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November 13, 2023

Dear TRACE 3D Plus User:

We are pleased to inform you that TRACE 3D Plus V6.00.106 was tested in compliance with ANSI/ASHRAE Standard 140-2020, *Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs*.

As you may know, ANSI/ASHRAE/IESNA Standard 90.1, *Energy Standard for Buildings, Except Low-Rise Residential Buildings*, stipulates that any computer program used to demonstrate code compliance via the performance path's Energy Cost Budget Method must be tested in accordance with Standard 140. The required BESTTEST test cases provided by the standard have been simulated and validated in TRACE 3D Plus V6.00.106.

As required by the standard, test results have been posted and can be downloaded from our [Trane CDS Download Center](#). These can be used for compliance of state and local code-writing bodies that reference ASHRAE Standard 90.1 or used along with other pertinent documentation for federal tax deductions.

If you have questions about the results or about any of Trane's design and analysis tools, please contact our C.D.S. Support Center at 608-787-3926 or cdshelp@trane.com

Sincerely,

Delia Estrada
Product Development Manager
Trane C.D.S

ASHRAE Standard 140-2020

Informative Annex B8, Section B8.1

Example Results

for

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

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).

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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 B8-1. Annual Heating Loads (MWh)

Simulation Model: Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRACE 3D Plus
							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%	4.319
610 S. Windows + Overhang	4.163	4.066	4.144	4.375	4.527	4.592	4.066	4.592	4.311	12.2%	4.370
620 East & West Windows	4.370	4.094	4.297	4.485	4.514	4.719	4.094	4.719	4.413	14.2%	4.479
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%	4.778
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%	2.674
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%	3.703
670 Single-Pane Windows	5.484	5.300	5.573	5.616	5.975	6.140	5.300	6.140	5.681	14.8%	5.608
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%	2.176
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%	4.876
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%	2.801
900 South Windows	1.726	1.379	1.591	1.664	1.585	1.814	1.379	1.814	1.626	26.8%	1.662
910 S. Windows + Overhang	2.163	1.648	1.860	1.956	2.067	2.132	1.648	2.163	1.971	26.1%	1.953
920 East & West Windows	3.500	2.956	3.259	3.337	3.300	3.607	2.956	3.607	3.326	19.6%	3.332
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%	3.989
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%	1.077
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%	2.704
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%	0.411
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%	2.367
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%	1.006
195 Solid Conduction	4.217	3.990	4.157	4.070	3.951	4.094	3.951	4.217	4.080	6.5%	4.068
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%	5.094
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%	6.044
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%	5.390
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%	6.450
230 Infiltration	9.851	9.812	10.417	9.930	9.939	10.234	9.812	10.417	10.031	6.0%	9.925
240 Internal Gains	5.116	5.443	5.944	5.279	5.539	5.657	5.116	5.944	5.496	15.1%	5.274
250 Exterior Shortwave Absorptance	4.733	5.044	5.373	4.899	4.935	5.105	4.733	5.373	5.015	12.8%	4.890
270 South Solar Windows		4.346	4.273	4.385	4.576	4.631	4.273	4.631	4.442	8.1%	4.385
280 Cavity Albedo		4.525	4.619	4.570	4.738	4.870	4.525	4.870	4.664	7.4%	4.570
290 South Shading		4.424	4.381	4.424	4.745	4.725	4.381	4.745	4.540	8.0%	4.424
300 East/West Window		4.318	4.460	4.425	4.668	4.726	4.318	4.726	4.519	9.0%	4.423
310 East/West Shading		4.580	4.846	4.691	5.240	5.163	4.580	5.240	4.904	13.4%	4.689
320 Thermostat		3.677	3.599	3.771	3.970	4.031	3.599	4.031	3.810	11.3%	3.766
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%	4.641
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%	6.343
410 Low Mass Infiltration	7.630	8.045	8.661	8.080	8.212	8.445	7.630	8.661	8.179	12.6%	8.075
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%	6.900
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%	5.607
440 Low Mass Cavity Albedo		4.156	4.330	4.500	4.504	4.721	4.156	4.721	4.442	12.7%	4.495
450 Constant Interior and Exterior Surf Coeffs	3.743	3.990	3.375	3.962	3.850	3.871	3.743	3.990	3.799	16.2%	3.954
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%	4.182
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%	4.090
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%	5.098
810 High Mass Cavity Albedo		2.038	2.454	2.342	2.185	2.610	2.038	2.610	2.326	24.6%	2.339

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

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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: Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRACE 3D Plus
							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%	6.027
610 S. Windows + Overhang	4.299	4.382	4.173	4.333	4.233	4.117	4.117	4.382	4.256	6.2%	4.332
620 East & West Windows	4.404	4.079	3.909	4.060	4.246	3.841	3.841	4.404	4.090	13.8%	4.060
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%	2.837
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%	5.771
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%	4.778
660 Low-E Windows	3.014	3.340	3.260	3.232	3.219	2.966	2.966	3.340	3.172	11.8%	3.230
670 Single-Pane Windows	6.539	6.578	5.954	6.623	6.520	6.198	5.954	6.623	6.402	10.4%	6.622
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%	6.439
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%	9.125
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%	9.175
900 South Windows	2.714	2.464	2.383	2.489	2.488	2.267	2.267	2.714	2.467	18.1%	2.491
910 S. Windows + Overhang	1.484	1.415	1.490	1.383	1.283	1.191	1.191	1.490	1.374	21.8%	1.386
920 East & West Windows	3.128	2.789	2.706	2.731	2.814	2.549	2.549	3.128	2.786	20.8%	2.734
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%	1.921
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%	2.428
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%	0.694
960 Sunspace		0.926	0.909	0.907	0.950	0.789	0.789	0.950	0.896	17.9%	0.901
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%	3.714
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%	6.364
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%	7.206
195 Solid Conduction	0.712	0.606	0.628	0.612	0.611	0.592	0.592	0.712	0.627	19.2%	0.612
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%	0.816
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%	0.560
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%	0.879
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%	0.609
230 Infiltration	1.184	0.991	0.929	0.991	0.955	0.897	0.897	1.184	0.991	29.0%	0.991
240 Internal Gains	1.287	0.982	0.876	0.979	0.922	0.834	0.834	1.287	0.980	46.2%	0.978
250 Exterior Shortwave Absorptance	3.612	3.429	3.471	3.182	3.467	2.904	2.904	3.612	3.344	21.2%	3.205
270 South Solar Windows		7.271	6.698	7.522	7.309	7.289	6.698	7.522	7.217	11.4%	7.524
280 Cavity Albedo		4.996	4.215	5.183	5.206	4.808	4.215	5.206	4.882	20.3%	5.185
290 South Shading		5.610	5.310	5.743	5.321	5.461	5.310	5.743	5.489	7.9%	5.744
300 East/West Window		5.055	4.805	5.152	5.038	4.913	4.805	5.152	4.993	7.0%	5.153
310 East/West Shading		3.752	3.402	3.669	3.128	3.324	3.128	3.752	3.455	18.1%	3.670
320 Thermostat		4.859	4.420	4.986	4.913	4.788	4.420	4.986	4.793	11.8%	4.980
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%	0.010
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%	0.030
410 Low Mass Infiltration	0.096	0.048	0.041	0.057	0.052	0.035	0.035	0.096	0.055	110.6%	0.057
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%	0.152
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%	0.860
440 Low Mass Cavity Albedo		3.985	3.458	4.085	4.414	3.741	3.458	4.414	3.937	24.3%	4.084
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%	6.485
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%	6.457
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%	6.023
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%	0.376
810 High Mass Cavity Albedo		1.481	1.357	1.508	1.606	1.295	1.295	1.606	1.449	21.5%	1.510

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

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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.

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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.

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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				TRACE 3D Plus														
Simulation Model:		BSIMAC			CSE			DeST			EnergyPlus			ESP-r			TRNSYS															
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	Min T (°C)	Max T (°C)	Mean T (°C)	(Max-Min)/ 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%	63.5	OCT	19	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%	44.3	SEP	13	14
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%	61.7	OCT	19	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%	36.6	SEP	12	15
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%	69.7	JAN	23	15
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%	49.6	SEP	13	14
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%	49.0	OCT	13	14

MINIMUM ANNUAL HOURLY INTEGRATED ZONE TEMPERATURE														Example Result Statistics				TRACE 3D Plus														
Simulation Model:		BSIMAC			CSE			DeST			EnergyPlus			ESP-r			TRNSYS															
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	Min T (°C)	Max T (°C)	Mean T (°C)	(Max-Min)/ 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%	-12.6	FEB	10	6
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%	1.2	FEB	10	6
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%	-17.0	DEC	32	23
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	10	5
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%	-7.1	FEB	10	6
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%	9.9	NOV	5	6
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%	5.0	FEB	10	6

AVERAGE ANNUAL HOURLY INTEGRATED ZONE TEMPERATURE														Example Result Statistics				TRACE 3D Plus														
Simulation Model:		BSIMAC			CSE			DeST			EnergyPlus			ESP-r			TRNSYS															
Case	T (°C)				T (°C)				T (°C)				T (°C)				T (°C)				Min T (°C)	Max T (°C)	Mean T (°C)	(Max-Min)/ 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%	24.9			
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%	25.1			
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%	14.8			
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%	30.9			
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%	31.2			
960 Sunspace					28.6				29.5				27.7				27.7				26.8				26.8	29.5	28.1	9.5%	27.5			

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

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1

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

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				TRACE 3D Plus
Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	0.051
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%	0.160
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%	0.299
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%	-1.646
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%	-0.616
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%	1.289
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%	-2.144
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%	0.557
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%	-2.075
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				TRACE 3D Plus
Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	-1.695
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%	-1.967
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%	-1.224
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%	-0.256
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%	-1.249
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%	-2.797
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%	0.595
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%	0.412
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%	3.098
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%	0.050
PEAK HEATING [kW]							Statistics for Example Results				TRACE 3D Plus
Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	-0.013
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%	0.026
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%	-0.023
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%	1.477
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%	-0.373
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%	0.650
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%	-1.151
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%	0.019
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%	-1.151
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				TRACE 3D Plus
Case	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	-0.215
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%	-1.553
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%	-0.585
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%	-0.053
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%	-0.218
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%	-2.582
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%	0.455
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%	0.418
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%	0.756
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%	0.228

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1

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

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.

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

Table B8-7. High Mass Basic Sensitivity Tests

ANNUAL HEATING [MWh]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
900-600 Mass, Heat	-2.324	-2.614	-2.456	-2.661	-2.777	-2.690	-2.777	-2.324	-2.587	17.5%	-2.657
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%	0.291
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%	1.669
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%	0.657
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%	-0.585
960-900 Heat, Sunspace		1.143	1.180	1.025	1.039	1.046	1.025	1.180	1.087	14.2%	1.042
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%	-1.251
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%	0.705
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%	-1.362
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
900-600 Mass, Cool	-3.108	-3.449	-3.049	-3.538	-3.674	-3.512	-3.674	-3.049	-3.389	18.4%	-3.536
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%	-1.105
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%	0.243
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%	-0.812
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%	-0.063
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%	-1.797
960-900 Cool, Sunspace		-1.538	-1.474	-1.582	-1.538	-1.478	-1.582	-1.474	-1.522	7.1%	-1.590
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%	1.223
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%	3.873
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%	0.842
PEAK HEATING [kW]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
900-600 Mass, Heat	-0.704	-0.577	-0.582	-0.517	-0.595	-0.580	-0.704	-0.517	-0.593	31.6%	-0.516
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%	0.011
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%	0.083
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%	0.015
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%	0.466
960-900 Heat, Sunspace		-0.311	-0.368	-0.428	-0.432	-0.478	-0.478	-0.311	-0.404	41.3%	-0.424
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%	-1.150
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%	0.008
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%	-1.073
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
900-600 Mass, Cool	-2.611	-3.105	-2.866	-3.311	-3.297	-3.106	-3.311	-2.611	-3.049	23.0%	-3.309
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%	-0.818
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%	0.219
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%	-0.479
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%	0.000
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%	-0.667
960-900 Cool, Sunspace		-1.999	-1.189	-1.561	-1.493	-1.602	-1.999	-1.189	-1.569	51.7%	-1.561

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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.

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%	0.410
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%	0.874
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%	0.262

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

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
200-195 Surface Convection	0.824	0.823	1.069	1.036	0.970	1.049	0.823	1.069	0.962	25.5%	1.027
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%	0.949
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%	1.060
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%	0.296
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%	0.407
230-220 Infiltration	3.474	3.146	3.239	3.475	3.213	3.366	3.146	3.475	3.319	9.9%	3.475
240-220 Internal Gains	-1.261	-1.224	-1.234	-1.176	-1.186	-1.211	-1.261	-1.176	-1.215	7.0%	-1.176
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%	-1.560
270-220 South Windows		-2.320	-2.905	-2.070	-2.149	-2.237	-2.905	-2.070	-2.336	35.8%	-2.065
280-270 Cavity Albedo		0.178	0.346	0.185	0.162	0.239	0.162	0.346	0.222	83.0%	0.185
320-270 Thermostat		-0.669	-0.674	-0.614	-0.607	-0.600	-0.674	-0.600	-0.633	11.7%	-0.619
290-270 South Shading		0.078	0.108	0.039	0.168	0.094	0.039	0.168	0.097	132.8%	0.039
300-270 E&W Windows		-0.028	0.187	0.039	0.092	0.094	-0.028	0.187	0.077	280.1%	0.038
310-300 E&W Shading		0.262	0.386	0.267	0.572	0.437	0.262	0.572	0.385	80.5%	0.266
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
200-195 Surface Convection	0.127	0.195	0.207	0.203	0.189	0.197	0.127	0.207	0.186	42.9%	0.204
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%	-0.256
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%	-0.270
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%	0.063
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%	0.050
230-220 Infiltration	0.381	0.381	0.379	0.381	0.379	0.399	0.379	0.399	0.383	5.3%	0.381
240-220 Internal Gains	0.484	0.372	0.326	0.369	0.346	0.336	0.326	0.484	0.372	42.5%	0.369
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%	2.596
270-220 South Windows		6.660	6.148	6.912	6.732	6.791	6.148	6.912	6.649	11.5%	6.914
280-270 Cavity Albedo		-2.274	-2.483	-2.339	-2.103	-2.480	-2.483	-2.103	-2.336	16.3%	-2.339
320-270 Thermostat		-2.412	-2.278	-2.536	-2.396	-2.501	-2.536	-2.278	-2.424	10.6%	-2.544
290-270 South Shading		-1.661	-1.388	-1.779	-1.988	-1.827	-1.988	-1.388	-1.729	34.7%	-1.779
300-270 E&W Windows		-2.216	-1.893	-2.370	-2.271	-2.376	-2.376	-1.893	-2.225	21.7%	-2.370
310-300 E&W Shading		-1.303	-1.403	-1.483	-1.910	-1.589	-1.910	-1.303	-1.538	39.5%	-1.483
PEAK HEATING [kW]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
200-195 Surface Convection	0.470	0.435	0.509	0.547	0.473	0.557	0.435	0.557	0.499	24.4%	0.544
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%	0.225
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%	0.217
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%	0.135
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%	0.127
230-220 Infiltration	1.588	1.294	1.360	1.624	1.372	1.437	1.294	1.624	1.446	22.9%	1.624
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%	-0.005
270-220 South Windows		-0.228	-0.303	-0.095	-0.040	-0.035	-0.303	-0.035	-0.140	190.7%	-0.094
280-270 Cavity Albedo		0.001	0.008	0.005	0.004	0.005	0.001	0.008	0.005	150.6%	0.005
320-270 Thermostat		-0.002	-0.014	-0.023	-0.015	-0.010	-0.023	-0.002	-0.013	161.1%	-0.024
290-270 South Shading		0.000	0.001	-0.013	0.002	0.000	-0.013	0.002	-0.002	763.1%	-0.013
300-270 E&W Windows		0.003	0.029	0.007	0.018	0.010	0.003	0.029	0.013	197.7%	0.007
310-300 E&W Shading		0.001	0.003	-0.023	0.005	0.003	-0.023	0.005	-0.002	1211.6%	-0.023
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
200-195 Surface Convection	0.153	0.221	0.266	0.266	0.254	0.265	0.153	0.266	0.238	47.8%	0.265
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%	-0.223
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%	-0.217
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%	0.092
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%	0.098
230-220 Infiltration	0.658	0.620	0.694	0.656	0.689	0.726	0.620	0.726	0.674	15.7%	0.658
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%	1.687
270-220 South Windows		5.903	4.792	5.654	5.601	5.669	4.792	5.903	5.524	20.1%	5.657
280-270 Cavity Albedo		-2.246	-2.064	-2.112	-1.937	-2.238	-2.246	-1.937	-2.119	14.6%	-2.112
320-270 Thermostat		-0.538	-0.528	-0.630	-0.620	-0.688	-0.688	-0.528	-0.601	26.6%	-0.632
290-270 South Shading		-0.139	-0.093	-0.244	-0.202	-0.236	-0.244	-0.093	-0.183	82.8%	-0.244
300-270 E&W Windows		-2.848	-2.137	-2.363	-2.392	-2.359	-2.848	-2.137	-2.420	29.4%	-2.364

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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.

310-300 E&W Shading		-0.367	-0.443	-0.506	-0.603	-0.577	-0.603	-0.367	-0.499	47.2%	-0.506
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** ABS[(Max-Min) / (Mean of Example Simulation Results)]

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	1.701
410-400 Infiltration	1.724	1.509	1.614	1.733	1.602	1.676	1.509	1.733	1.643	13.6%	1.733
420-410 Internal Gains	-1.231	-1.211	-1.228	-1.175	-1.185	-1.209	-1.231	-1.175	-1.206	4.7%	-1.175
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%	-1.294
600-430 South Windows	-1.121	-1.461	-1.907	-1.296	-1.183	-1.347	-1.907	-1.121	-1.386	56.7%	-1.288
440-600 Cavity Albedo		0.163	0.283	0.176	0.142	0.217	0.142	0.283	0.196	71.9%	0.176
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%	-0.366
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%	-0.137
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%	0.229
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%	-0.229
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%	0.137
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	0.020
410-400 Infiltration	0.033	0.025	0.024	0.027	0.028	0.022	0.022	0.033	0.027	39.8%	0.027
420-410 Internal Gains	0.132	0.092	0.078	0.095	0.090	0.074	0.074	0.132	0.094	61.7%	0.095
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%	0.707
600-430 South Windows	4.738	5.007	4.488	5.171	5.209	5.040	4.488	5.209	4.942	14.6%	5.168
440-600 Cavity Albedo		-1.928	-1.974	-1.942	-1.748	-2.038	-2.038	-1.748	-1.926	15.1%	-1.944
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%	0.458
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%	0.430
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%	-0.028
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%	-0.004
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%	-0.462
PEAK HEATING [kW]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	0.739
410-400 Infiltration	0.779	0.601	0.680	0.812	0.685	0.718	0.601	0.812	0.713	29.6%	0.812
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%	-0.003
600-430 South Windows	-0.045	-0.234	-0.325	-0.112	-0.057	-0.050	-0.325	-0.045	-0.137	204.3%	-0.111
440-600 Cavity Albedo		0.007	0.025	0.014	0.009	0.015	0.007	0.025	0.014	127.7%	0.015
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%	-0.104
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%	-0.114
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%	-0.009
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%	0.003
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%	0.107
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	0.228
410-400 Infiltration	0.213	0.206	0.252	0.221	0.168	0.232	0.168	0.252	0.215	39.0%	0.221
420-410 Internal Gains	0.197	0.209	0.208	0.205	0.212	0.210	0.197	0.212	0.207	7.3%	0.205
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%	0.900
600-430 South Windows	3.483	4.641	3.582	4.422	4.319	4.342	3.483	4.641	4.132	28.0%	4.420
440-600 Cavity Albedo		-1.815	-1.656	-1.666	-1.514	-1.738	-1.815	-1.514	-1.678	18.0%	-1.665
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%	0.112
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%	0.021
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%	-0.092
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%	0.092
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%	-0.021

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

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1

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

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.

