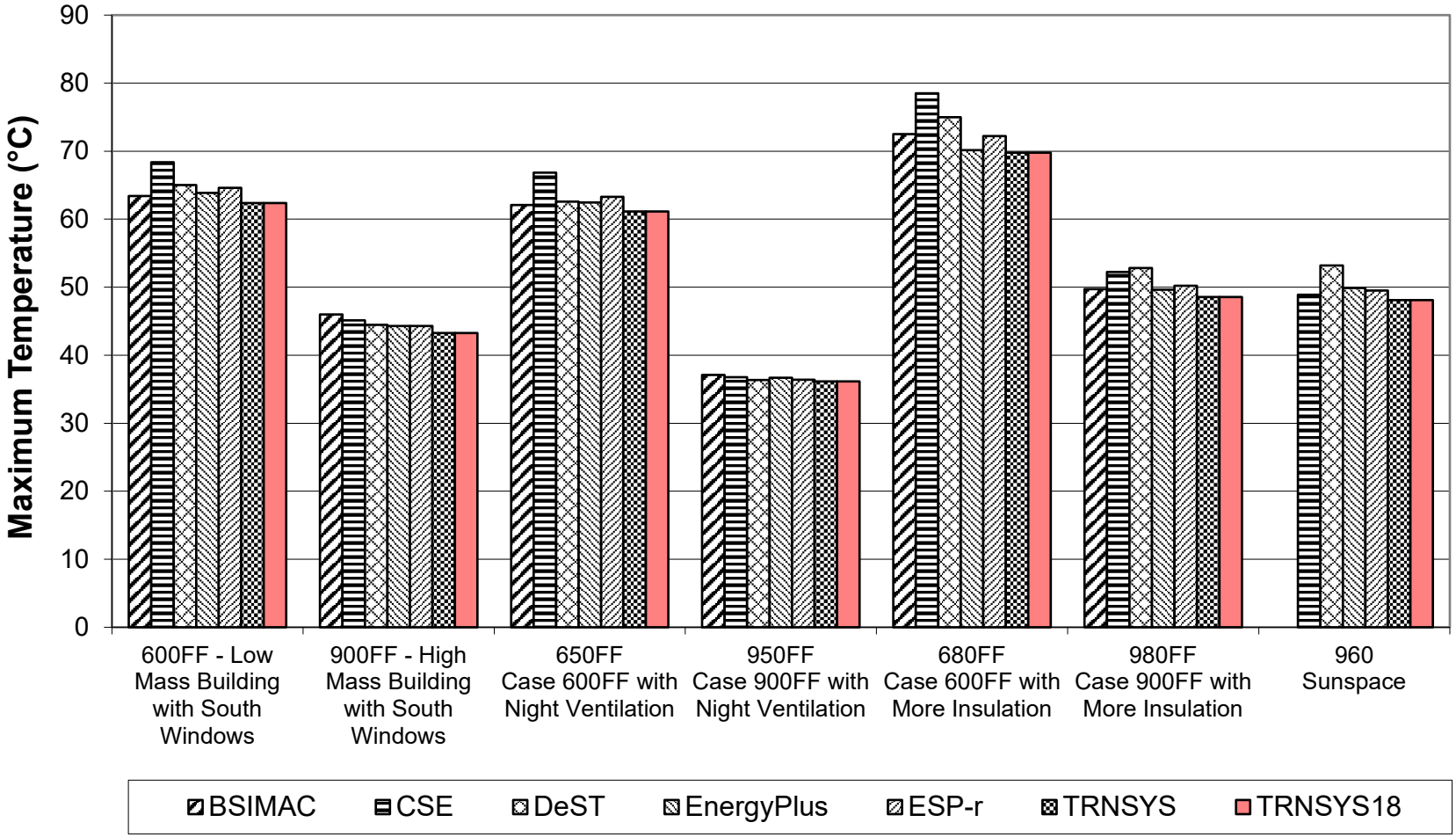


Figure B8-35. Basic: Minimum Hourly Annual Temperature Free-Float Cases

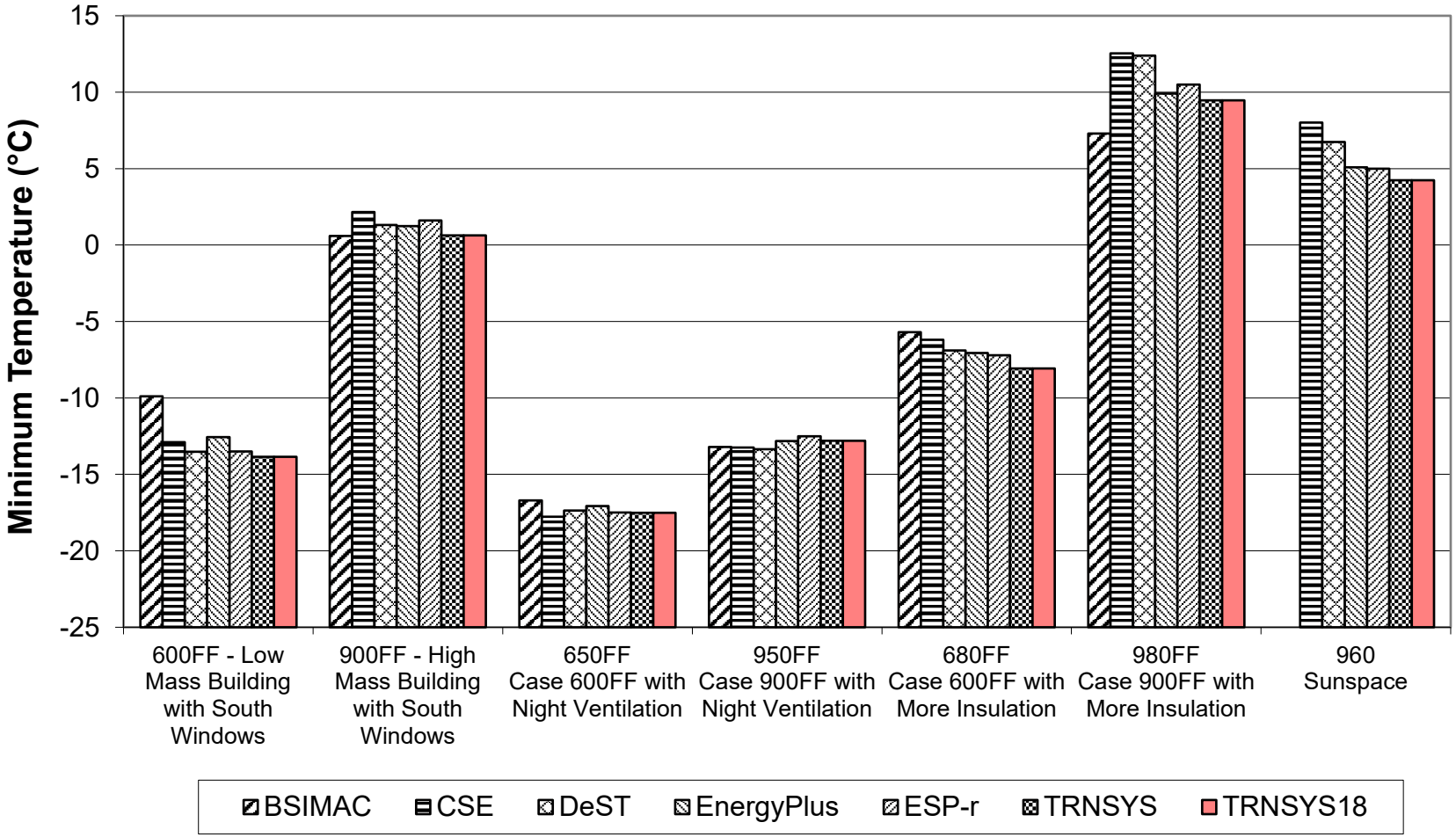


Figure B8-36. In-Depth: Low Mass Cases 195 to 250 Annual Heating

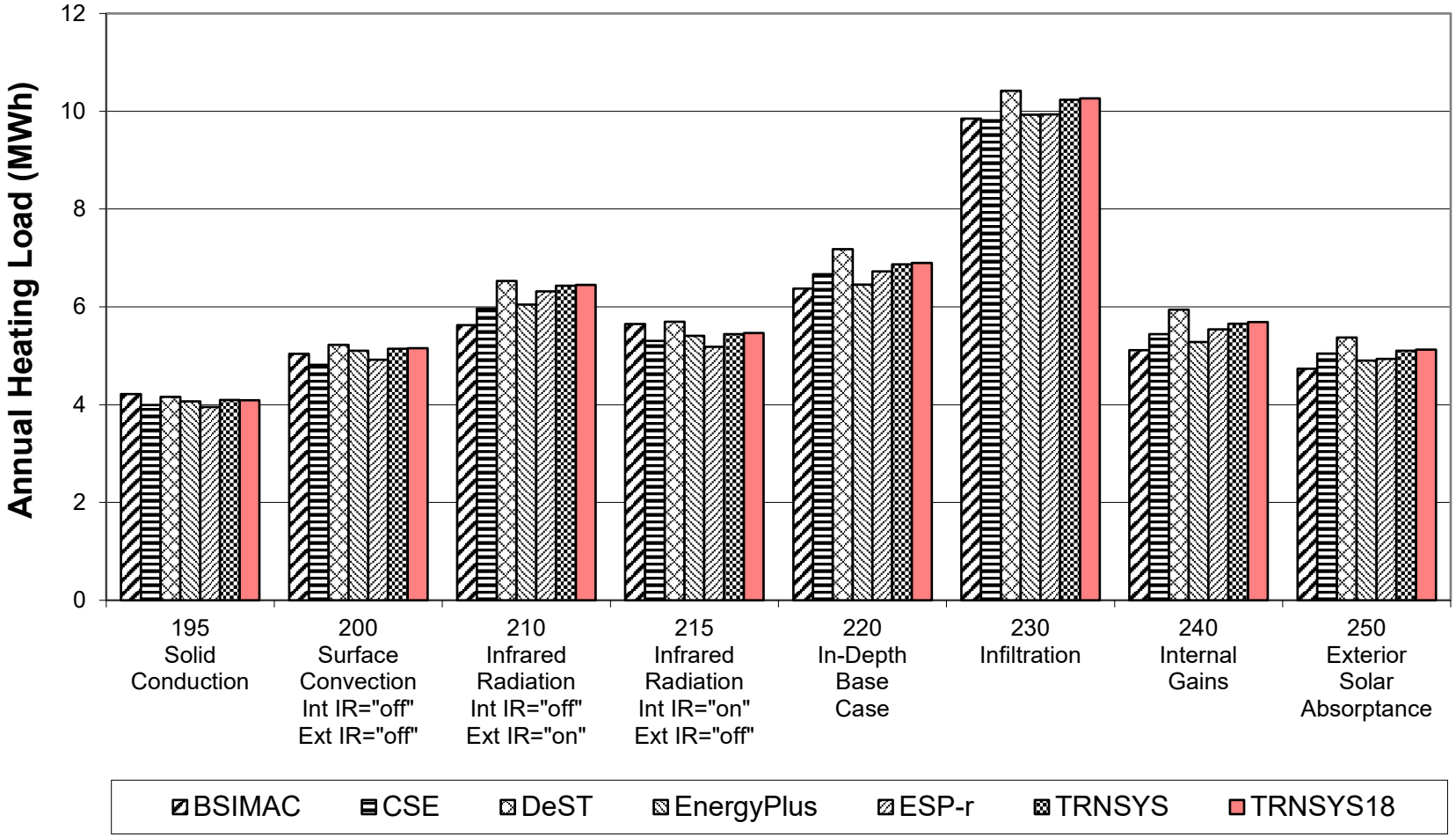


Figure B8-37. In-Depth: Low Mass Cases 195 to 250 Annual Sensible Cooling

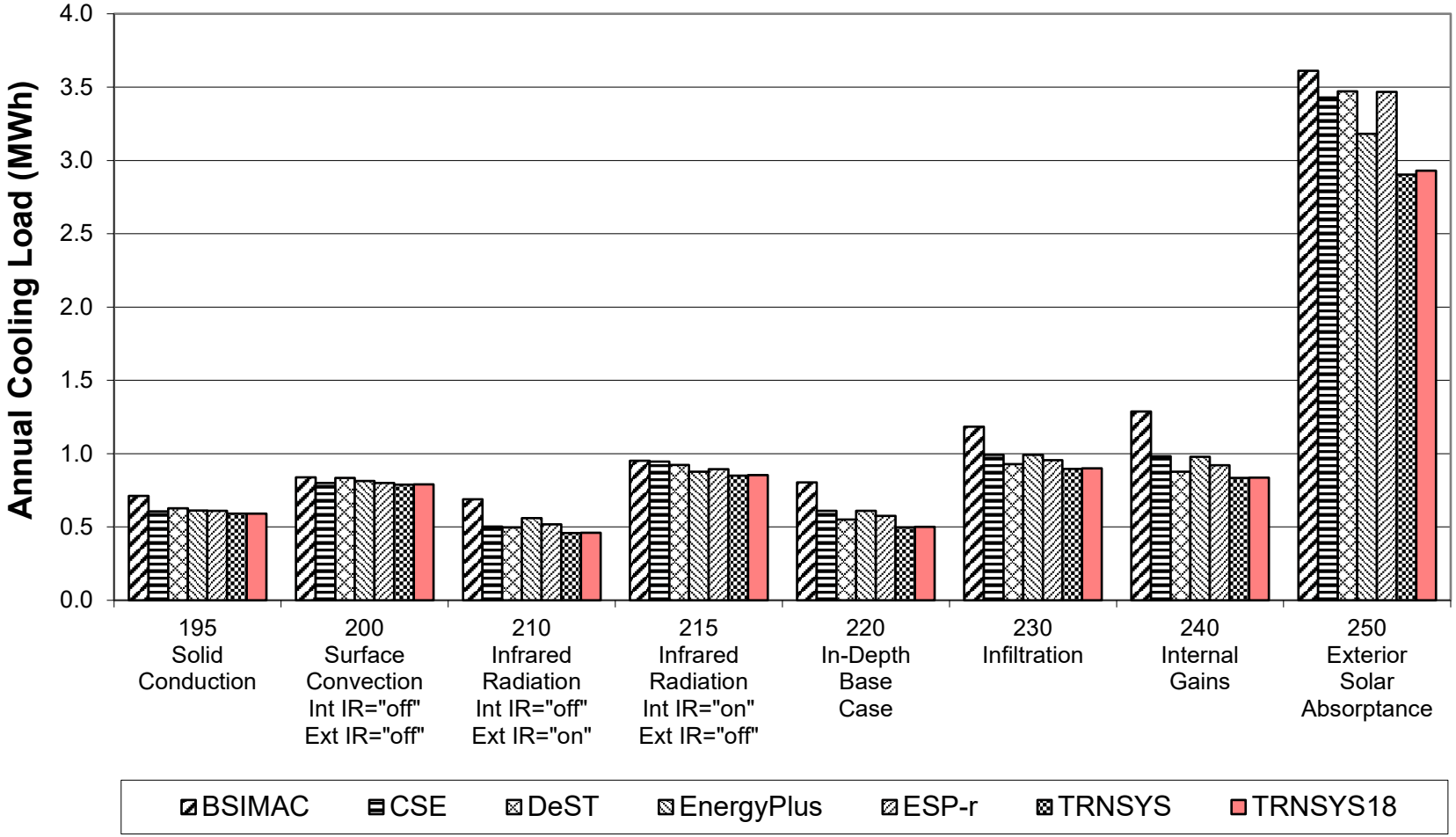


Figure B8-38. In-Depth: Low Mass Cases 195 to 250 Peak Heating

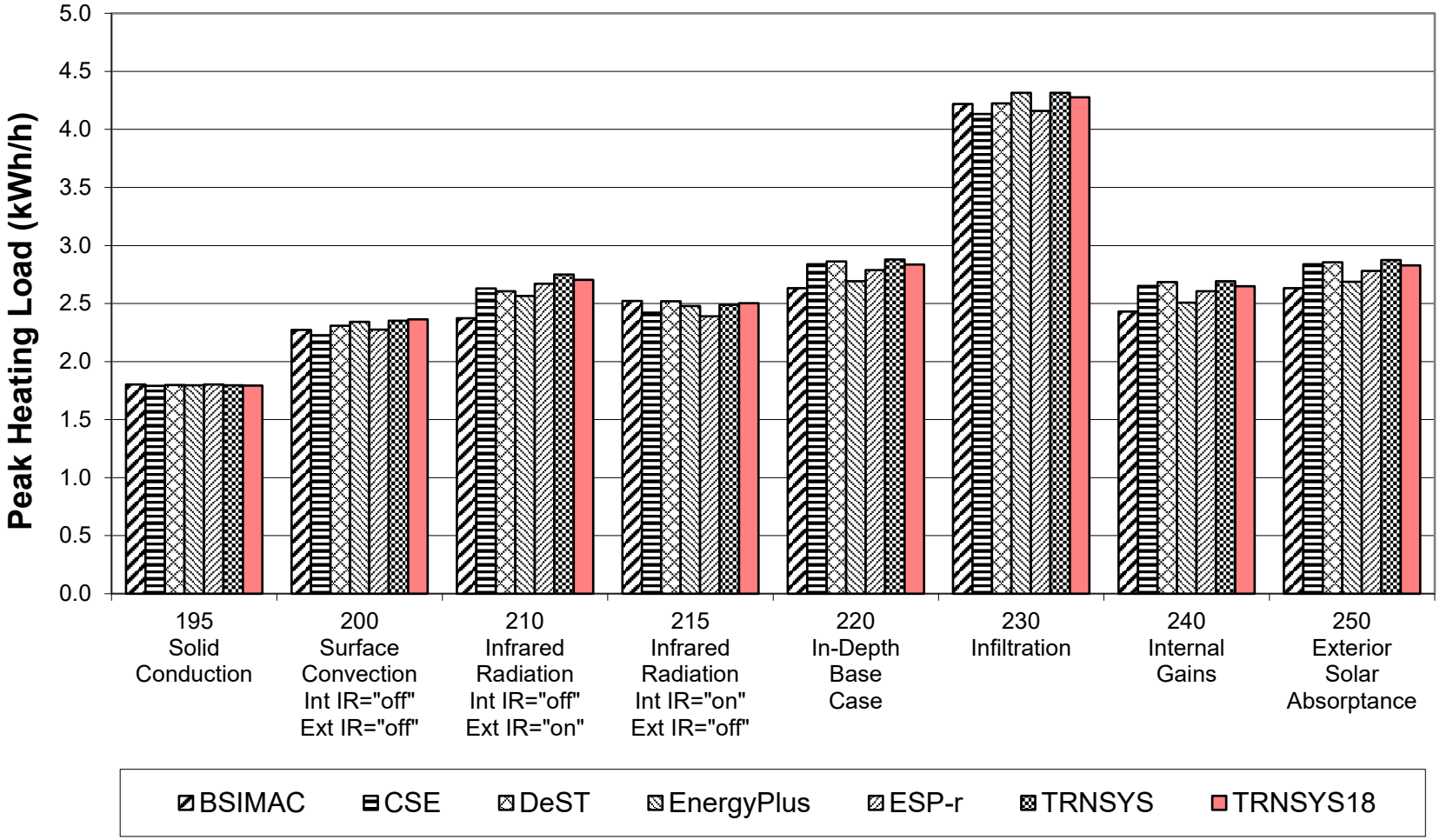


Figure B8-39. In-Depth: Low Mass Cases 195 to 250 Peak Sensible Cooling

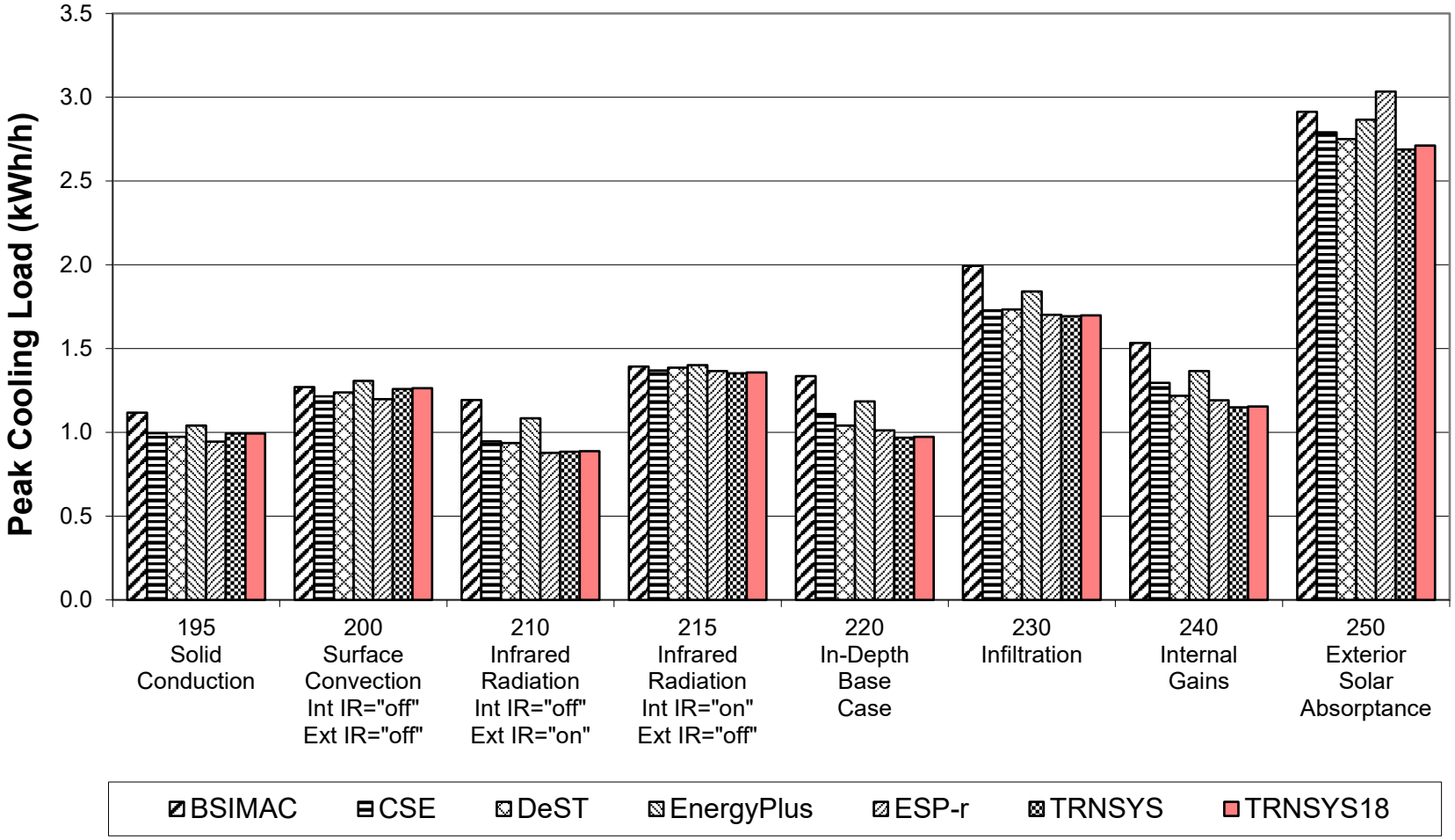


Figure B8-40. In-Depth: Low Mass Cases 270 to 320 Annual Heating

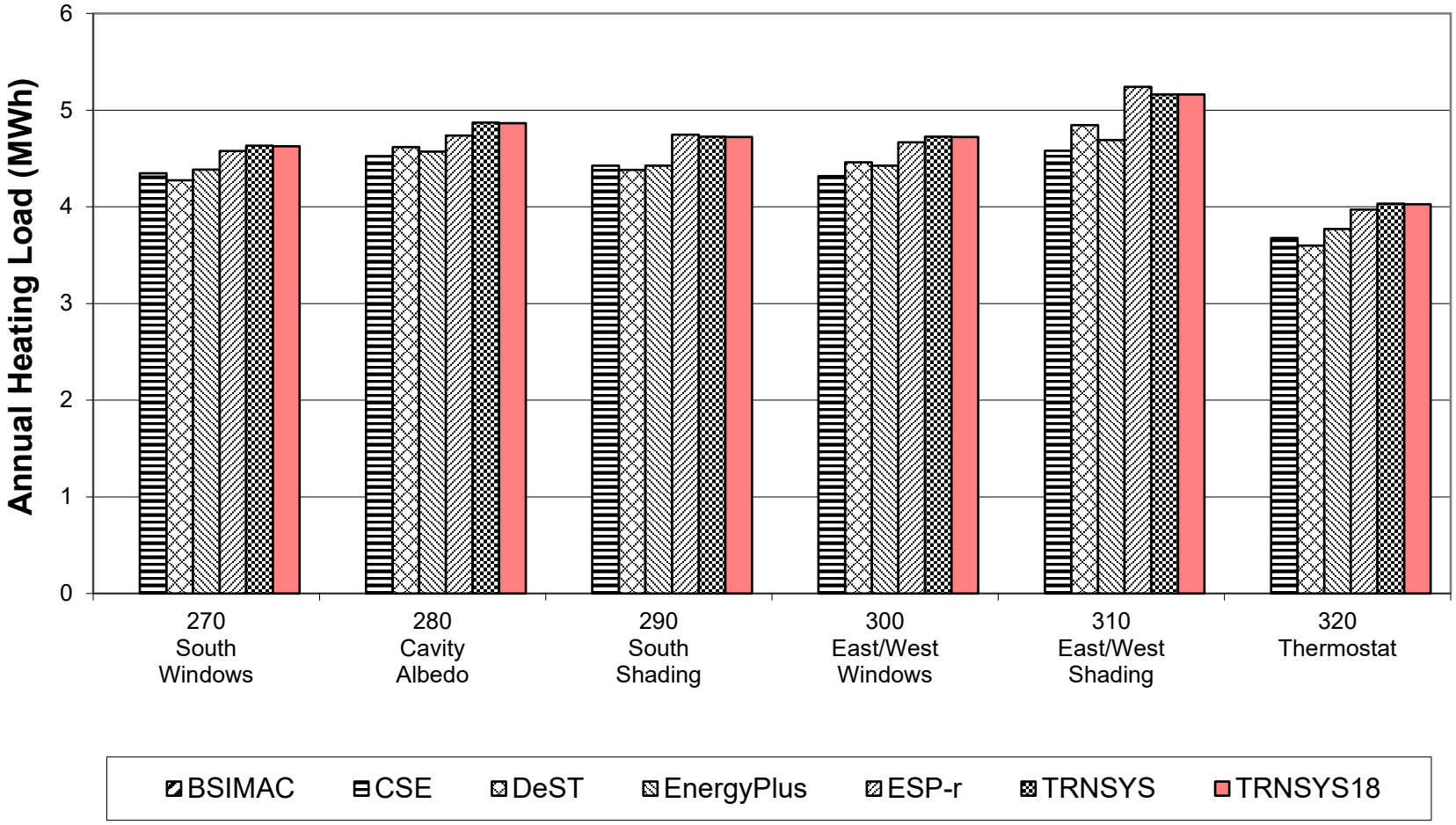


Figure B8-41. In-Depth: Low Mass Cases 270 to 320 Annual Sensible Cooling

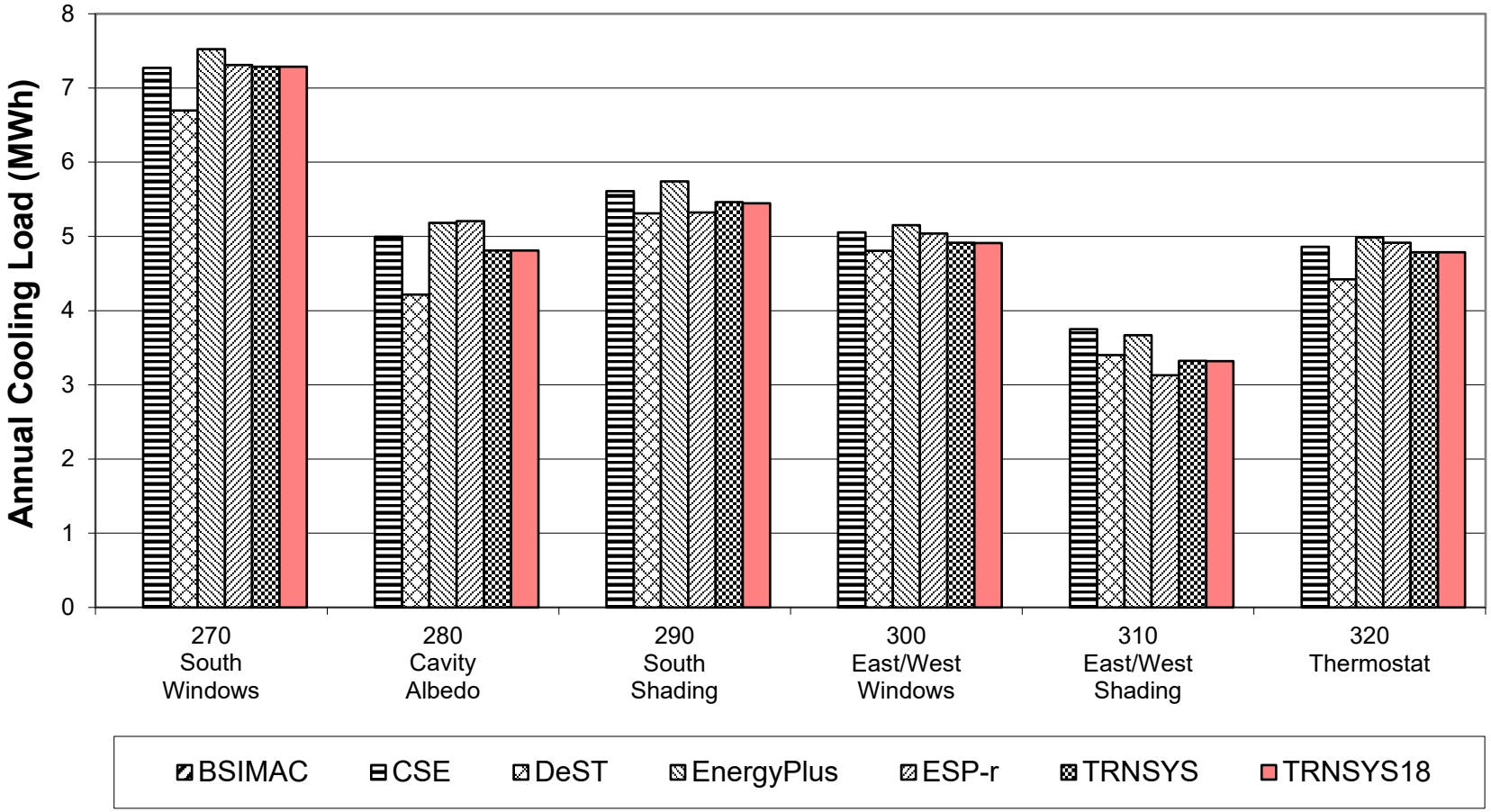


Figure B8-42. In-Depth: Low Mass Cases 270 to 320 Peak Heating

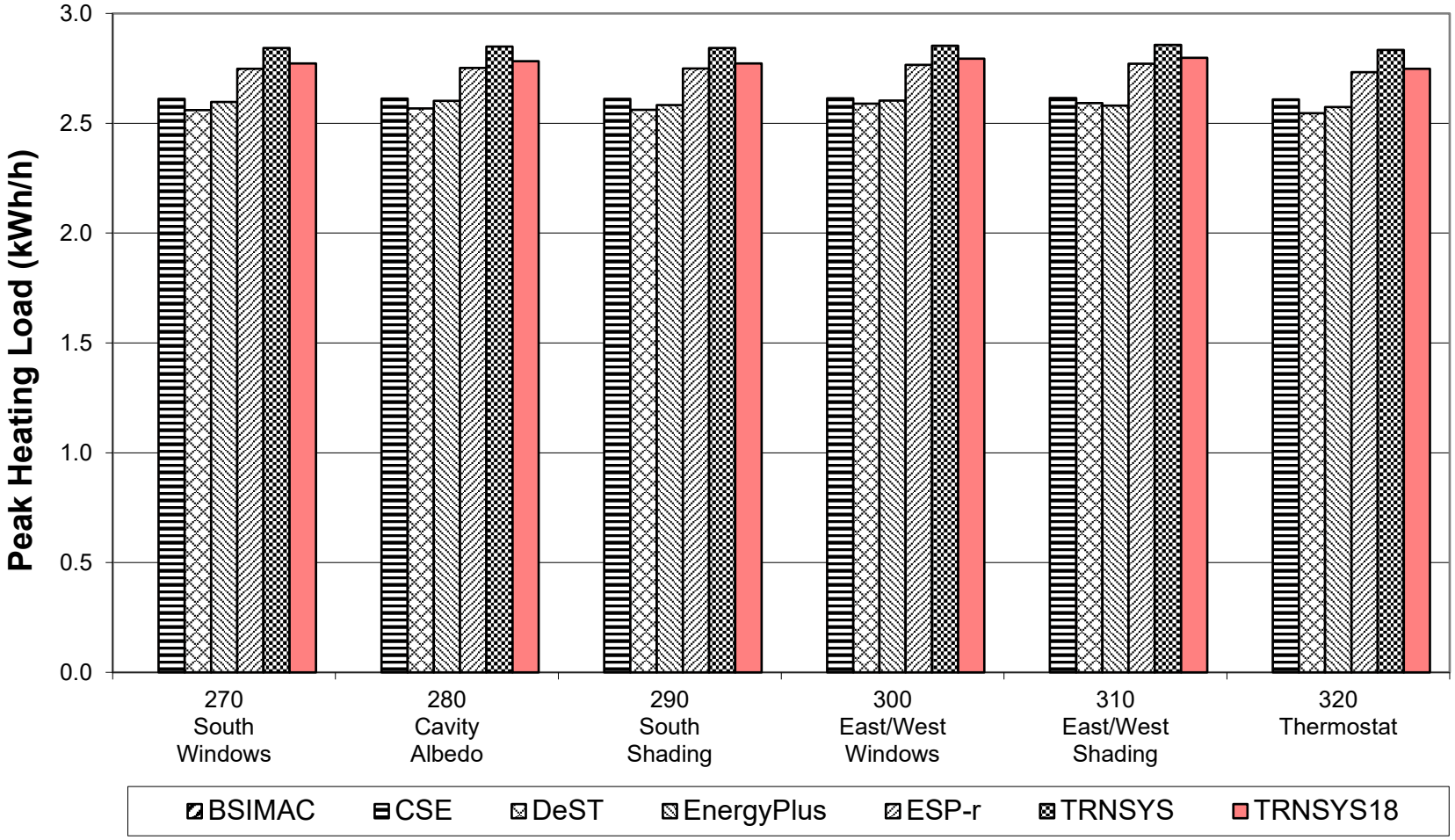


Figure B8-43. In-Depth: Low Mass Cases 270 to 320 Peak Sensible Cooling

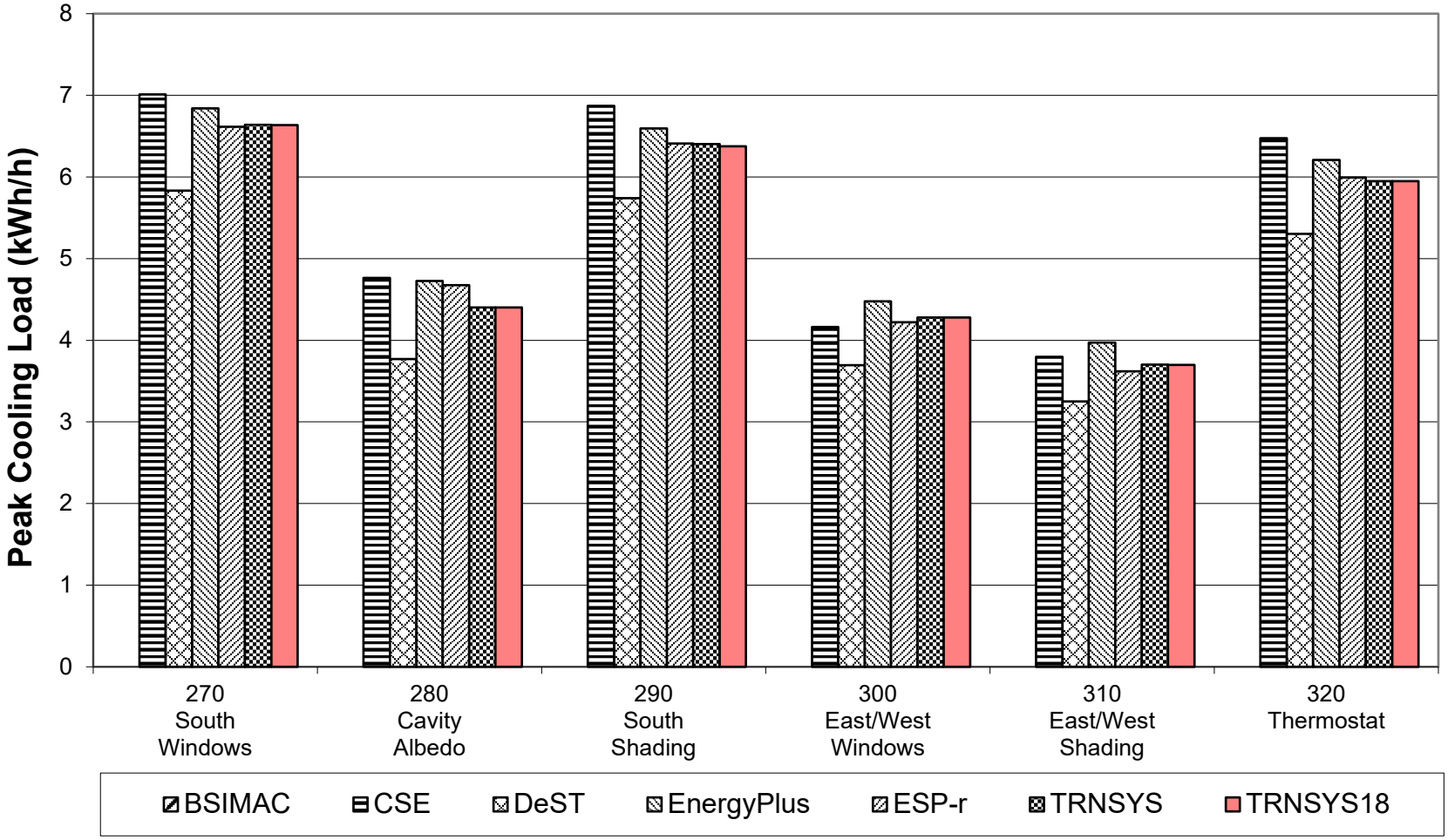


Figure B8-44. In-Depth: Cases 195 to 220 (Delta) Annual Heating and Sensible Cooling