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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 B8-10. High Mass Basic and In-Depth Sensitivity Tests

ANNUAL HEATING [MWh]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	-0.509
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%	-3.436
900-810 Himass, Int. Sol. Abs.		-0.659	-0.863	-0.678	-0.600	-0.796	-0.863	-0.600	-0.719	36.5%	-0.677
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%	-2.417
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%	-1.148
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%	-0.789
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%	-1.597
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%	-1.765
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%	-2.509
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%	-1.796
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	-0.483
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%	2.115
900-810 Himass, Int. Sol. Abs.		0.983	1.026	0.981	0.882	0.973	0.882	1.026	0.969	14.9%	0.981
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%	-2.947
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%	-1.327
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%	-0.915
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%	-3.343
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%	-4.084
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%	-2.726
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%	-2.761
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%	-1.969
PEAK HEATING [kW]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	-0.393
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%	-0.235
900-810 Himass, Int. Sol. Abs.		-0.057	-0.059	-0.062	-0.062	-0.066	-0.066	-0.057	-0.061	15.4%	-0.062
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%	-0.492
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%	-0.459
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%	-0.422
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%	-1.527
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%	-0.514
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%	-0.527
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%	-0.449
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				TRACE 3D Plus
CASES	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
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%	-0.883
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%	1.994
900-810 Himass, Int. Sol. Abs.		0.966	0.616	0.770	0.717	0.827	0.616	0.966	0.779	44.9%	0.771
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%	-3.912
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%	-1.537
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%	-1.430
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%	-3.257
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%	-3.759
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%	-3.318
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%	-3.192
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%	-3.157

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

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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				TRACE 3D Plus
							Min	Max	Mean	(Max-Min)/ Mean* (%)	
Case											
600 South	0.591	0.627	0.624	0.587	0.597	0.594	0.587	0.627	0.603	6.7%	0.587
620 West	0.600		0.629	0.601	0.616	0.640	0.600	0.640	0.617	6.5%	0.633
660 South, Low-E	0.322	0.381	0.392	0.318	0.325	0.324	0.318	0.392	0.344	21.6%	0.318
670 South, Single-Pane	0.748	0.750	0.770	0.747	0.754	0.751	0.747	0.770	0.753	3.1%	0.747

* 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				TRACE 3D Plus
							Min	Max	Mean	(Max-Min)/ Mean* (%)	
Case											
610/600 South	0.218	0.194	0.176	0.196	0.224	0.195	0.176	0.224	0.201	24.0%	0.196
630/620 West	0.268		0.299	0.278	0.342	0.286	0.268	0.342	0.294	25.2%	0.273

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

Table B8-13. Case 600 Annual Incident Solar Radiation (kWh/m²)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRACE 3D Plus
							Min	Max	Mean	(Max-Min)/ Mean* (%)	
Case											
Horizontal	1670	1663	1667	1664	1665	1669	1663	1670	1666	0.4%	1664
North	453	399	477	438	432	440	399	477	440	17.8%	438
East	1061	1027	1017	1062	1054	1068	1017	1068	1048	4.9%	1062
South	1387	1317	1291	1370	1363	1384	1291	1387	1352	7.1%	1370
West	997	903	906	967	961	974	903	997	951	9.9%	967

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

Table B8-14. Annual Transmitted Solar Radiation - Unshaded (kWh/m²)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRACE 3D Plus
							Min	Max	Mean	(Max-Min)/ Mean* (%)	
Case											
600 South	820	826	805	804	814	823	804	826	815	2.6%	804
620 West	598		569	581	592	624	569	624	593	9.2%	612
660 South	447	501	506	436	443	448	436	506	464	15.2%	436
670 South	1037	988	994	1024	1028	1039	988	1039	1018	5.0%	1024

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

Table B8-15. Annual Transmitted Solar Radiation - Shaded (kWh/m²)

Simulation Model:	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Statistics for Example Results				TRACE 3D Plus
							Min	Max	Mean	(Max-Min)/ Mean* (%)	
Case											
610 South	641	665	663	646	631	662	631	665	651	5.2%	647
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, Informative Annex B8, Section B8.1
Example Results for Section 5.2 - Building Thermal Envelope and Fabric Load Cases 195-995 & 600FF-980FF

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														Example Result Statistics				TRACE 3D Plus															
Simulation Model:		BSIMAC			CSE			DeST			EnergyPlus			ESP-r			TRNSYS			TestSpec-Alt Alternative Values				TRACE 3D Plus									
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)	T (°C)	T (°C)	(Max-Min)/ Mean** (%)	T (°C)	Mo.	Day	Hr					
Average Annual Hourly Integrated					-3.9				-5.9				-2.0				-5.9				-5.1				-5.9	-5.9	-2.0	-4.7	83.2%	-2.0			
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%	-38.0	DEC	32	23
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%	24.7	AUG	5	15

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

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1

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

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				TRACE 3D Plus
							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%	711.0
Feb	653.3	626.3	635.3	682.6	682.0	702.1	626.3	702.1	663.6	11.4%	681.9
Mar	433.5	435.7	450.5	472.2	481.0	495.0	433.5	495.0	461.3	13.3%	471.5
Apr	511.0	457.0	448.0	510.1	479.0	517.3	448.0	517.3	487.1	14.2%	509.4
May	112.8	127.8	128.0	136.8	139.0	150.7	112.8	150.7	132.5	28.6%	136.6
Jun	2.7	11.7	11.2	10.1	14.0	16.0	2.7	16.0	10.9	120.7%	10.1
Jul	4.8	11.5	10.1	12.0	14.0	16.7	4.8	16.7	11.5	103.0%	12.0
Aug	1.4	6.9	8.4	6.6	9.0	9.6	1.4	9.6	7.0	118.1%	6.6
Sep	51.8	74.3	76.7	73.3	81.0	84.8	51.8	84.8	73.7	44.9%	73.3
Oct	317.0	328.4	324.1	347.7	354.0	367.1	317.0	367.1	339.7	14.7%	347.2
Nov	598.7	575.6	585.8	625.3	629.0	645.8	575.6	645.8	610.0	11.5%	624.6
Dec	698.7	682.0	697.8	735.7	750.0	763.5	682.0	763.5	721.3	11.3%	735.0
Case 900											
Jan	277.8	206.1	275.3	255.8	266.0	291.9	206.1	291.9	262.2	32.7%	255.6
Feb	307.4	243.2	292.9	294.2	283.0	322.1	243.2	322.1	290.5	27.2%	293.9
Mar	134.4	102.4	120.0	125.5	115.0	143.8	102.4	143.8	123.5	33.5%	125.4
Apr	275.7	222.4	214.2	268.7	228.0	275.5	214.2	275.7	247.4	24.9%	268.3
May	20.1	33.3	26.8	33.4	29.0	37.5	20.1	37.5	30.0	58.0%	33.3
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%	0.1
Oct	80.5	65.1	63.6	81.1	70.0	85.0	63.6	85.0	74.2	28.9%	81.0
Nov	298.2	251.6	283.9	297.0	286.0	318.2	251.6	318.2	289.2	23.0%	296.7
Dec	329.8	254.7	314.3	307.9	308.0	339.4	254.7	339.4	309.0	27.4%	307.8

** 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				TRACE 3D Plus
							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%	521.6
Feb	349.2	394.3	315.4	387.5	398.0	367.4	315.4	398.0	368.6	22.4%	387.5
Mar	450.3	474.4	410.7	484.4	489.0	457.4	410.7	489.0	461.0	17.0%	484.2
Apr	218.7	220.1	230.2	240.5	263.0	235.4	218.7	263.0	234.6	18.9%	240.0
May	342.7	321.2	338.6	339.9	364.0	325.2	321.2	364.0	338.6	12.7%	339.9
Jun	578.3	497.4	526.4	539.6	550.0	516.1	497.4	578.3	534.6	15.1%	541.6
Jul	568.4	505.9	525.1	536.4	556.0	514.4	505.9	568.4	534.4	11.7%	536.7
Aug	658.2	606.5	621.1	648.5	674.0	634.1	606.5	674.0	640.4	10.5%	650.2
Sep	724.8	705.2	672.1	733.7	743.0	710.5	672.1	743.0	714.9	9.9%	734.0
Oct	628.4	676.1	611.1	675.3	681.0	649.5	611.1	681.0	653.6	10.7%	675.6
Nov	394.3	454.7	377.1	437.7	444.0	418.6	377.1	454.7	421.1	18.4%	437.6
Dec	433.3	503.3	386.2	481.9	476.0	456.1	386.2	503.3	456.1	25.7%	481.6
Case 900											
Jan	73.3	67.8	33.5	53.3	42.0	44.6	33.5	73.3	52.4	76.0%	53.1
Feb	24.0	15.1	4.7	12.3	11.0	9.2	4.7	24.0	12.7	151.4%	12.4
Mar	86.4	68.5	40.9	65.4	56.0	50.6	40.9	86.4	61.3	74.2%	65.6
Apr	29.3	12.3	18.3	18.5	22.0	16.1	12.3	29.3	19.4	87.8%	18.6
May	131.1	117.8	128.6	114.5	125.0	98.4	98.4	131.1	119.2	27.5%	114.9
Jun	447.5	372.3	408.5	401.3	404.0	365.8	365.8	447.5	399.9	20.4%	404.2
Jul	440.9	380.4	408.1	398.7	410.0	365.5	365.5	440.9	400.6	18.8%	399.7
Aug	532.6	485.7	510.2	510.3	531.0	487.6	485.7	532.6	509.6	9.2%	512.9
Sep	517.9	484.0	466.1	492.8	492.0	458.9	458.9	517.9	485.3	12.2%	493.4
Oct	296.2	305.6	269.6	292.7	281.0	260.9	260.9	305.6	284.3	15.7%	292.8
Nov	72.7	80.5	56.2	68.0	63.0	60.2	56.2	80.5	66.8	36.4%	68.0
Dec	62.1	73.7	38.1	60.9	48.0	49.5	38.1	73.7	55.4	64.4%	60.8

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

ASHRAE Standard 140-2020, Informative Annex B8, Section B8.1

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

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				TRACE 3D Plus
Month	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
Jan	386.2	449.5	397.4	456.0	466.0	443.0	386.2	466.0	433.0	18.4%	455.4
Feb	345.9	383.0	342.4	388.5	399.0	379.9	342.4	399.0	373.1	15.2%	387.9
Mar	299.1	333.3	330.5	346.7	366.0	351.2	299.1	366.0	337.8	19.8%	346.1
Apr	235.3	234.6	233.8	241.5	251.0	241.8	233.8	251.0	239.7	7.2%	241.1
May	92.7	94.4	101.2	103.4	110.0	113.2	92.7	113.2	102.5	20.1%	103.4
Jun	2.7	11.7	11.2	10.1	14.0	16.0	2.7	16.0	10.9	120.7%	10.1
Jul	4.8	11.5	10.1	12.0	14.0	16.7	4.8	16.7	11.5	103.0%	12.0
Aug	1.4	6.9	8.4	6.6	9.0	9.6	1.4	9.6	7.0	118.1%	6.6
Sep	49.7	74.3	76.7	73.2	81.0	84.3	49.7	84.3	73.2	47.3%	73.2
Oct	236.5	263.3	260.6	266.6	284.0	282.0	236.5	284.0	265.5	17.9%	266.3
Nov	300.5	324.0	301.9	328.3	343.0	327.6	300.5	343.0	320.9	13.3%	327.9
Dec	368.9	427.3	383.5	427.9	442.0	424.2	368.9	442.0	412.3	17.7%	427.2
ANNUAL SENSIBLE COOLING [MWh]							Statistics for Example Results				TRACE 3D Plus
Month	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
Jan	402.1	486.2	384.4	468.5	481.0	450.4	384.4	486.2	445.4	22.8%	468.5
Feb	325.2	379.2	310.7	375.2	387.0	358.2	310.7	387.0	355.9	21.4%	375.1
Mar	363.9	405.8	369.8	419.0	433.0	406.8	363.9	433.0	399.7	17.3%	418.7
Apr	189.4	207.8	211.9	222.0	241.0	219.3	189.4	241.0	215.2	24.0%	221.4
May	211.6	203.3	210.0	225.4	239.0	226.8	203.3	239.0	219.4	16.3%	225.0
Jun	130.8	125.2	118.0	138.3	146.0	150.2	118.0	150.2	134.7	24.0%	137.4
Jul	127.5	125.4	117.0	137.7	146.0	148.9	117.0	148.9	133.7	23.8%	137.0
Aug	125.6	120.8	110.9	138.2	143.0	146.6	110.9	146.6	130.8	27.2%	137.3
Sep	206.9	221.2	206.0	240.9	251.0	251.6	206.0	251.6	229.6	19.9%	240.6
Oct	332.2	370.6	341.6	382.6	400.0	388.6	332.2	400.0	369.3	18.4%	382.8
Nov	321.6	374.3	320.9	369.7	381.0	358.4	320.9	381.0	354.3	17.0%	369.6
Dec	371.2	429.5	348.2	420.9	428.0	406.6	348.2	429.5	400.7	20.3%	420.8
PEAK HEATING [kW]							Statistics for Example Results				TRACE 3D Plus
Month	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
Jan	0.778	0.943	0.858	1.075	1.030	0.980	0.778	1.075	0.944	31.4%	1.020
Feb	0.490	0.456	0.469	0.379	0.510	0.447	0.379	0.510	0.459	28.5%	0.370
Mar	0.501	0.422	0.419	0.370	0.470	0.429	0.370	0.501	0.435	30.1%	0.370
Apr	0.449	0.437	0.513	0.319	0.450	0.421	0.319	0.513	0.431	45.0%	0.340
May	0.350	0.450	0.445	0.356	0.520	0.454	0.350	0.520	0.429	39.6%	0.360
Jun	0.805	0.778	0.748	0.732	0.760	0.853	0.732	0.853	0.779	15.4%	0.770
Jul	0.599	0.540	0.512	0.514	0.570	0.619	0.512	0.619	0.559	19.1%	0.540
Aug	0.572	0.553	0.532	0.479	0.560	0.591	0.479	0.591	0.548	20.5%	0.500
Sep	1.116	1.120	1.114	1.065	1.190	1.017	1.017	1.190	1.104	15.7%	1.090
Oct	0.501	0.435	0.461	0.356	0.560	0.482	0.356	0.560	0.466	43.7%	0.380
Nov	0.828	0.764	0.730	0.790	0.830	0.744	0.730	0.830	0.781	12.8%	0.750
Dec	1.051	1.014	0.991	1.030	1.130	1.098	0.991	1.130	1.052	13.2%	1.050
PEAK SENSIBLE COOLING [kW]							Statistics for Example Results				TRACE 3D Plus
Month	BSIMAC	CSE	DeST	EnergyPlus	ESP-r	TRNSYS	Min	Max	Mean	(Max-Min)/ Mean** (%)	
Jan	3.668	4.239	3.785	4.274	4.380	4.168	3.668	4.380	4.086	17.4%	4.270
Feb	3.825	4.397	3.856	4.558	4.570	4.326	3.825	4.570	4.255	17.5%	4.550
Mar	2.950	3.714	3.109	3.515	3.770	3.314	2.950	3.770	3.395	24.2%	3.510
Apr	2.380	3.384	2.568	2.978	3.090	2.966	2.380	3.384	2.894	34.7%	3.020
May	1.219	1.652	1.448	1.553	1.640	1.576	1.219	1.652	1.515	28.6%	1.590
Jun	1.152	1.352	1.194	1.483	1.540	1.405	1.152	1.540	1.354	28.7%	1.550
Jul	1.179	1.347	1.325	1.560	1.670	1.522	1.179	1.670	1.434	34.3%	1.550
Aug	1.560	1.634	1.826	2.146	2.190	2.117	1.560	2.190	1.912	32.9%	2.200
Sep	2.125	2.313	2.355	2.726	2.770	2.549	2.125	2.770	2.473	26.1%	2.770
Oct	2.538	2.894	2.729	3.182	3.170	2.983	2.538	3.182	2.916	22.1%	3.230
Nov	3.494	3.916	3.546	4.192	4.090	3.883	3.494	4.192	3.854	18.1%	4.260
Dec	3.468	4.345	3.699	4.283	4.450	4.252	3.468	4.450	4.083	24.1%	4.410