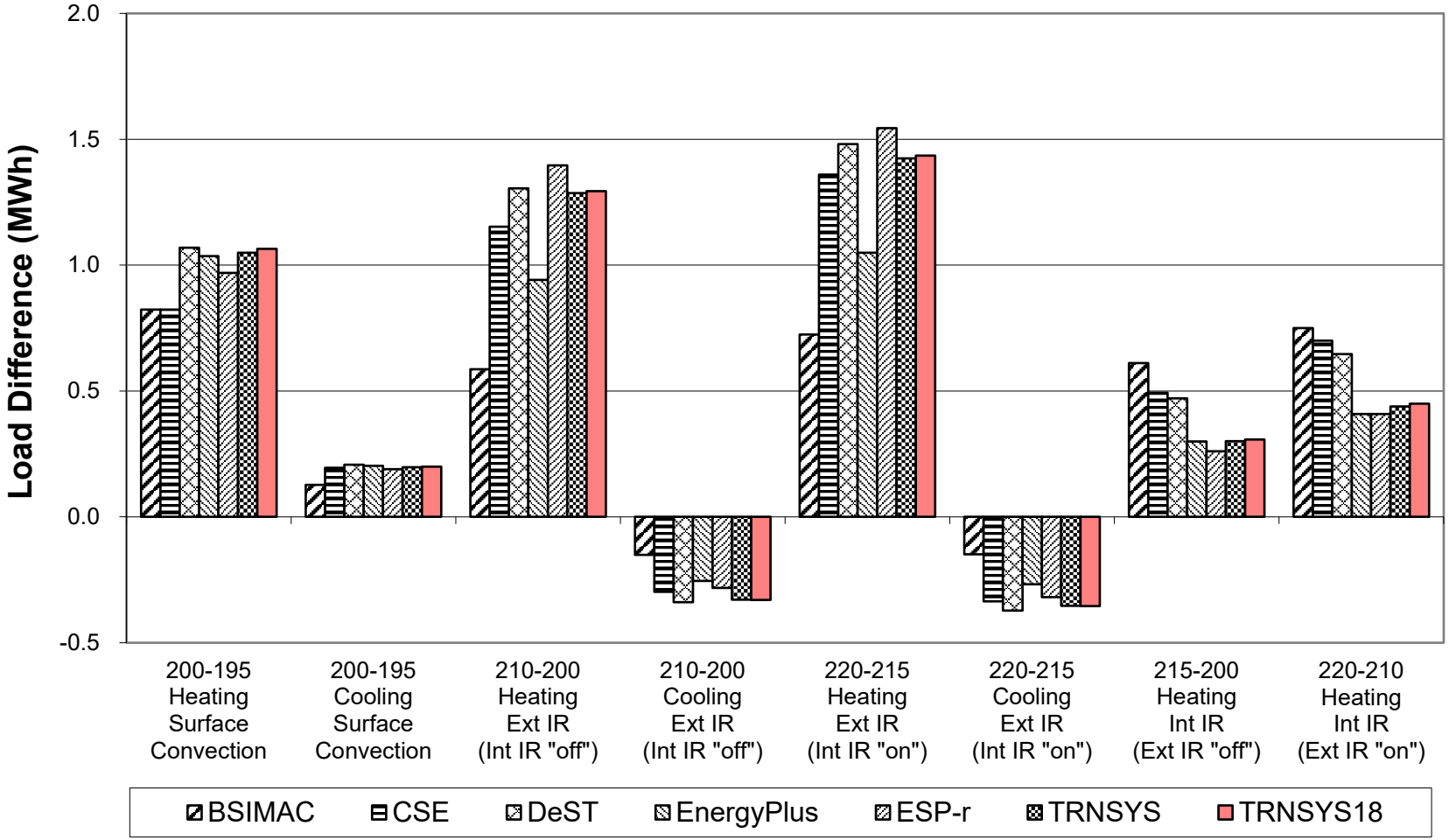


Figure B8-45. In-Depth: Cases 195 to 220 (Delta) Peak Heating and Sensible Cooling

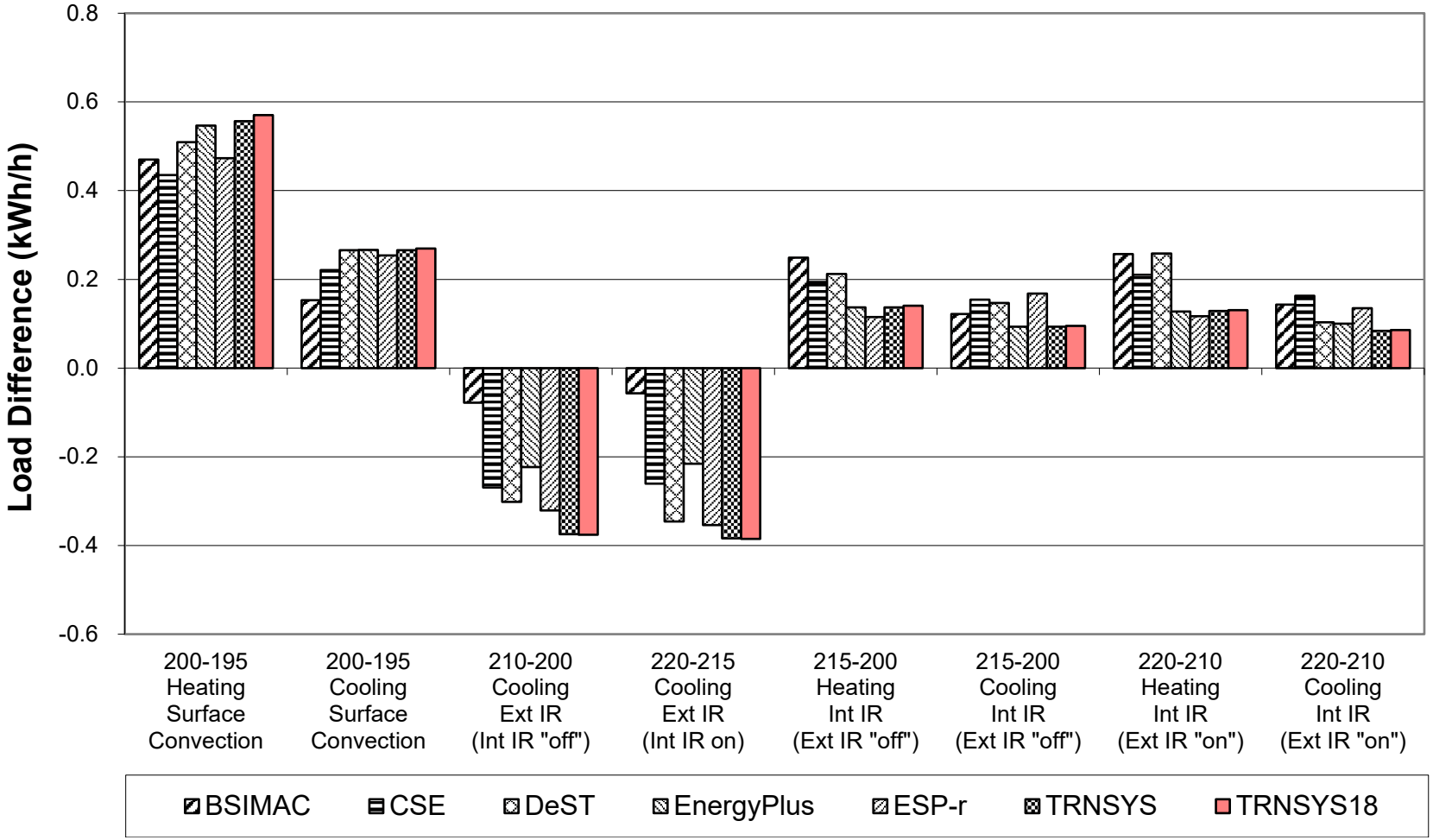


Figure B8-46. In-Depth: Cases 220 to 270 (Delta) Annual Heating and Sensible Cooling

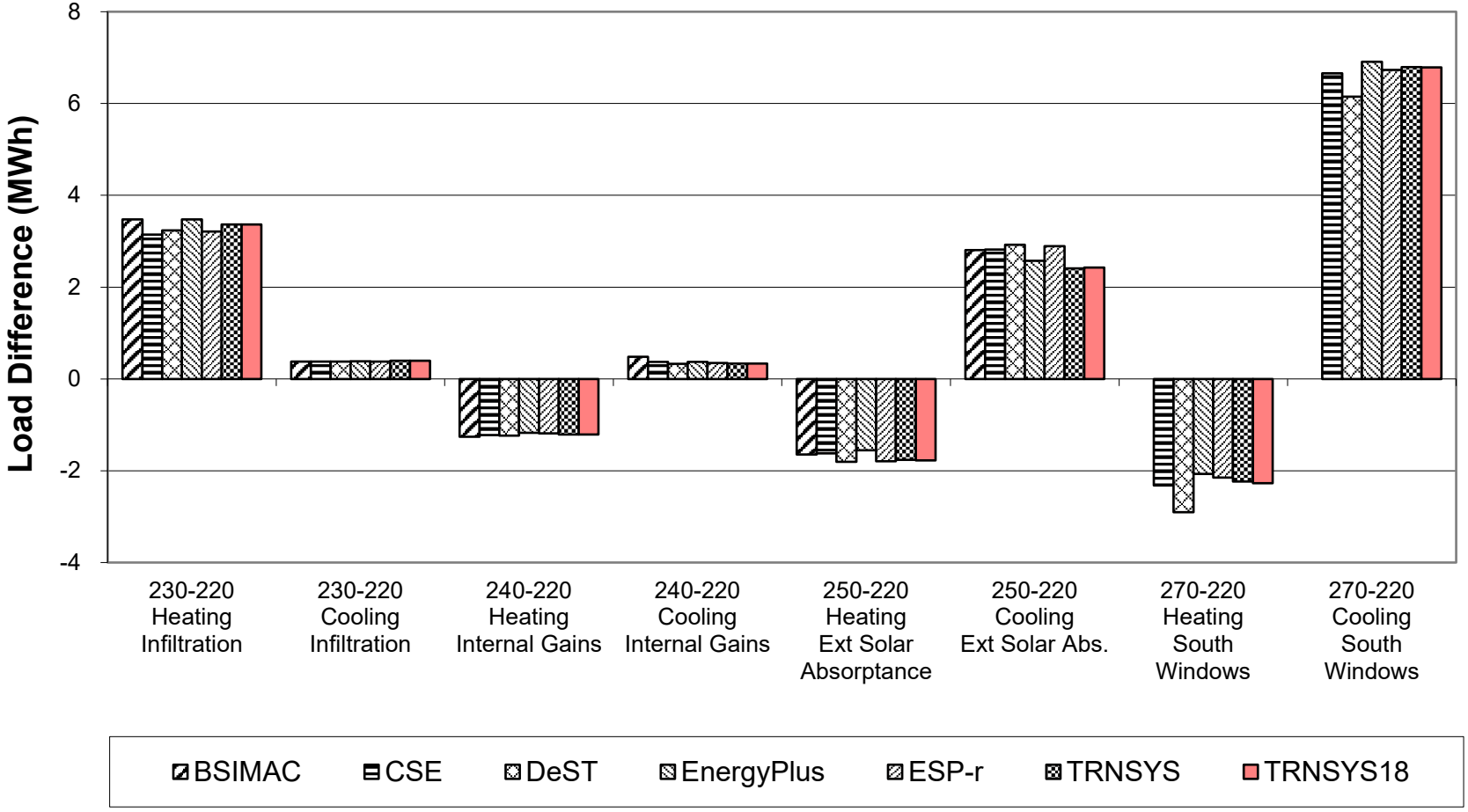


Figure B8-47. In-Depth: Cases 220 to 270 (Delta) Peak Heating and Sensible Cooling

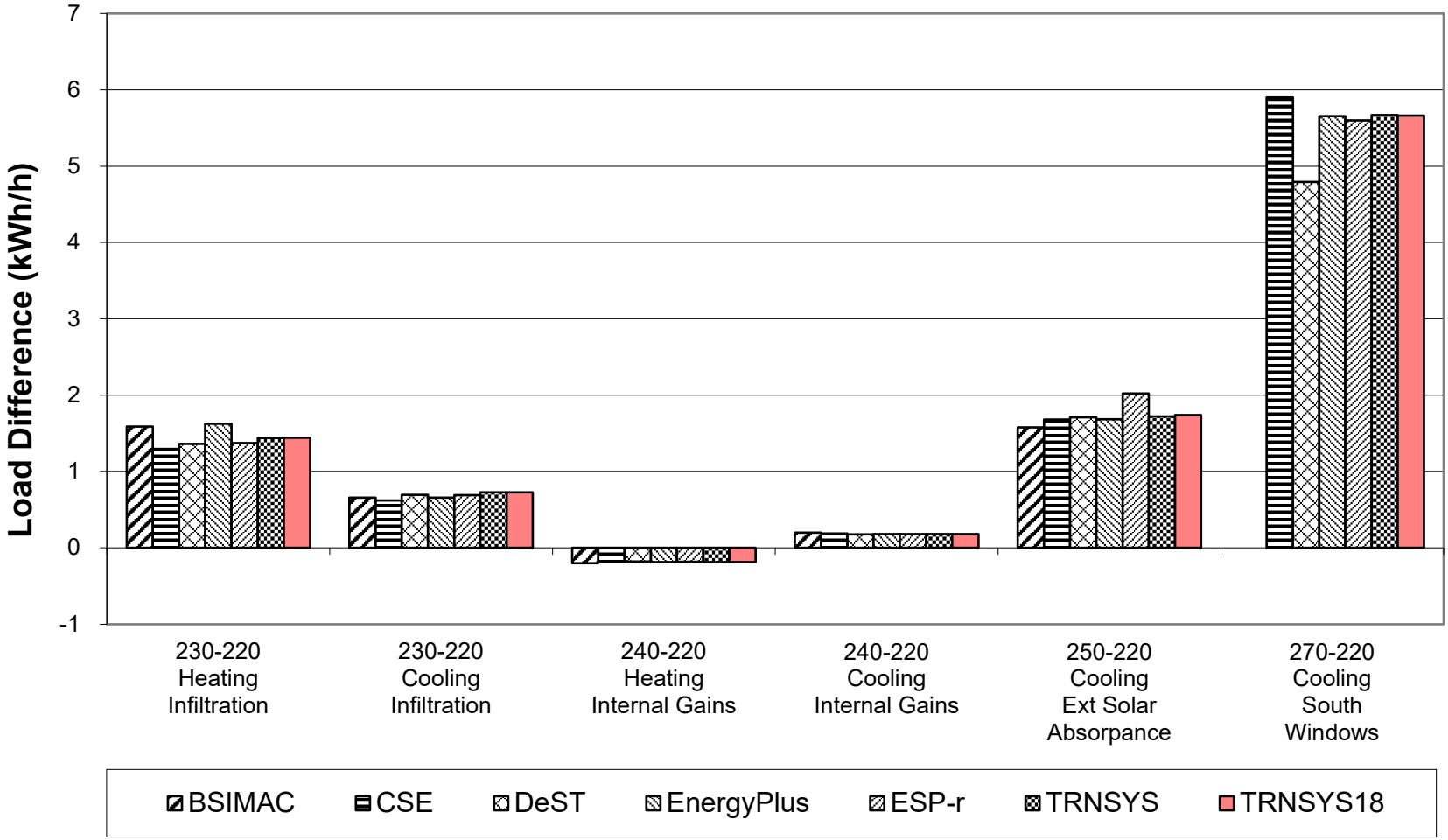


Figure B8-48. In-Depth: Cases 270 to 320 (Delta) Annual Heating and Sensible Cooling

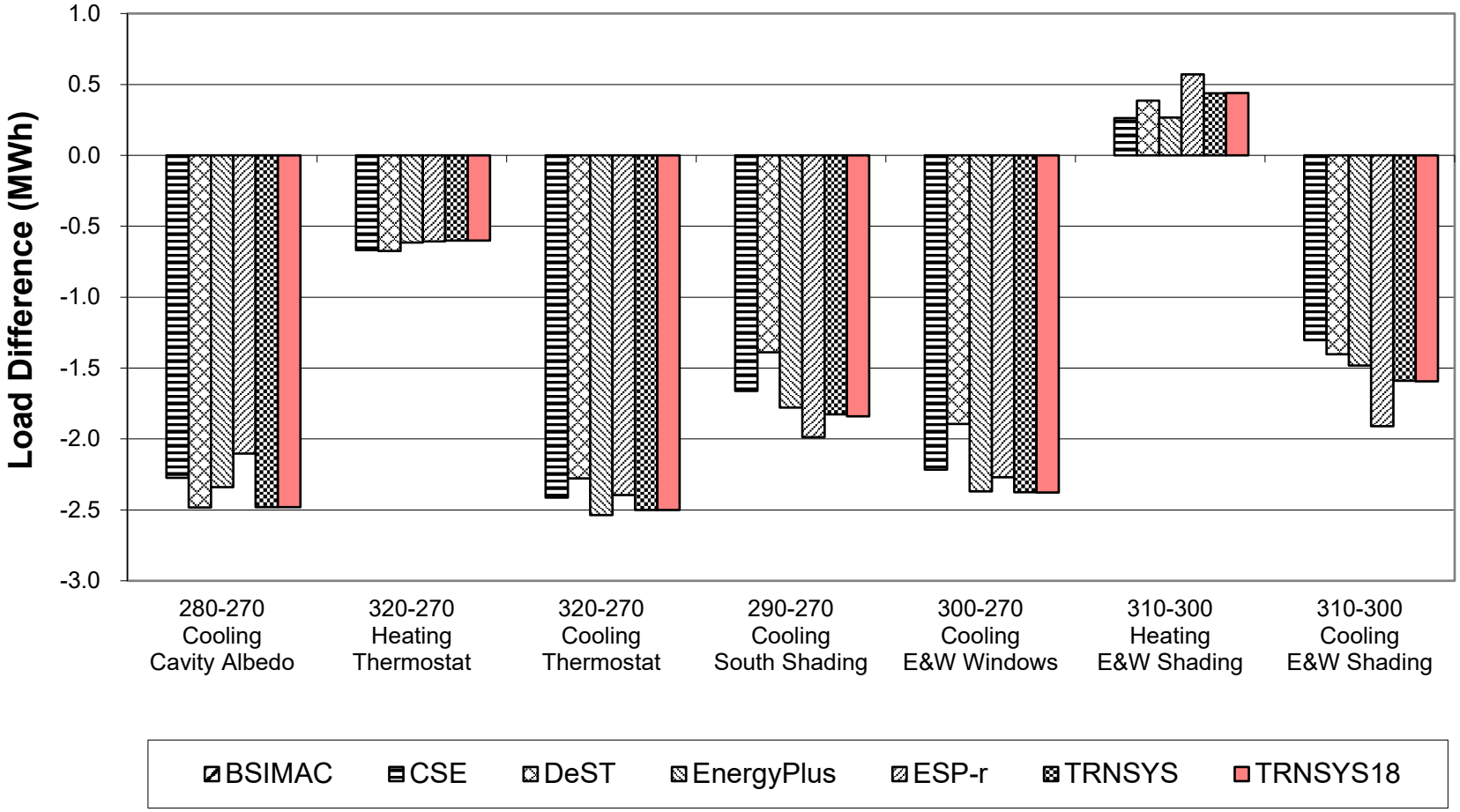


Figure B8-49. In-Depth: Cases 270 to 320 (Delta) Peak Sensible Cooling

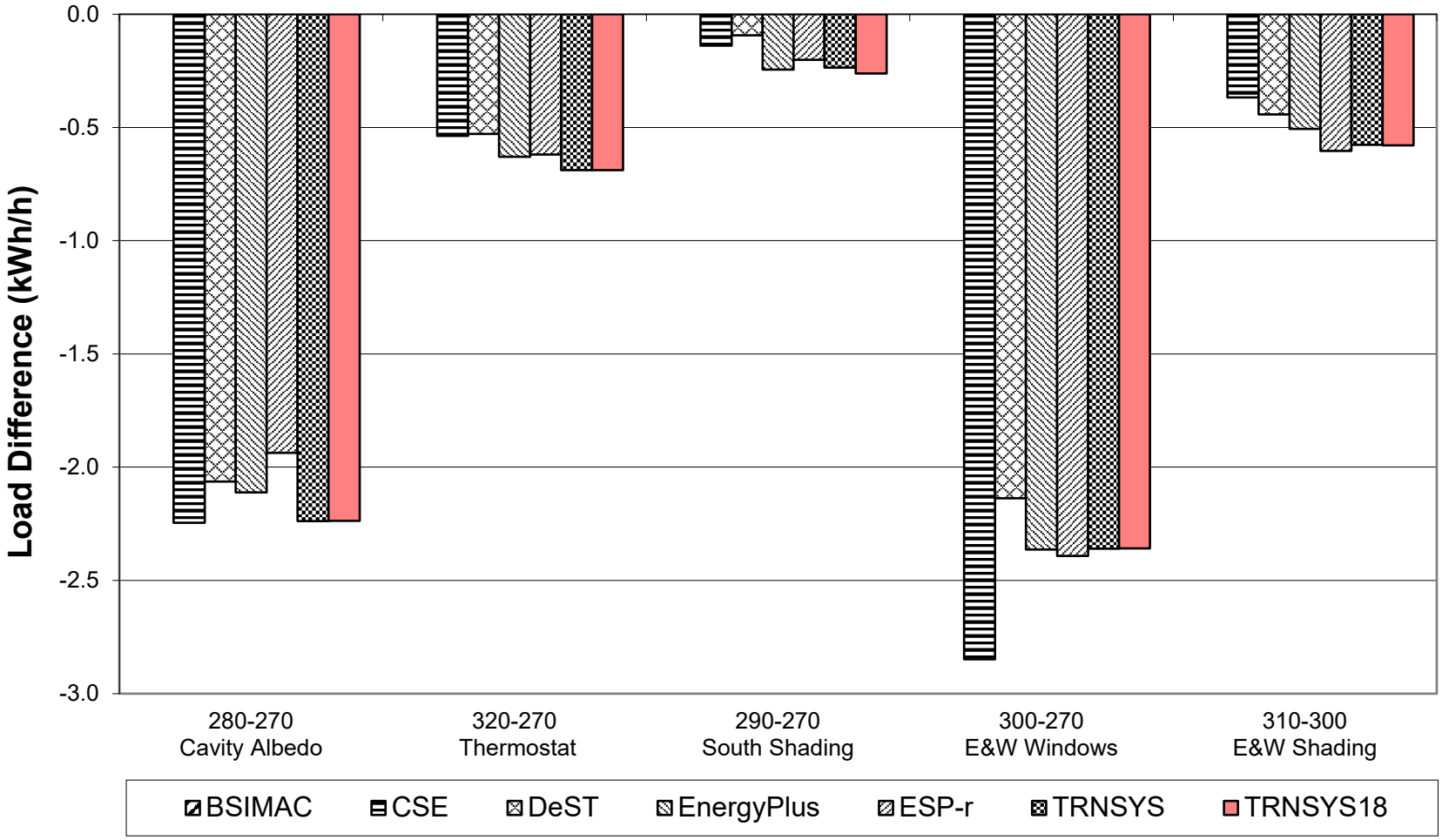


Figure B8-50. In-Depth: Cases 395 to 440, 800, 810 Annual Heating

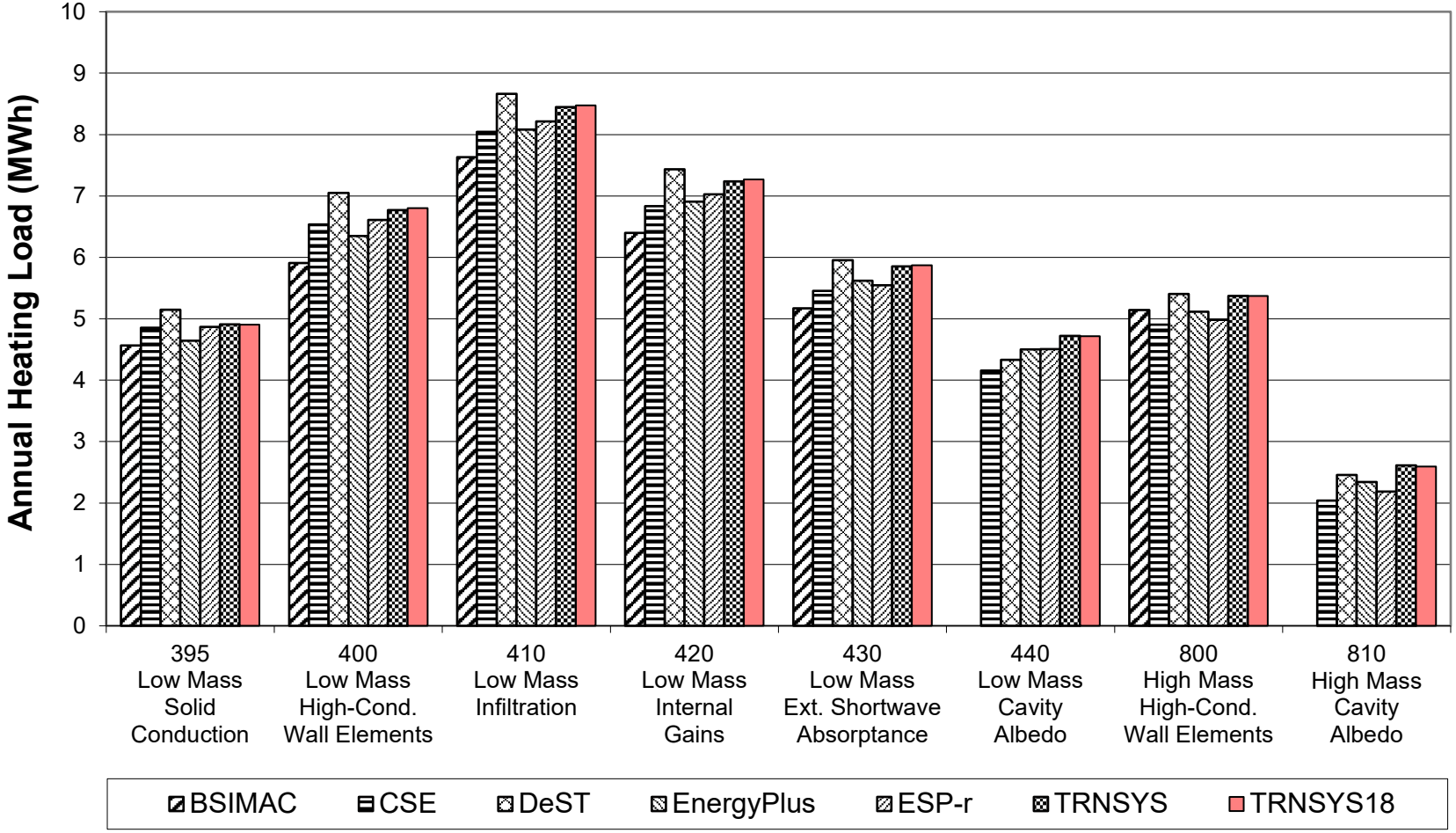


Figure B8-51. In-Depth: Cases 395 to 440, 800, 810 Annual Sensible Cooling

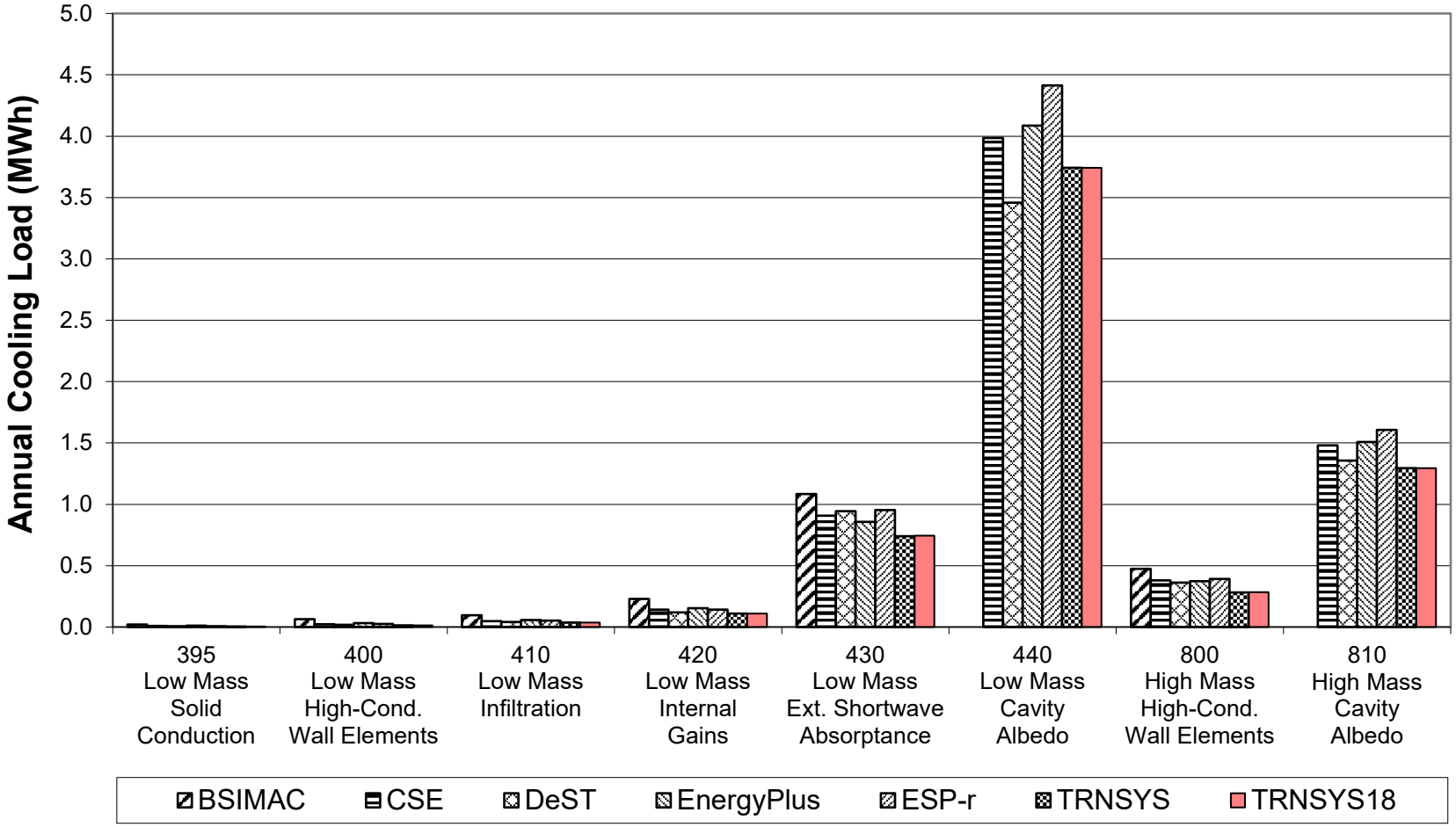


Figure B8-52. In-Depth: Cases 395 to 440, 800, 810 Peak Heating

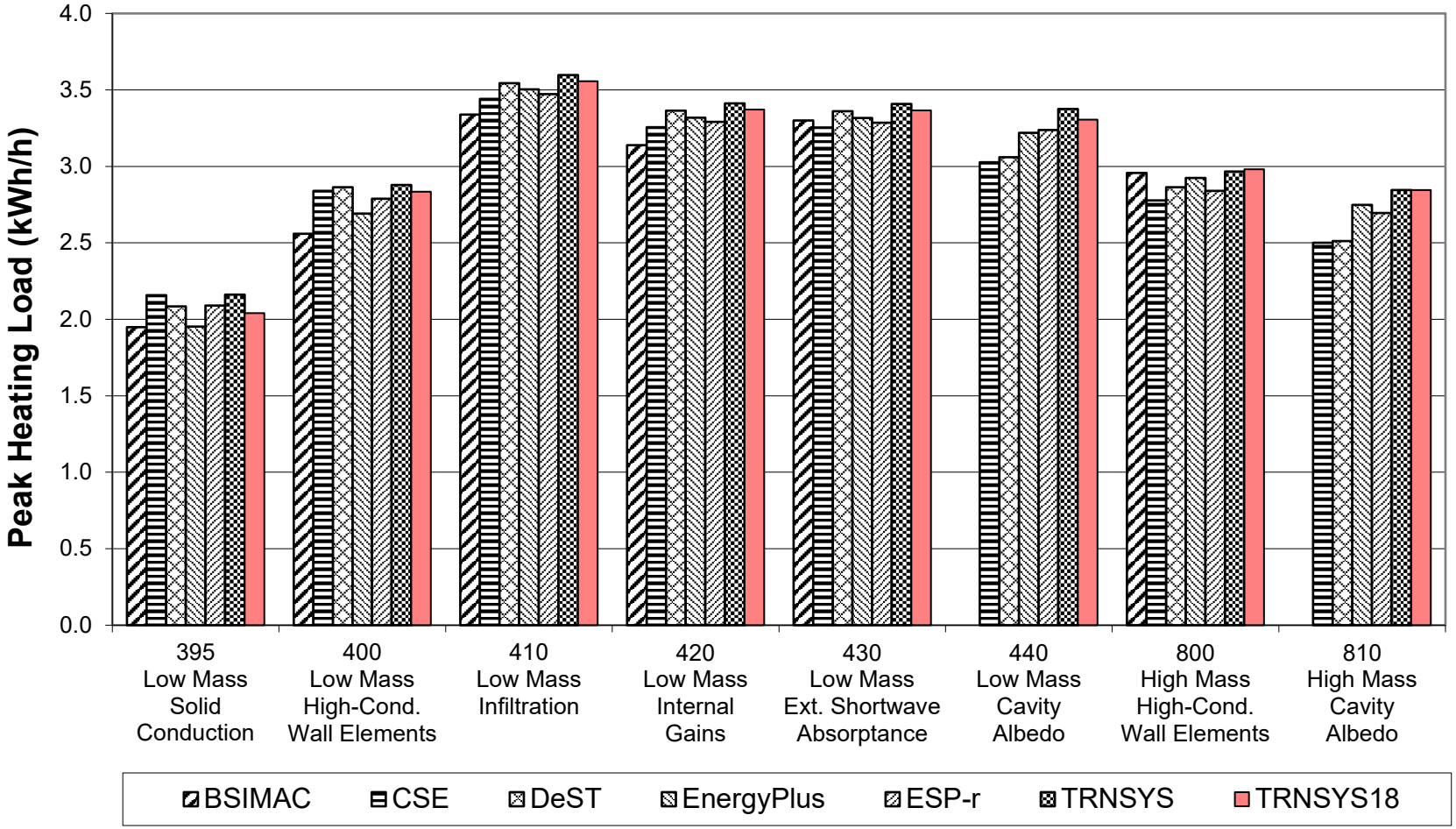


Figure B8-53. In-Depth: Cases 395 to 440, 800, 810 Peak Sensible Cooling

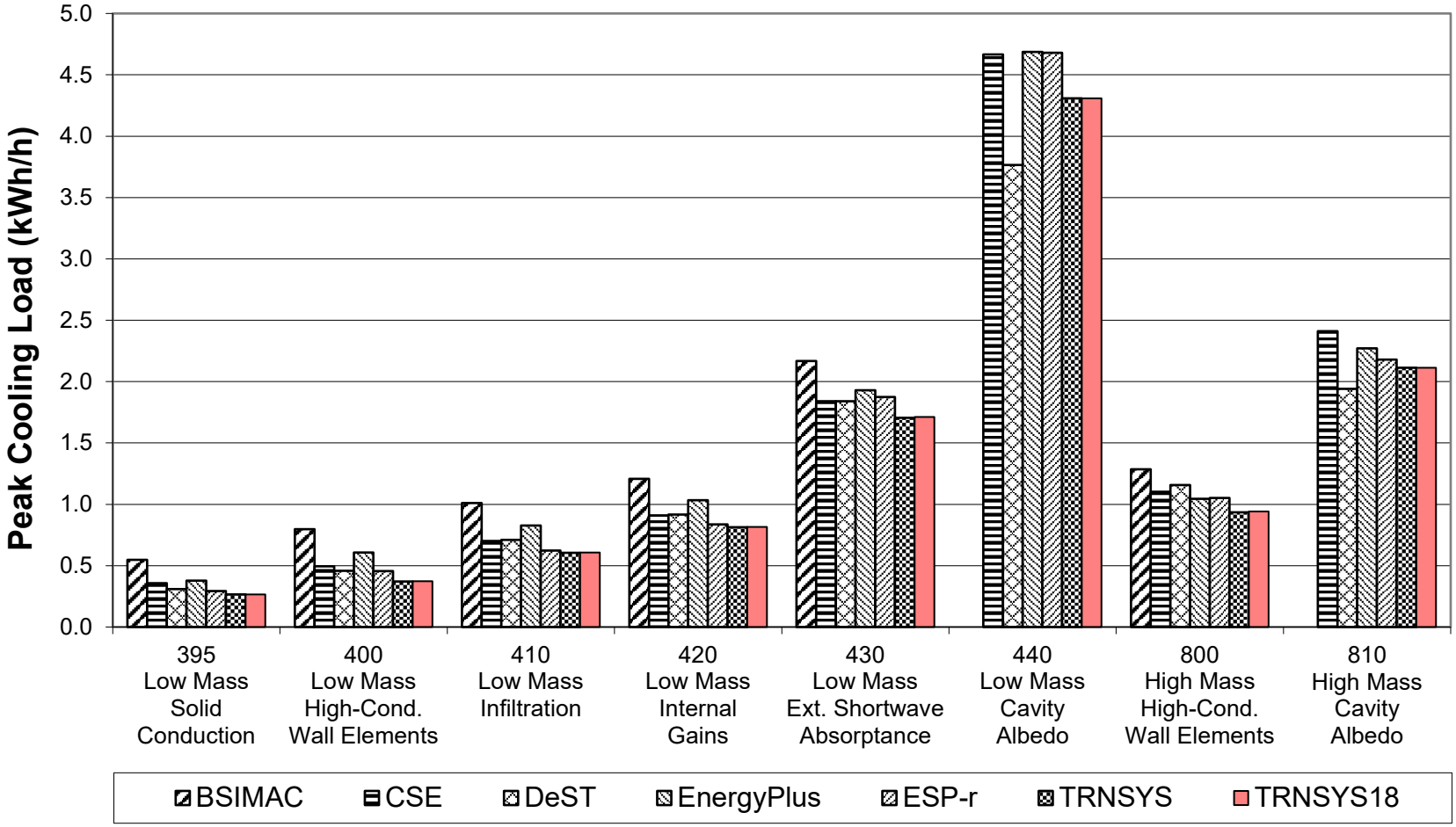


Figure B8-54. In-Depth: Cases 395 to 600, 810 to 900 (Delta) Annual Heating and Sensible Cooling