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

Figure B8-1.
Annual Incident Solar Radiation

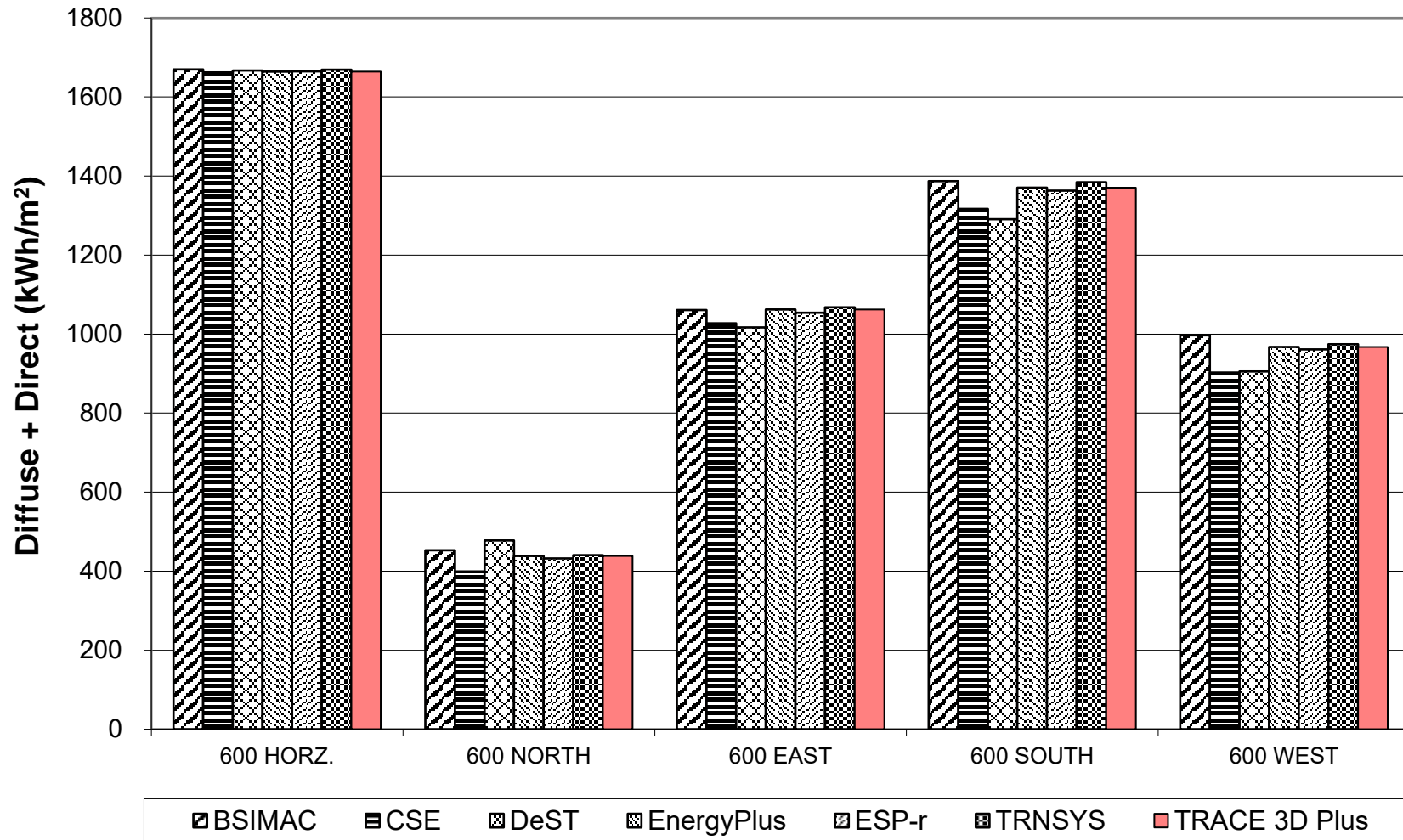


Figure B8-2.
Annual Transmitted Solar Radiation - Unshaded

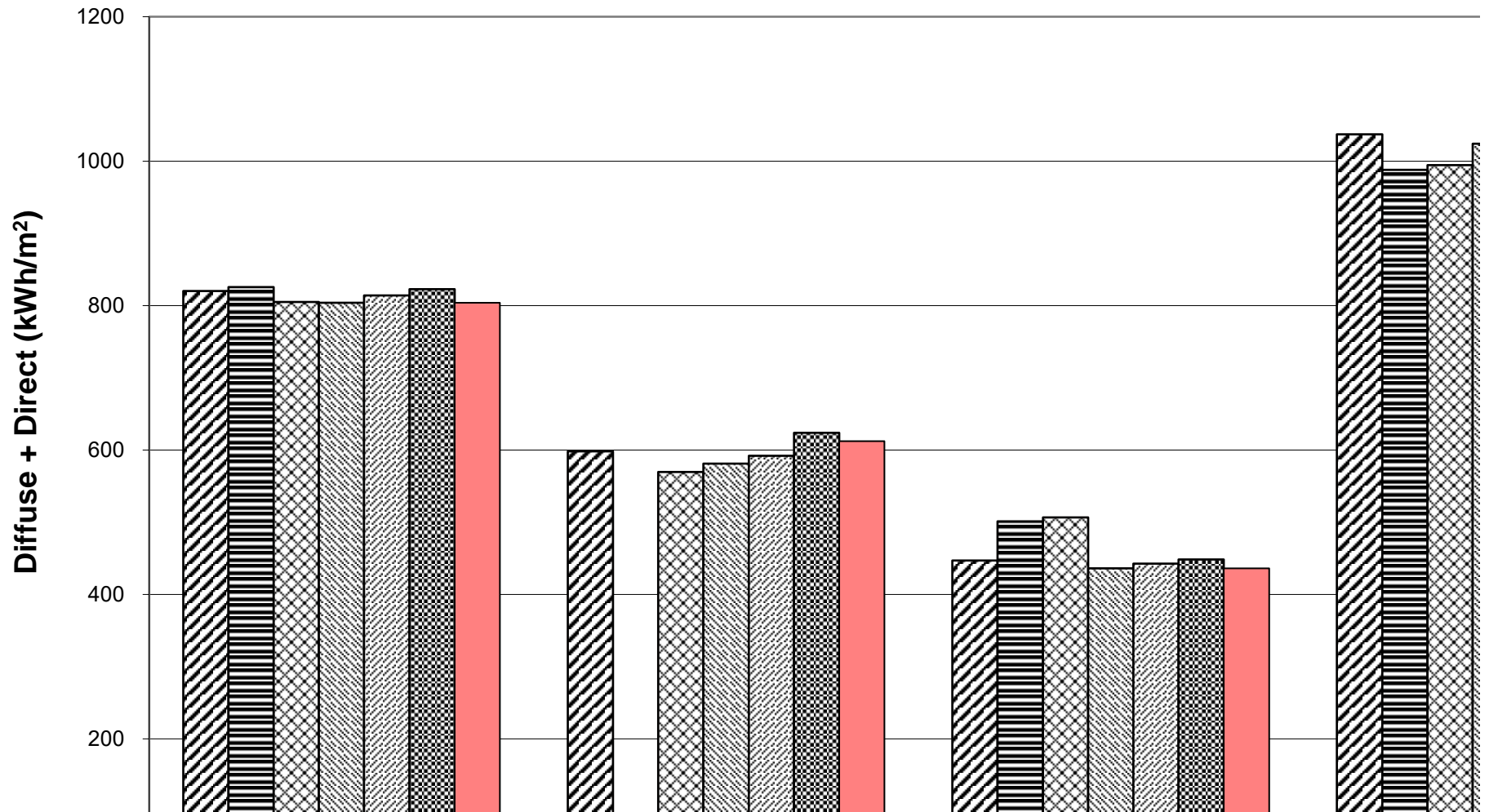


Figure B8-3.
Annual Transmitted Solar Radiation - Shaded

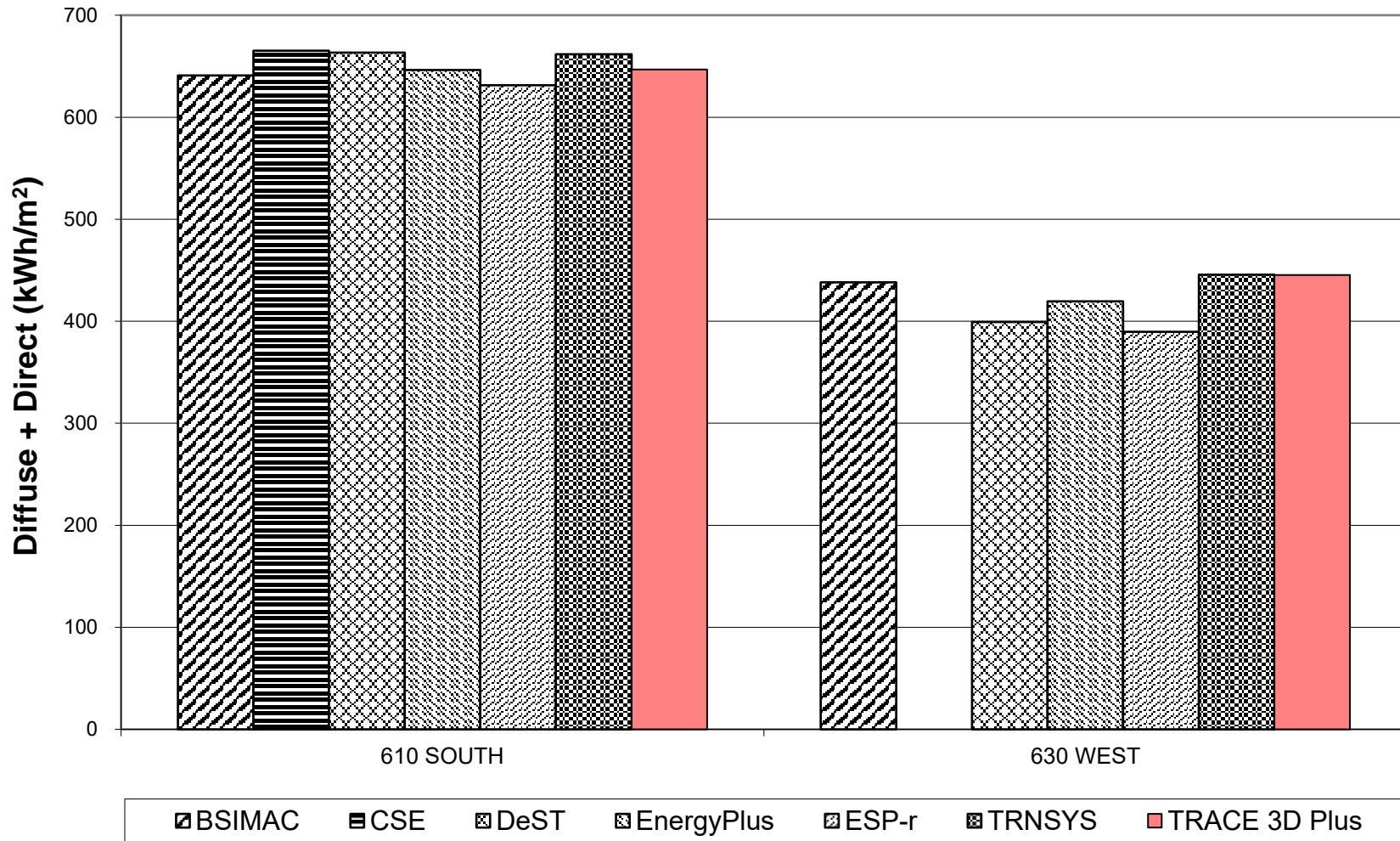


Figure B8-4.
Annual Transmissivity Coefficient of Windows
(Unshaded Transmitted)/(Incident Solar Radiation)

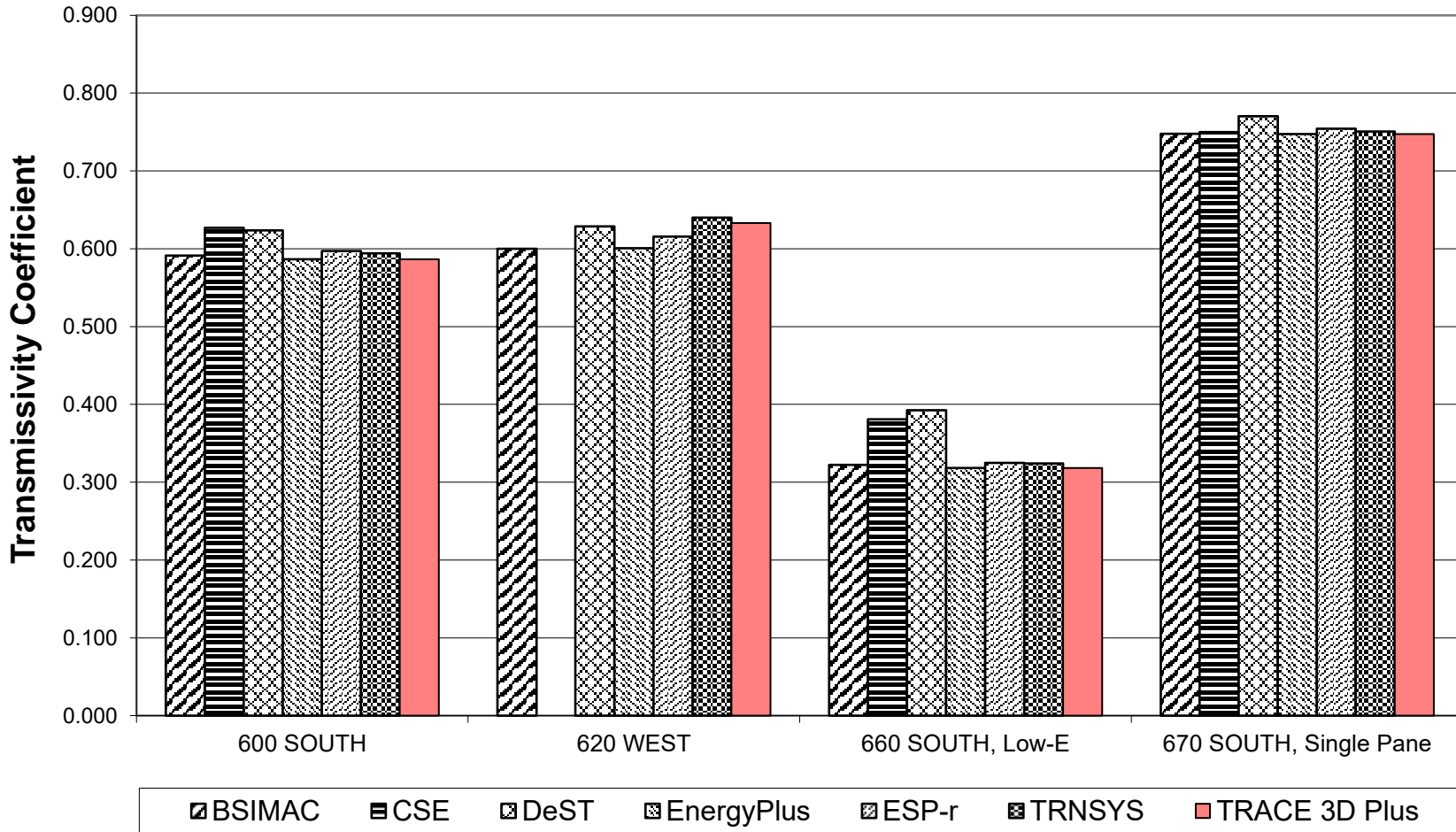


Figure B8-5.
Annual Overhang and Fin Shading Coefficients
(1-(Shaded)/(Unshaded)) Transmitted Solar Radiation