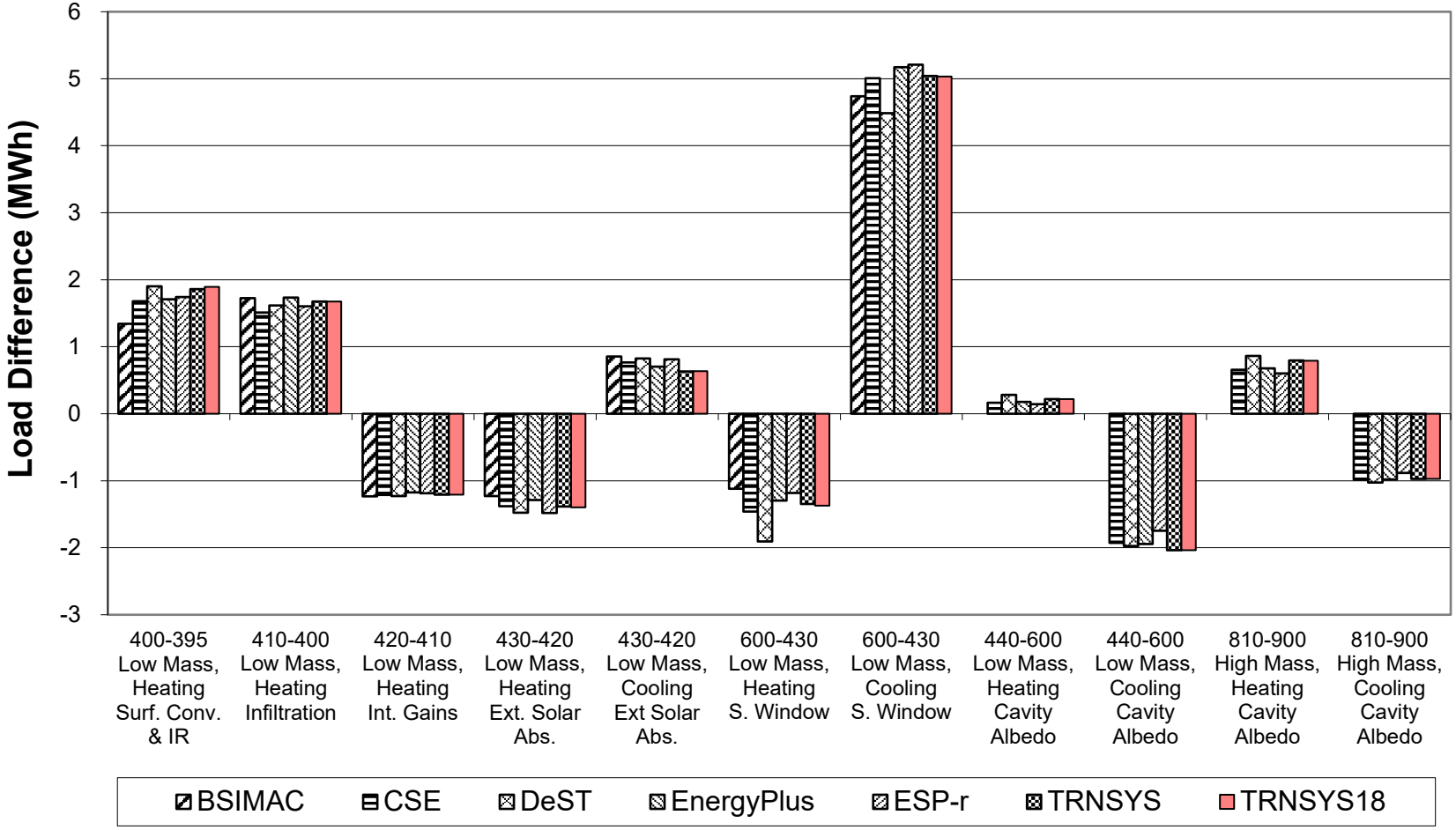


Figure B8-55. In-Depth: Cases 395 to 600, 810 to 900 (Delta) Peak Heating and Sensible Cooling

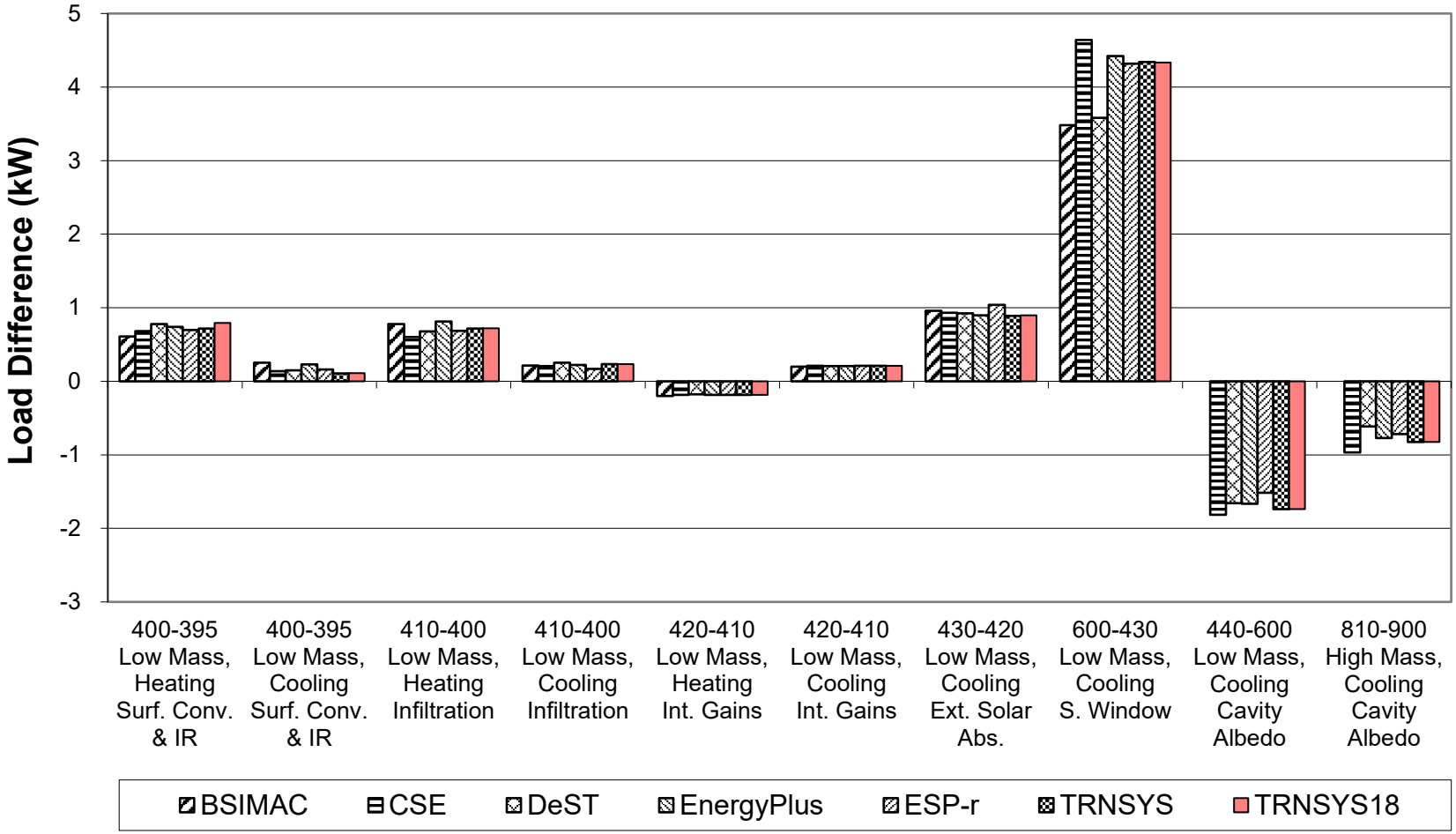


Figure B8-56. In-Depth: Surface Heat Transfer Cases 600, 450, 460, 470 Annual Heating and Sensible Cooling

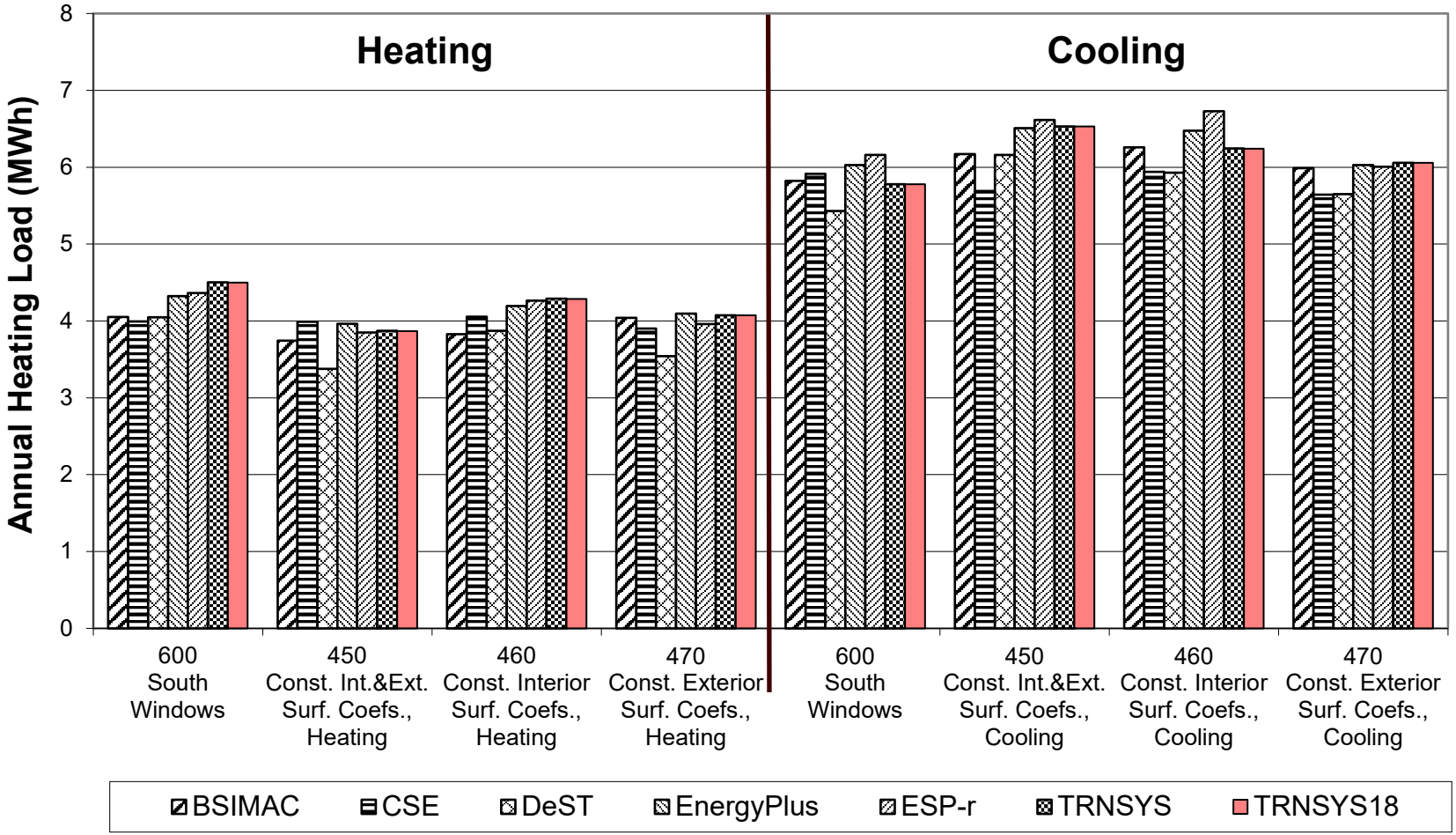


Figure B8-57. In-Depth: Surface Heat Transfer Cases 600, 450, 460, 470 Peak Heating and Sensible Cooling

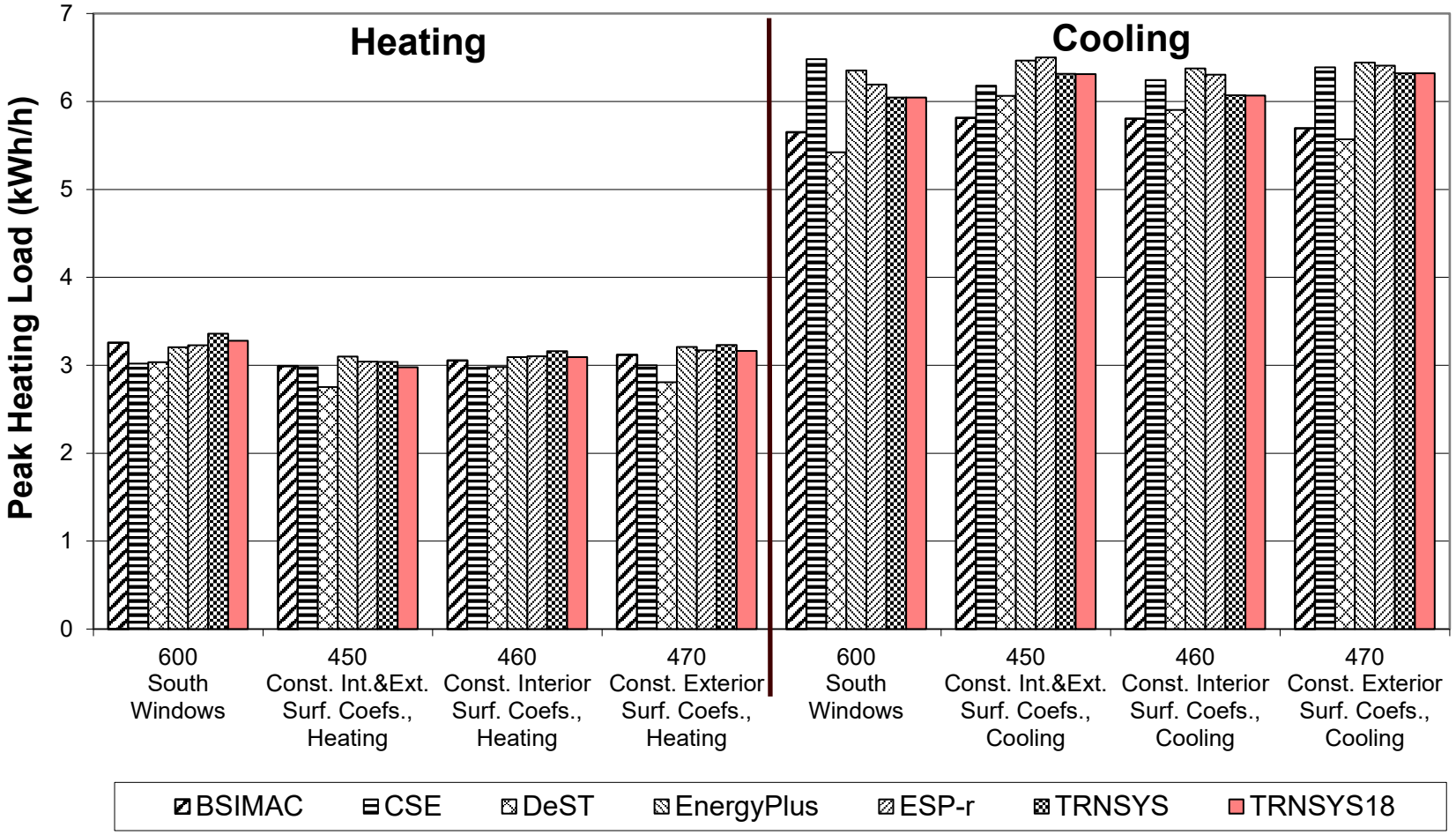


Figure B8-58. In-Depth: Surface Heat Transfer Cases 450 to 600 (Delta) Annual Heating and Sensible Cooling

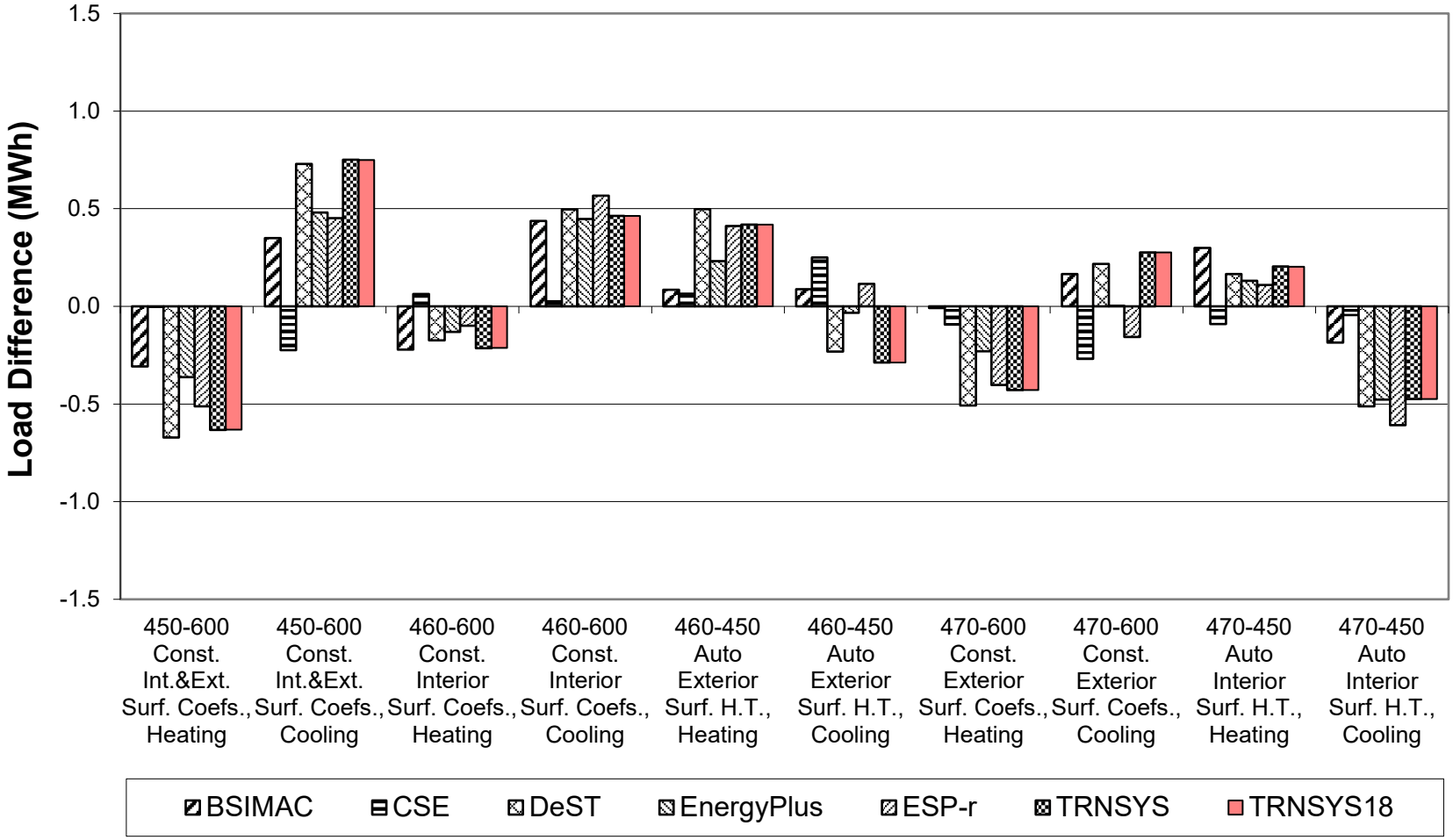


Figure B8-59. In-Depth: Surface Heat Transfer Cases 450 to 600 (Delta) Peak Heating and Sensible Cooling

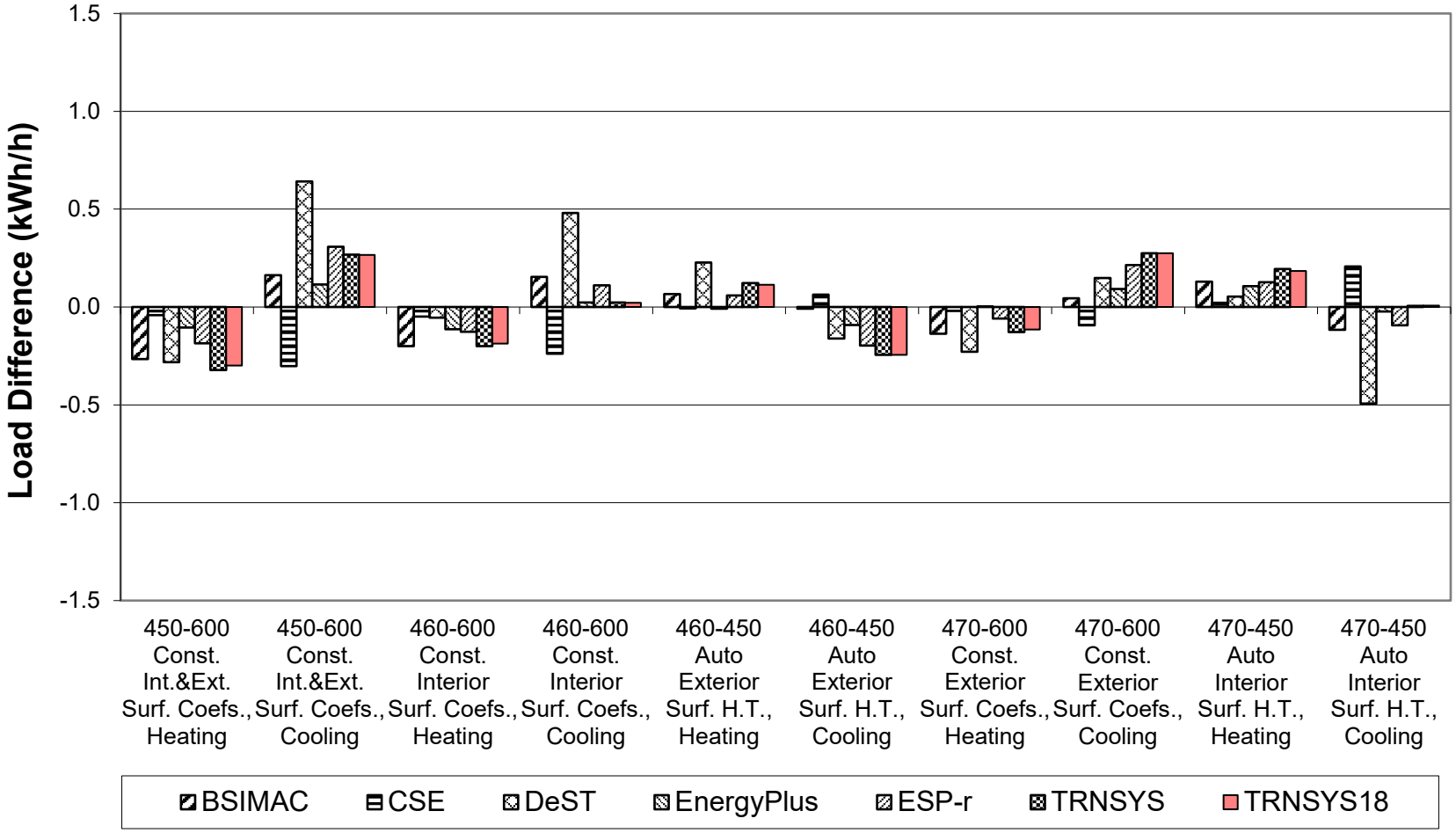


Figure B8-M1.
Monthly Heating
Case 600

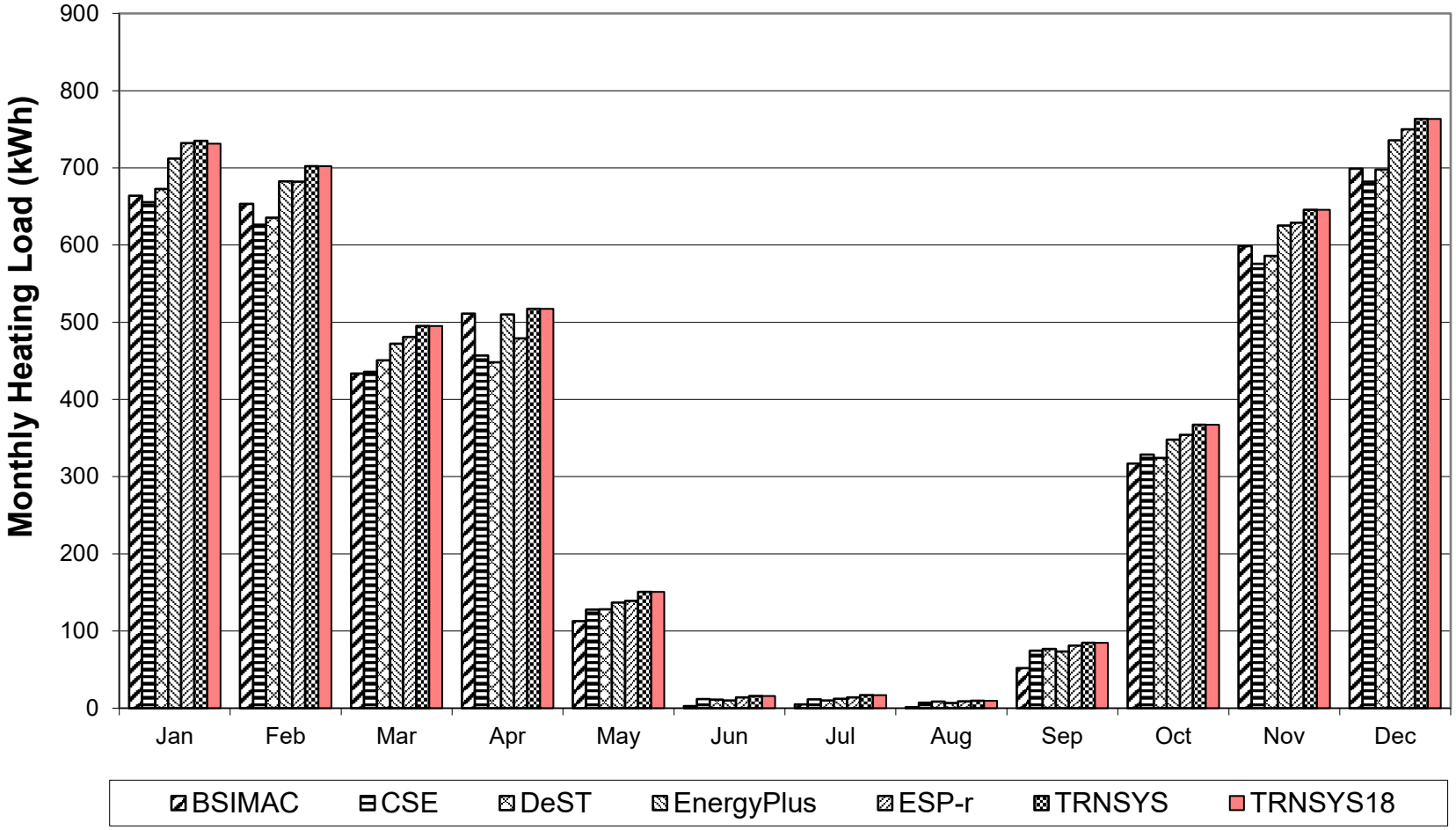


Figure B8-M2.
Monthly Sensible Cooling
Case 600

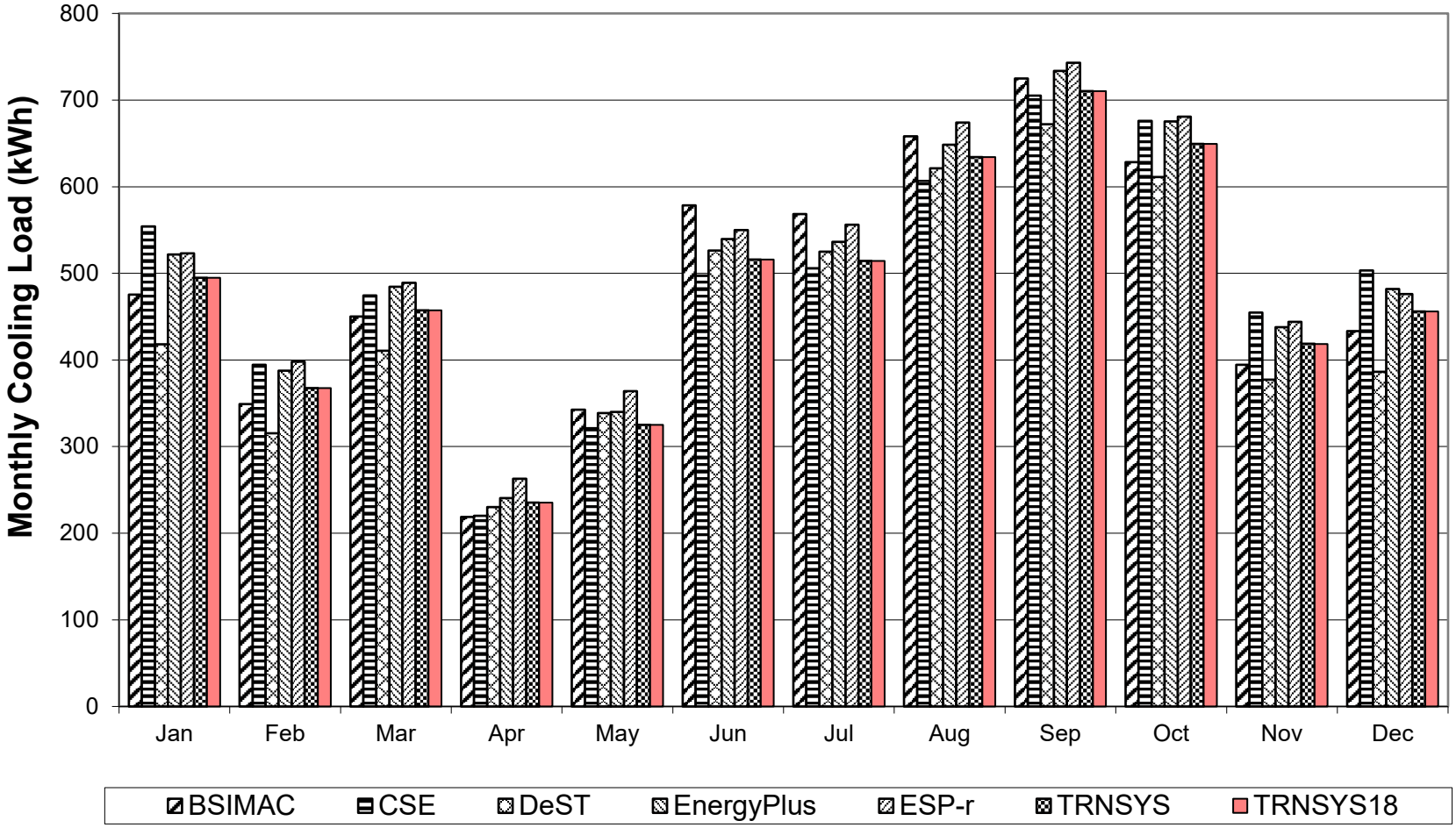


Figure B8-M3.
Monthly Peak Heating
Case 600

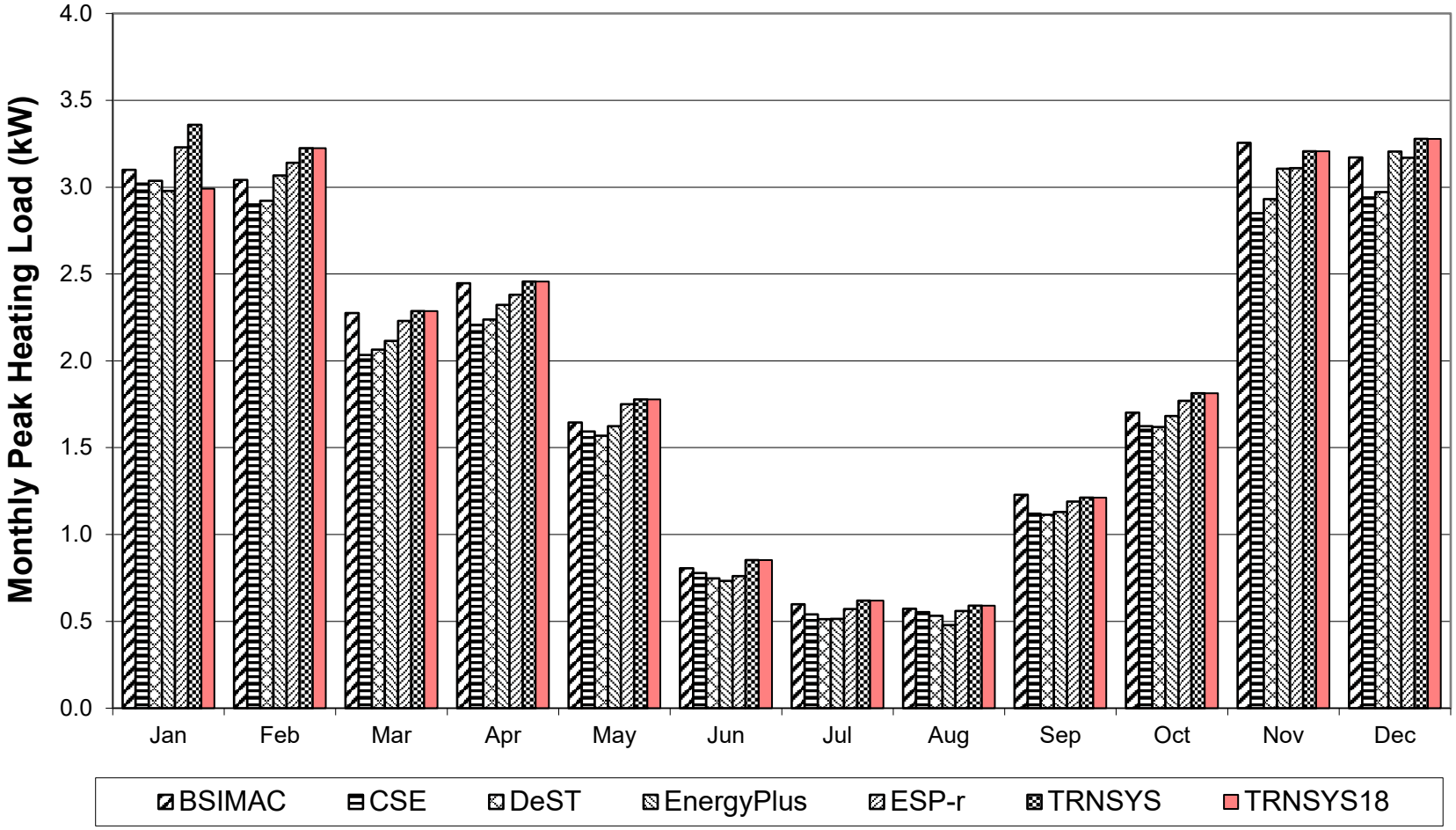


Figure B8-M4.
Monthly Peak Sensible Cooling
Case 600

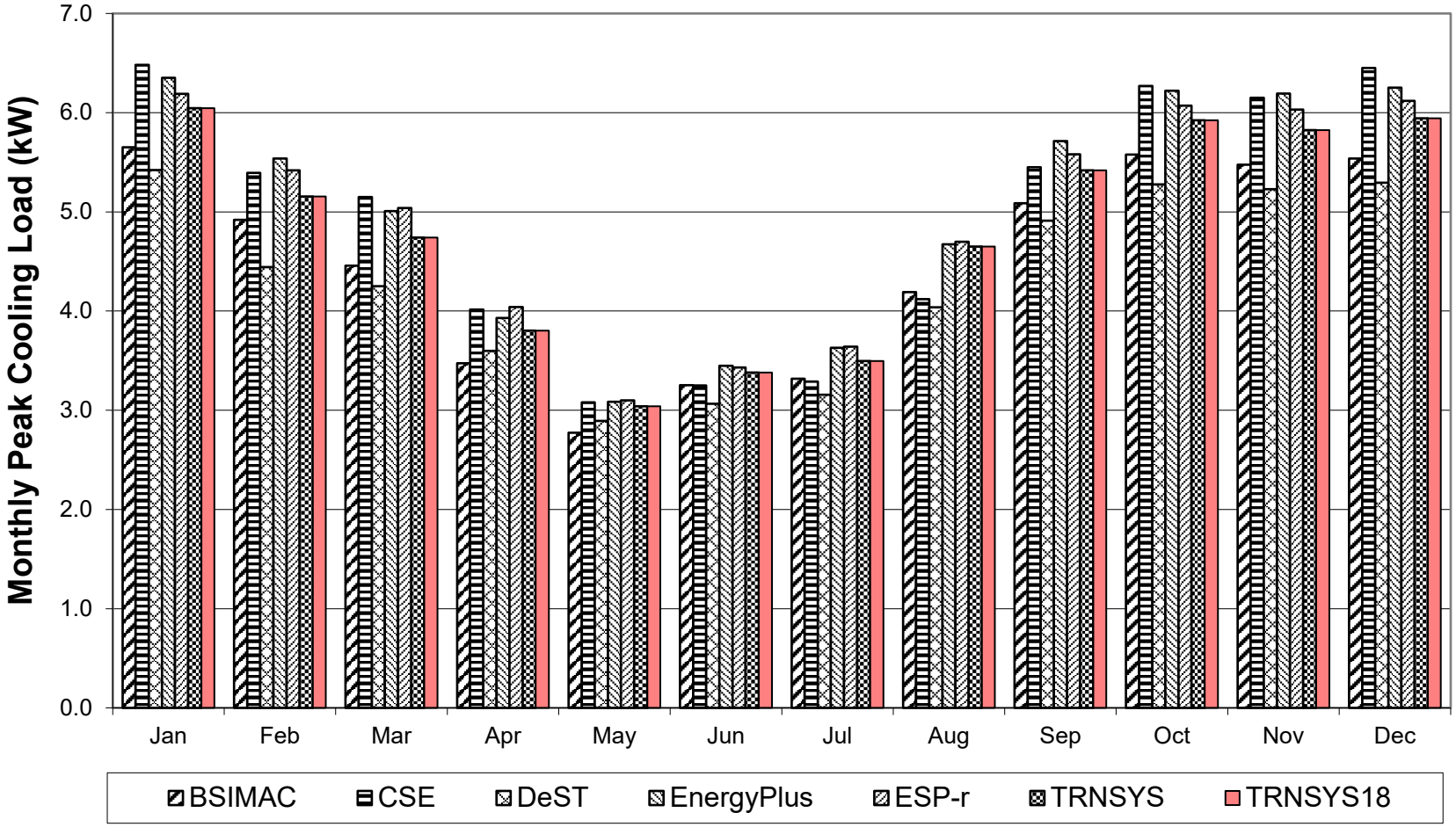


Figure B8-M5.
Monthly Heating
Case 900

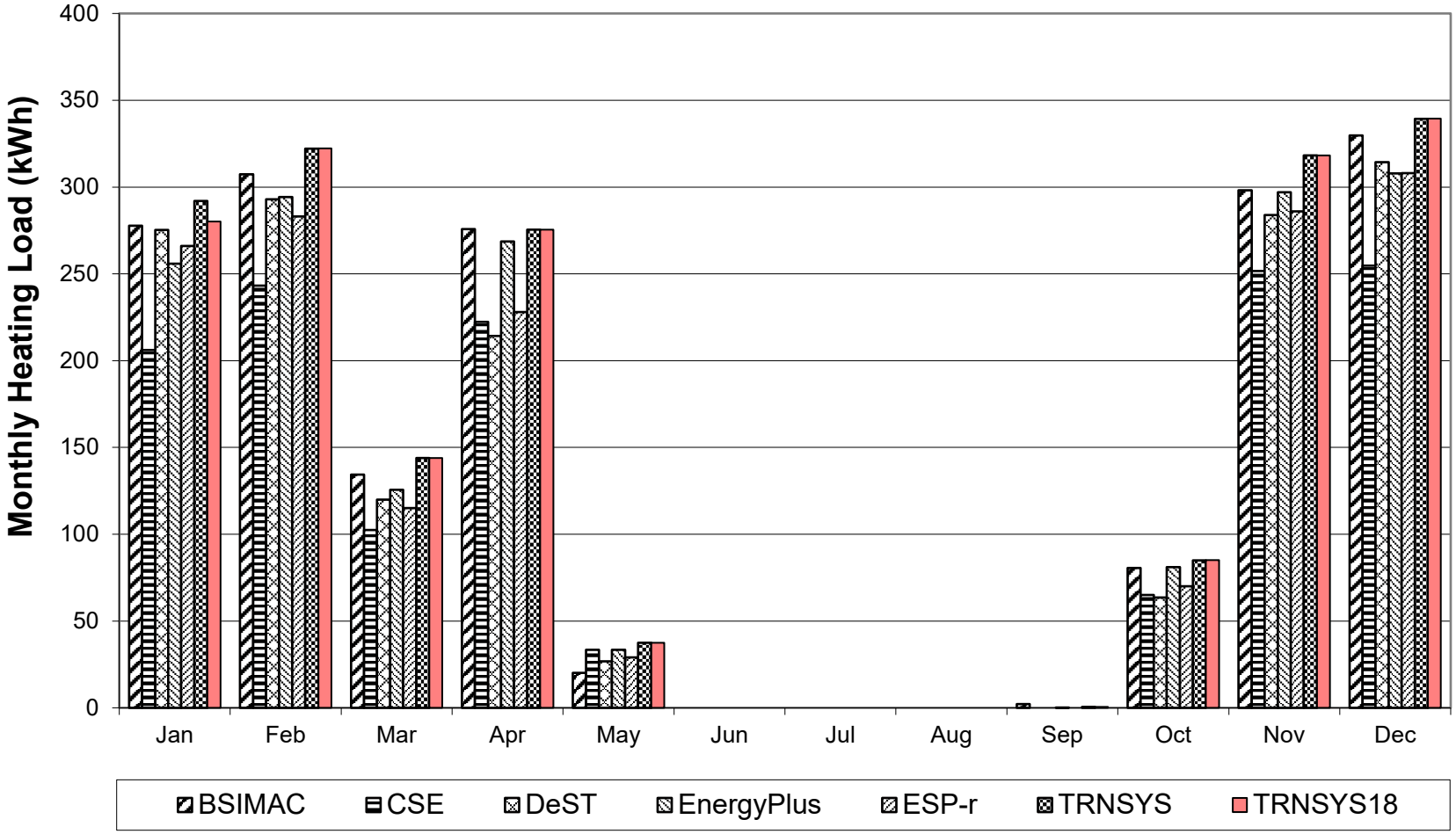


Figure B8-M6.
Monthly Sensible Cooling
Case 900

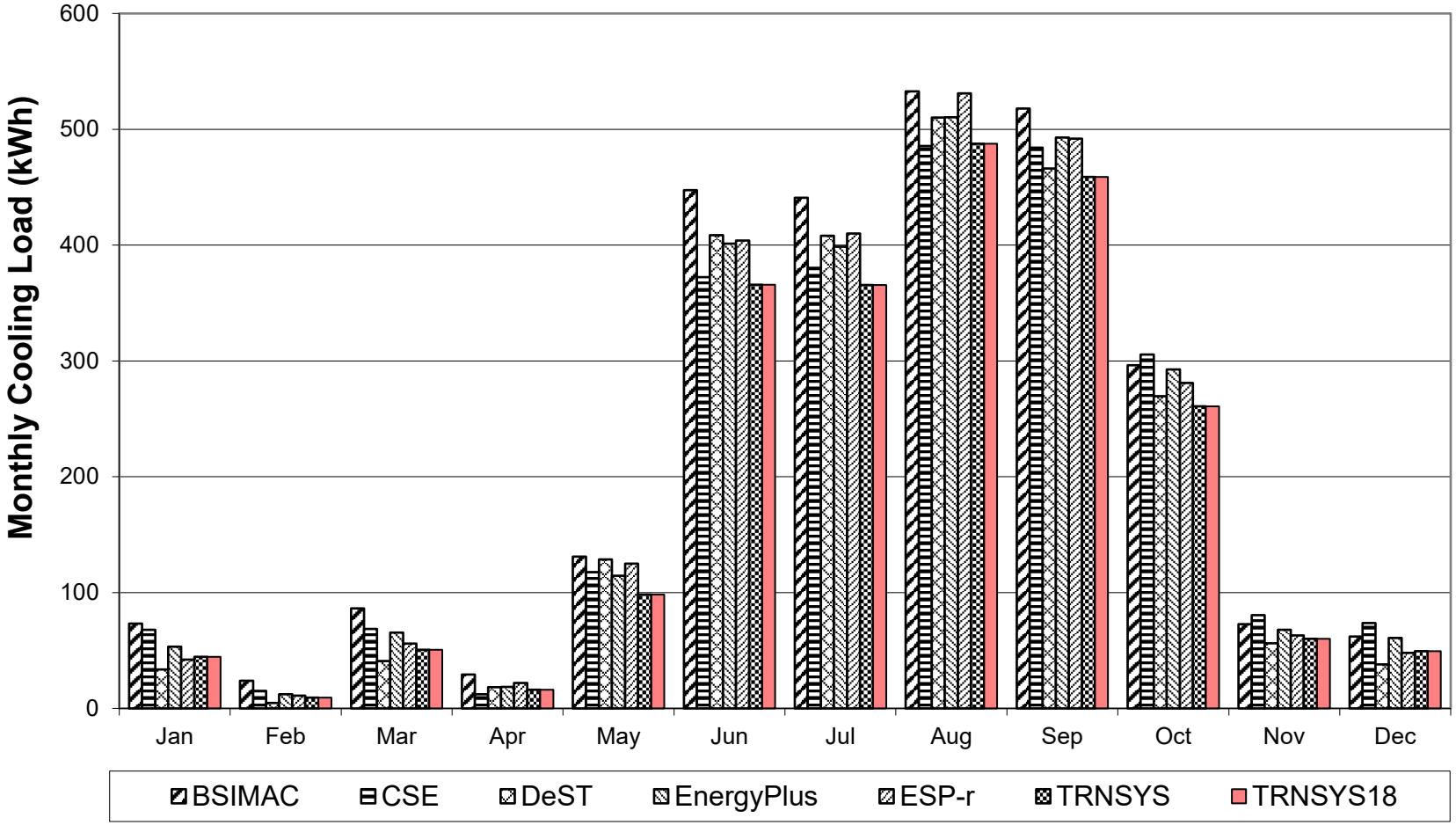


Figure B8-M7.
Monthly Peak Heating
Case 900

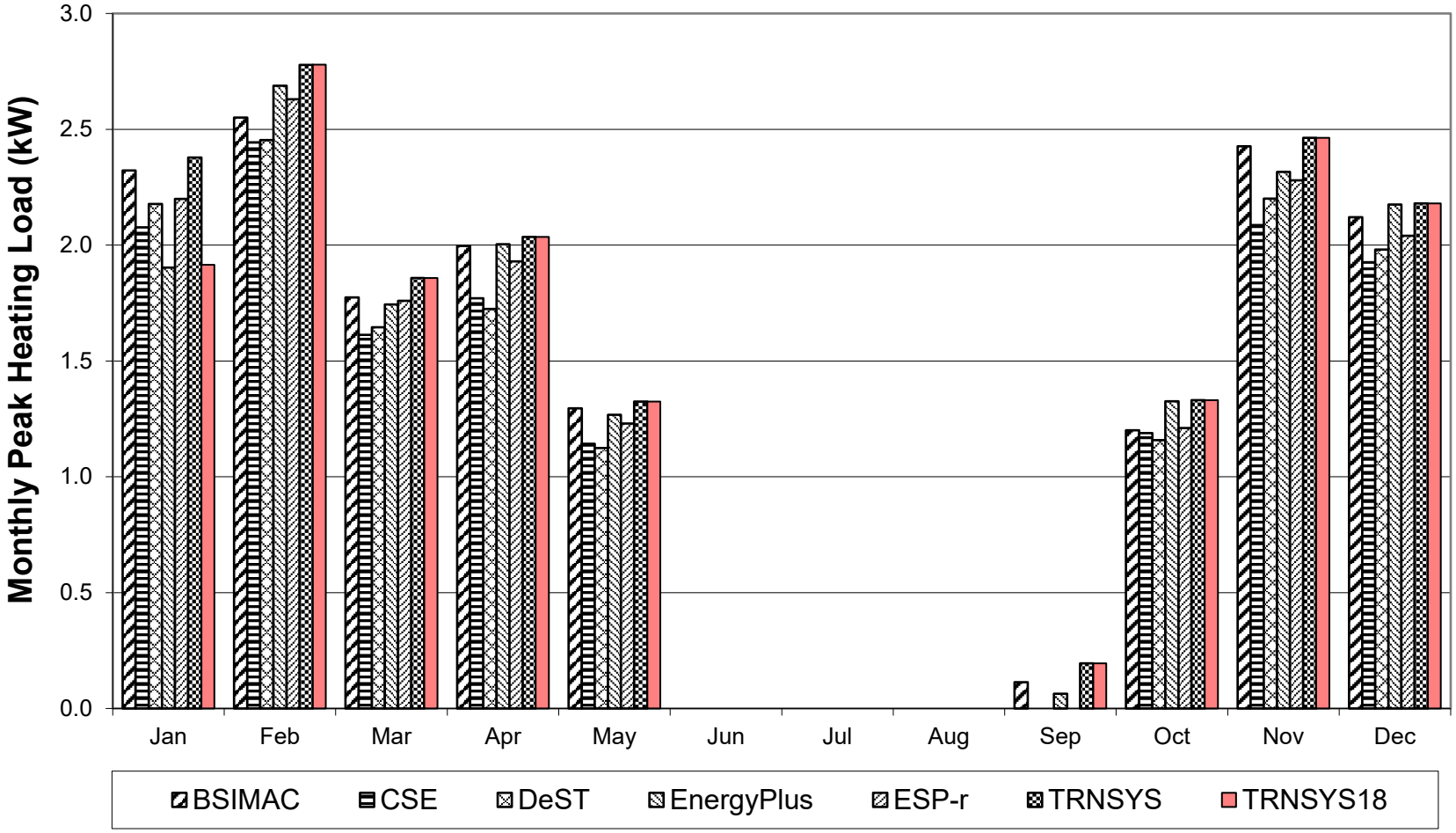


Figure B8-M8.
Monthly Peak Sensible Cooling
Case 900

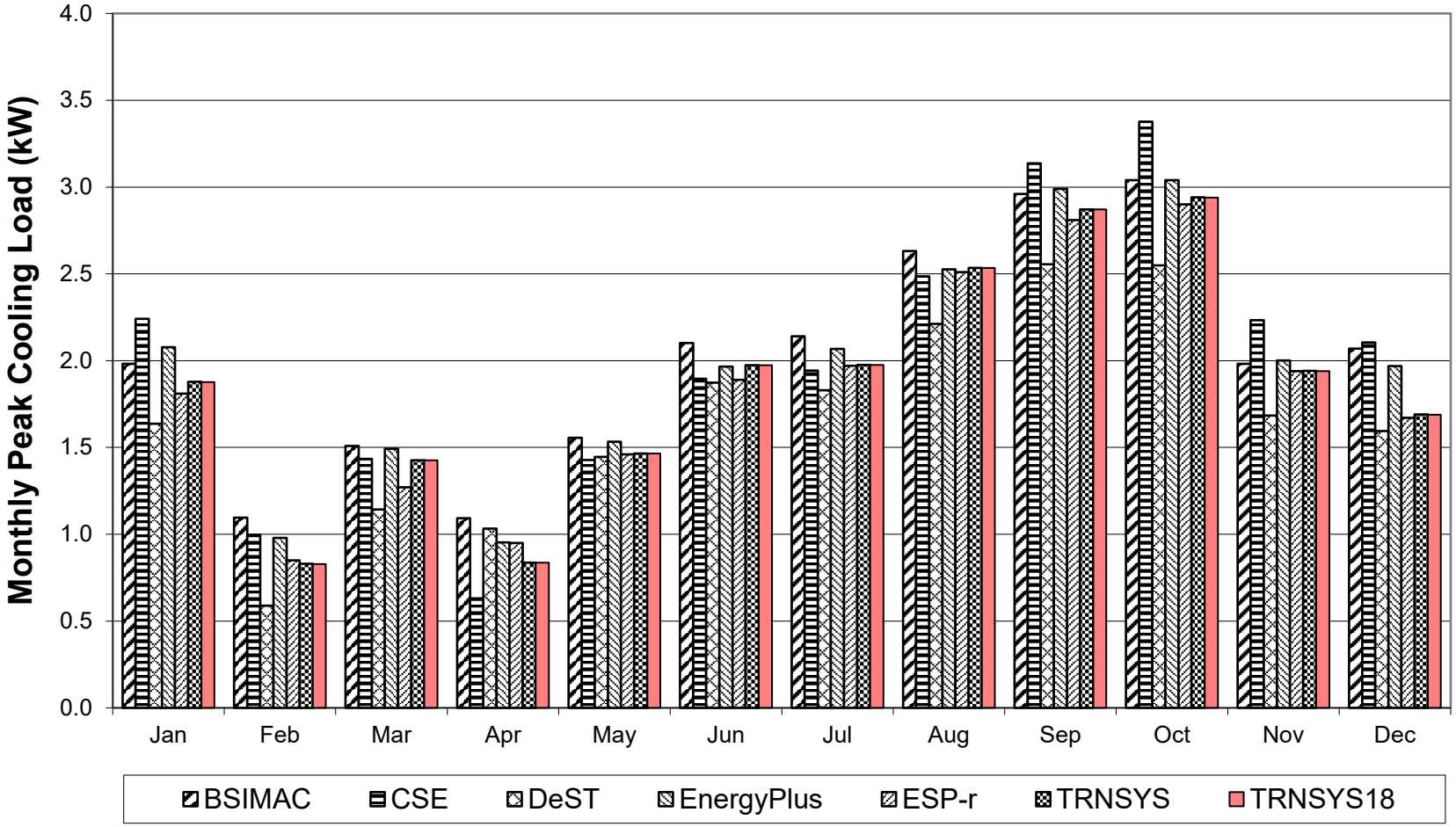


Figure B8-M9.
Monthly Heating Sensitivity (Delta)
Case 600-900

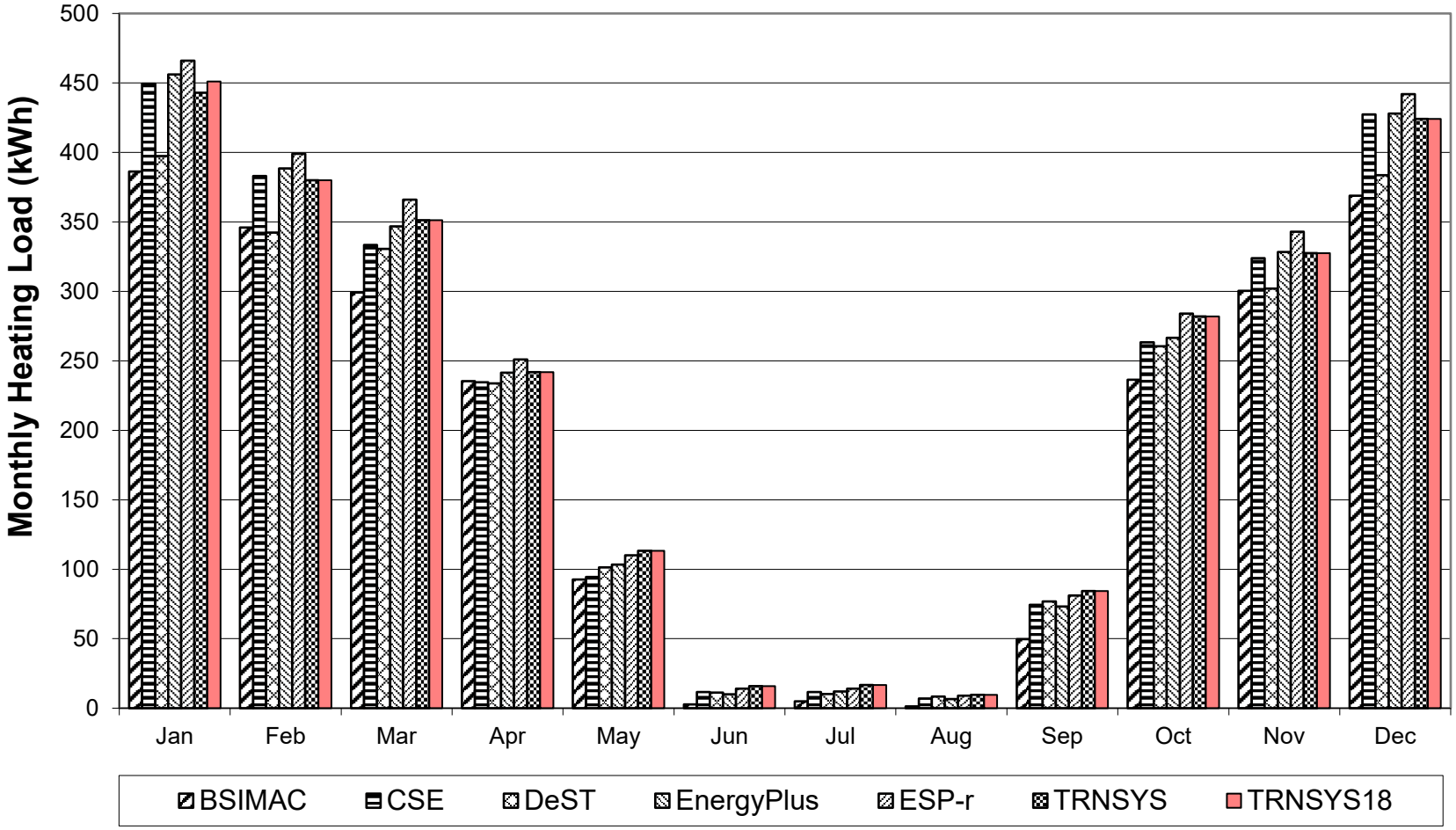


Figure B8-M10.
Monthly Cooling Sensitivity (Delta)
Case 600-900

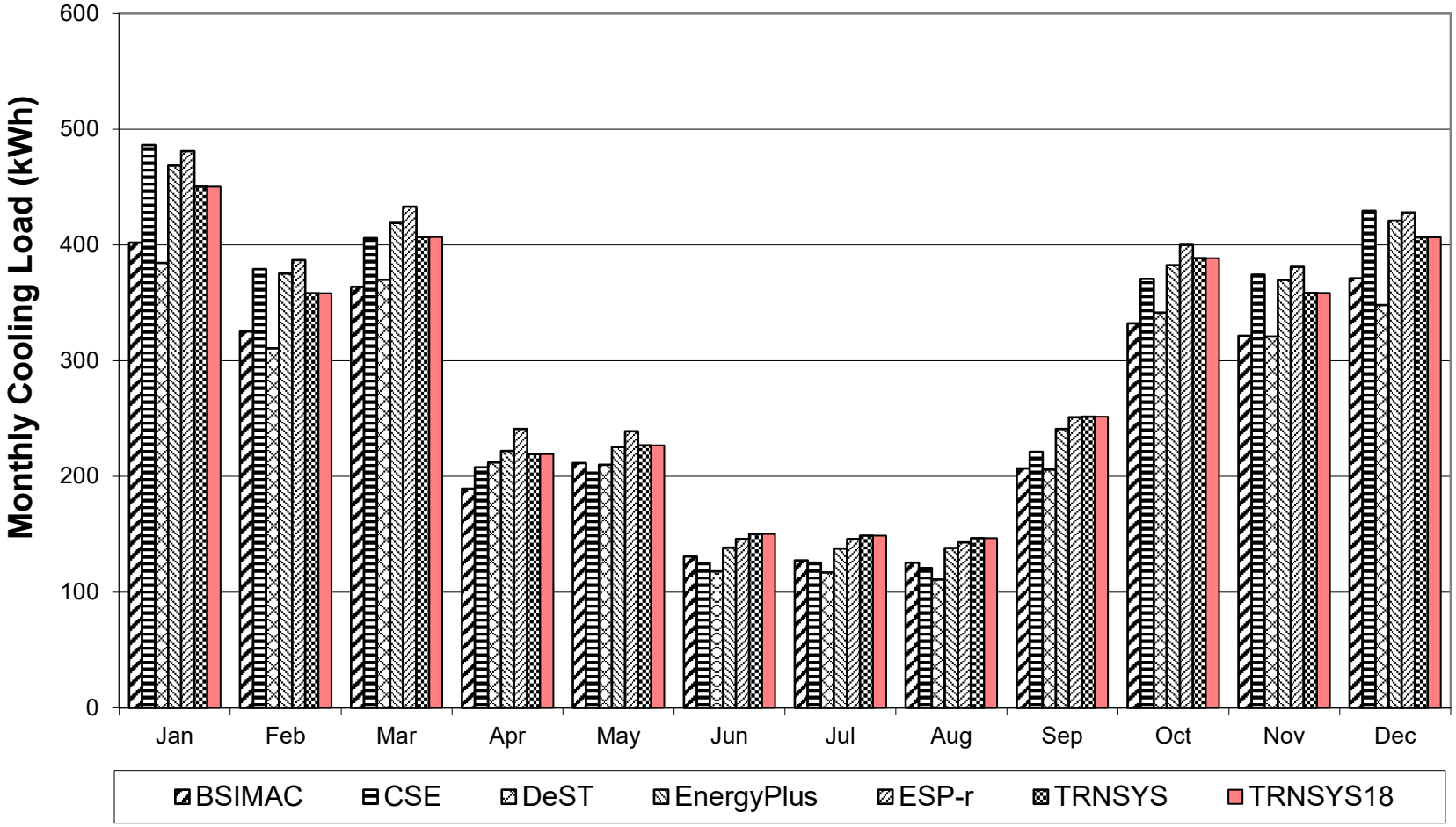


Figure B8-M11.
Monthly Peak Heating Sensitivity (Delta)
Case 600-900

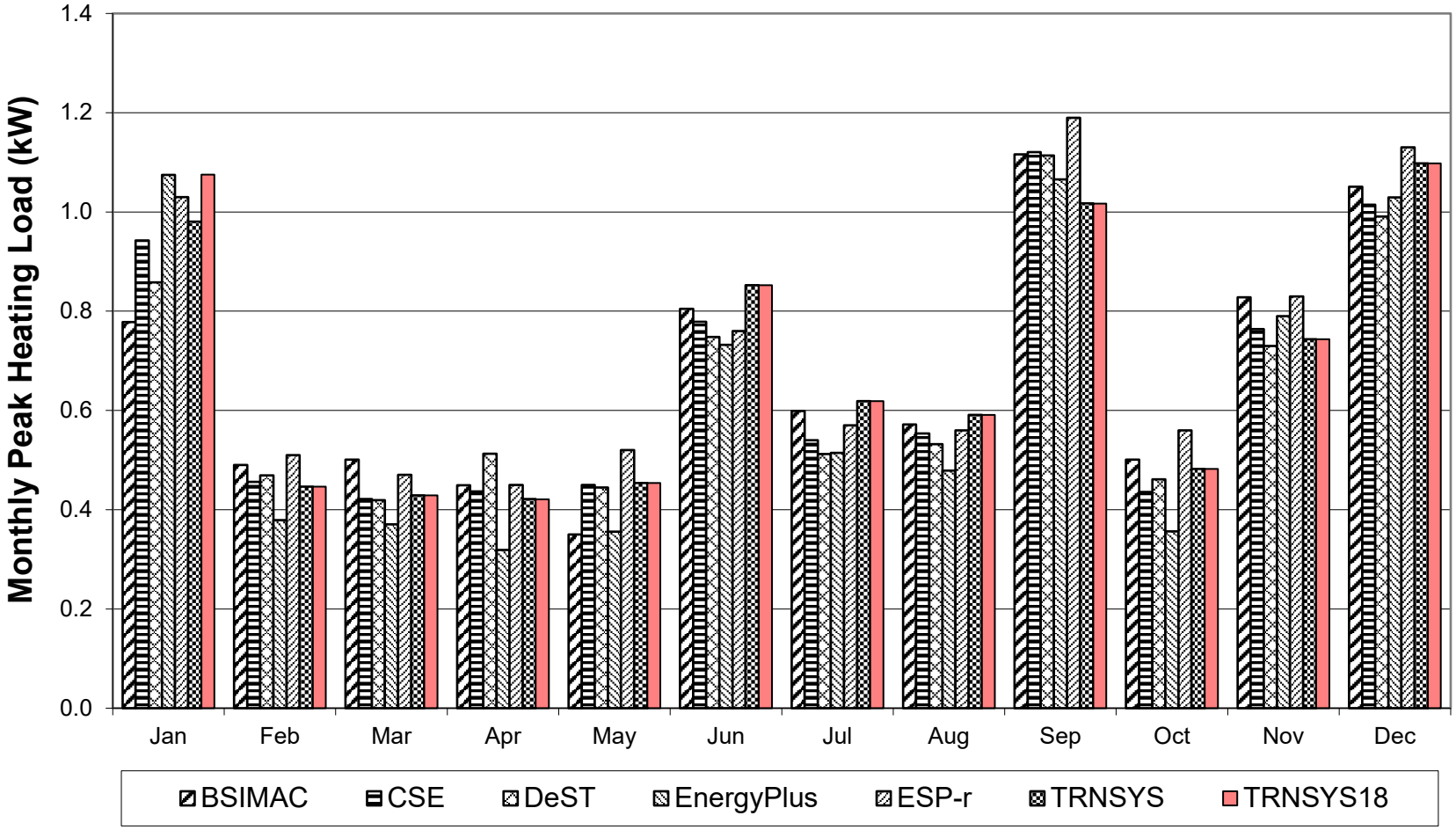


Figure B8-M12.
Monthly Peak Cooling Sensitivity (Delta)
Case 600-900

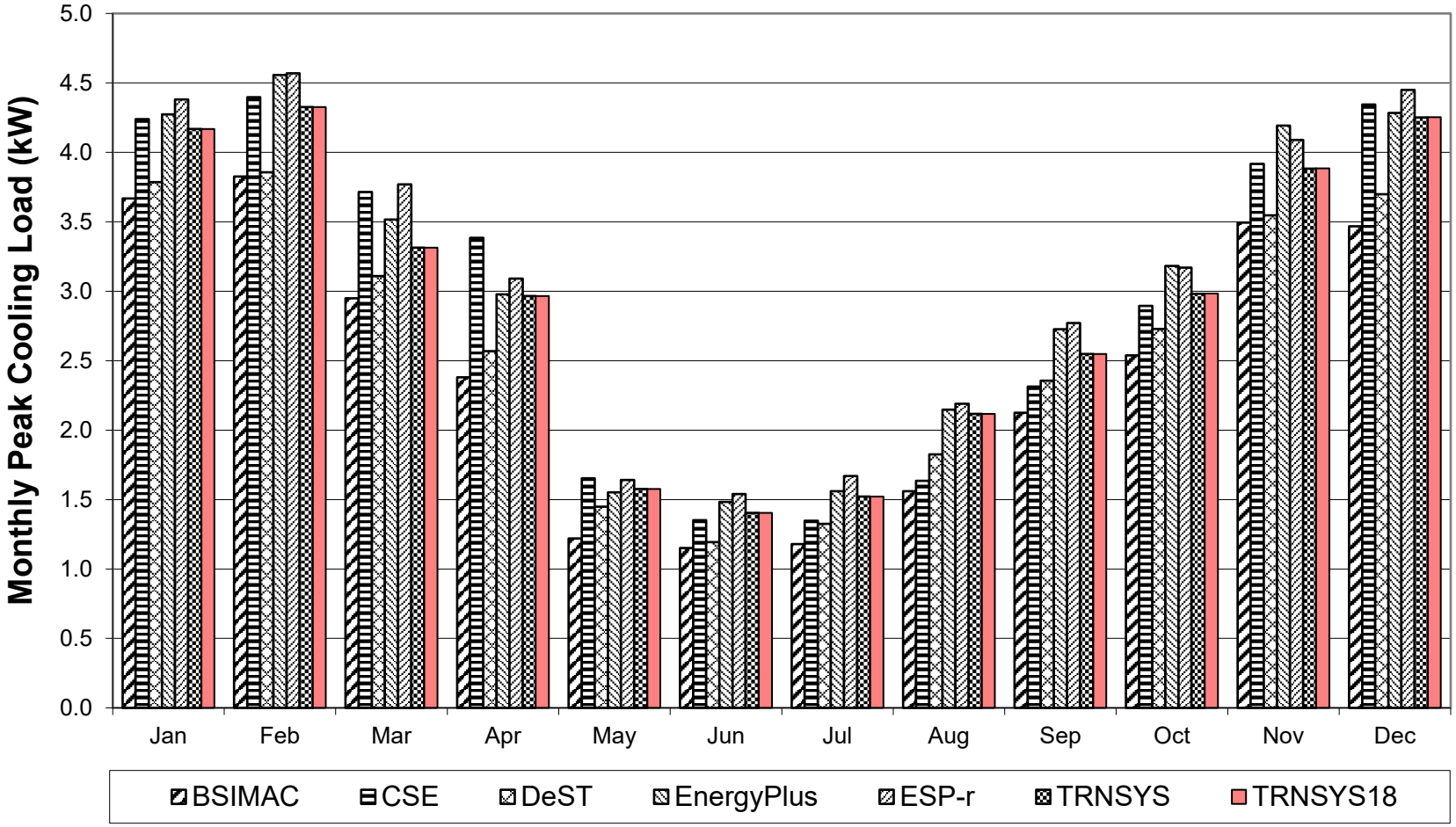