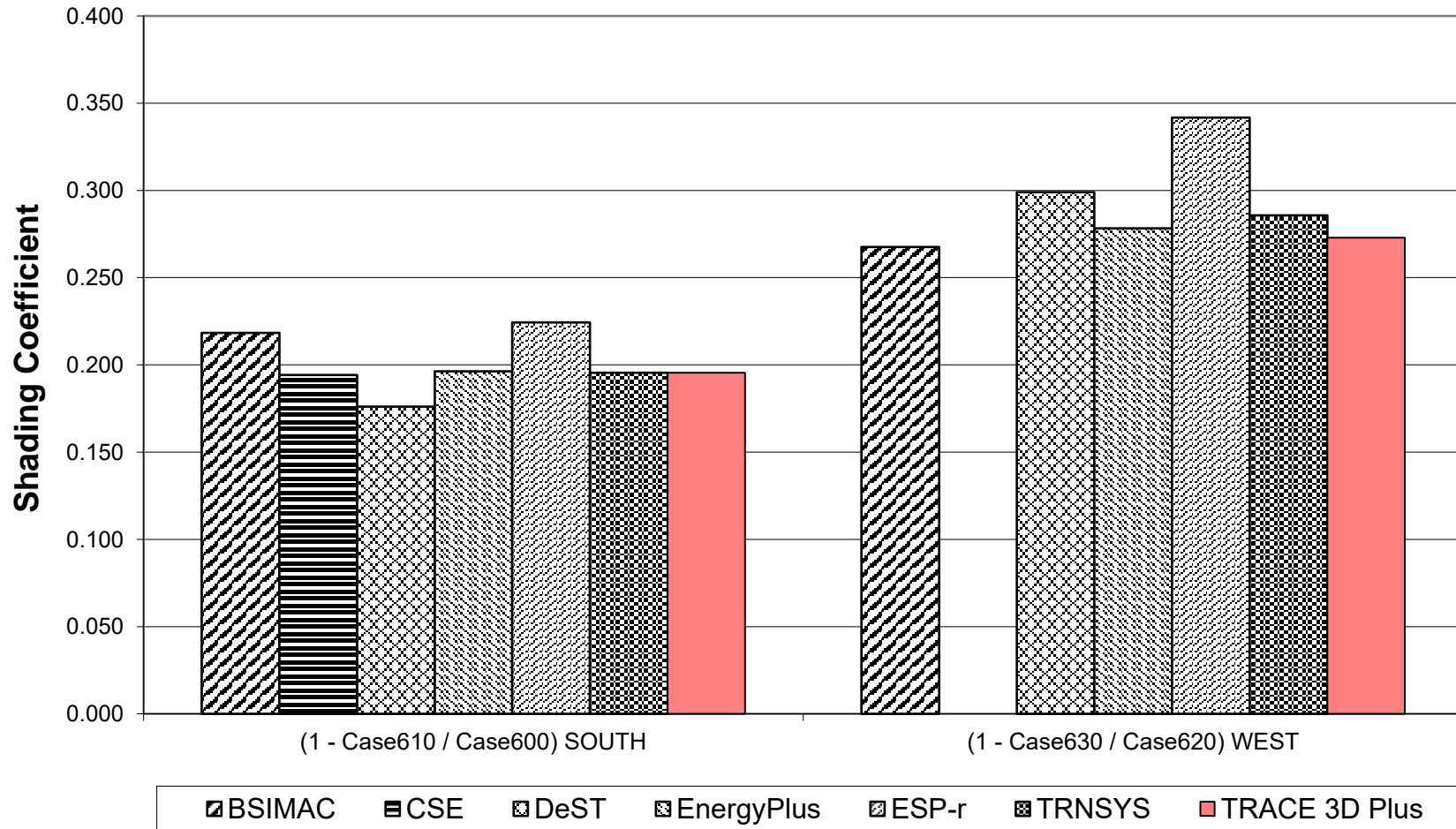
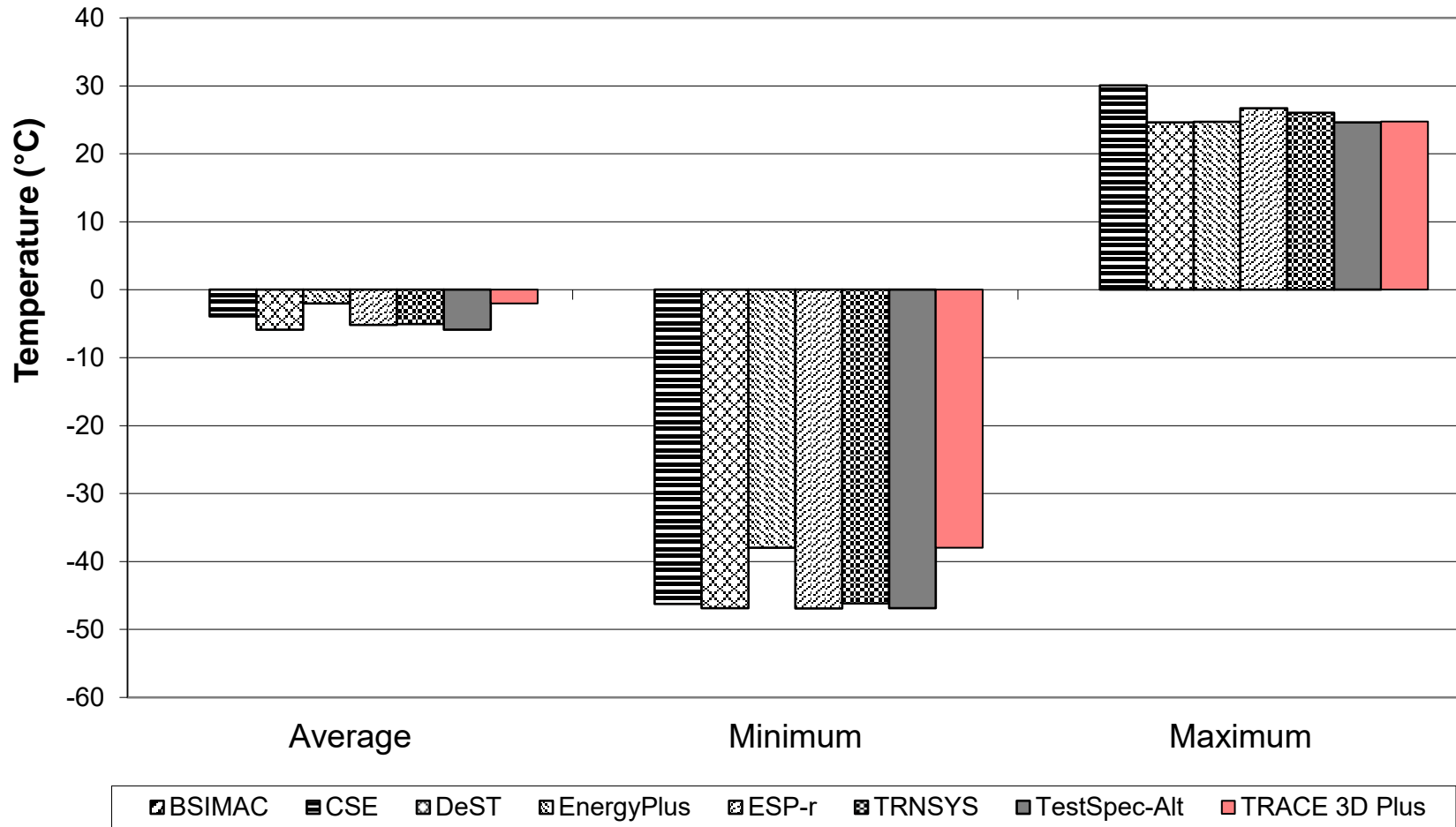
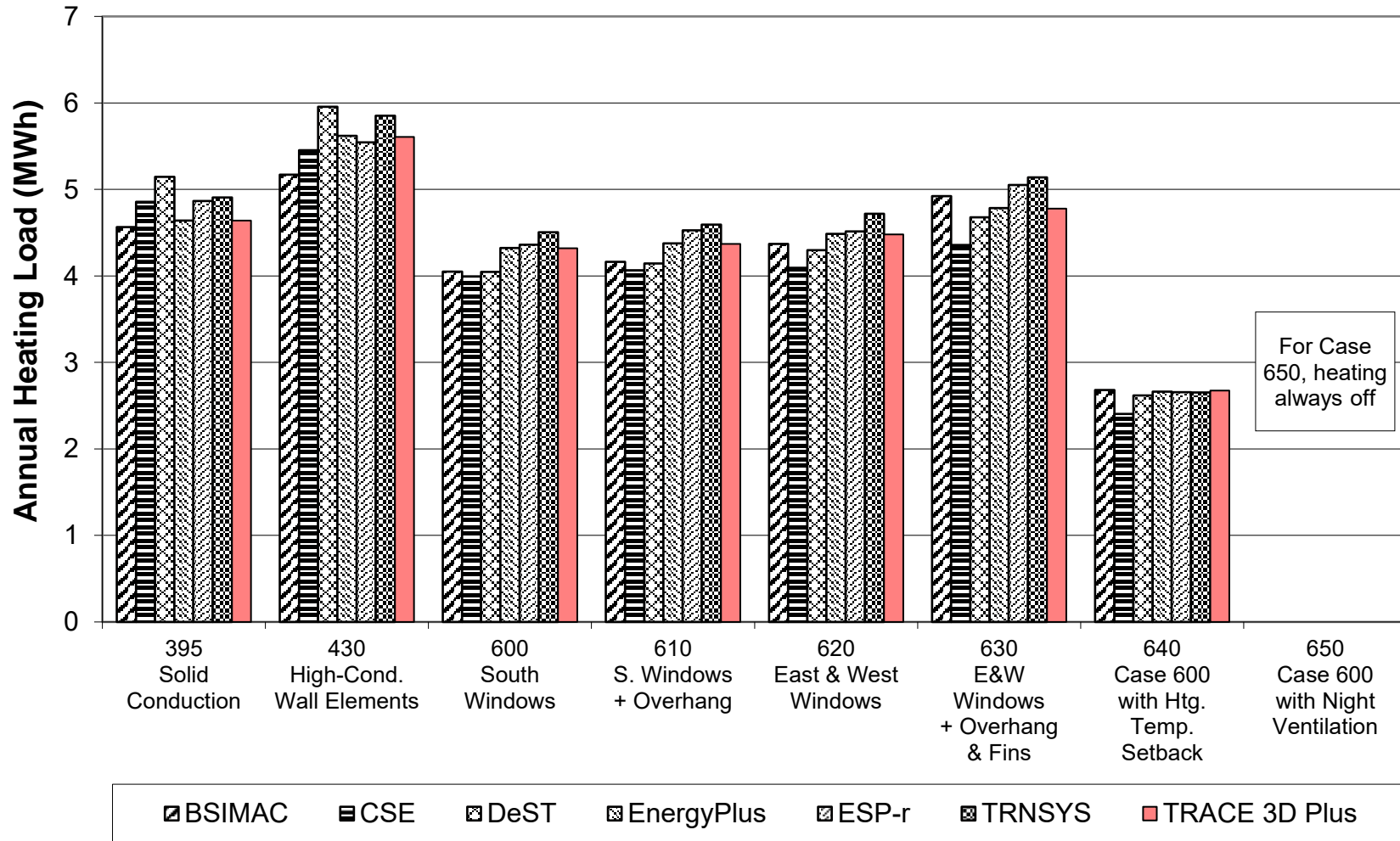


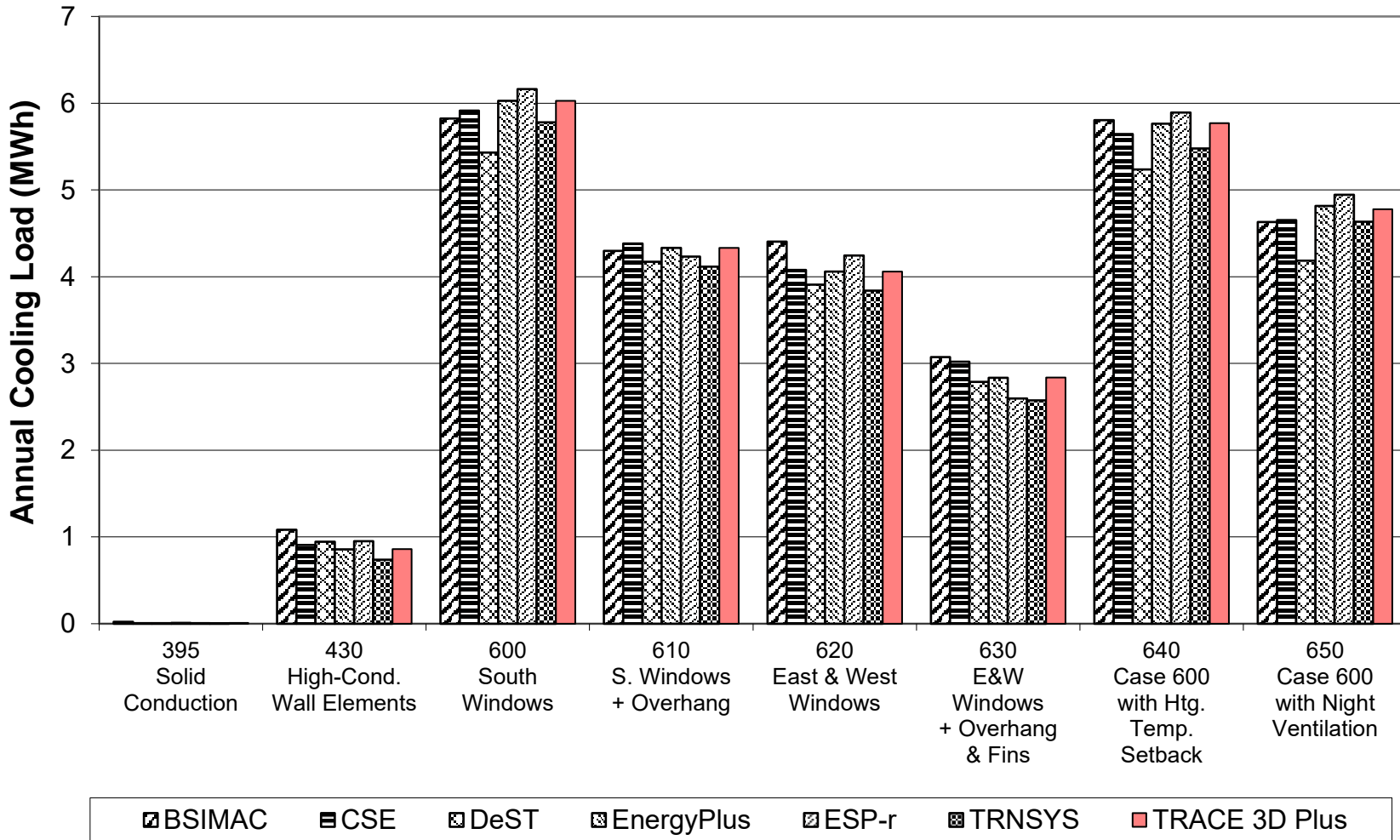
Figure B8-6.
Average, Minimum and Maximum Sky Temperature
Case 600



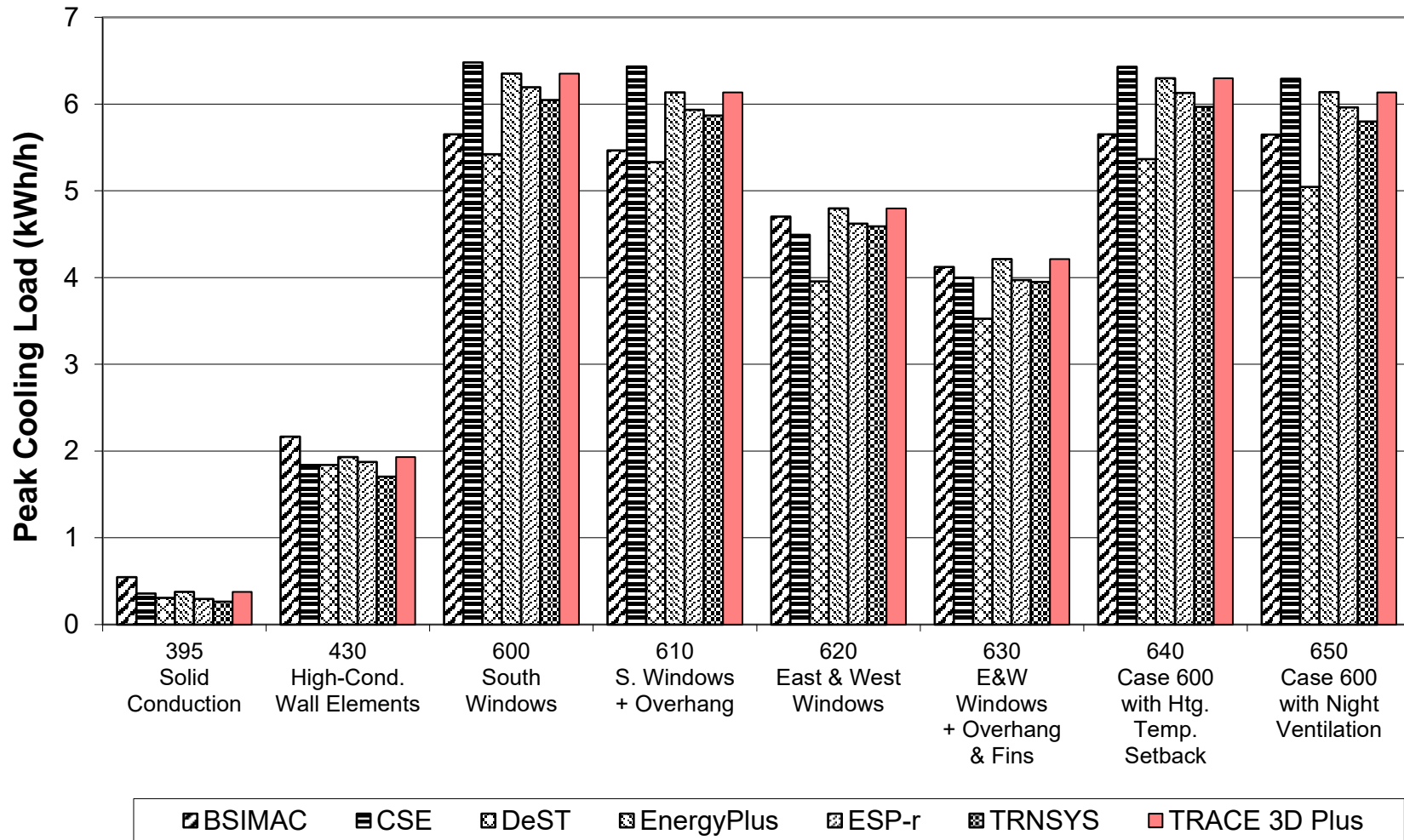
**Figure B8-7. Basic:
 Low Mass Annual Heating**



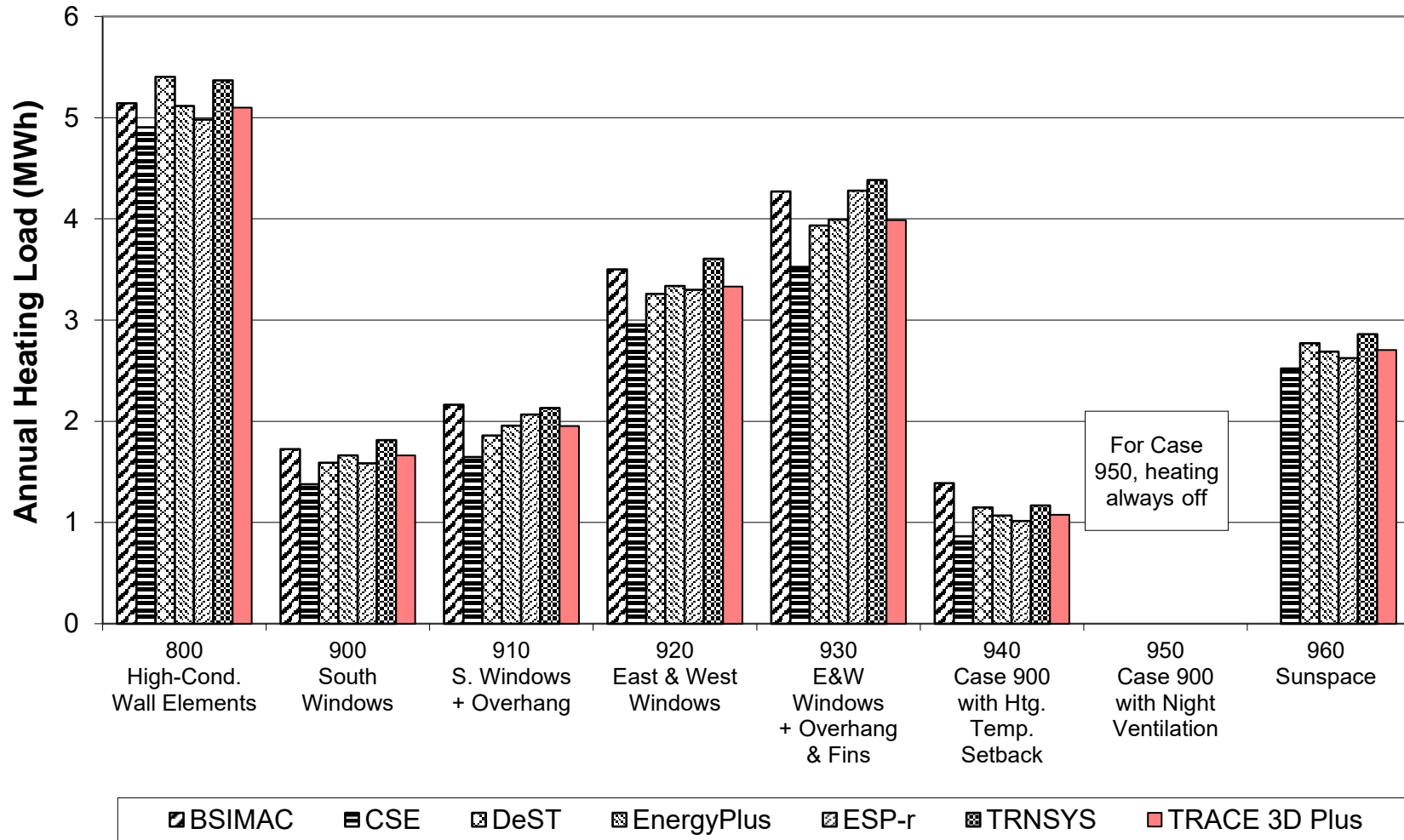
**Figure B8-8. Basic:
 Low Mass Annual Sensible Cooling**