Figure B8-H1. Case 900FF
Annual Hourly Zone Air Temperature Frequency

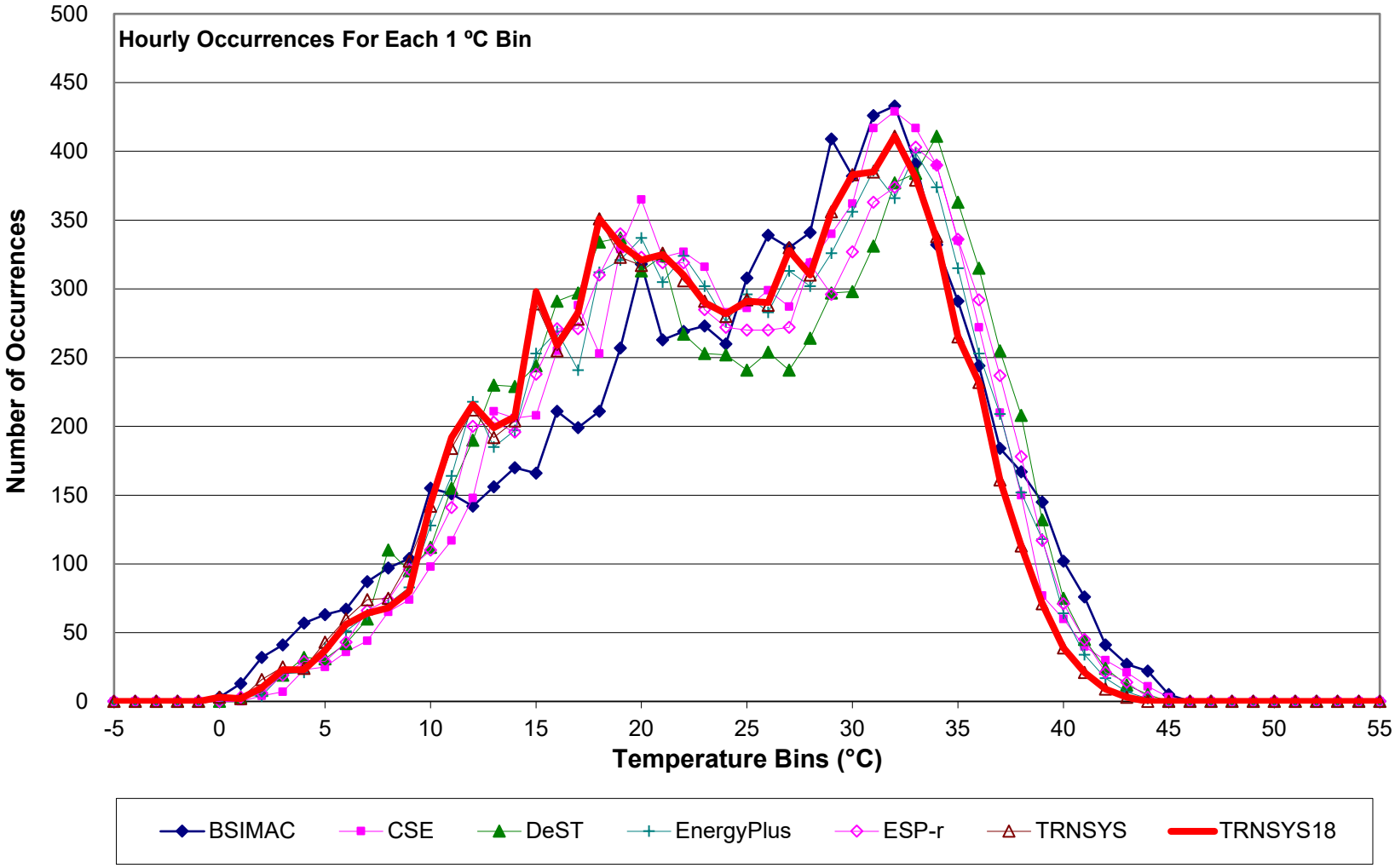


Figure B8-H2. Case 600
Cloudy & Clear Day Hourly Incident Solar
Horizontal (Upward) Facing Surface

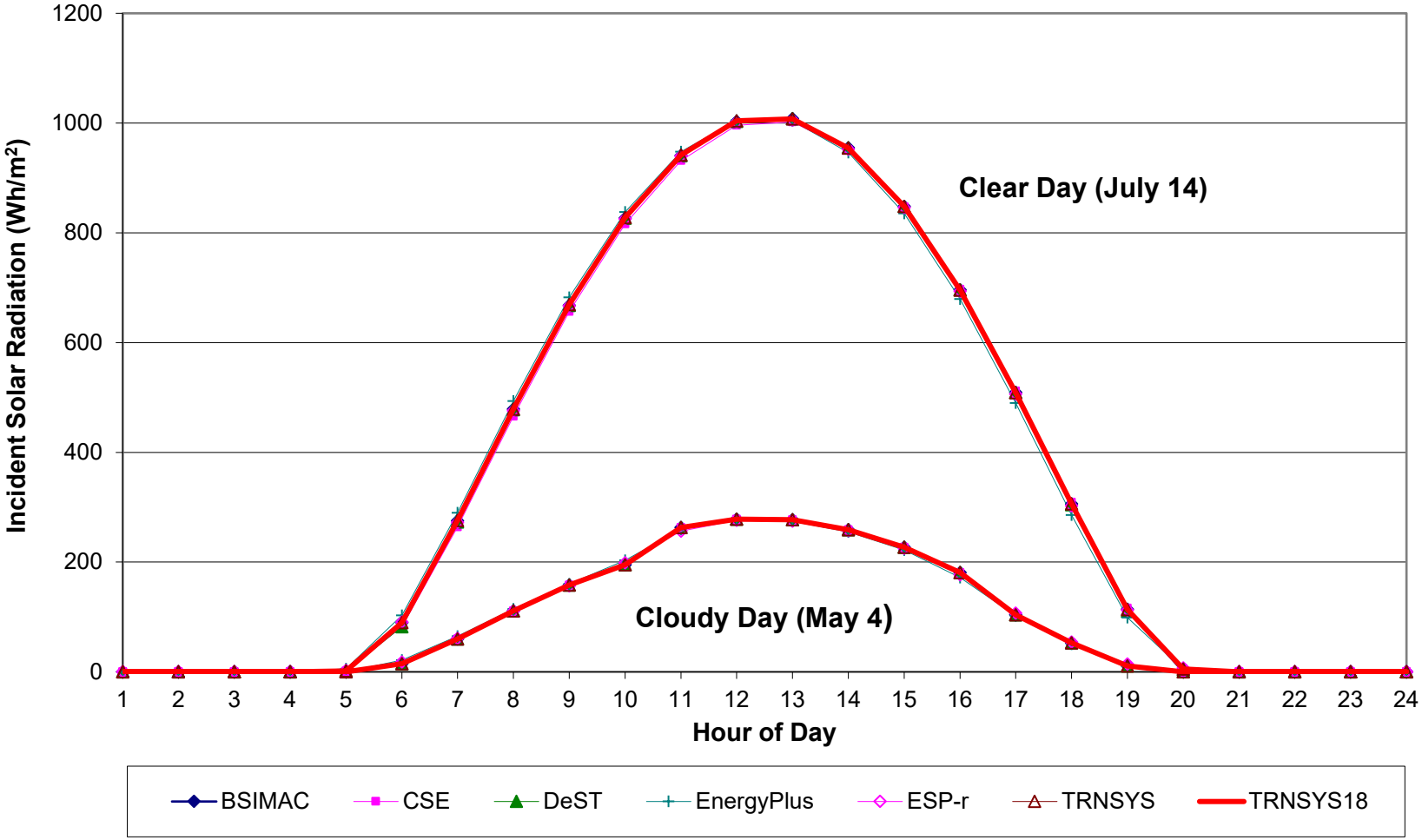


Figure B8-H3. Case 600
Cloudy & Clear Day Hourly Incident Solar
South Facing Surface

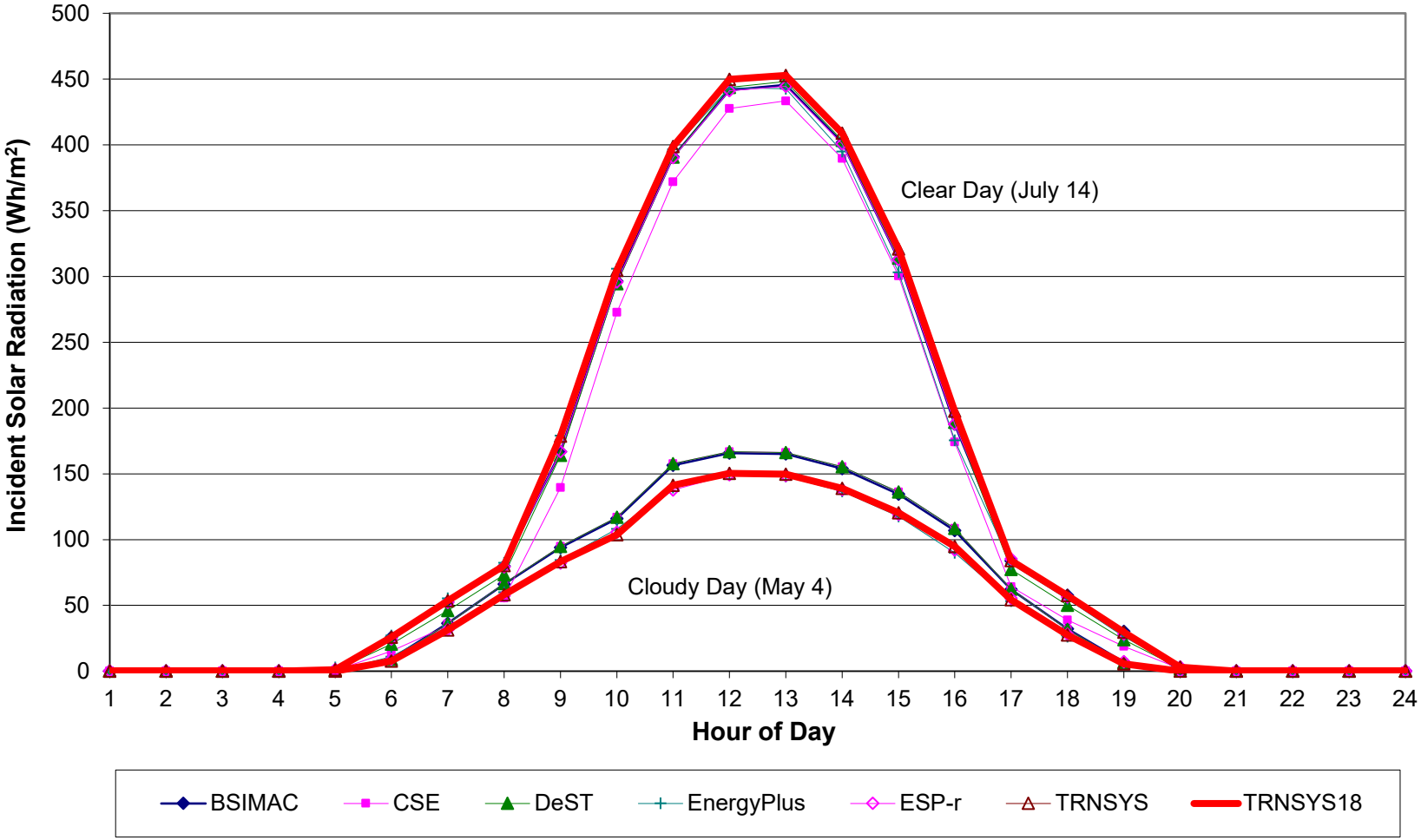


Figure B8-H4. Case 600
Cloudy & Clear Day Hourly Incident Solar
West Facing Surface

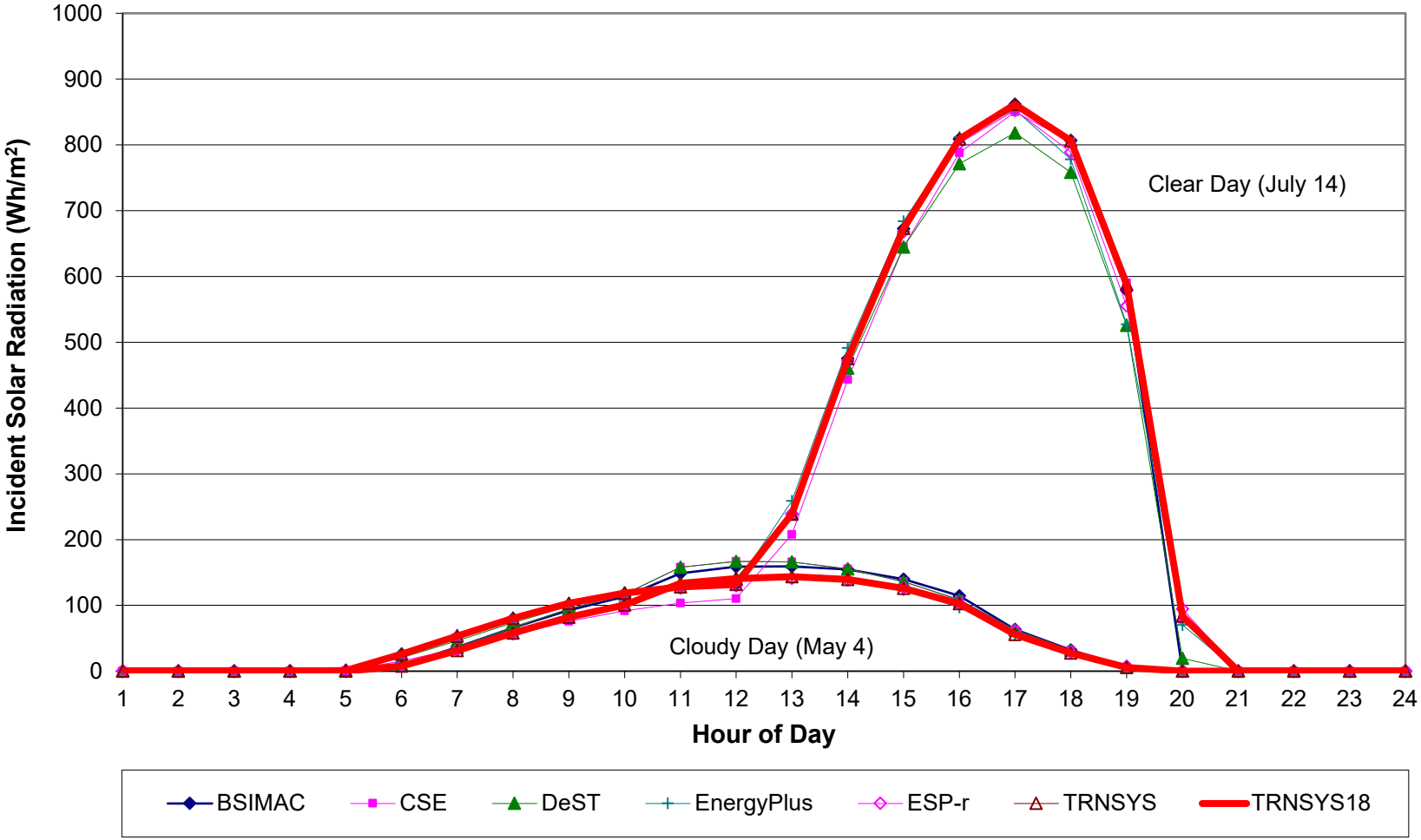


Figure B8-H5. Cases 600, 660, 670
Hourly Transmitted Solar, Clear/Cold Day (Feb 1)
Double-Pane, Low-E, Single-Pane Windows

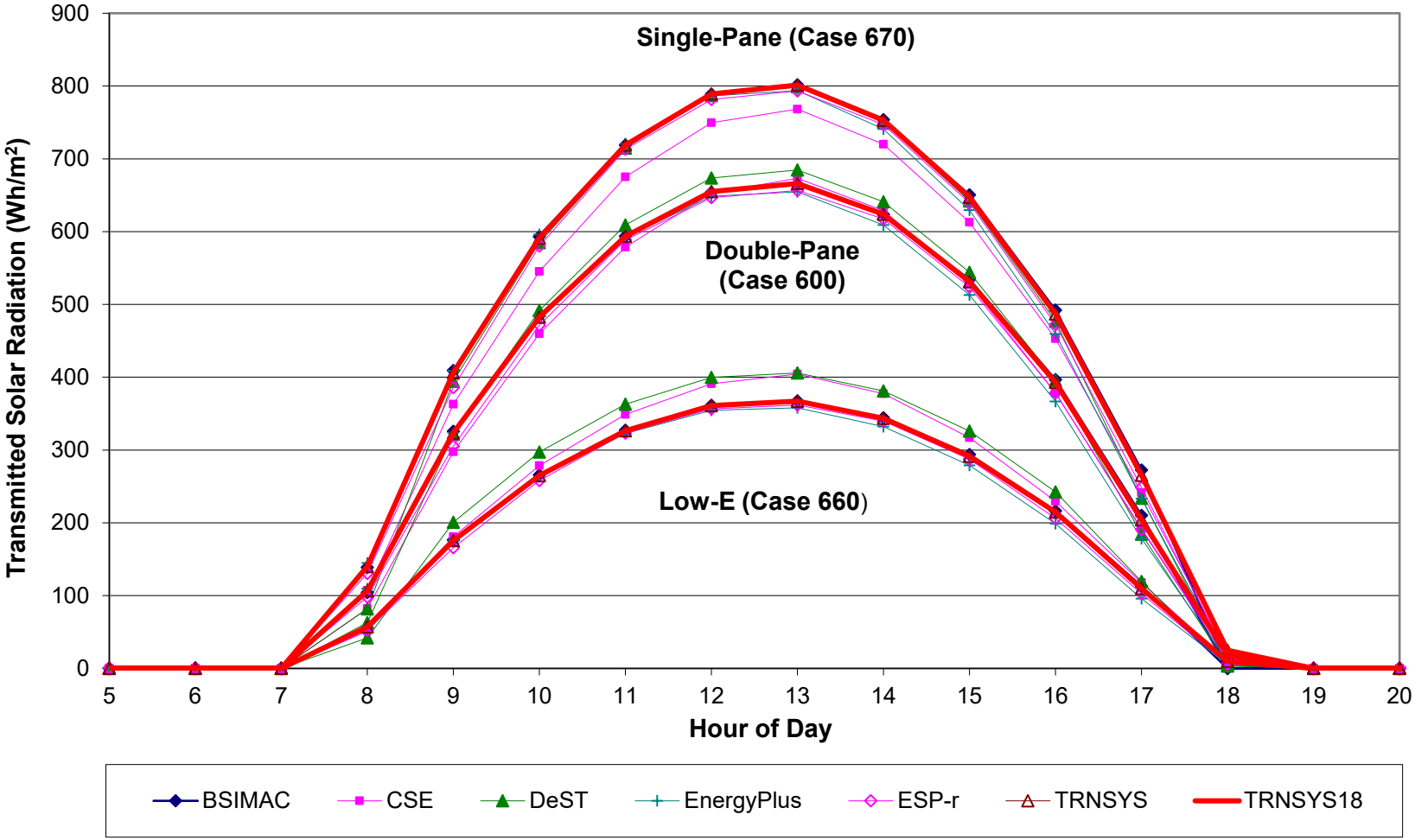


Figure B8-H6. Case 600
Hourly Transmitted Solar, Cloudy Day (May 4)
Double-Pane Windows

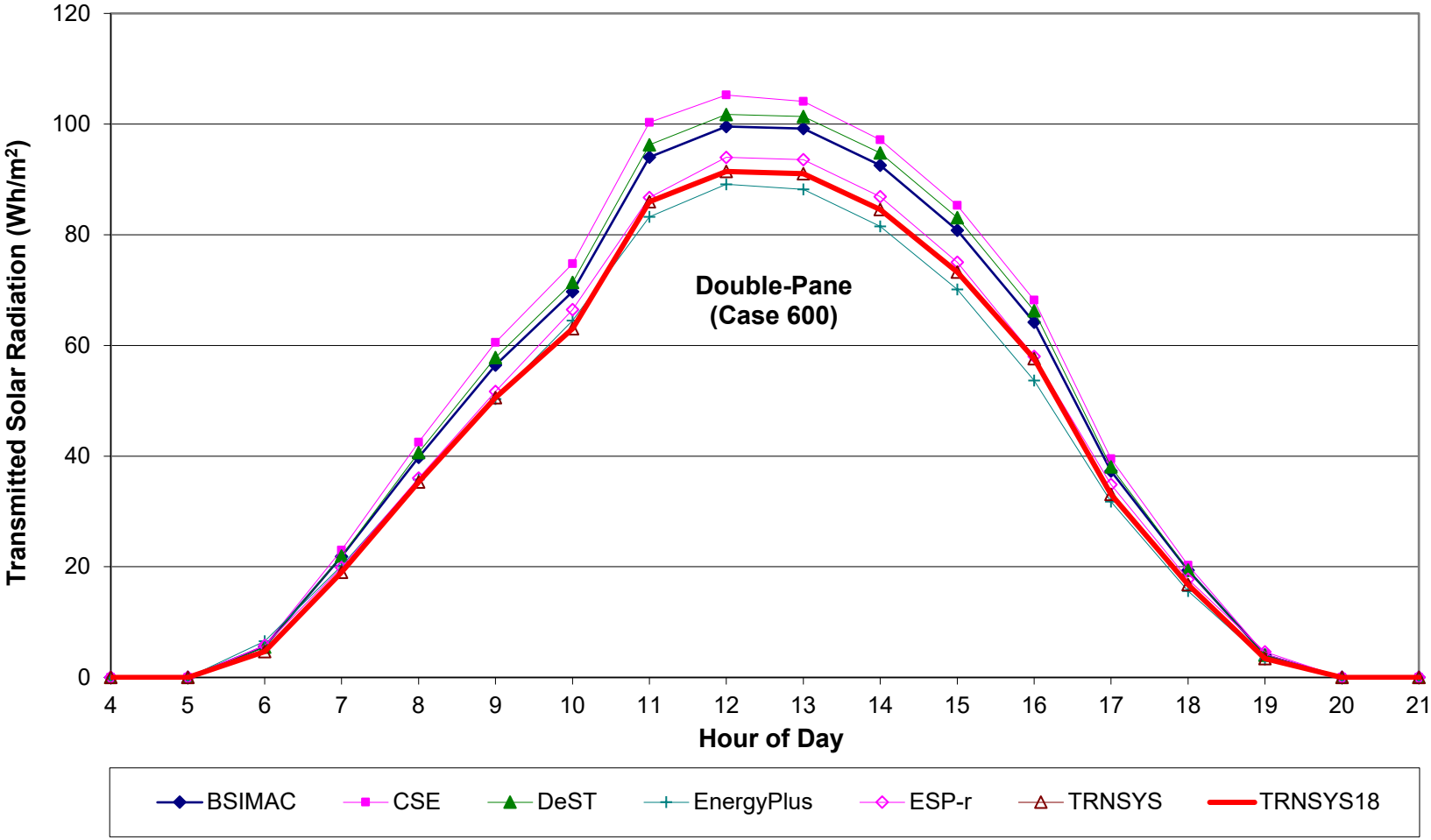


Figure B8-H7. Cases 660, 670
Hourly Transmitted Solar, Cloudy Day (May 4)
Low-E and Single-Pane Windows

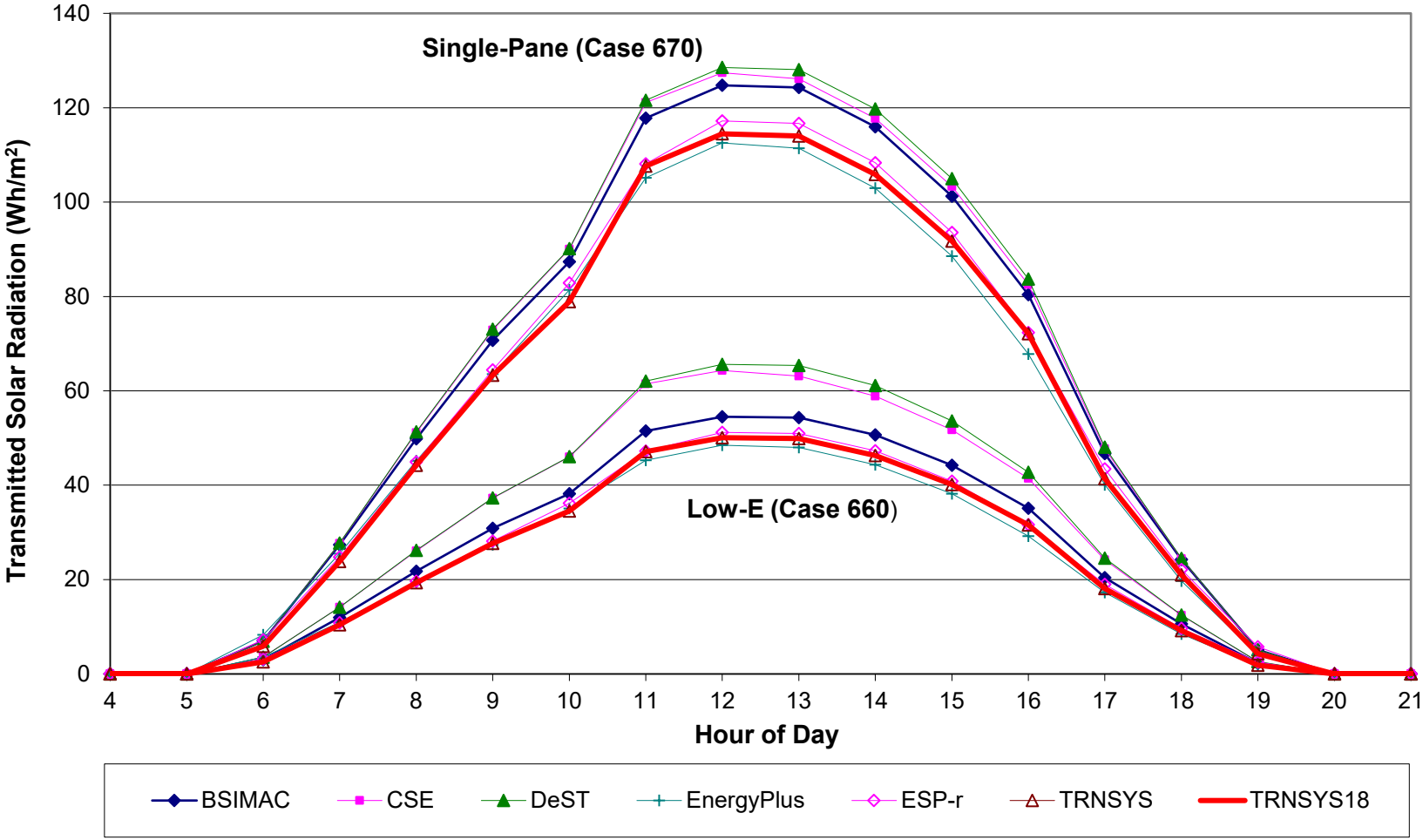


Figure B8-H8. Case 600
Hourly Transmitted Solar, Clear/Hot Day (Jul 14)
Double-Pane Windows

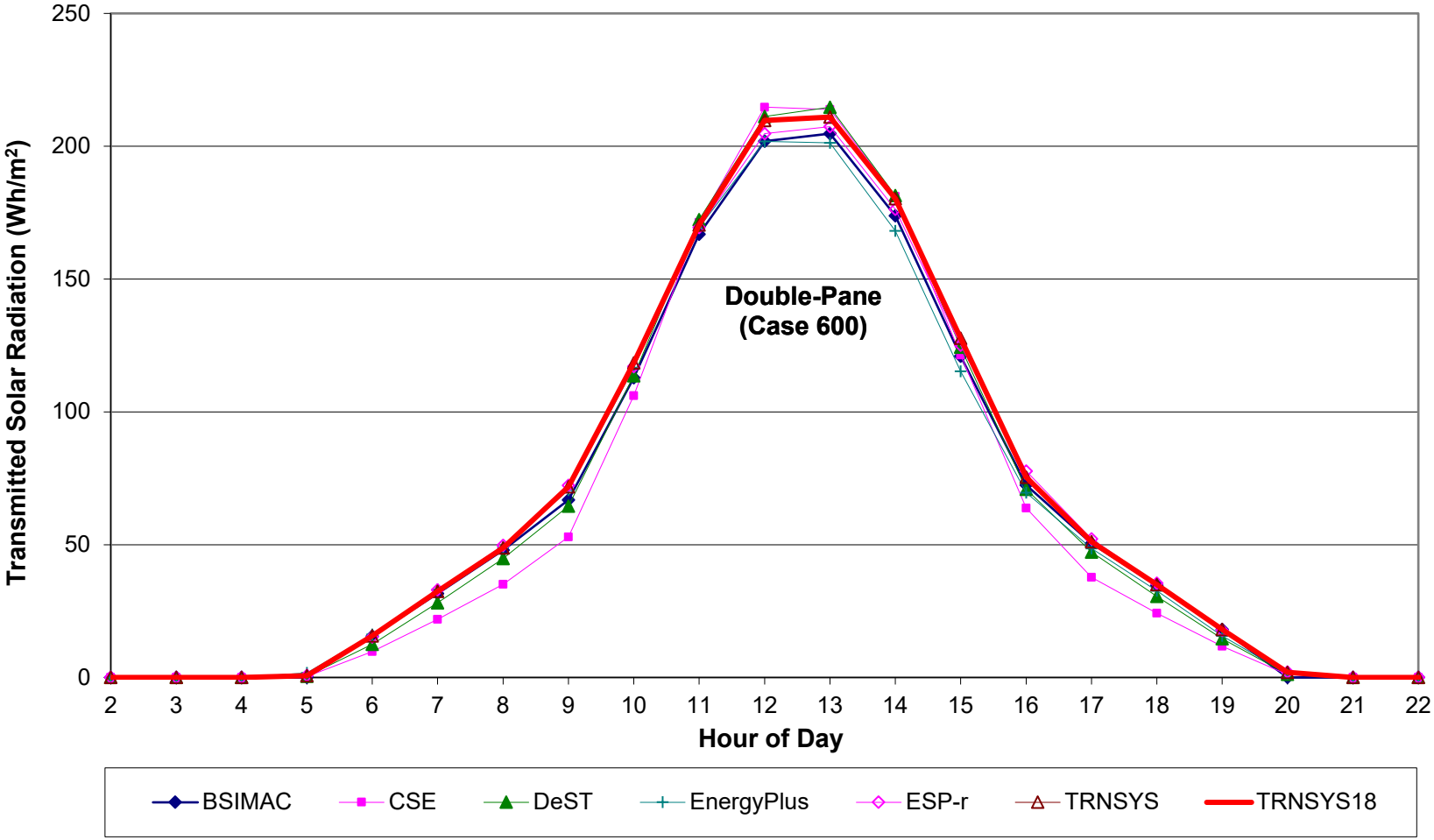


Figure B8-H9. Cases 660, 670
Hourly Transmitted Solar, Clear/Hot Day (Jul 14)
Low-E and Single-Pane Windows

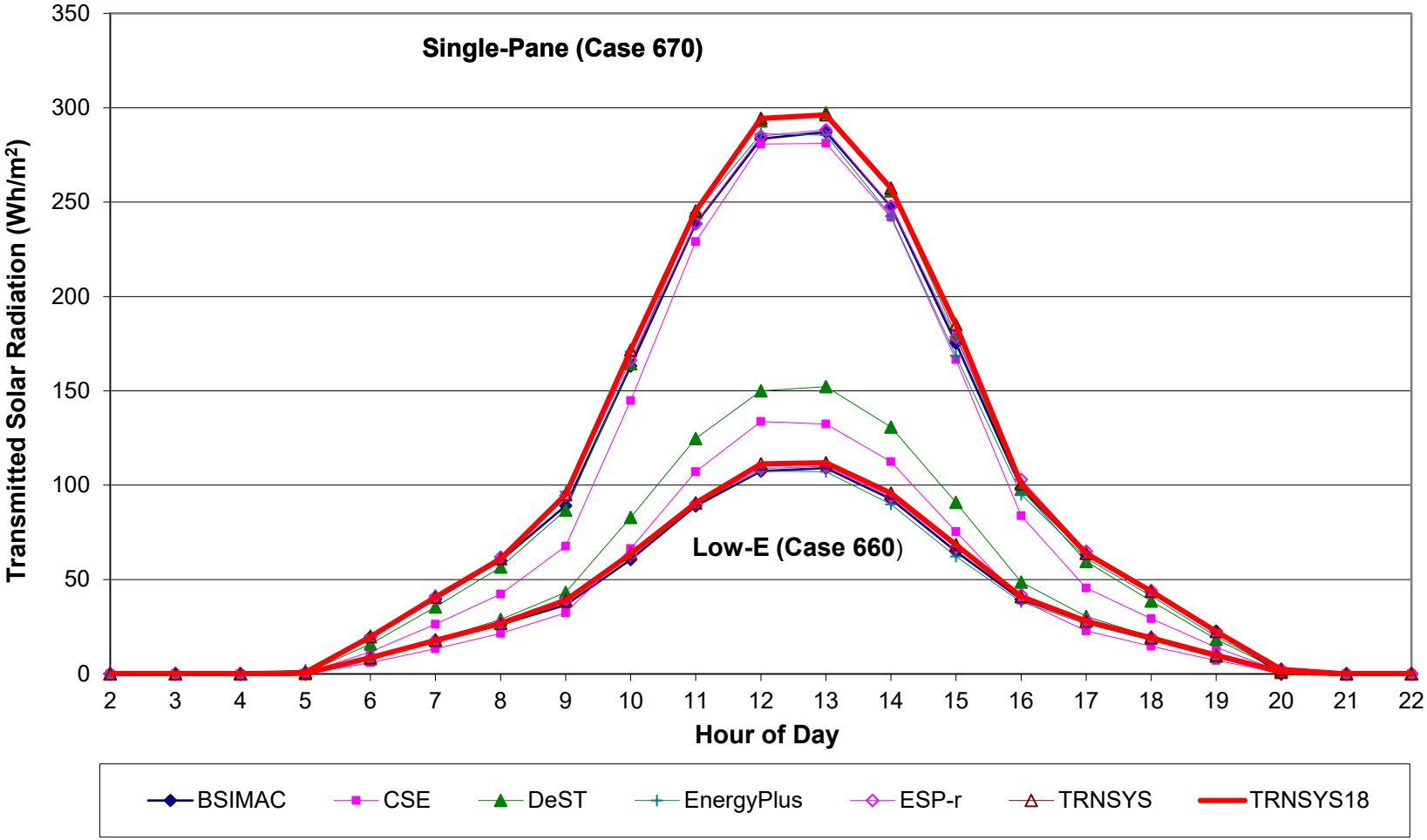


Figure B8-H10.
Hourly Sky Temperatures
Case 600: Clear/Cold, Cloudy Days

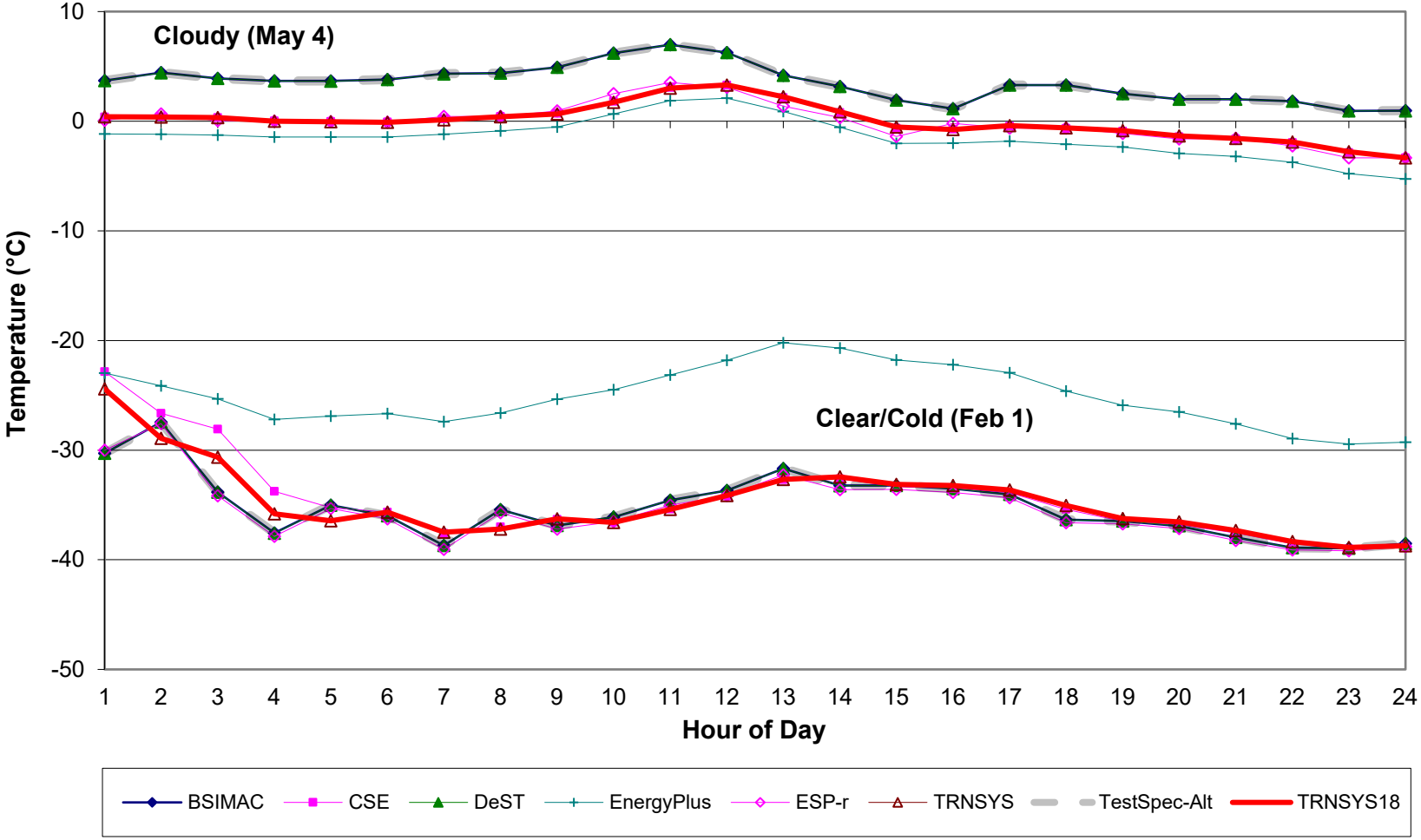


Figure B8-H11.
Hourly Sky Temperatures
Case 600: Clear/Cold, Clear/Hot Days

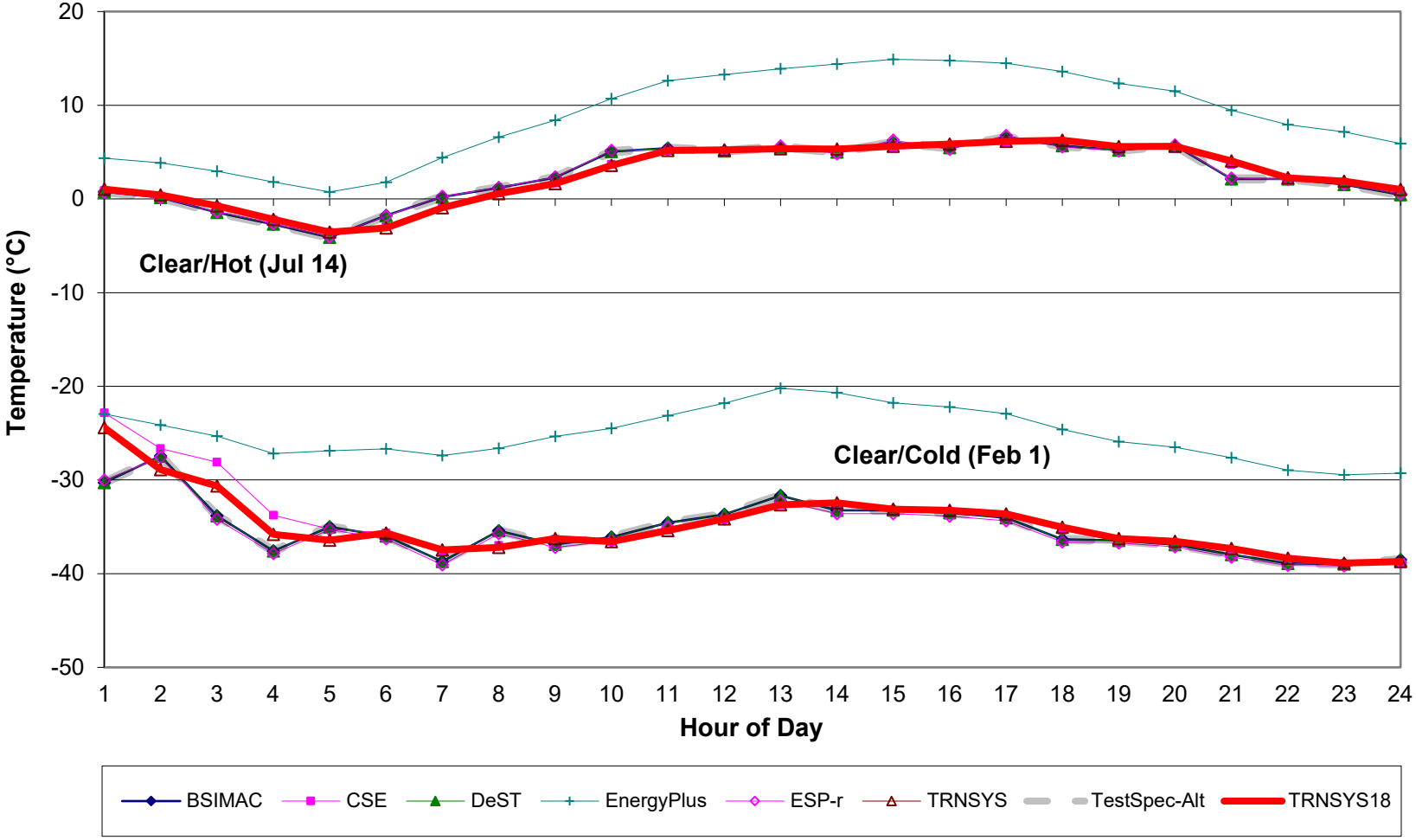


Figure B8-H12.
Hourly Free-Float Temperatures
Clear Cold Day (Feb 1), Cases 600FF and 900FF

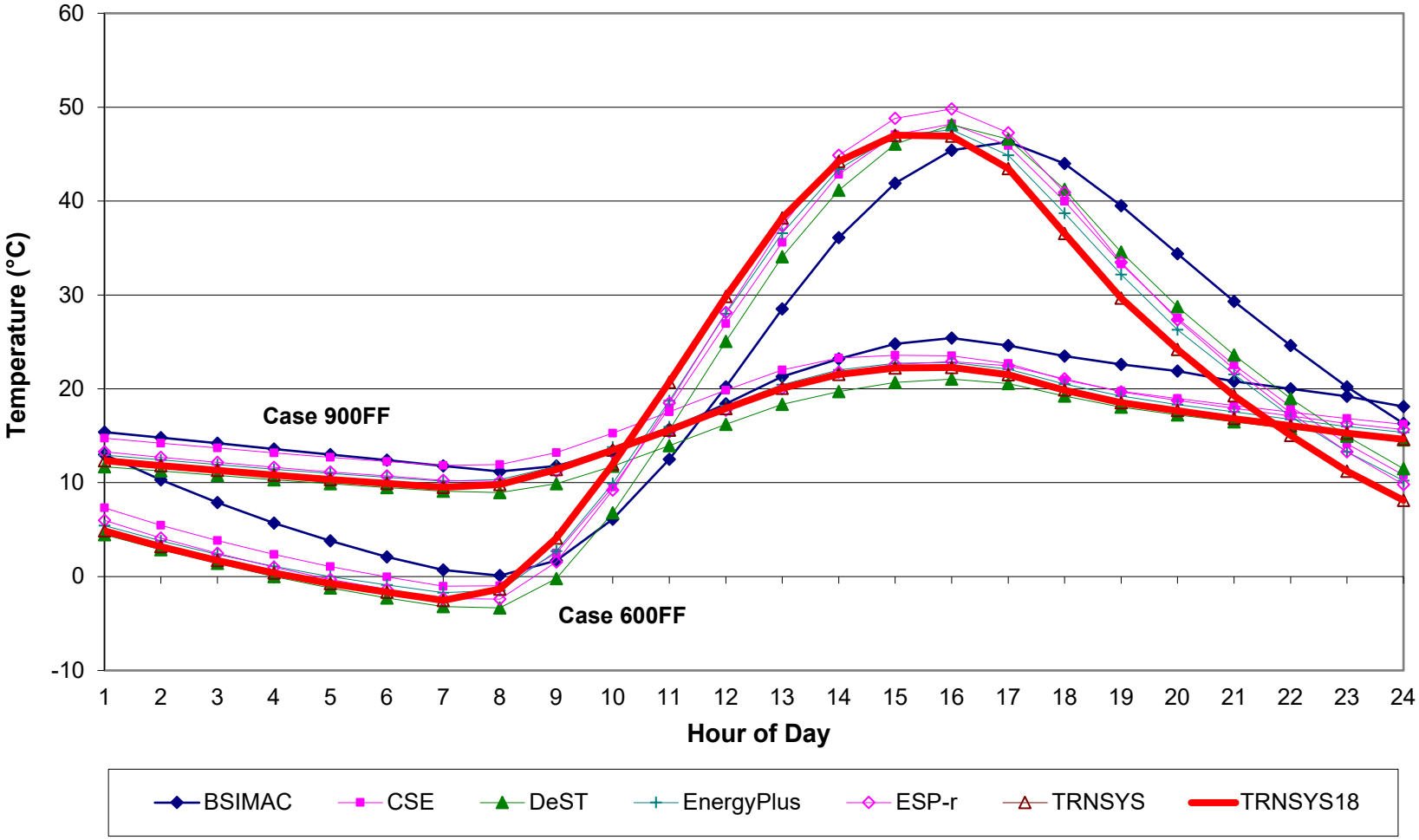


Figure B8-H13.
Hourly Free-Float Temperatures
Clear Hot Day (Jul 14), Cases 650FF and 950FF

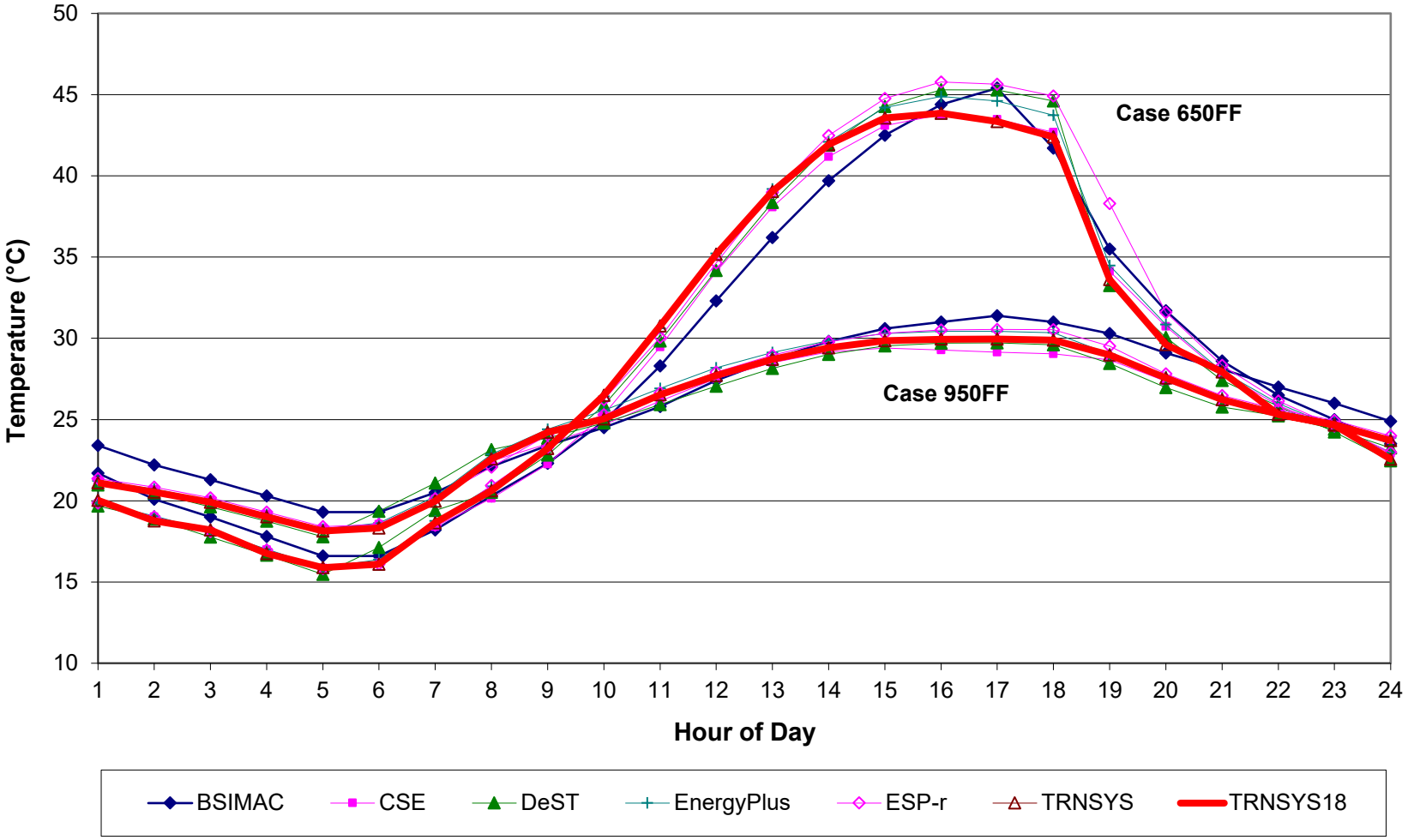


Figure B8-H14.
Hourly Free-Float Temperatures
Clear Cold Day (Feb1), Cases 680FF and 980FF

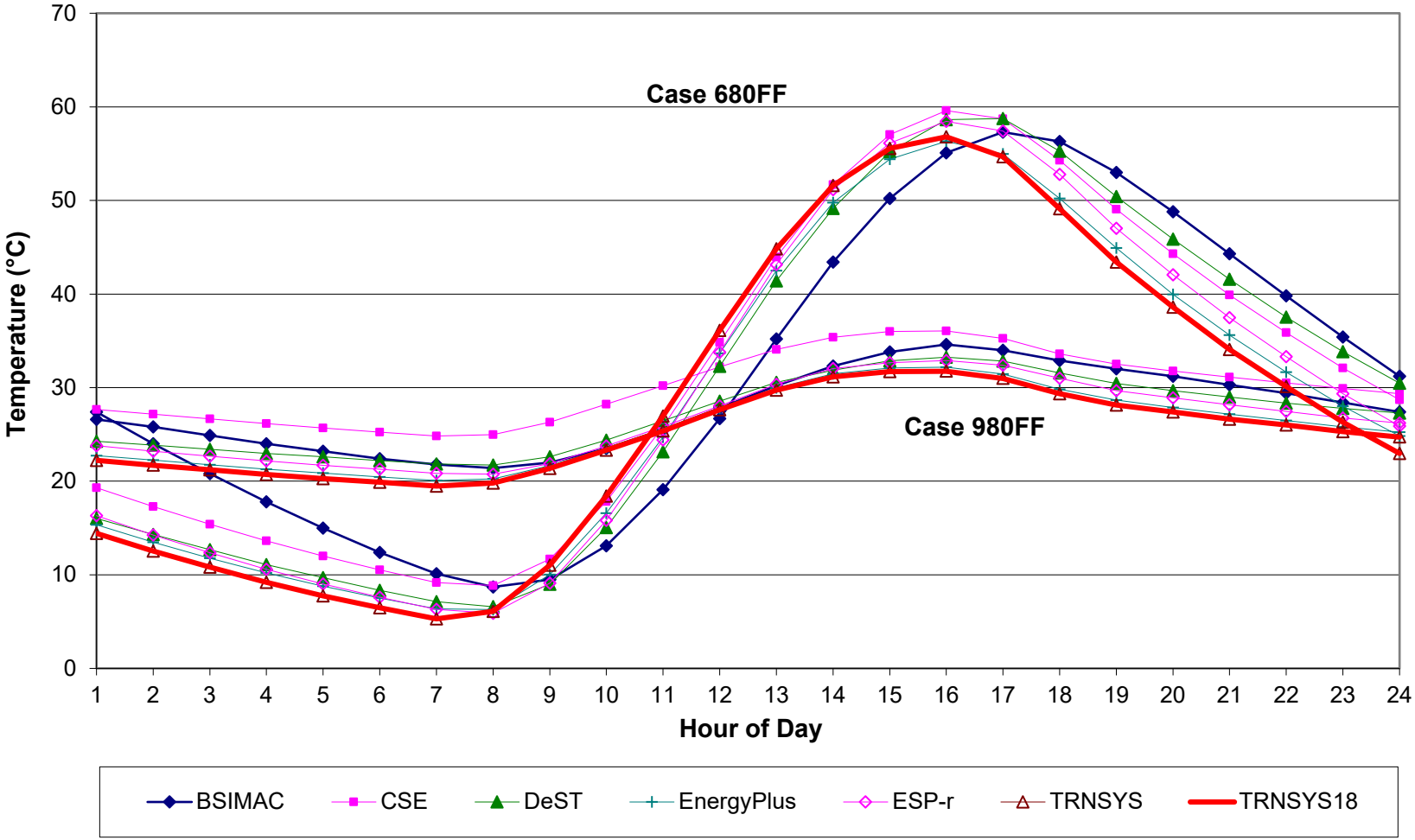


Figure B8-H15. Hourly Loads
Clear Cold Day, Case 600 (Low Mass, Double-Clear Window)
Heating (+), Sensible Cooling (-)

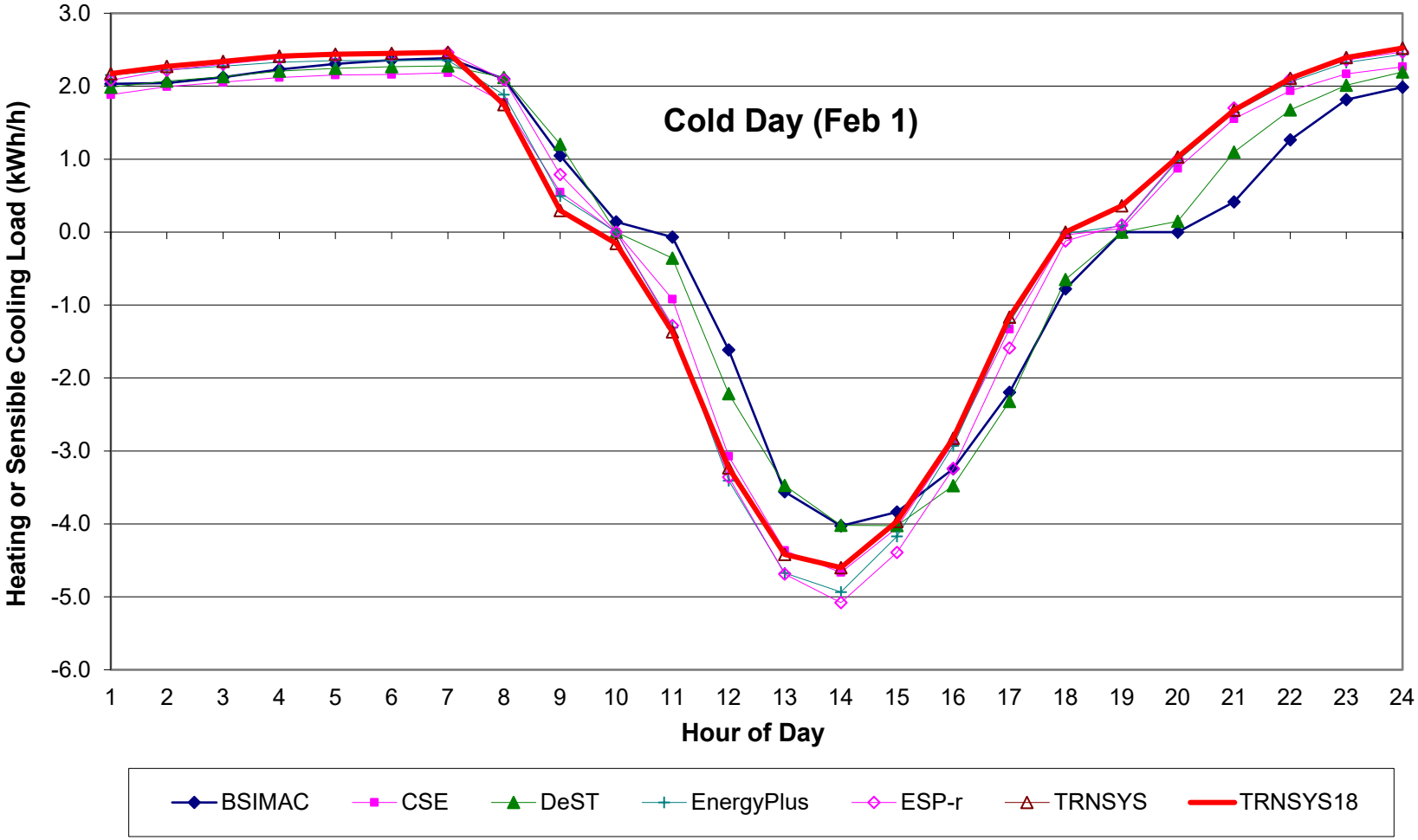


Figure B8-H16. Hourly Loads
Clear Hot Day, Case 600 (Low Mass, Double-Clear Window)
Heating (+), Sensible Cooling (-)

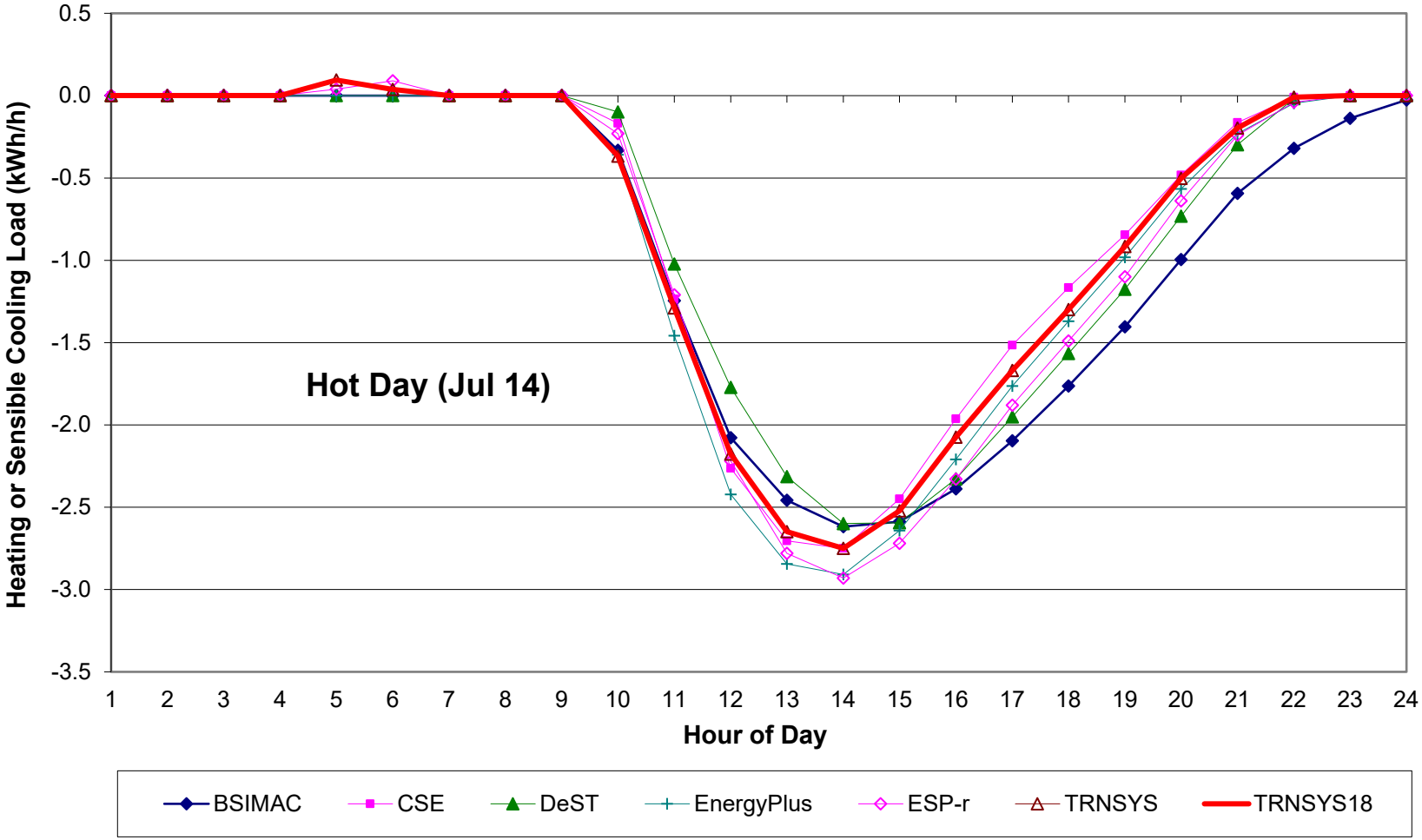


Figure B8-H17. Hourly Loads
Clear Cold Day, Case 640 (Low Mass, Night Setback)
Heating (+), Sensible Cooling (-)

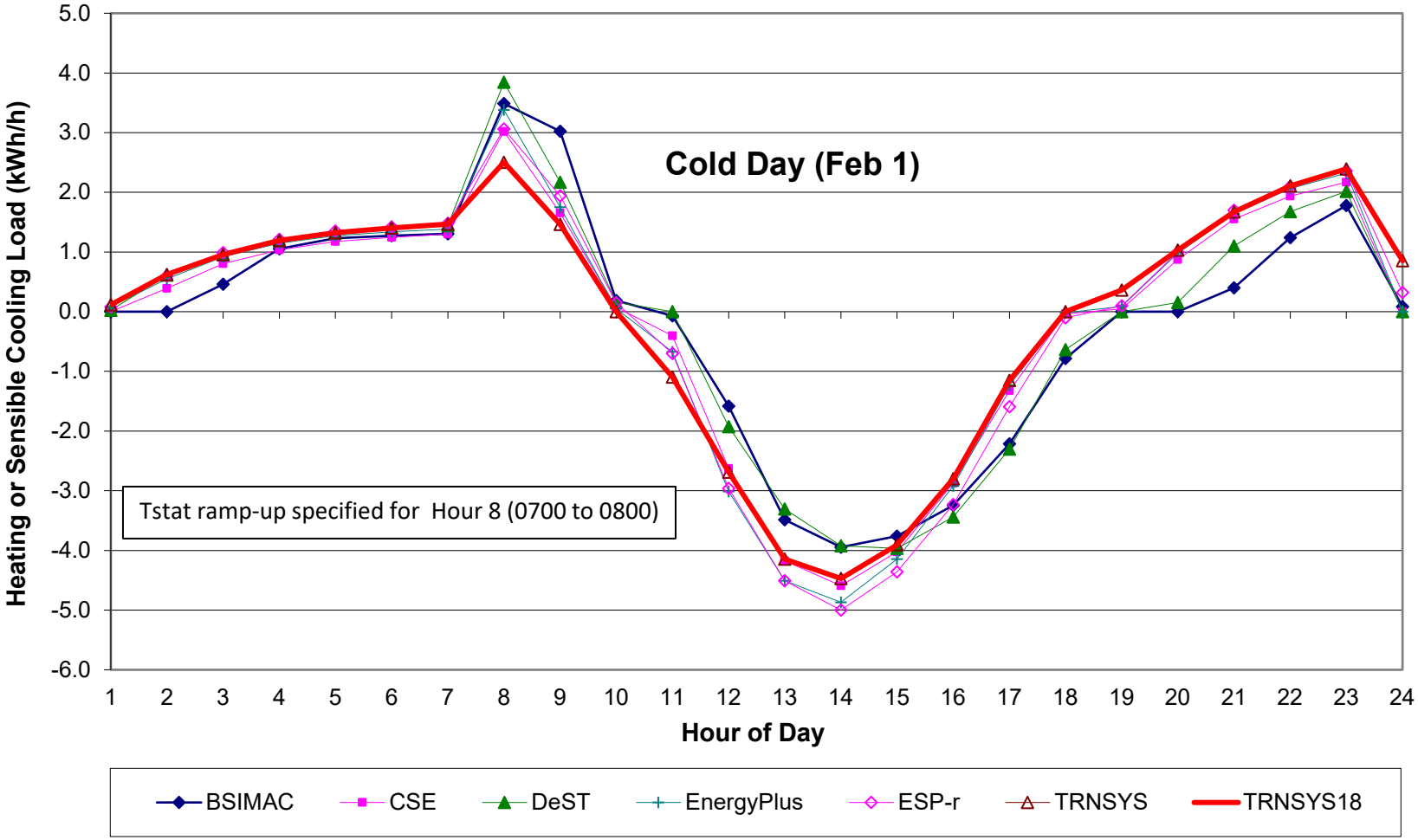


Figure B8-H18.
Hourly Conditioned Zone Temperatures
Clear Cold Day, Case 640

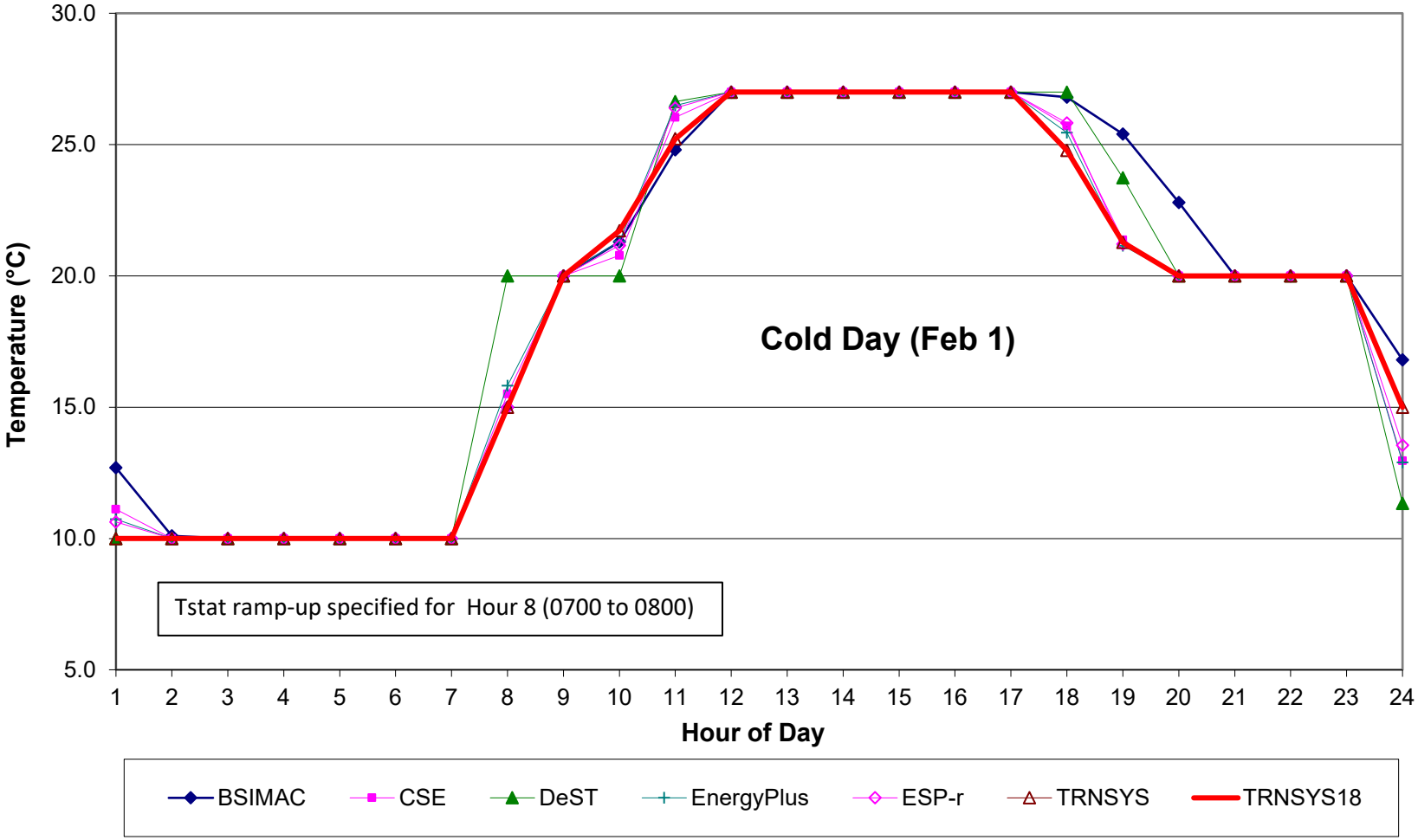


Figure B8-H19. Hourly Loads
Clear Cold Day, Case 940 (High Mass, Night Setback)
Heating (+), Sensible Cooling (-)