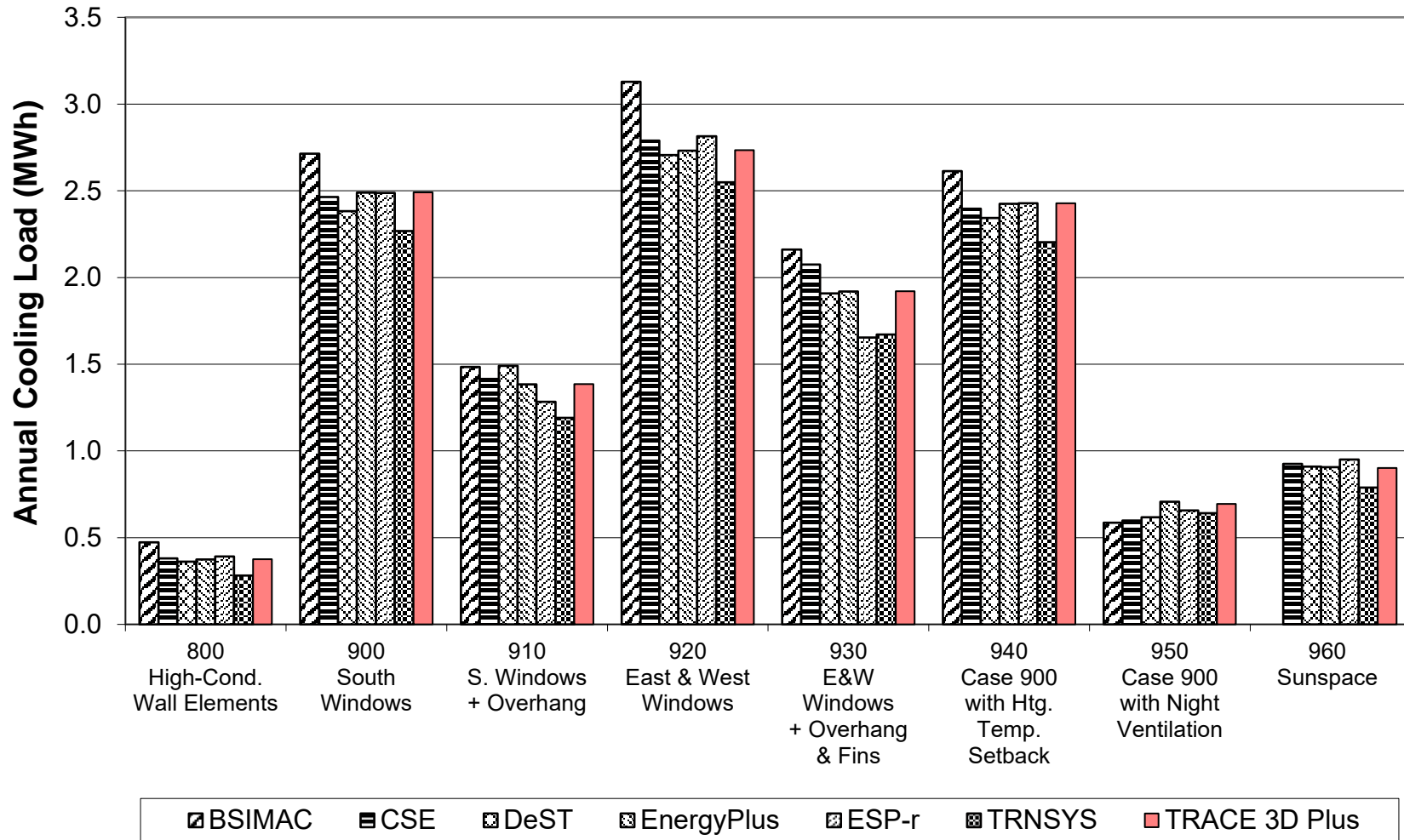
**Figure B8-10. Basic:
 Low Mass Peak Sensible Cooling**



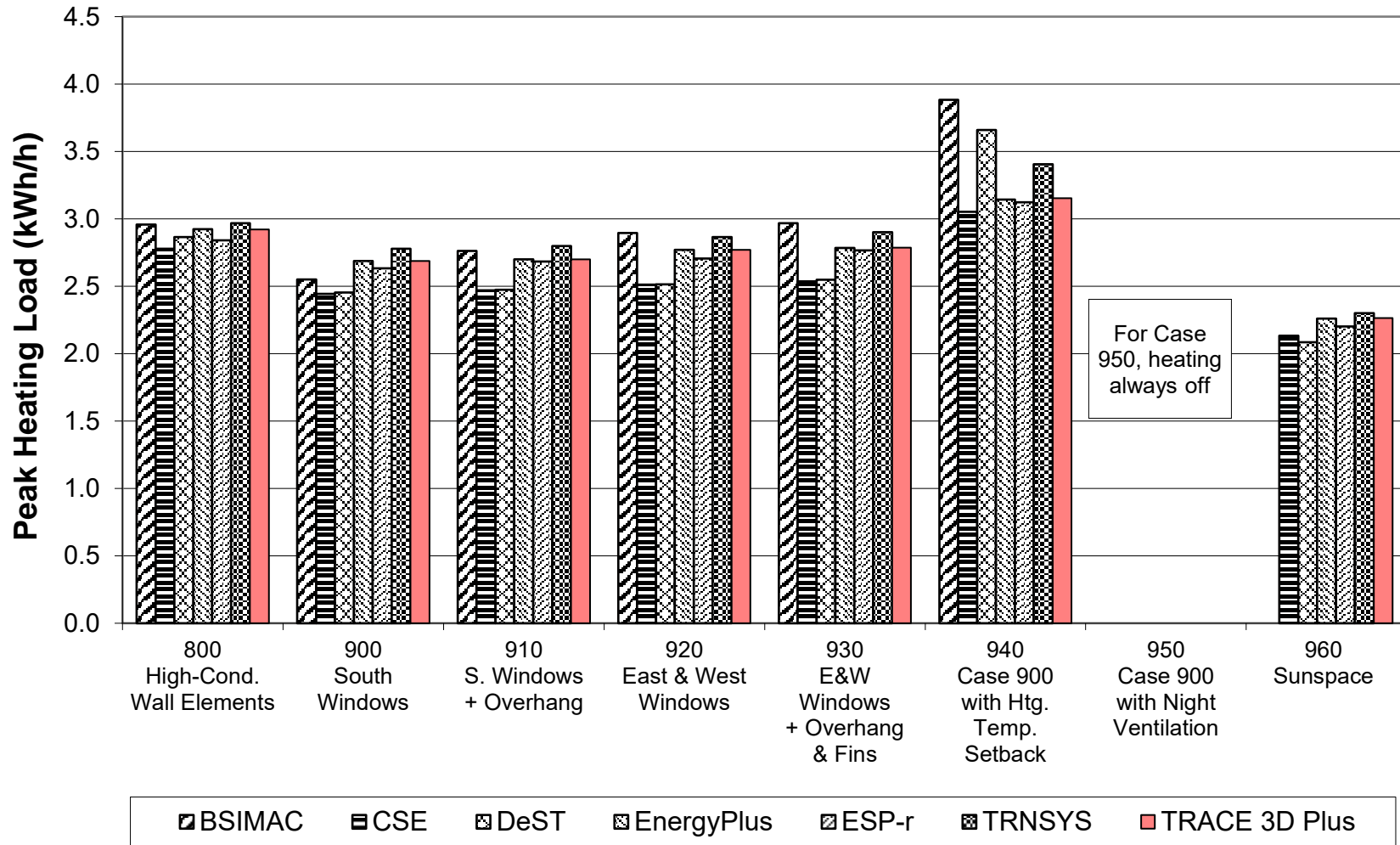
**Figure B8-11. Basic:
 High Mass Annual Heating**



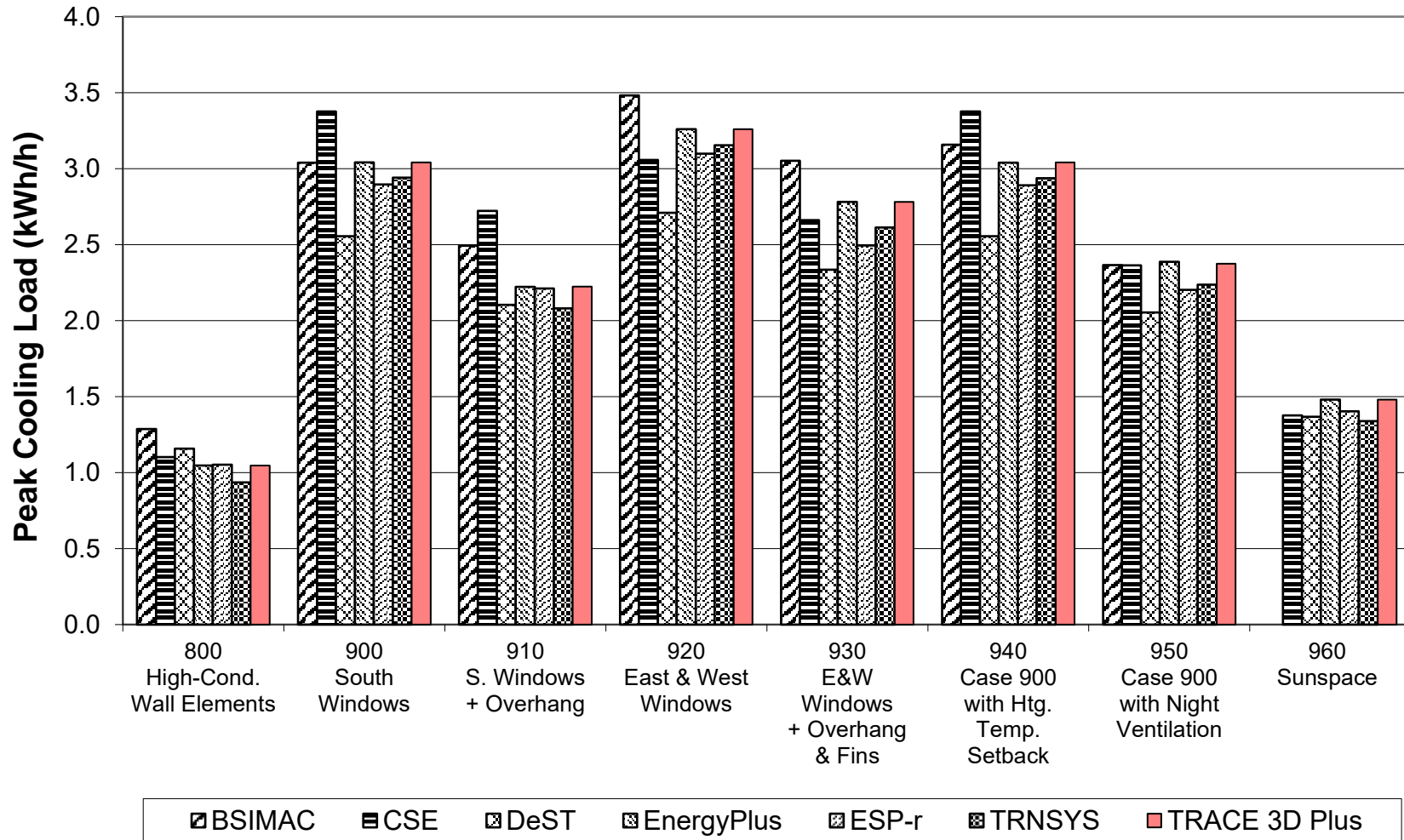
**Figure B8-12. Basic:
 High Mass Annual Sensible Cooling**



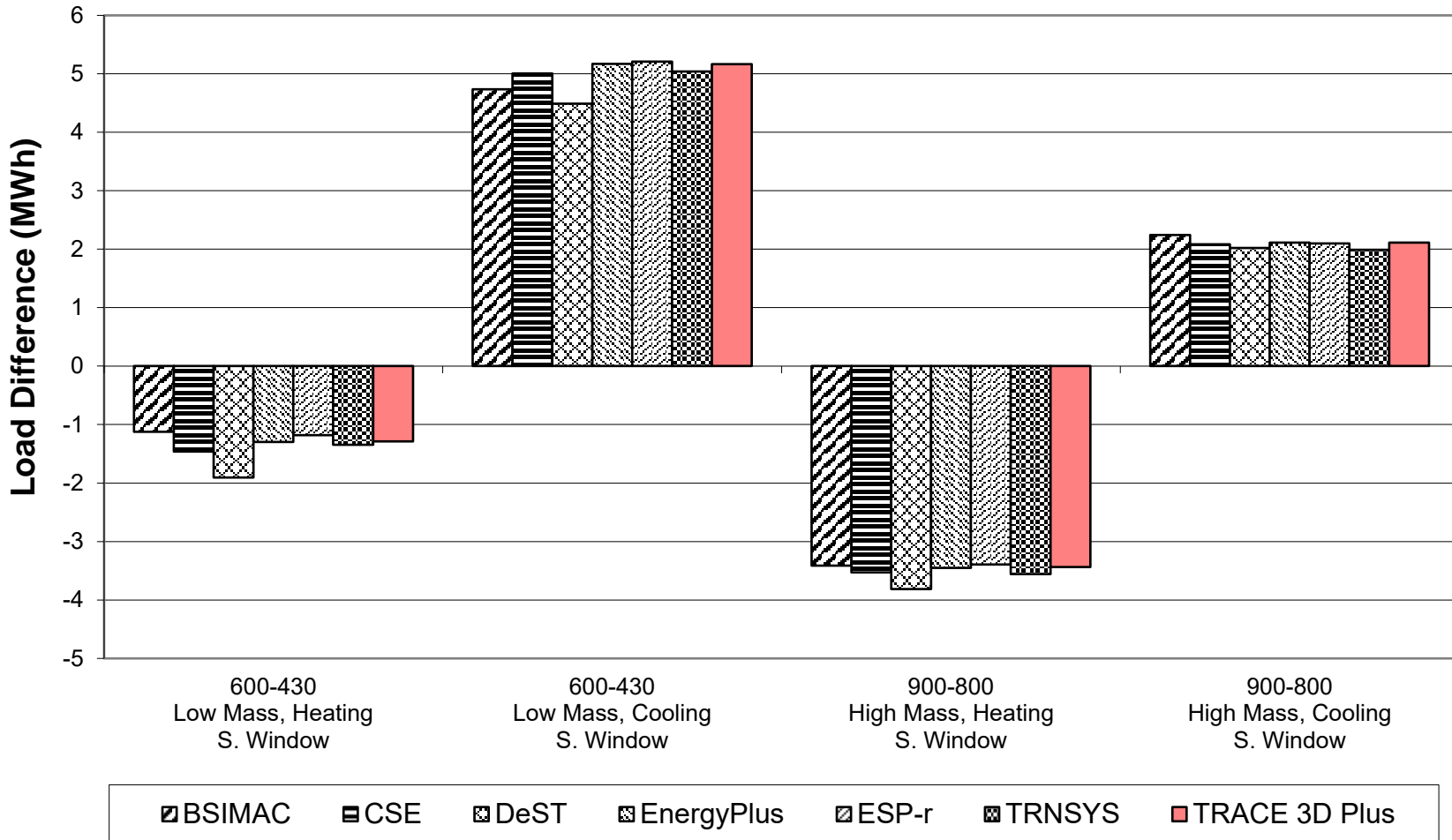
**Figure B8-13. Basic:
 High Mass Peak Heating**



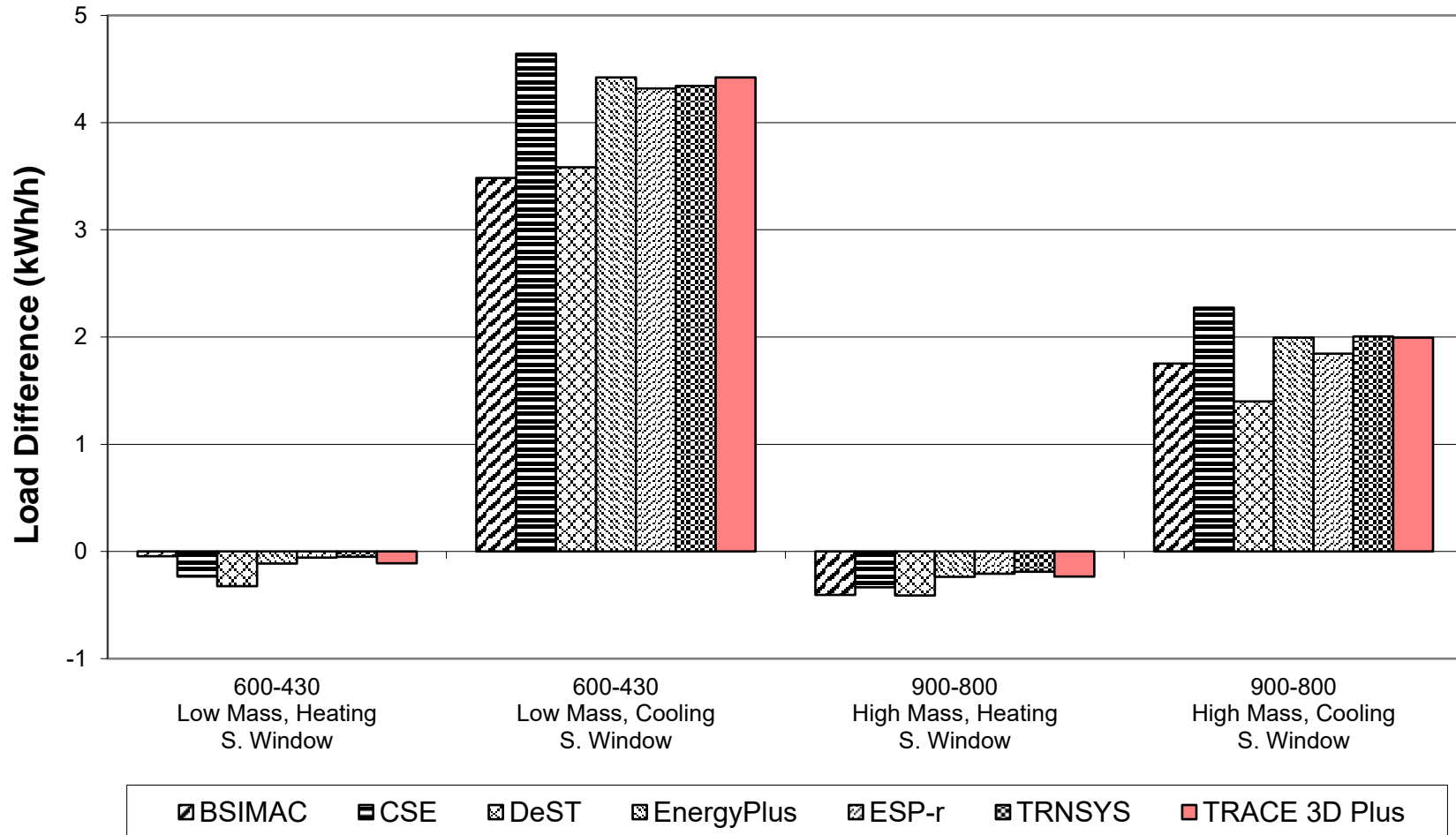
**Figure B8-14. Basic:
 High Mass Peak Sensible Cooling**



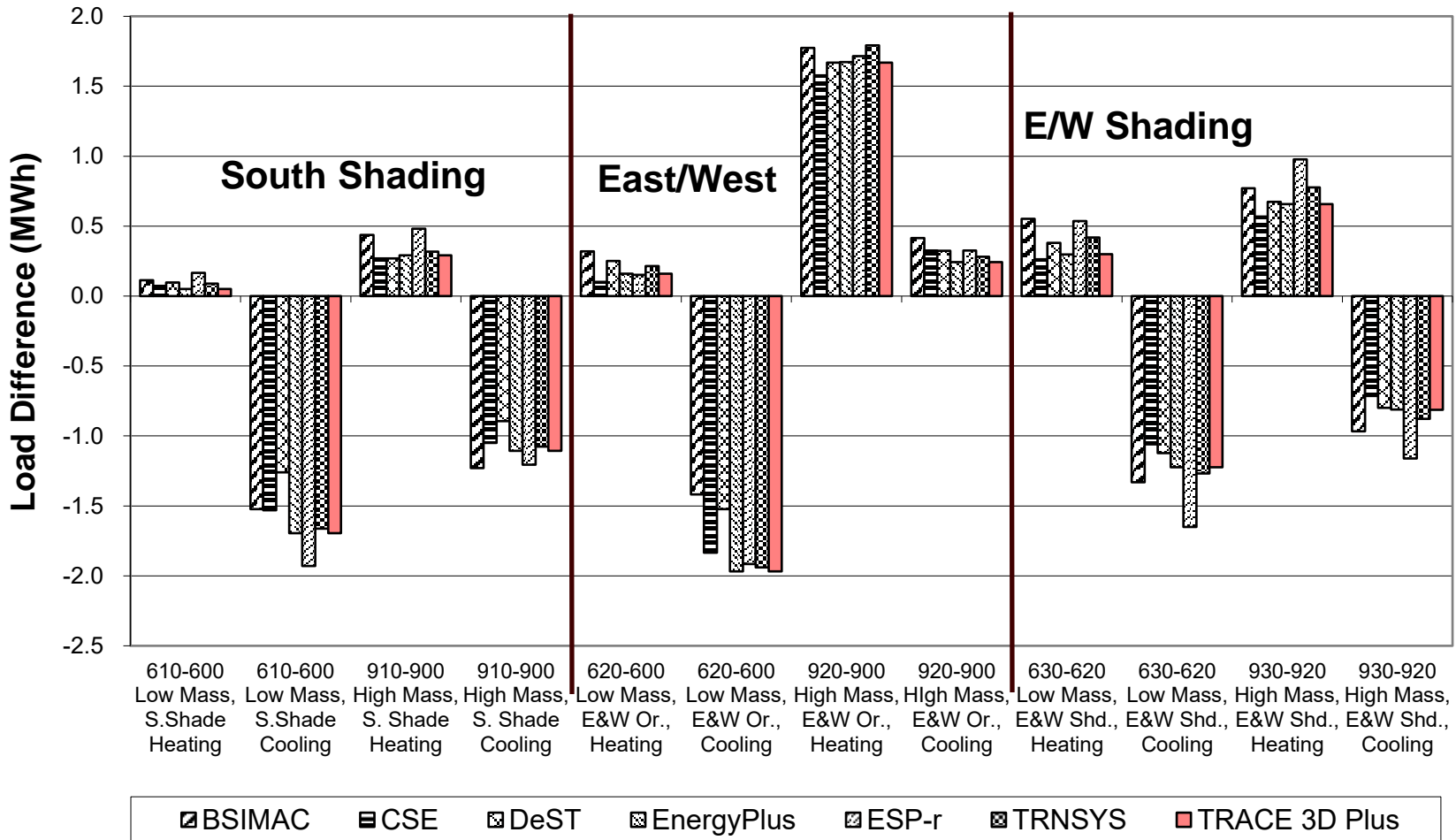
**Figure B8-15. Basic and In-Depth:
 South Window (Delta)
 Annual Heating and Sensible Cooling**



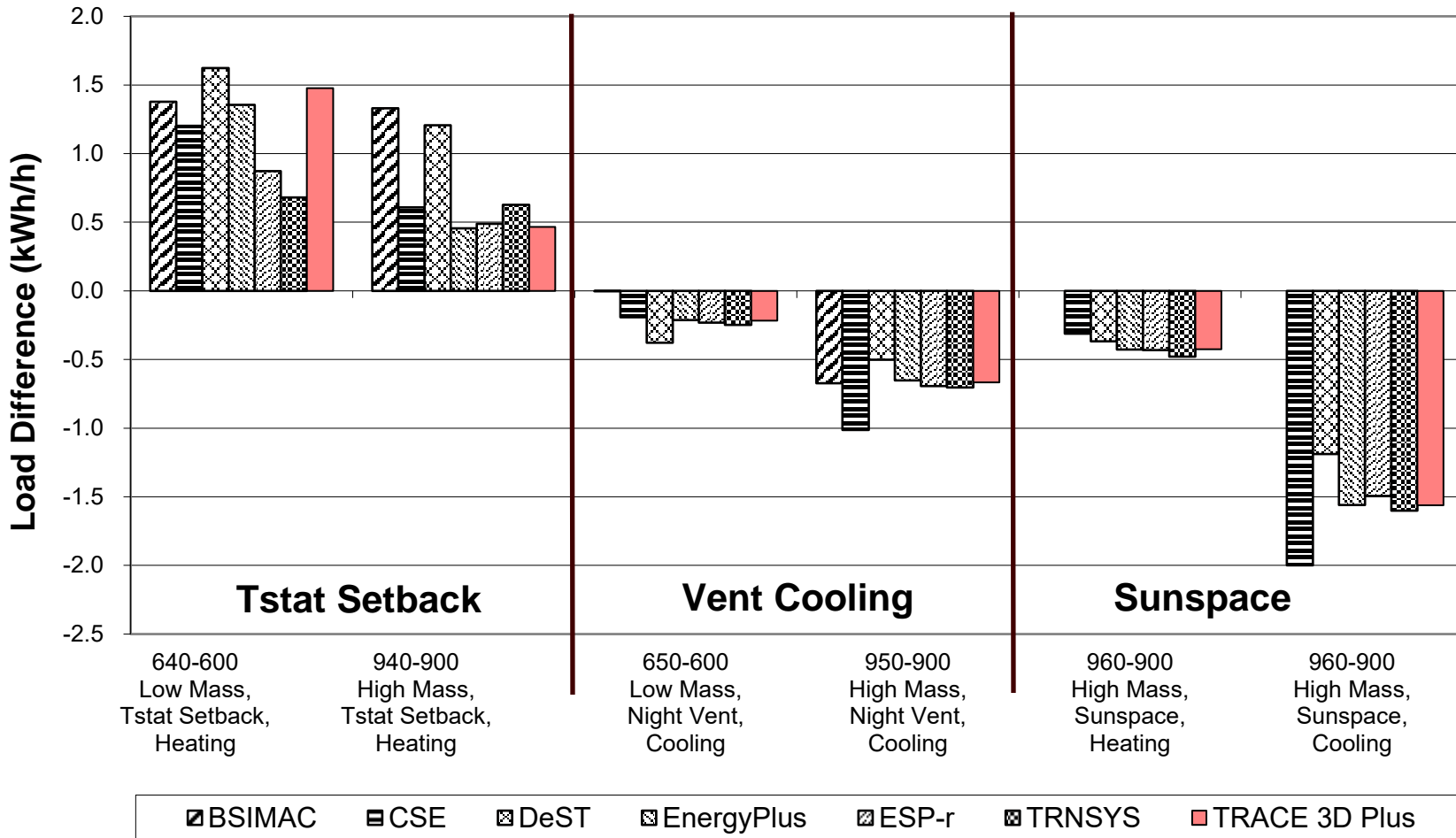
**Figure B8-16. Basic and In-Depth:
 South Window (Delta)
 Peak Heating and Sensible Cooling**



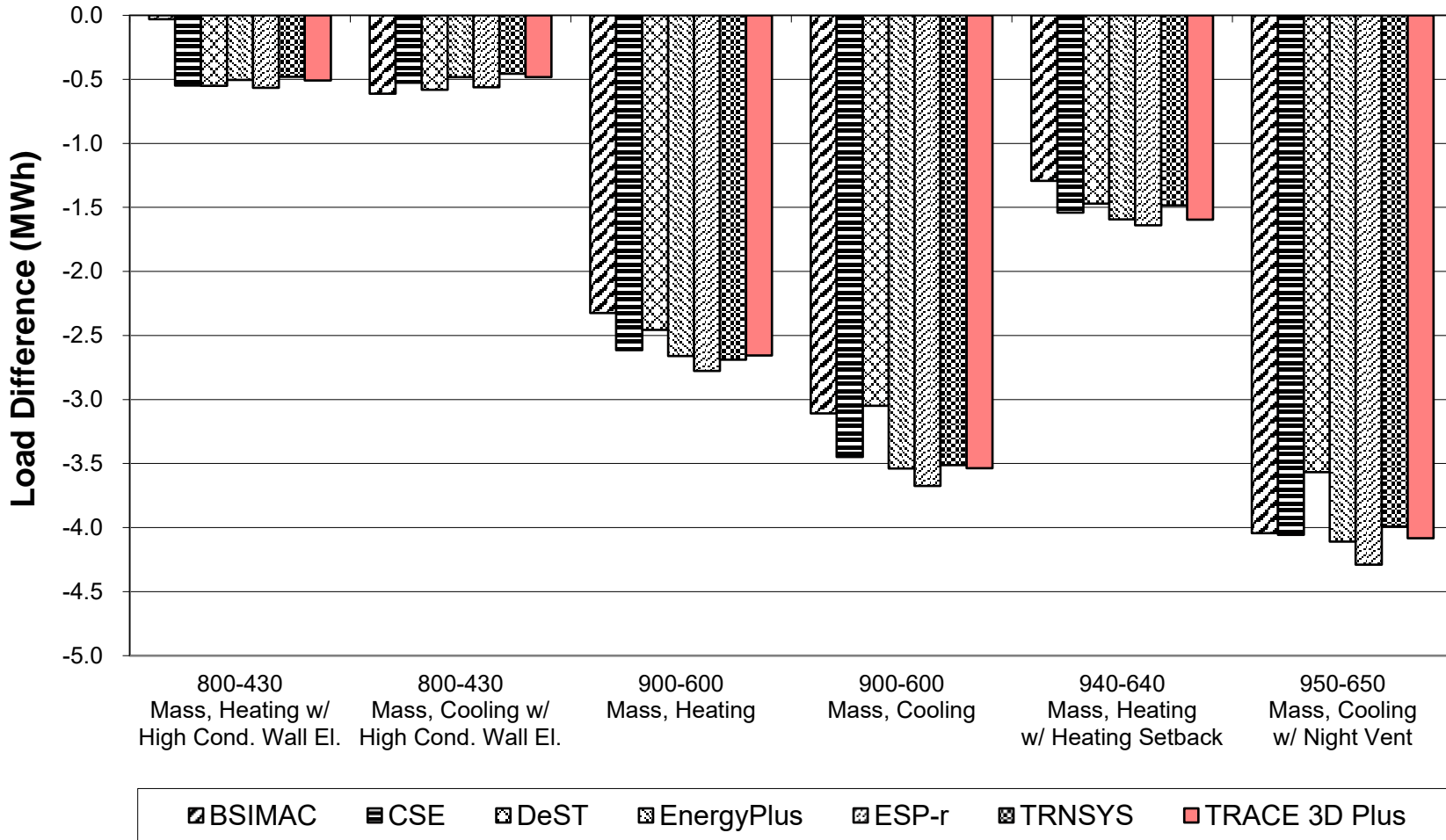
**Figure B8-17. Basic:
 Window Shading and Orientation (Delta)
 Annual Heating and Sensible Cooling**



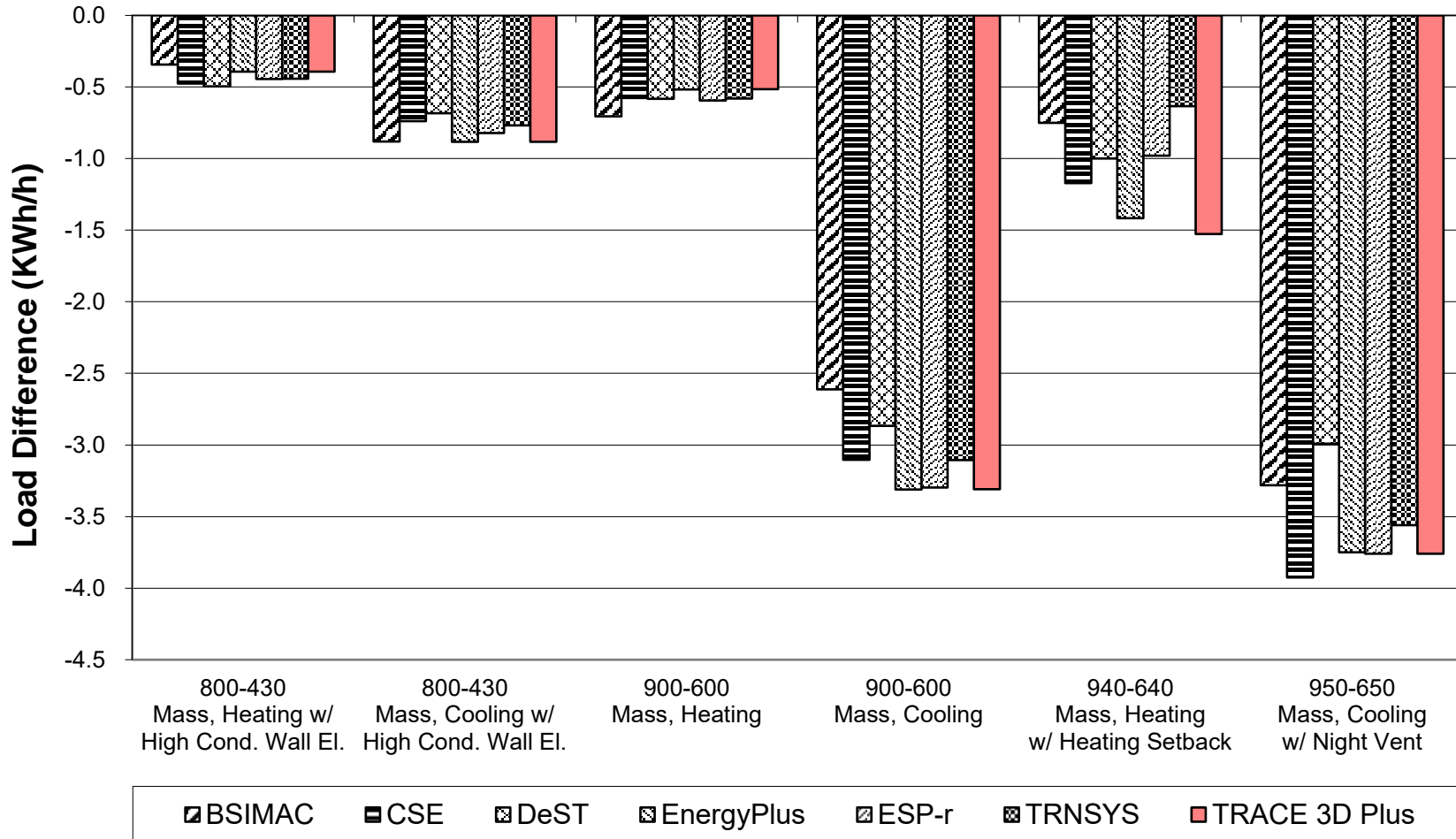
**Figure B8-20. Basic:
 Thermostat Setback, Vent Cooling, and Sunspace (Delta)
 Peak Heating and Sensible Cooling**



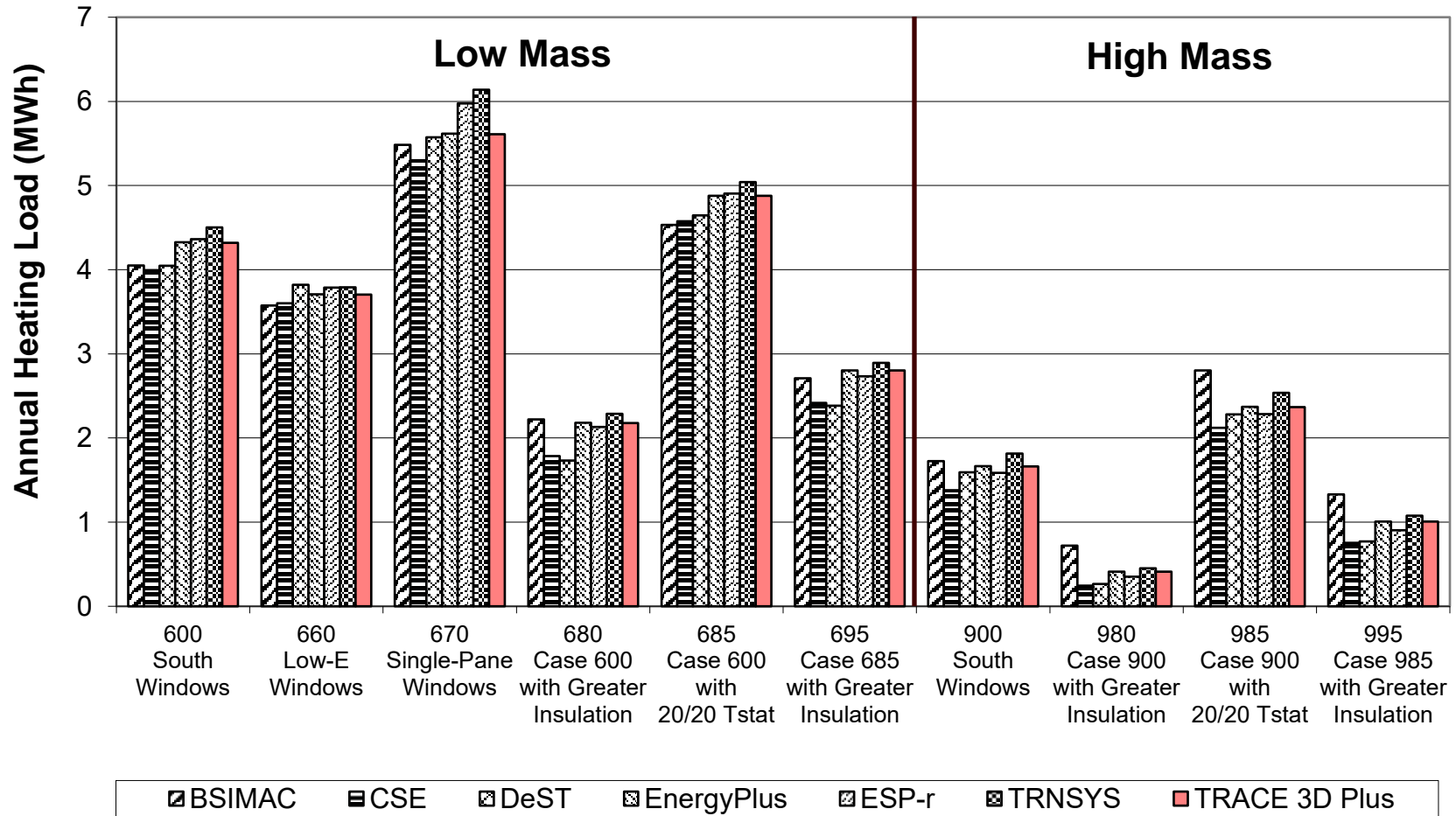
**Figure B8-21. Basic and In-Depth:
 Mass Effect (Delta)
 Annual Heating and Sensible Cooling**