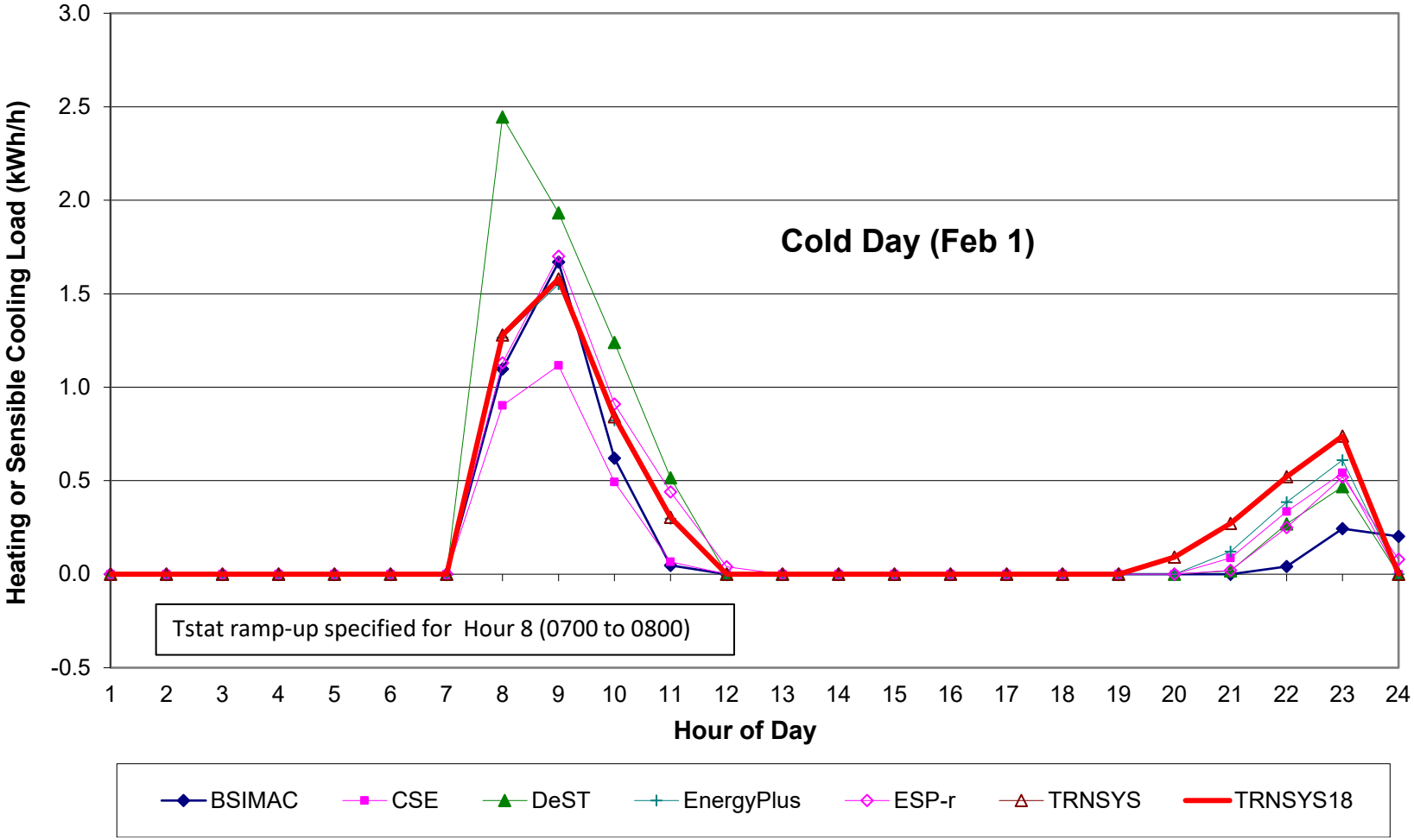


Figure B8-H20.
Hourly Conditioned Zone Temperatures
Clear Cold Day, Case 940

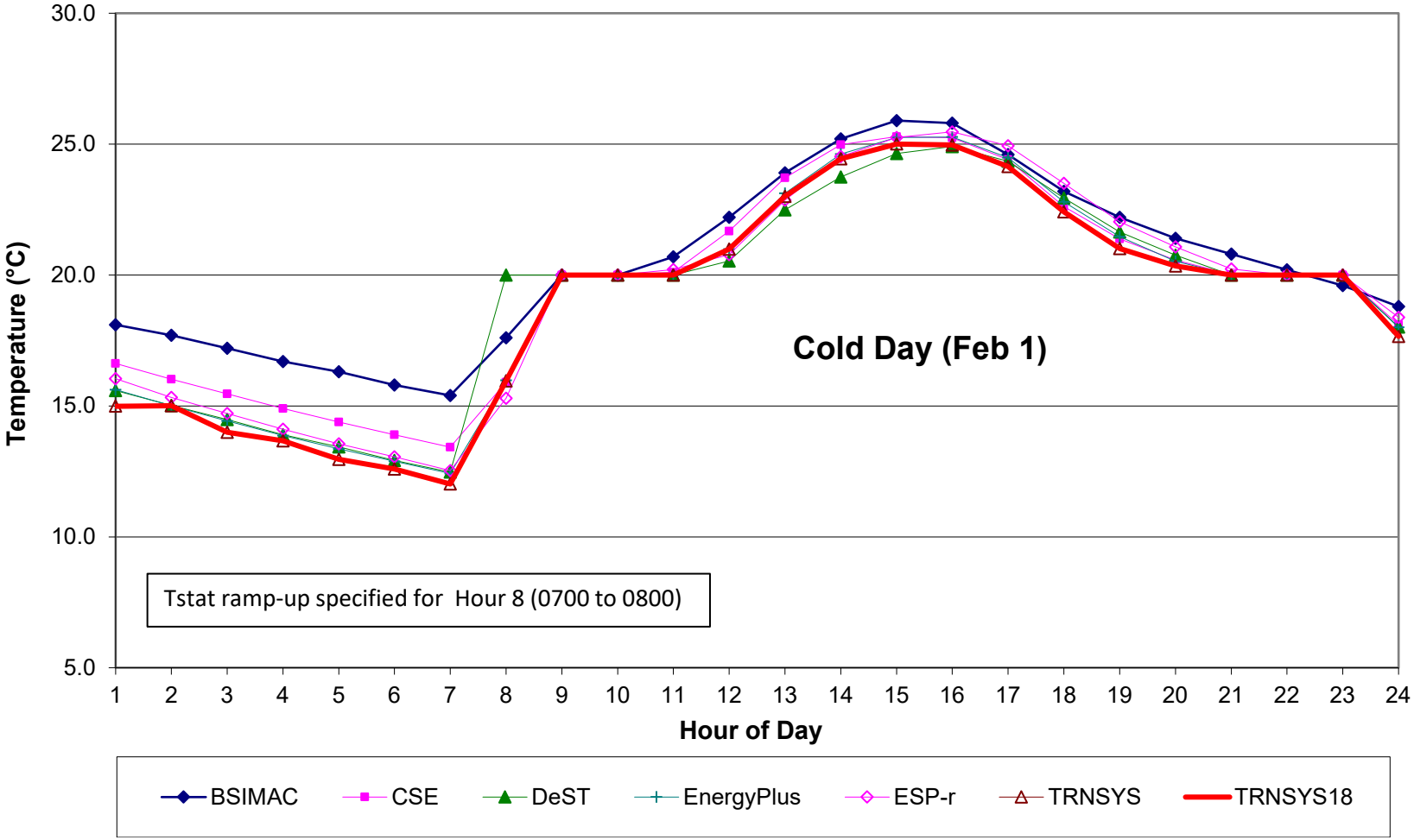


Figure B8-H21. Hourly Loads
Clear Cold Day, Case 660 (Low-E Window)
Heating (+), Sensible Cooling (-)

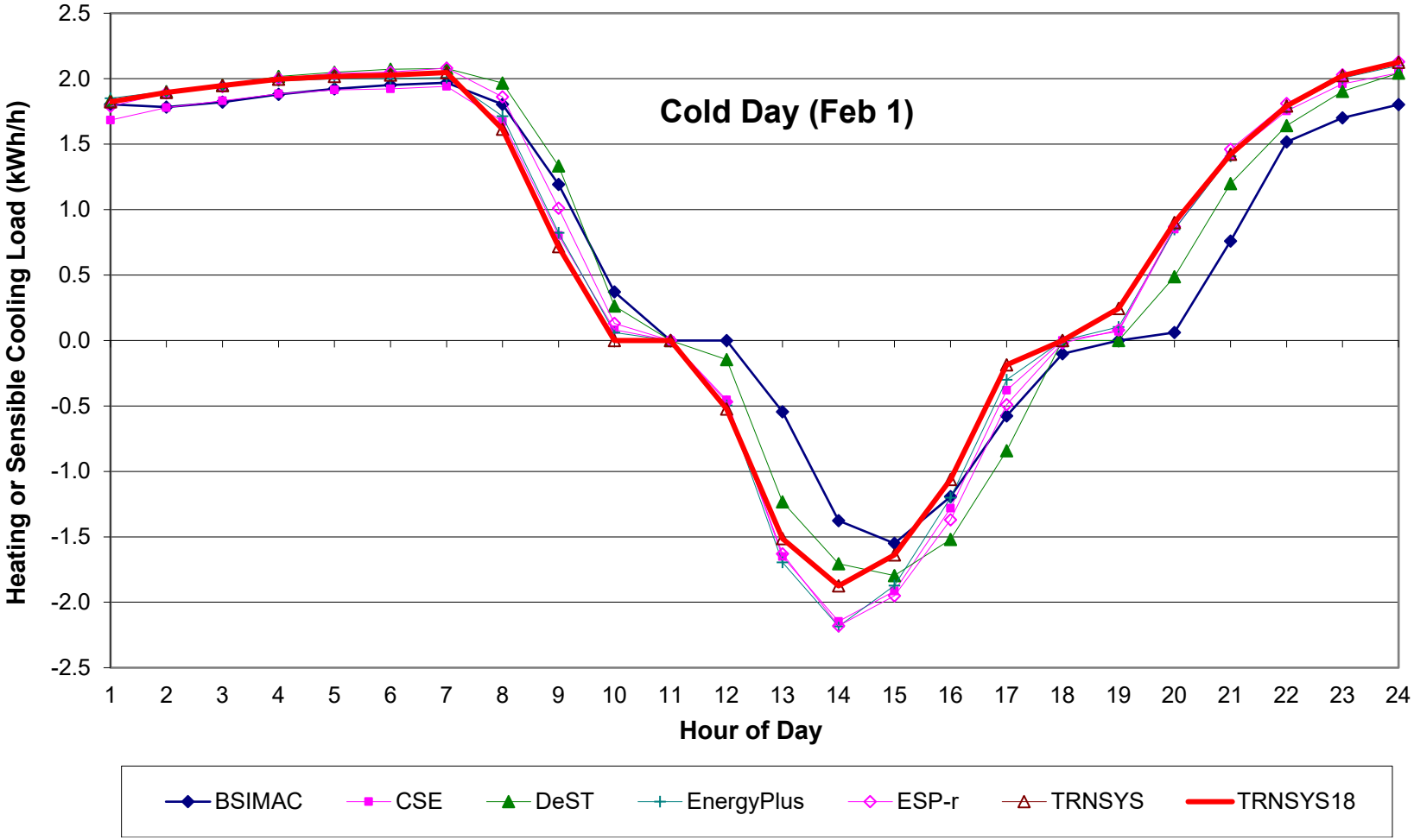


Figure B8-H22. Hourly Loads
Clear Hot Day, Case 660 (Low-E Window)
Heating (+), Sensible Cooling (-)

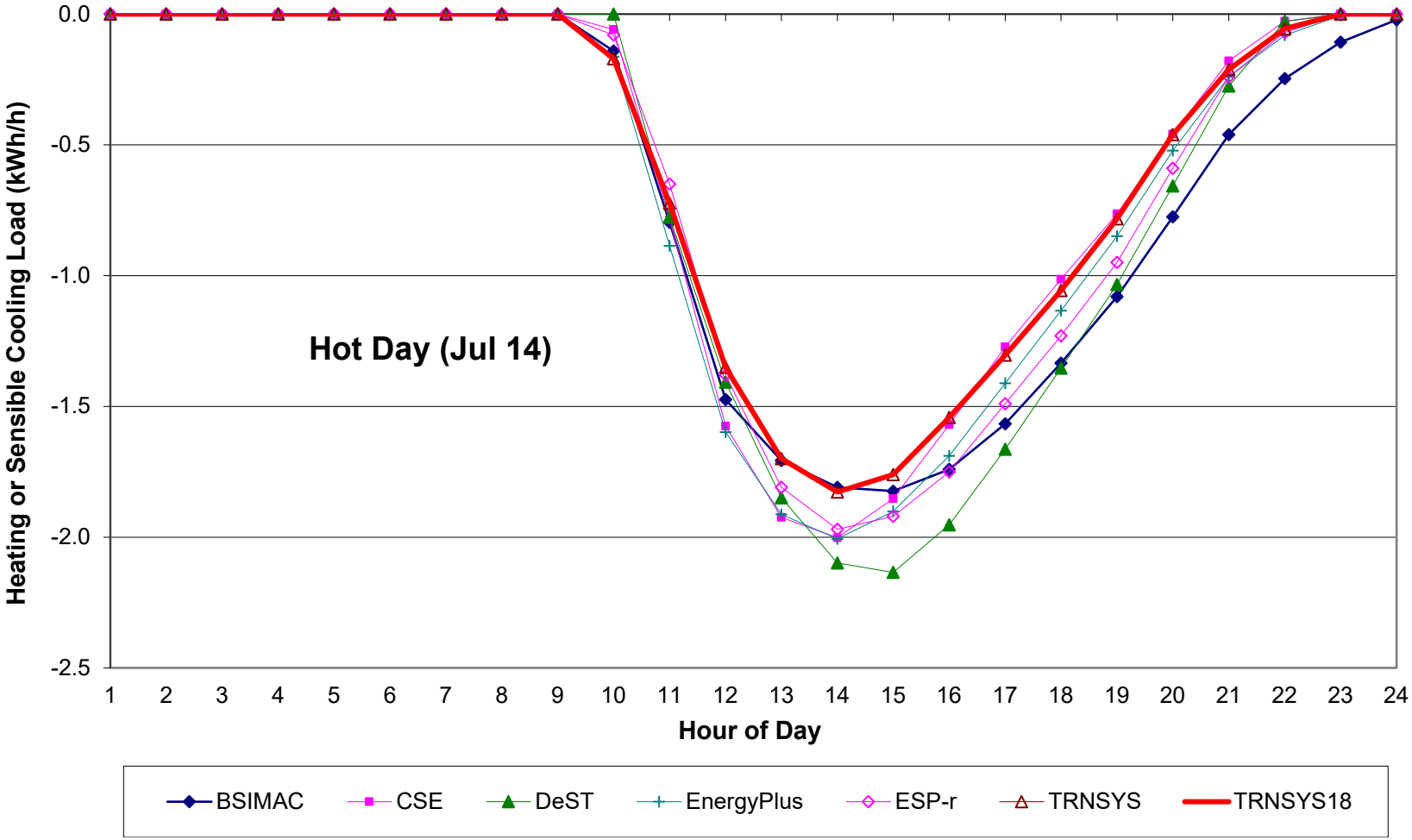


Figure B8-H23. Hourly Loads
Clear Cold Day, Case 670 (Single-Pane Window)
Heating (+), Sensible Cooling (-)

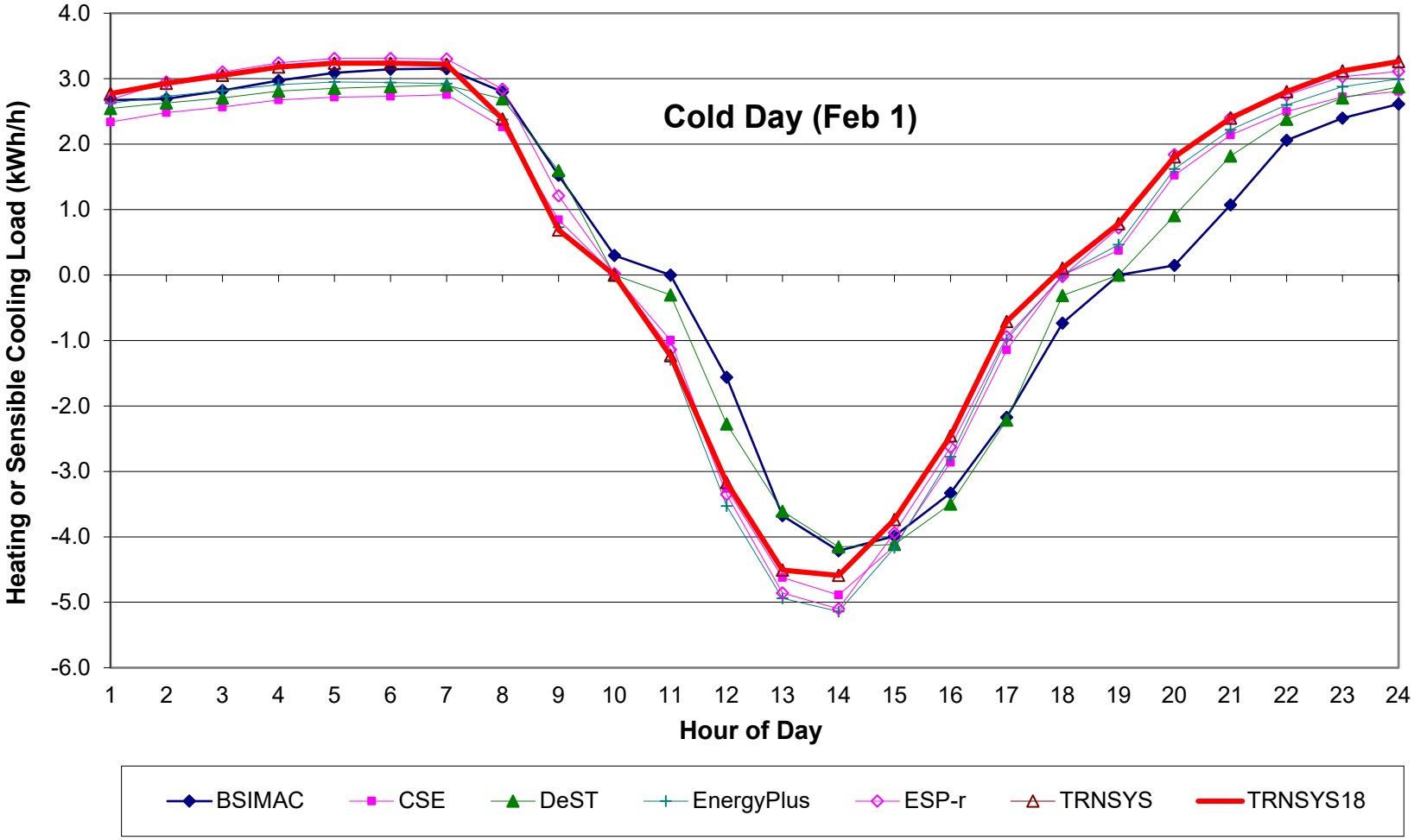


Figure B8-H24. Hourly Loads
Clear Hot Day, Case 670 (Single-Pane Window)
Heating (+), Sensible Cooling (-)

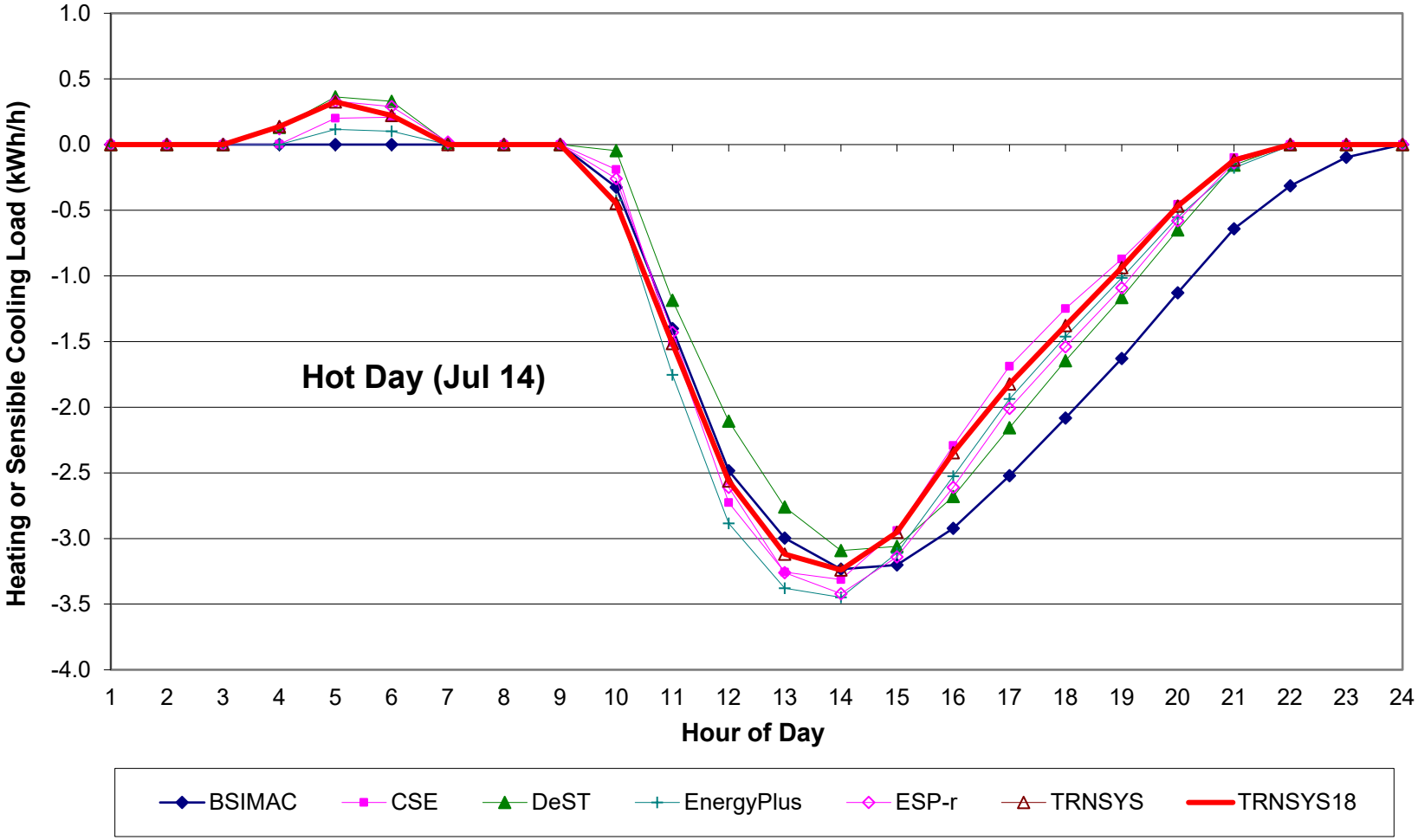


Figure B8-H25. Hourly Loads
Clear Cold Day, Case 680 (Insulation)
Heating (+), Sensible Cooling (-)

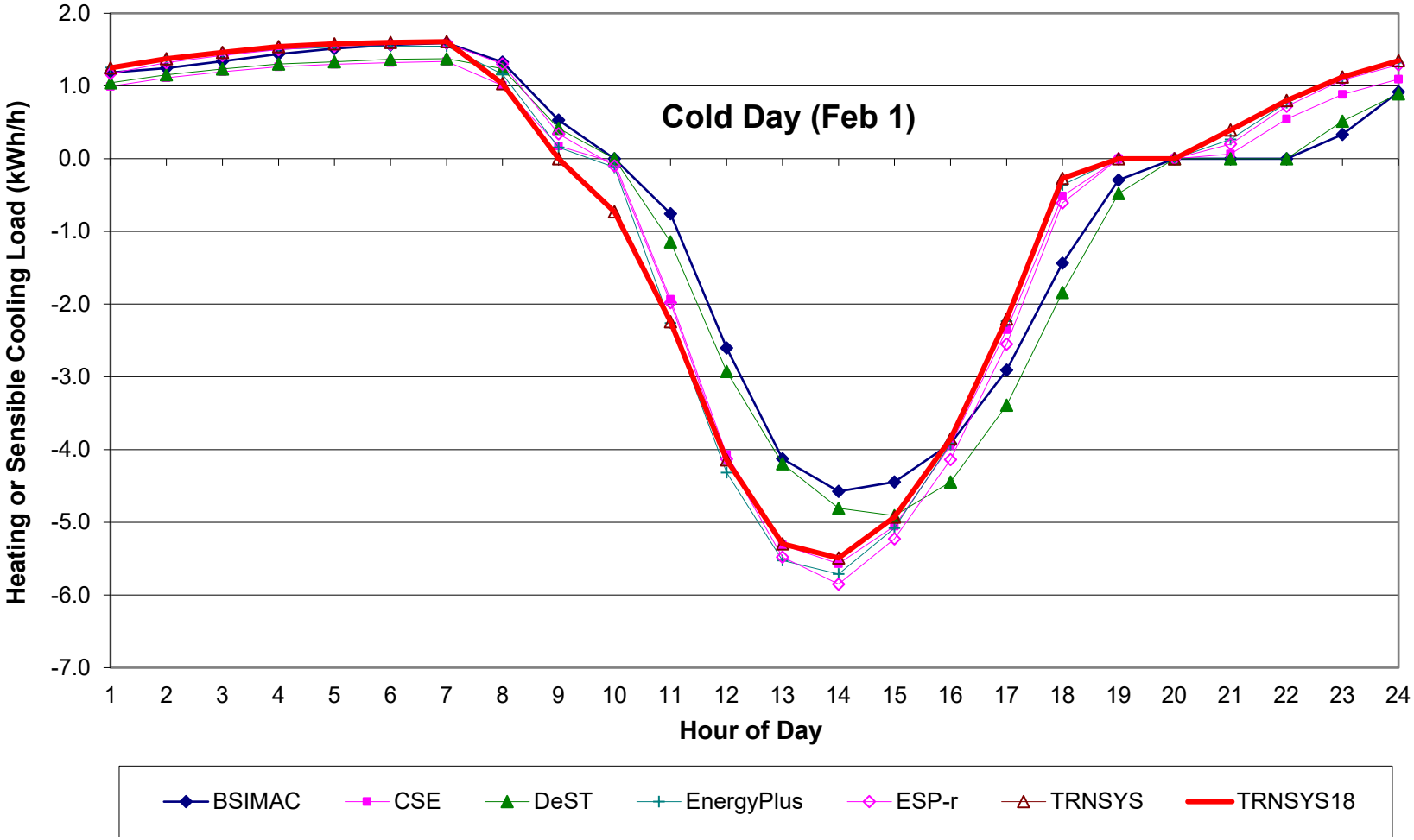


Figure B8-H26. Hourly Loads
Clear Hot Day, Case 680 (Insulation)
Heating (+), Sensible Cooling (-)

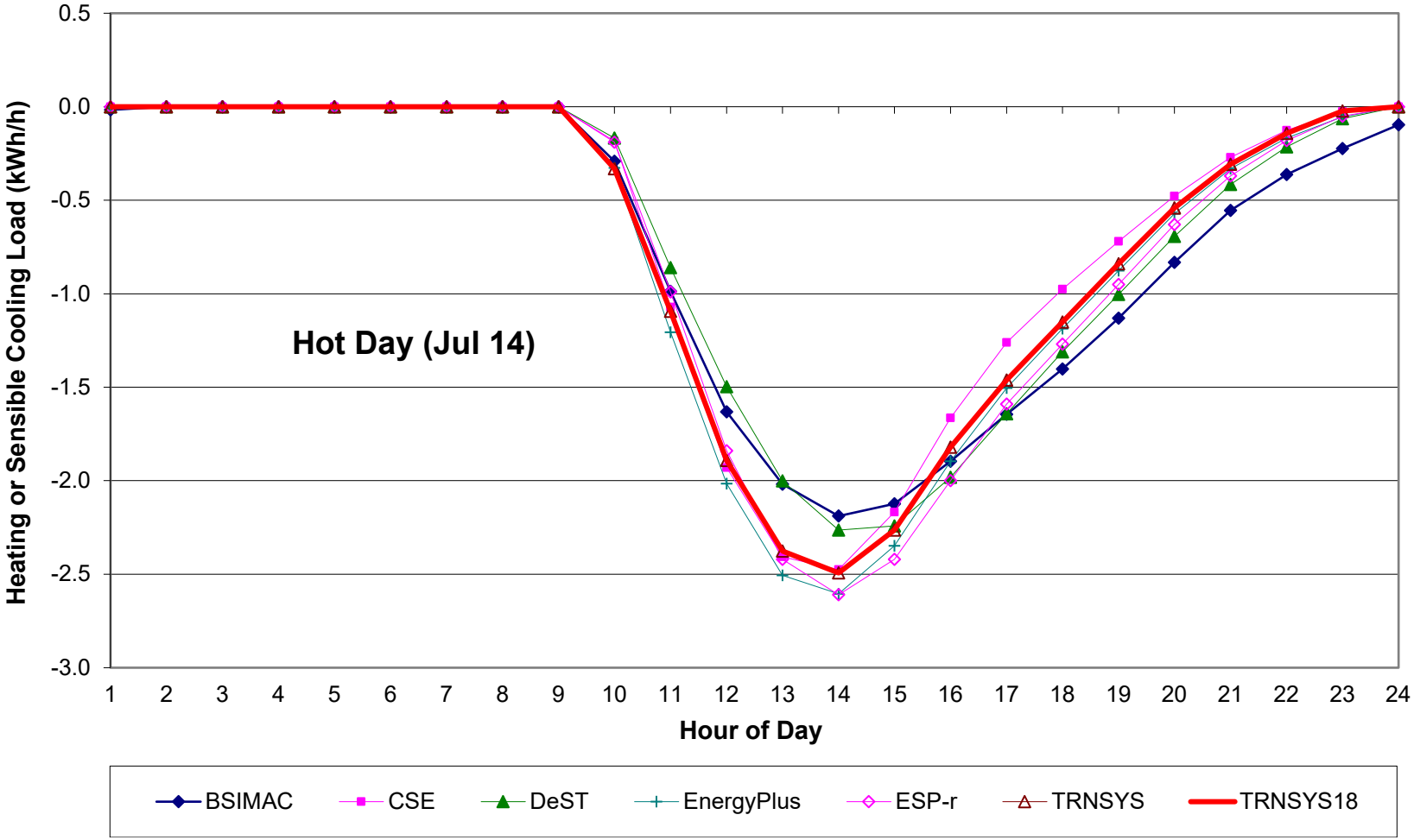


Figure B8-H27. Hourly Loads
Clear Cold Day, Case 685 (20/20 Tstat)
Heating (+), Sensible Cooling (-)

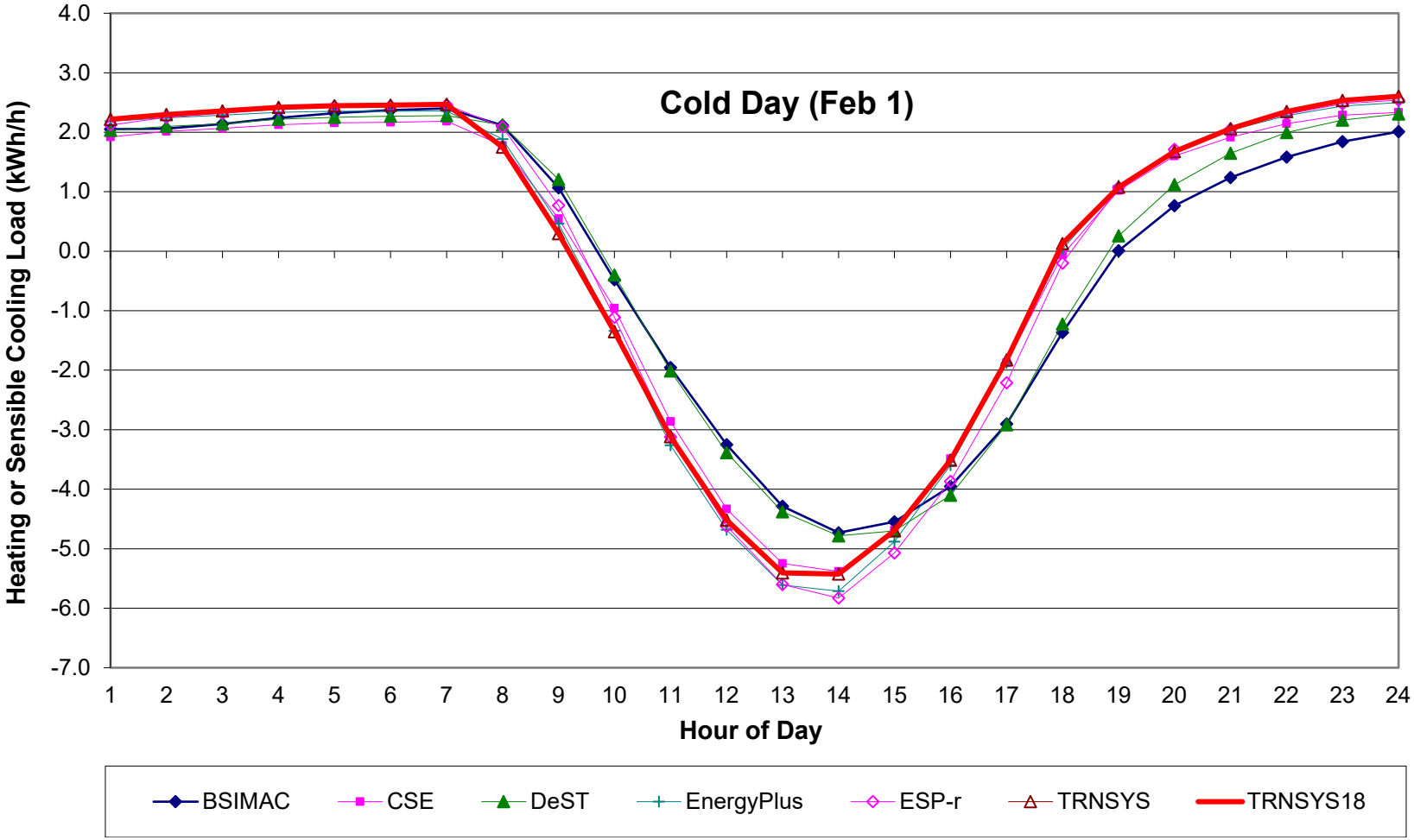


Figure B8-H28. Hourly Loads
Clear Hot Day, Case 685 (20/20 Tstat)
Heating (+), Sensible Cooling (-)

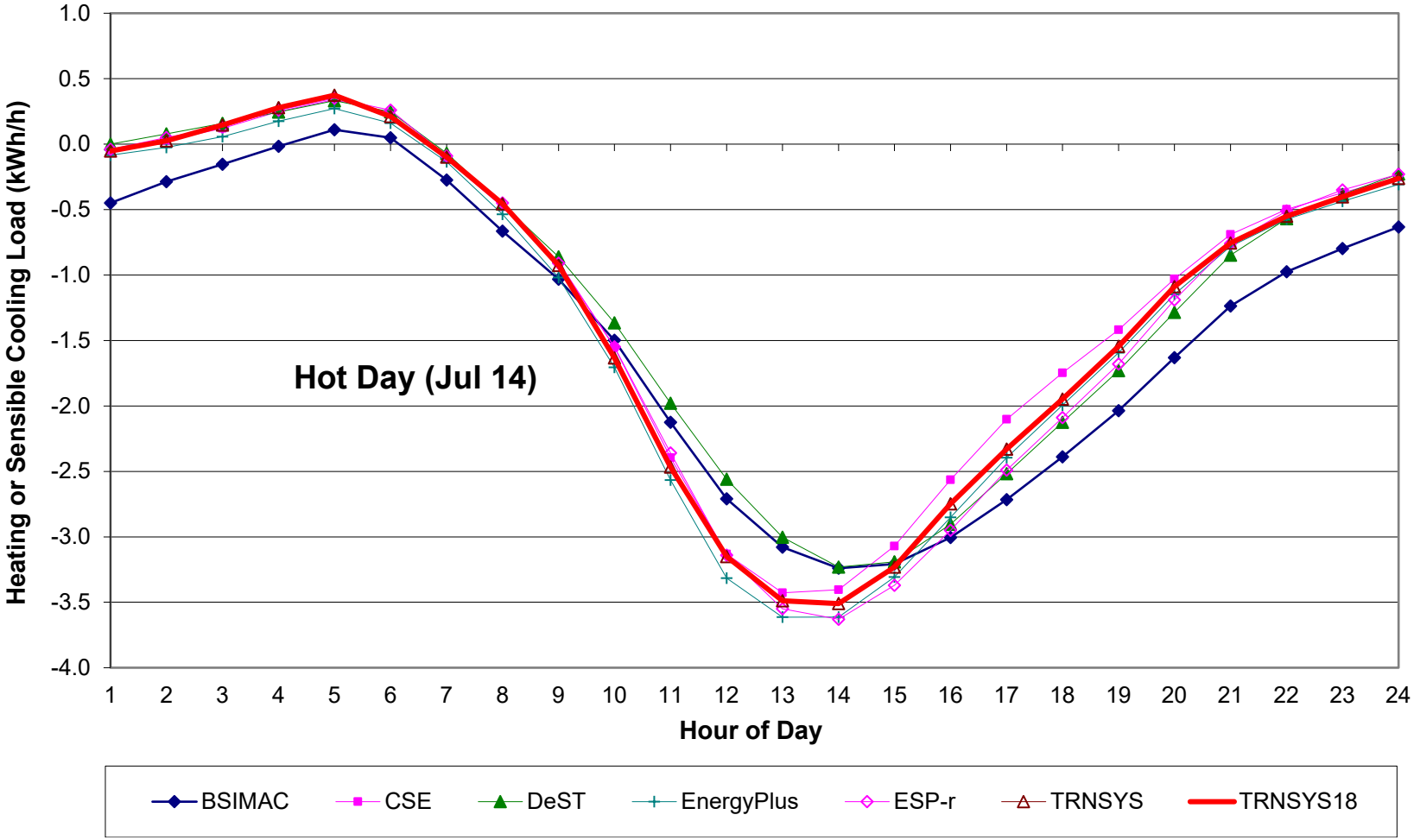


Figure B8-H29. Hourly Loads
Clear Cold Day, Case 695 (20/20, Insulation)
Heating (+), Sensible Cooling (-)