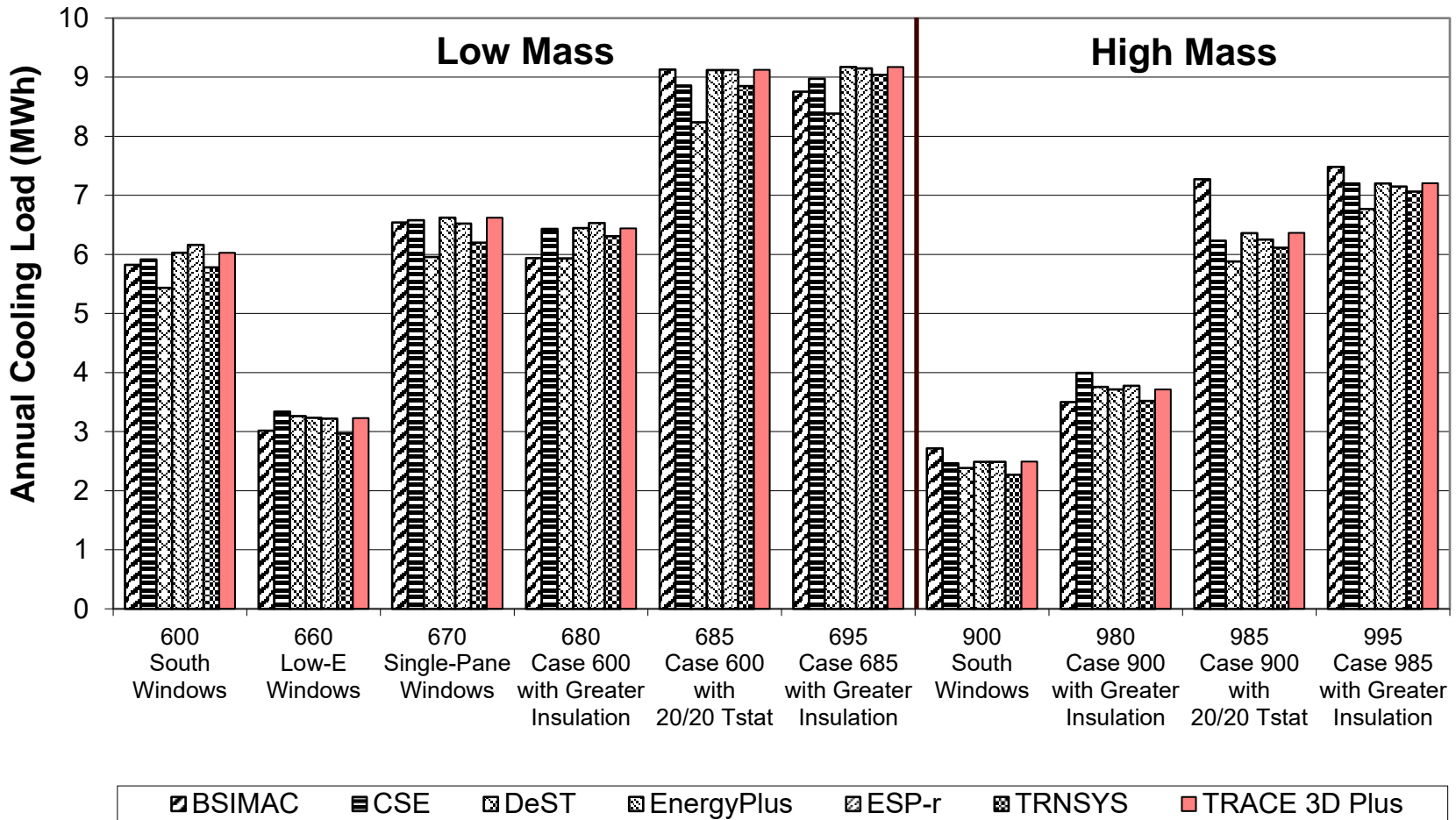
**Figure B8-22. Basic and In-Depth:
 Mass Effect (Delta)
 Peak Heating and Sensible Cooling**



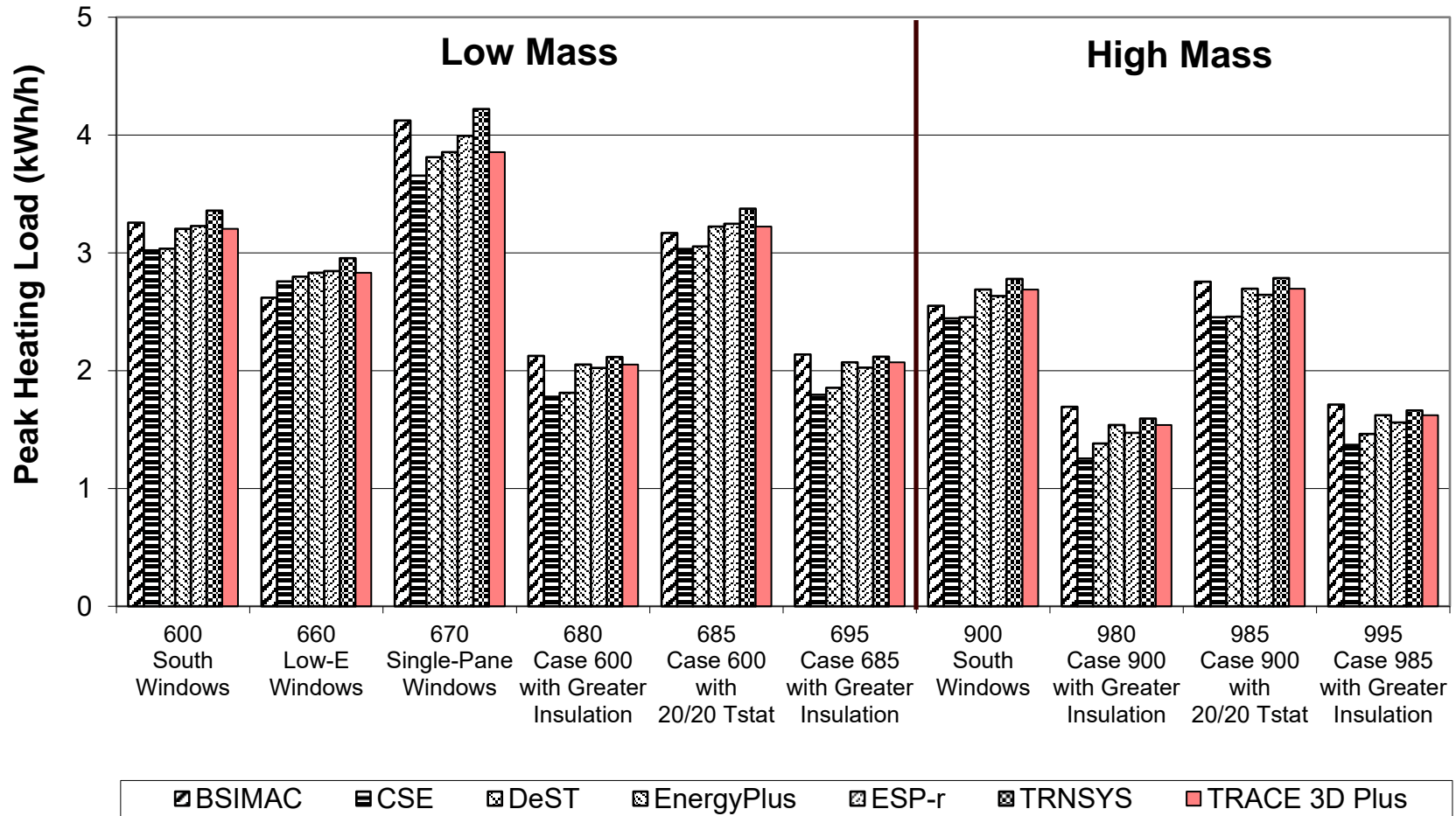
**Figure B8-23. Basic:
 Cases 660 to 695 and 980 to 995
 Annual Heating**



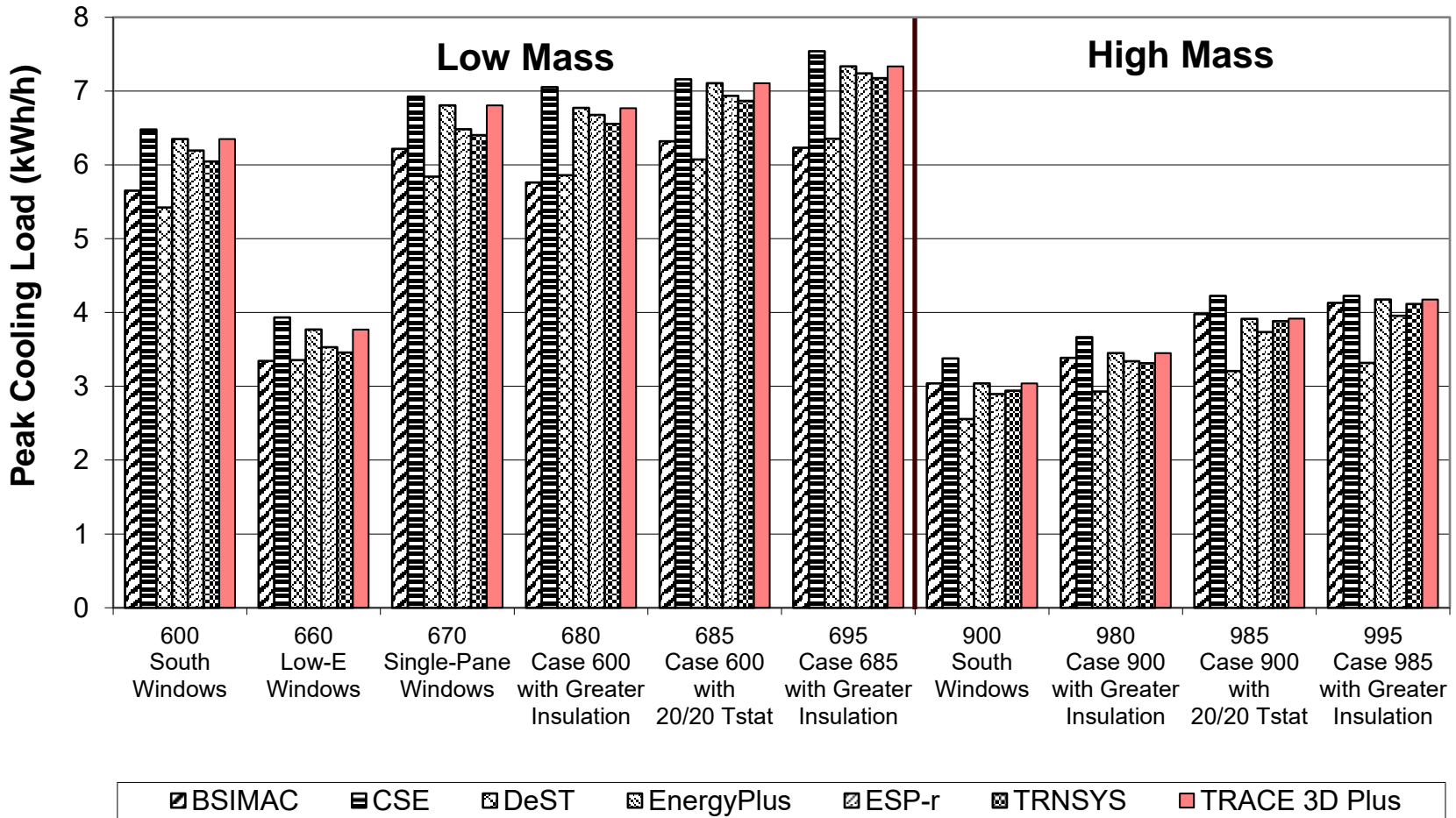
**Figure B8-24. Basic:
 Cases 660 to 695 and 980 to 995
 Annual Cooling**



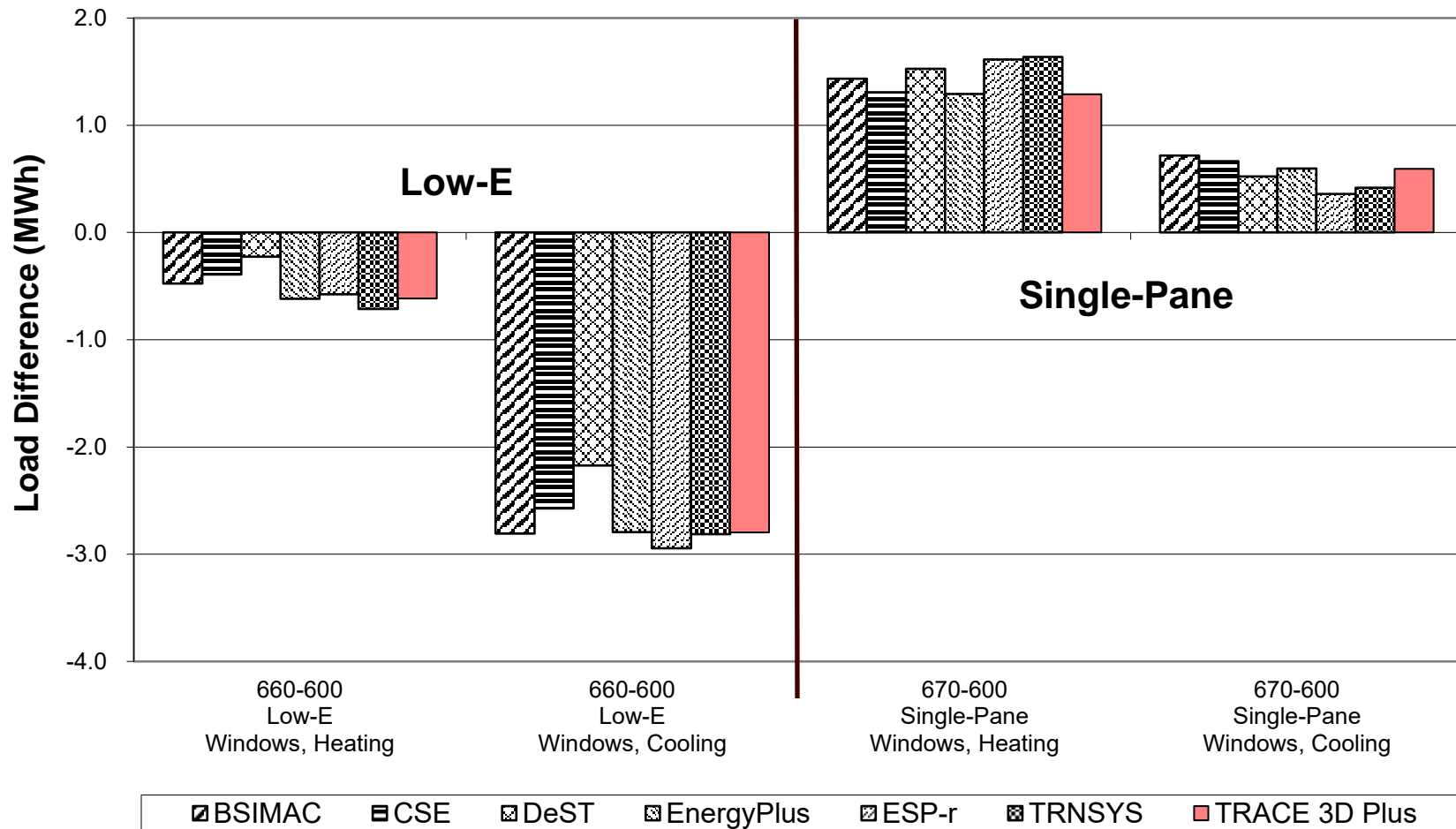
**Figure B8-25. Basic:
 Cases 660 to 695 and 980 to 995
 Peak Heating**



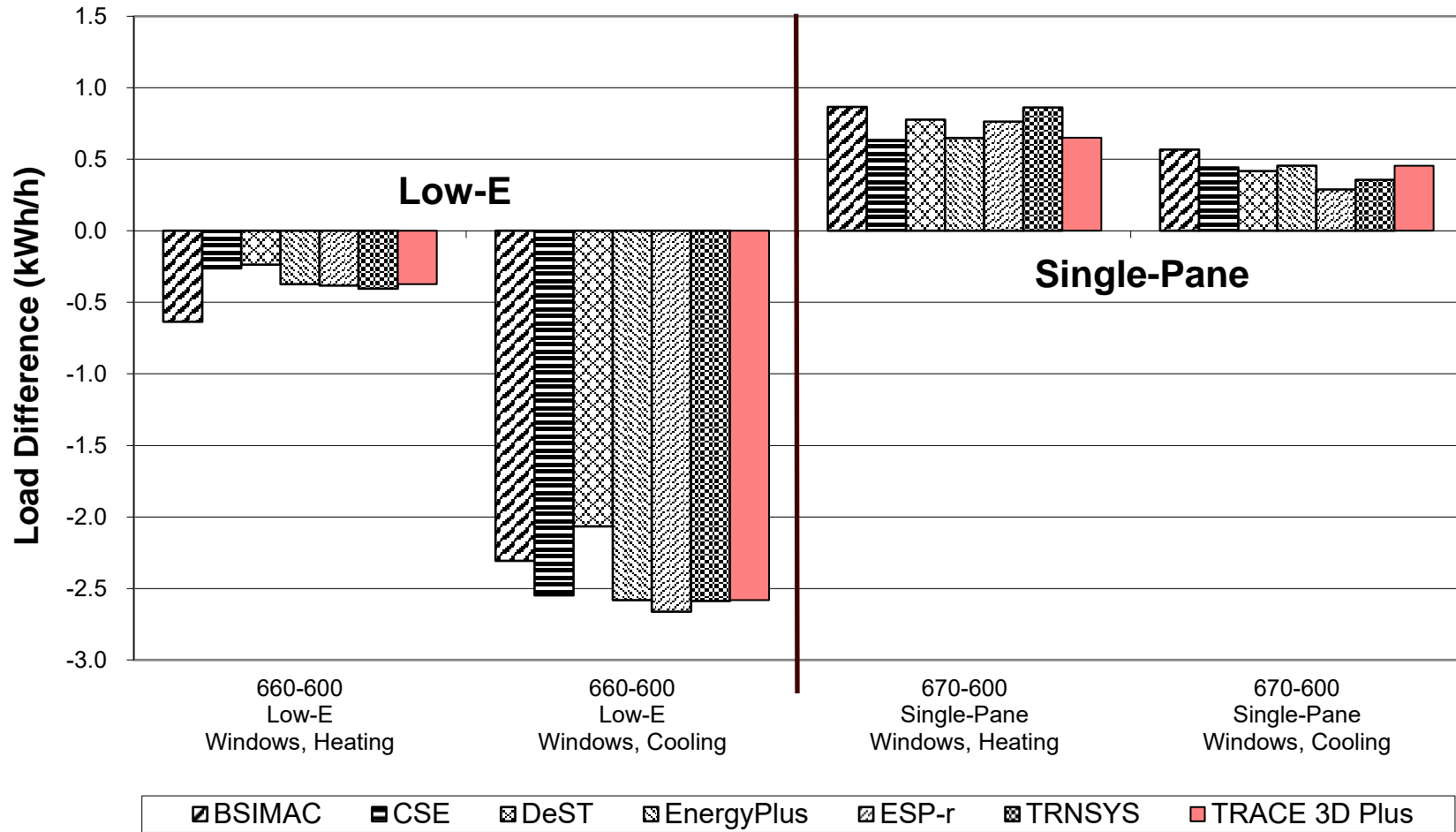
**Figure B8-26. Basic:
 Cases 660 to 695 and 980 to 995
 Peak Cooling**