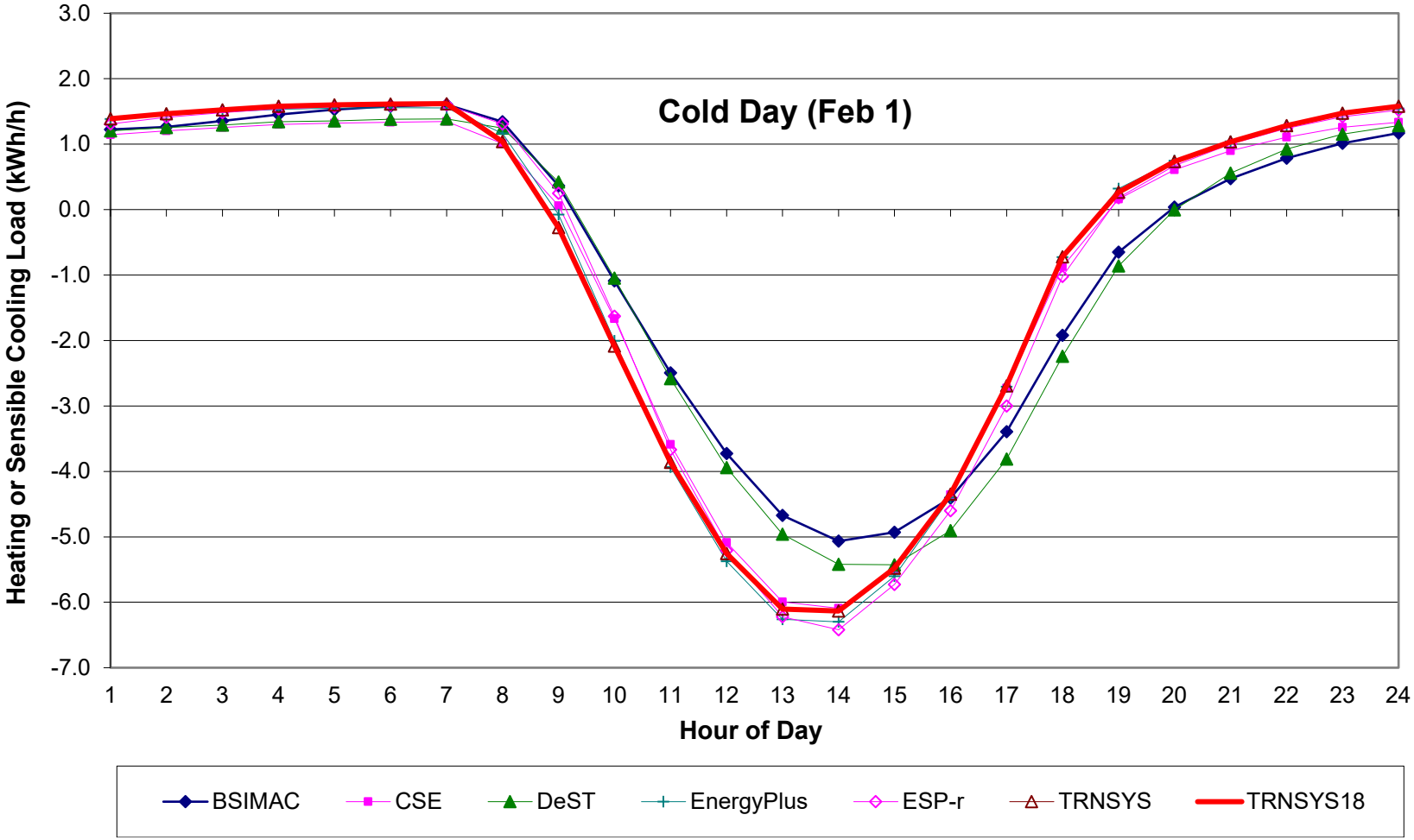


Figure B8-H30. Hourly Loads
Clear Hot Day, Case 695 (20/20, Insulation)
Heating (+), Sensible Cooling (-)

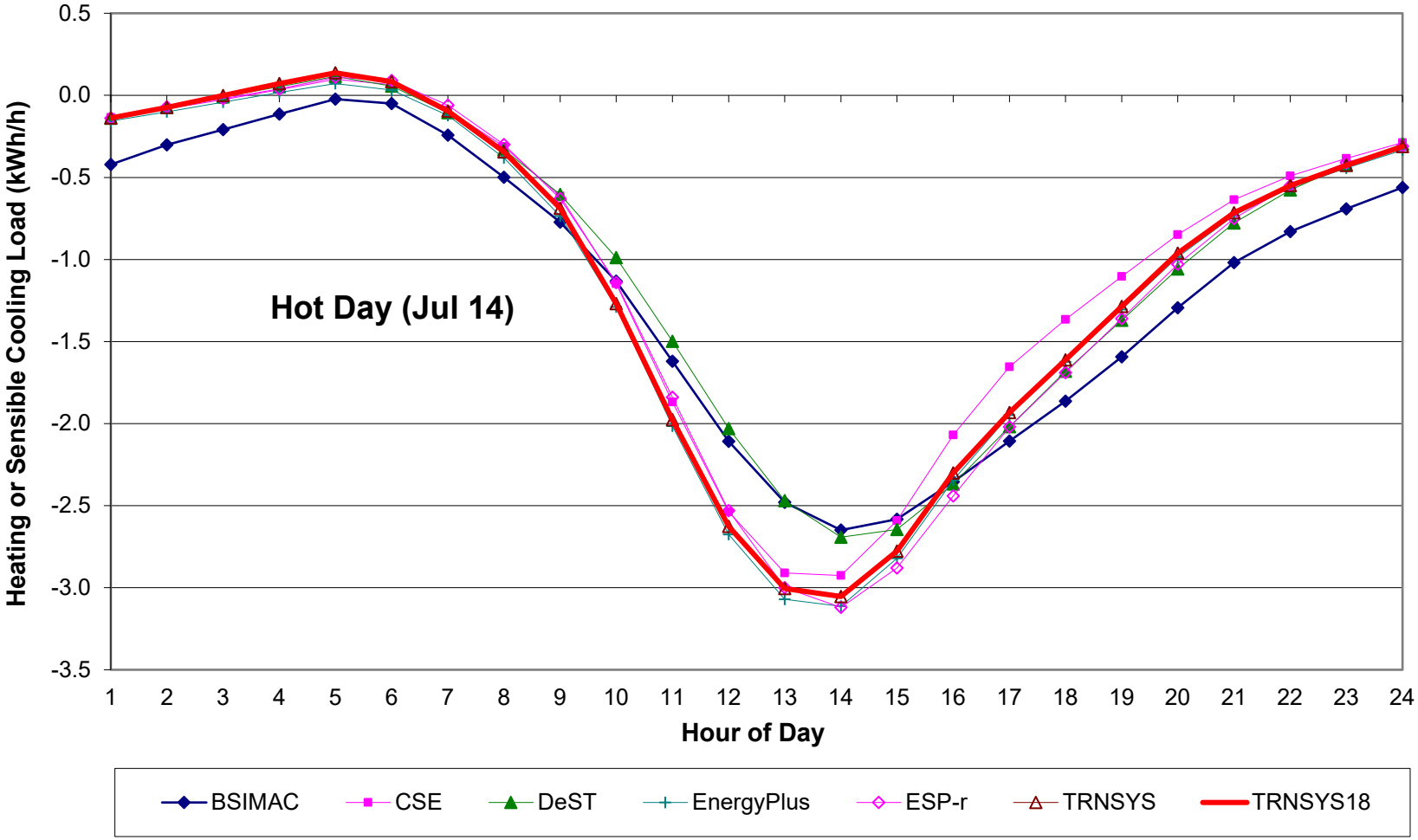


Figure B8-H31. Hourly Loads
Clear Cold Day, Case 900 (High Mass)
Heating (+), Sensible Cooling (-)

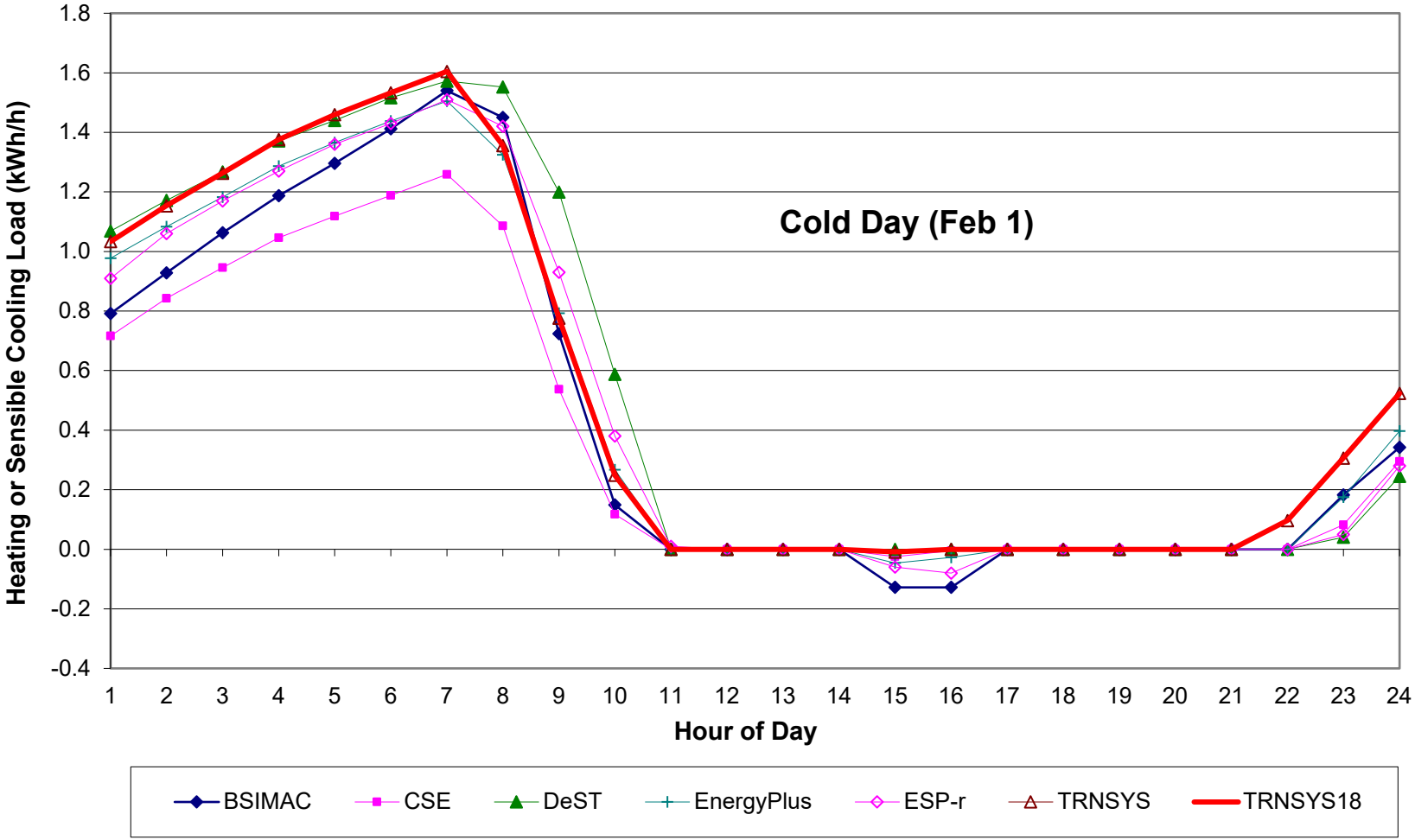


Figure B8-H32. Hourly Loads
Clear Hot Day, Case 900 (High Mass)
Heating (+), Sensible Cooling (-)

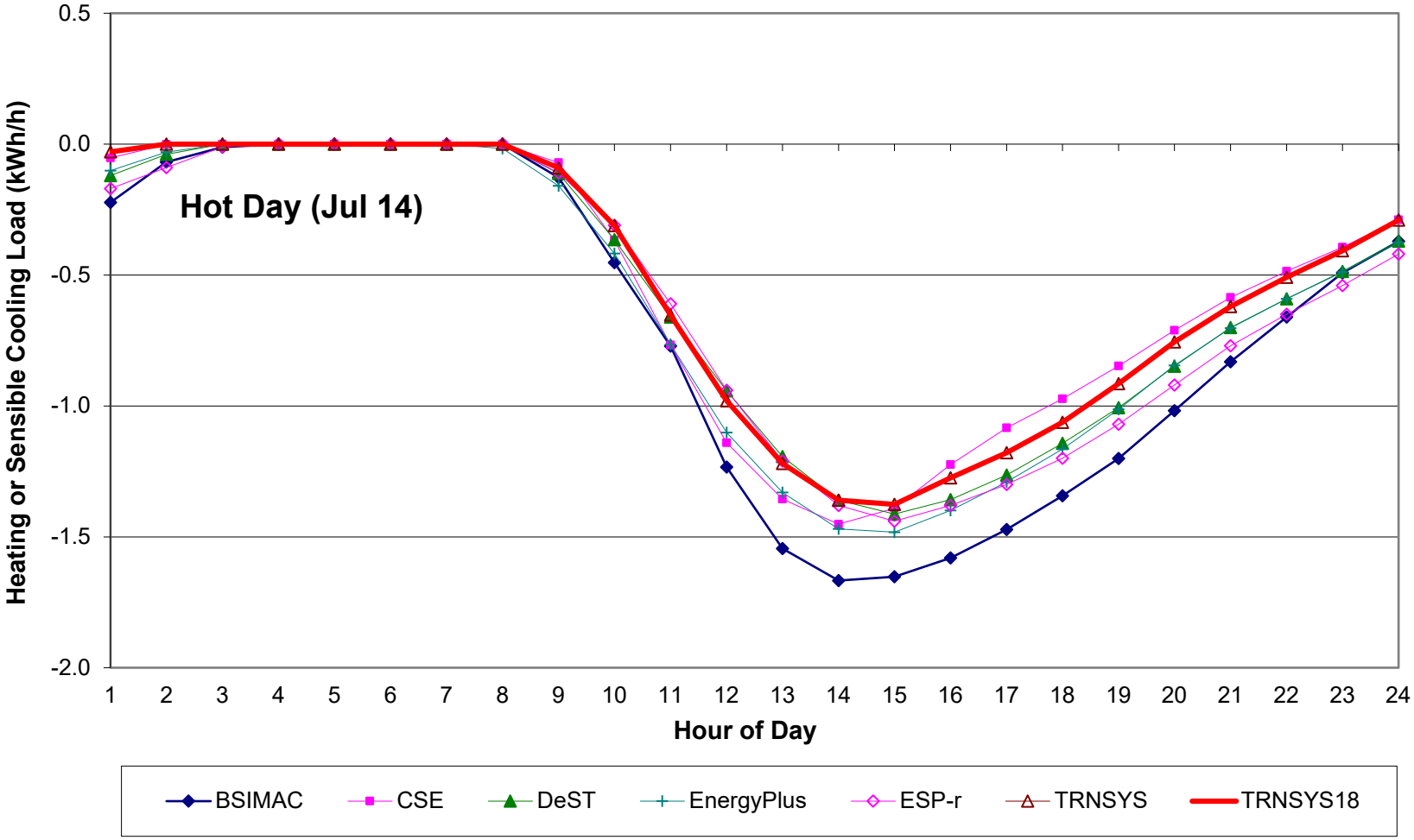


Figure B8-H33. Hourly Loads
Clear Cold Day, Case 980 (High Mass, Insulation)
Heating (+), Sensible Cooling (-)

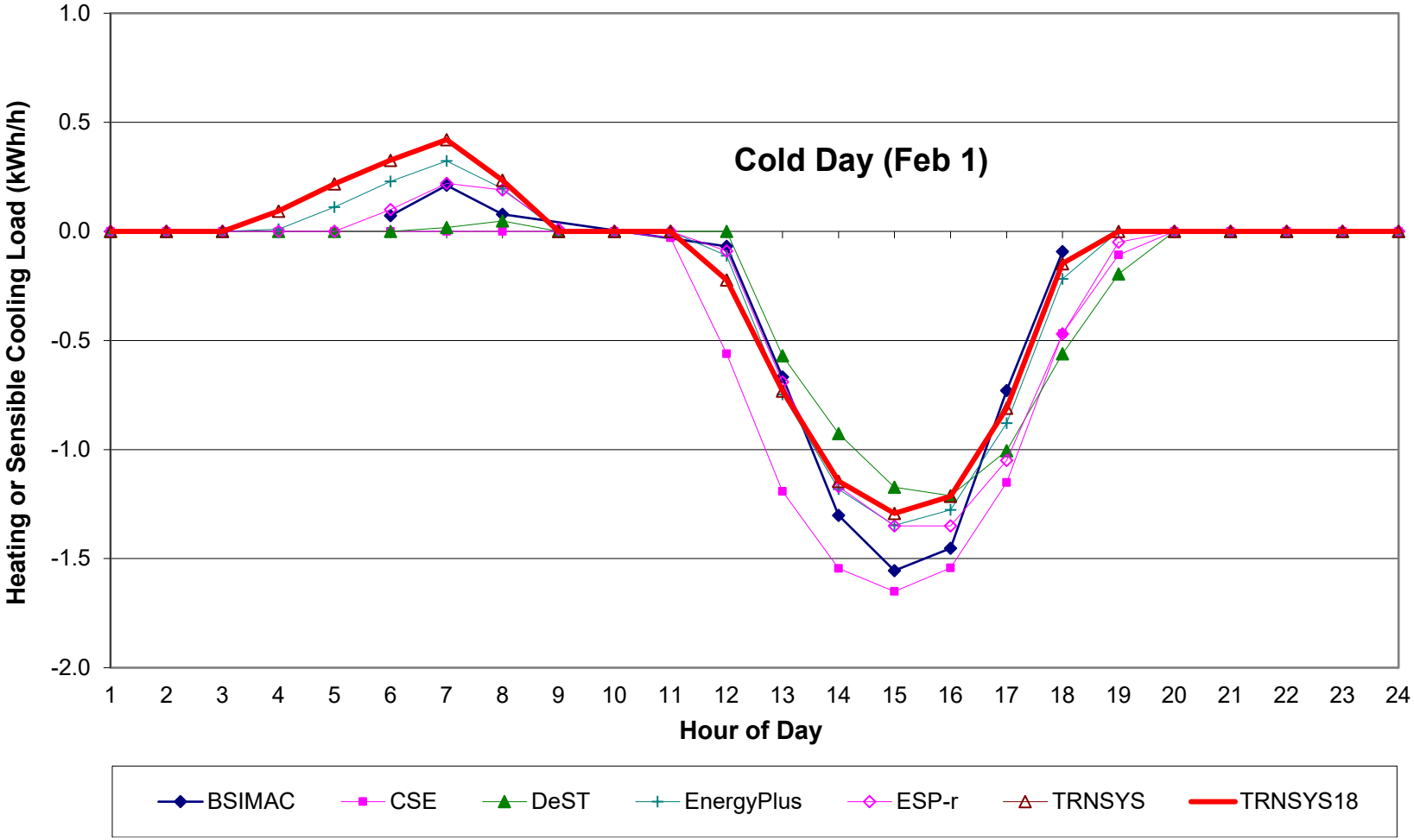


Figure B8-H34. Hourly Loads
Clear Hot Day, Case 980 (High Mass, Insulation)
Heating (+), Sensible Cooling (-)

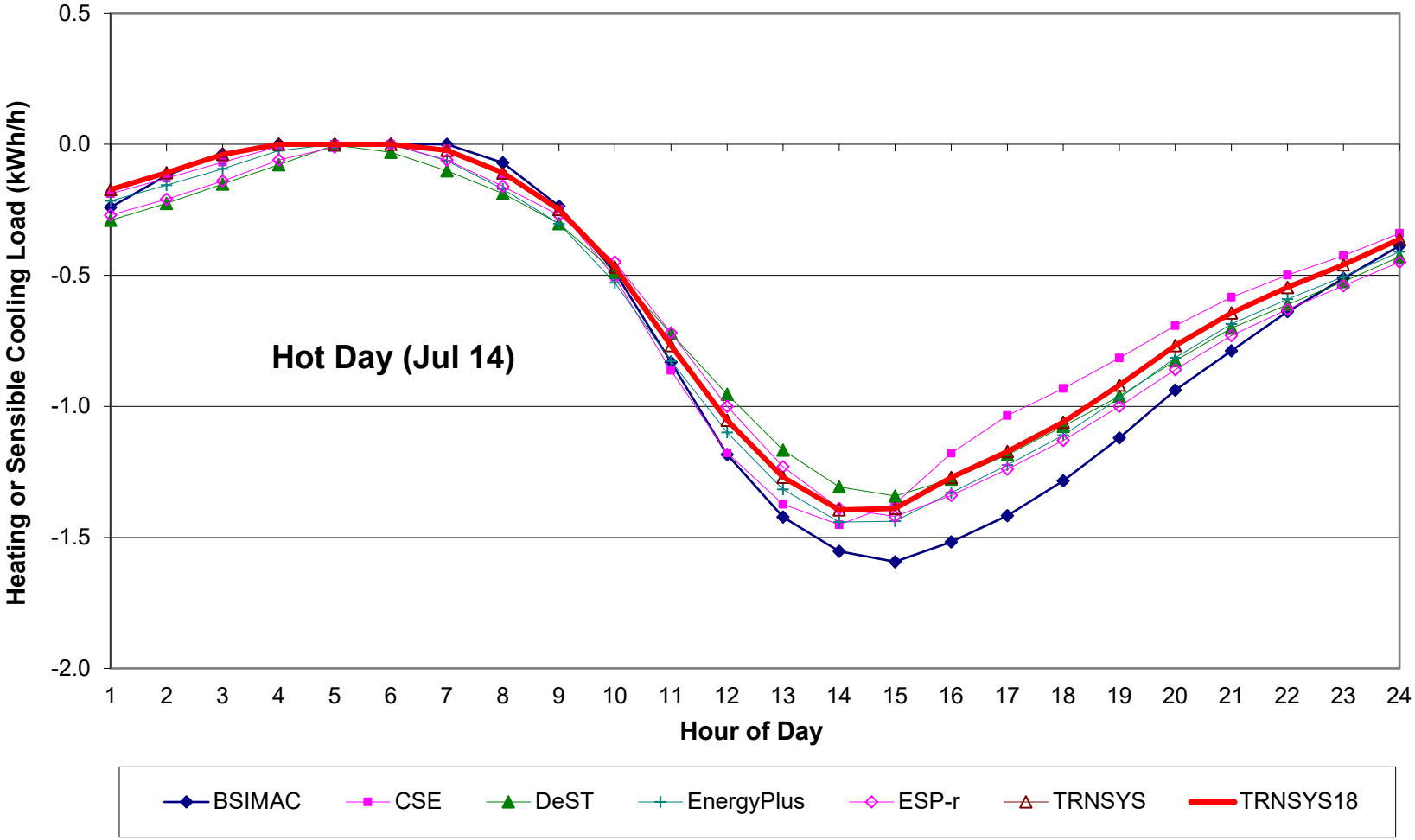


Figure B8-H35. Hourly Loads
Clear Cold Day, Case 985 (High Mass, 20/20 Tstat)
Heating (+), Sensible Cooling (-)

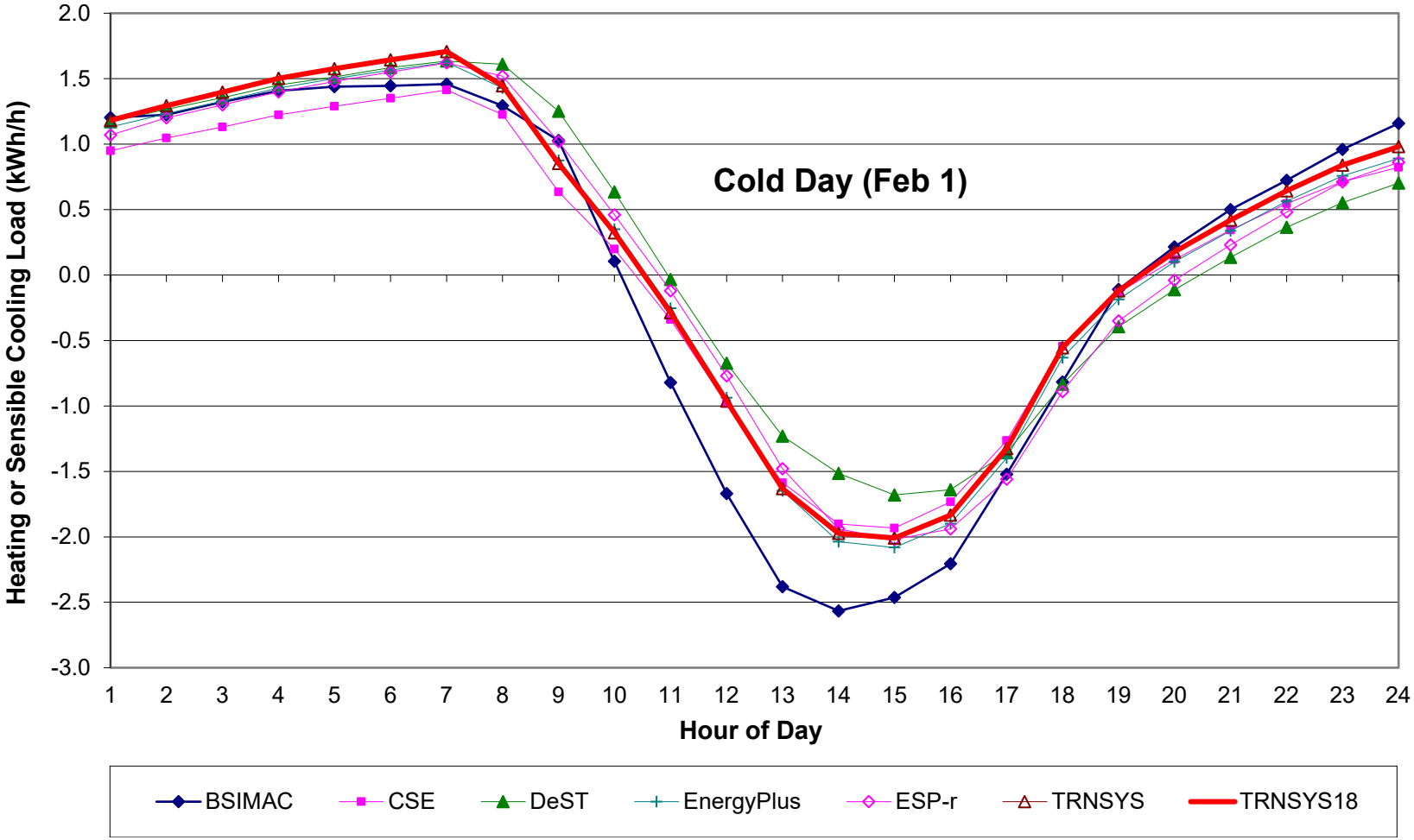


Figure B8-H36. Hourly Loads
Clear Hot Day, Case 985 (High Mass, 20/20 Tstat)
Heating (+), Sensible Cooling (-)

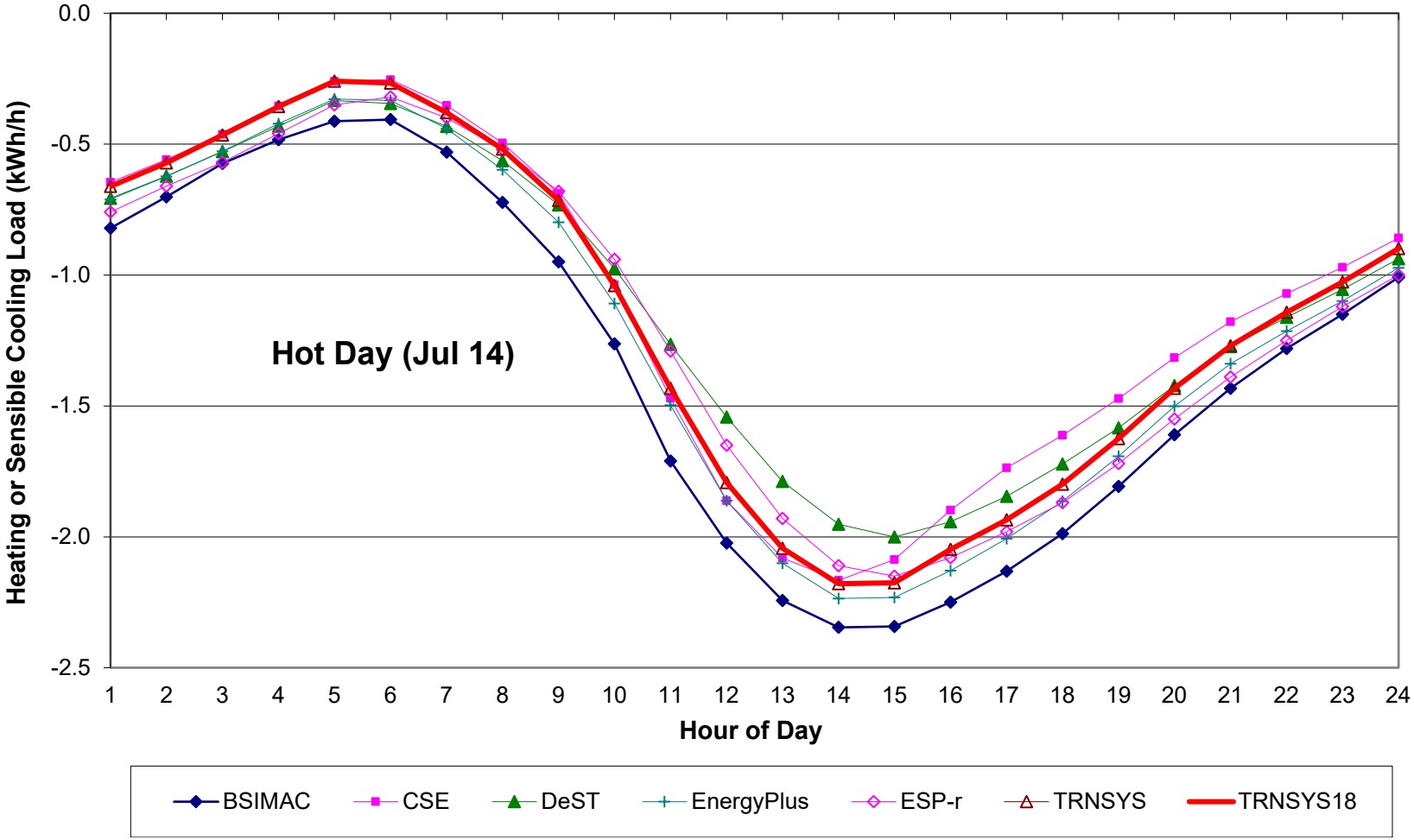


Figure B8-H37. Hourly Loads
Clear Cold Day, Case 995 (High Mass, 20/20, Insulation)
Heating (+), Sensible Cooling (-)

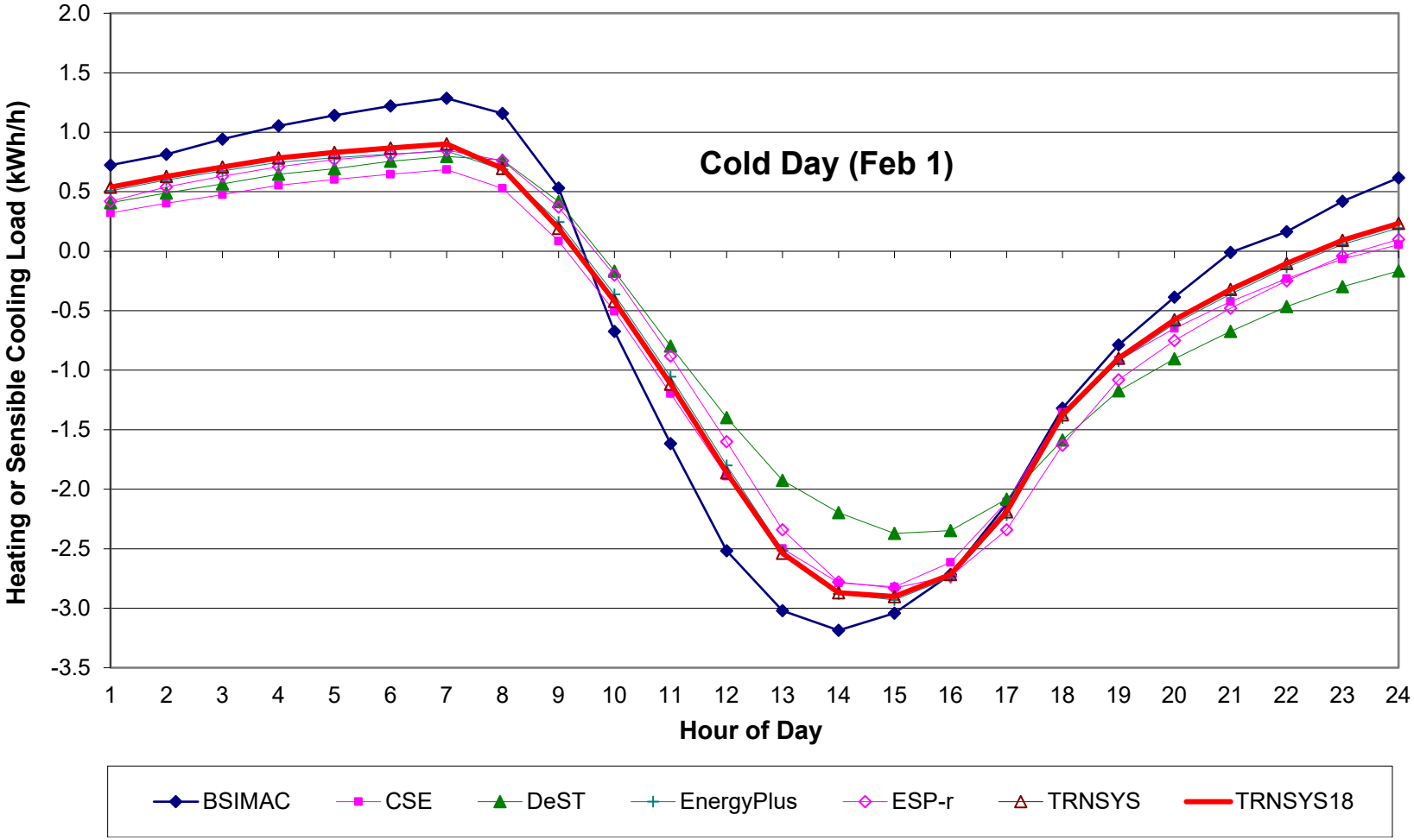


Figure B8-H38. Hourly Loads
Clear Hot Day, Case 995 (High Mass, 20/20, Insulation)
Heating (+), Sensible Cooling (-)