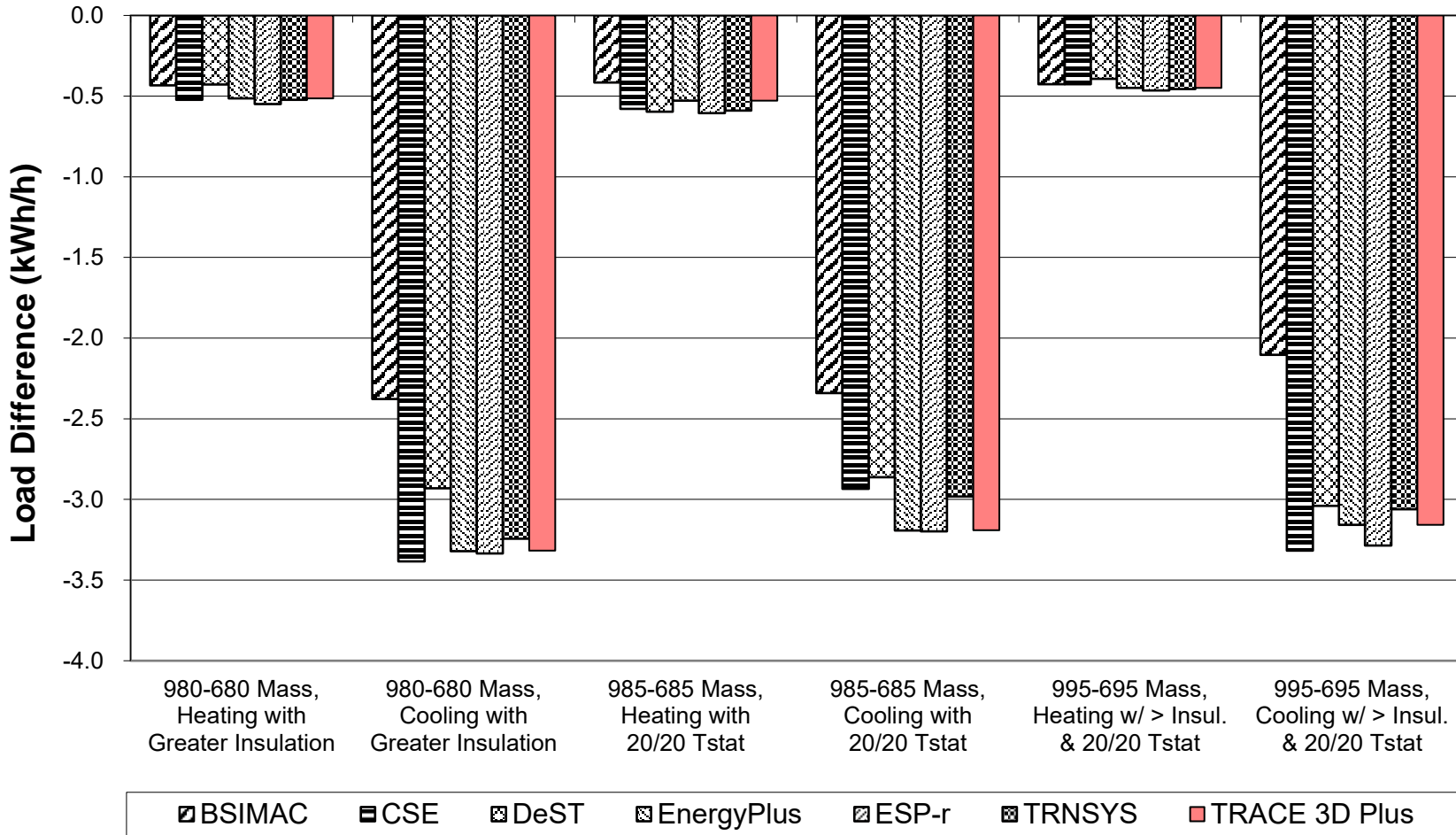
**Figure B8-27. Basic:
 Window Types (Delta)
 Annual Heating and Sensible Cooling**



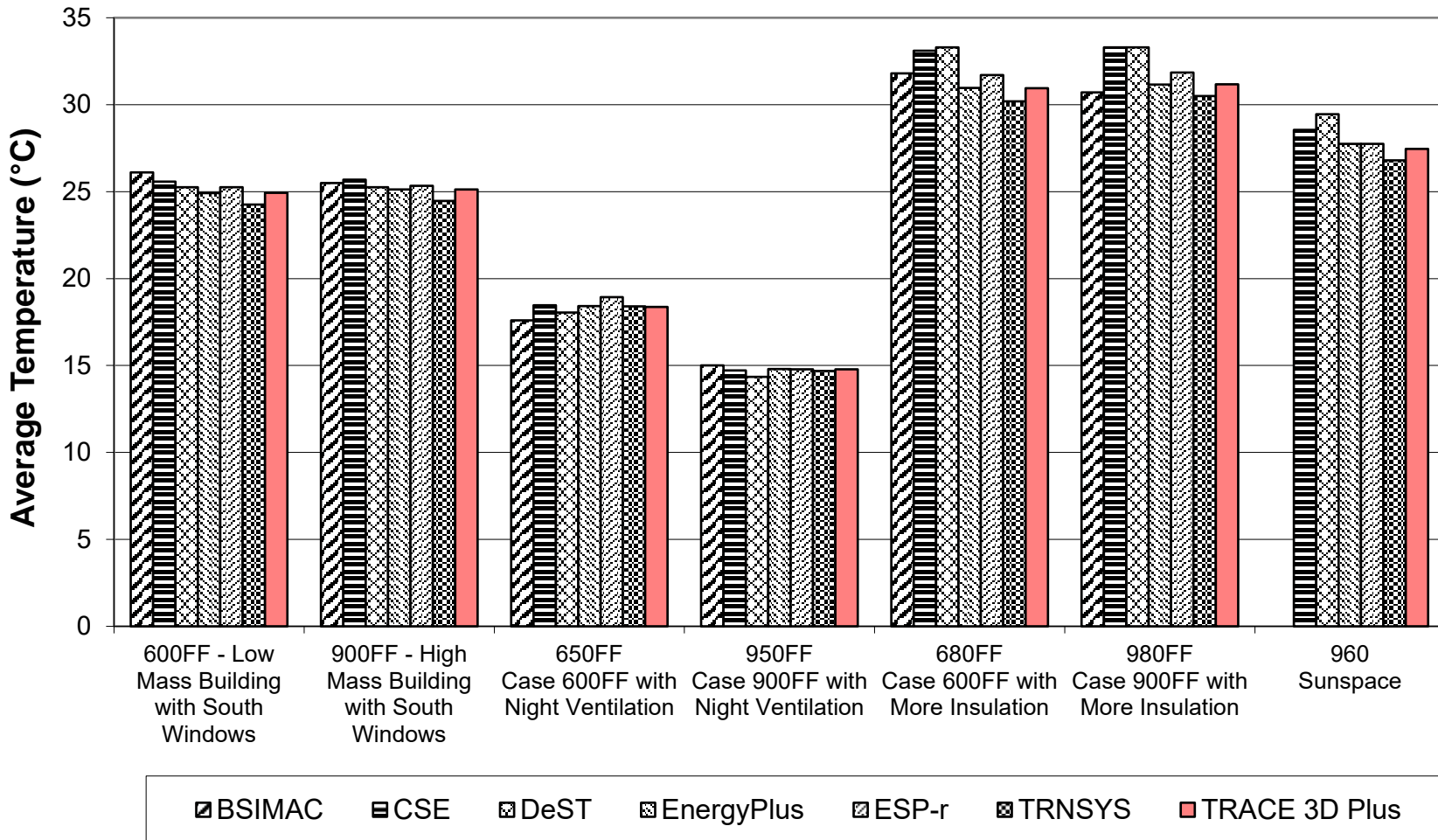
**Figure B8-28. Basic:
 Window Types (Delta)
 Peak Heating and Sensible Cooling**



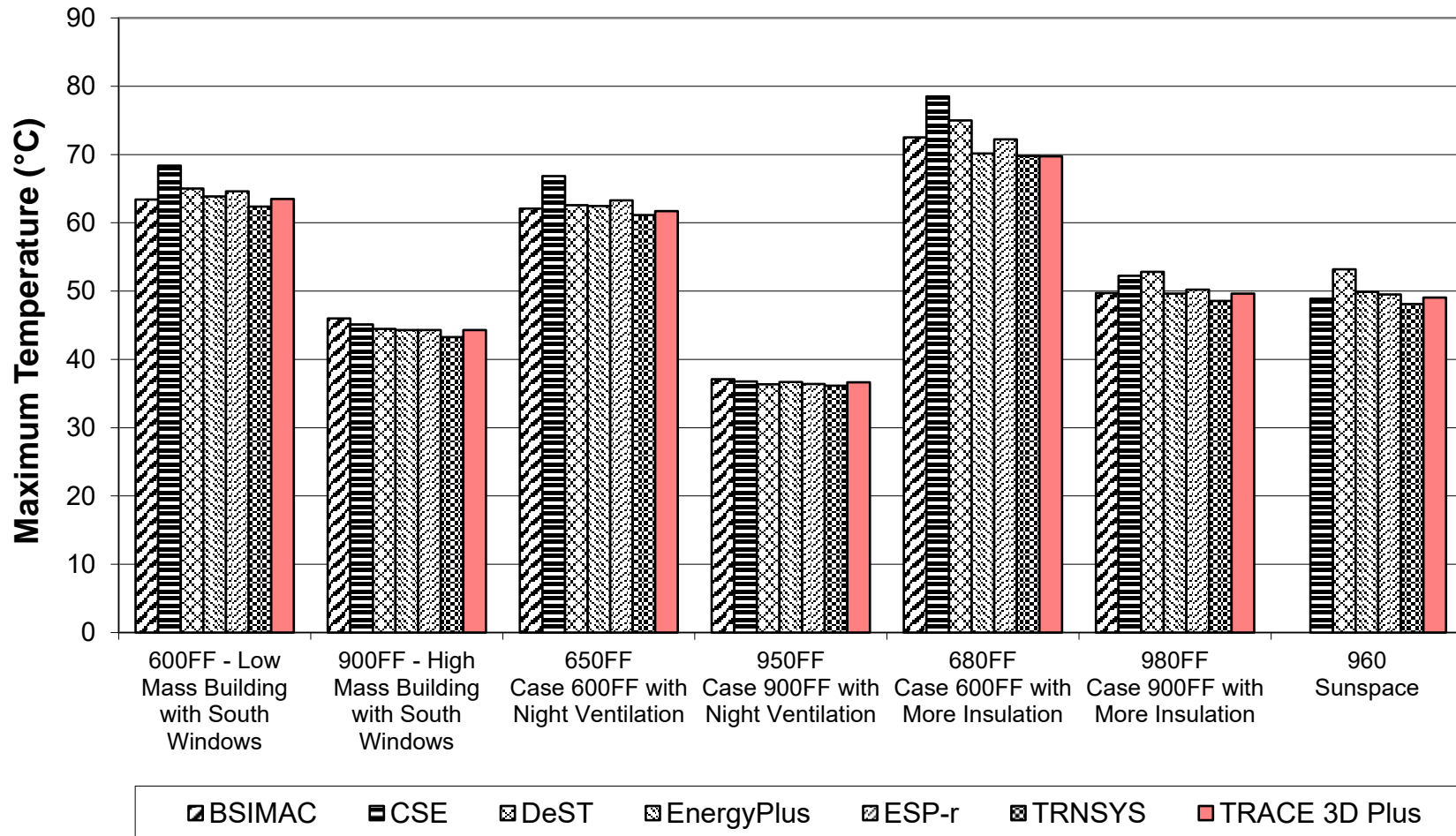
**Figure B8-32. Basic:
 Insulation, Mass Effect (Delta)
 Peak Heating and Sensible Cooling**



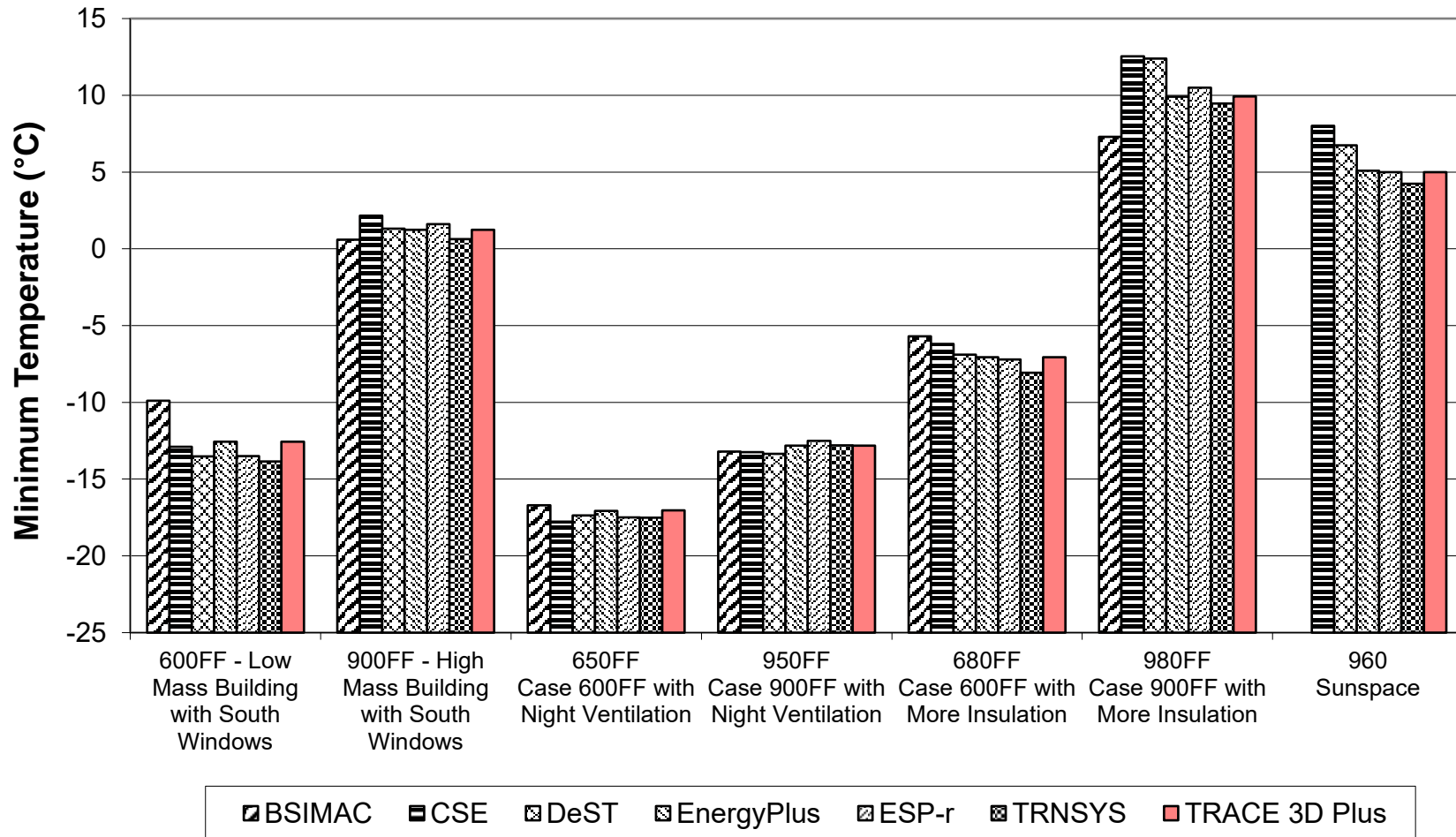
**Figure B8-33. Basic:
 Average Hourly Annual Temperature
 Free-Float Cases**



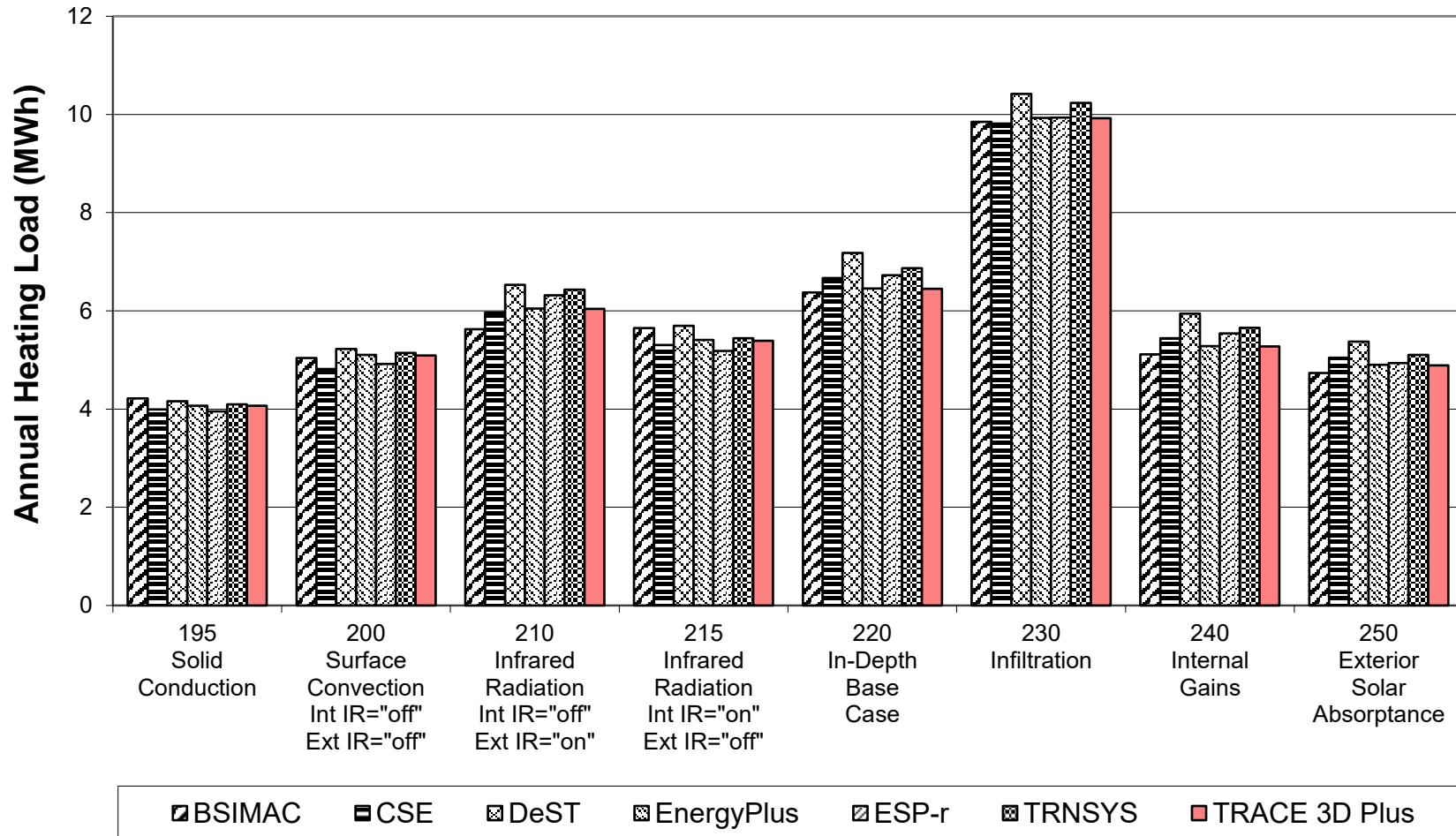
**Figure B8-34. Basic:
 Maximum Hourly Annual Temperature
 Free-Float Cases**



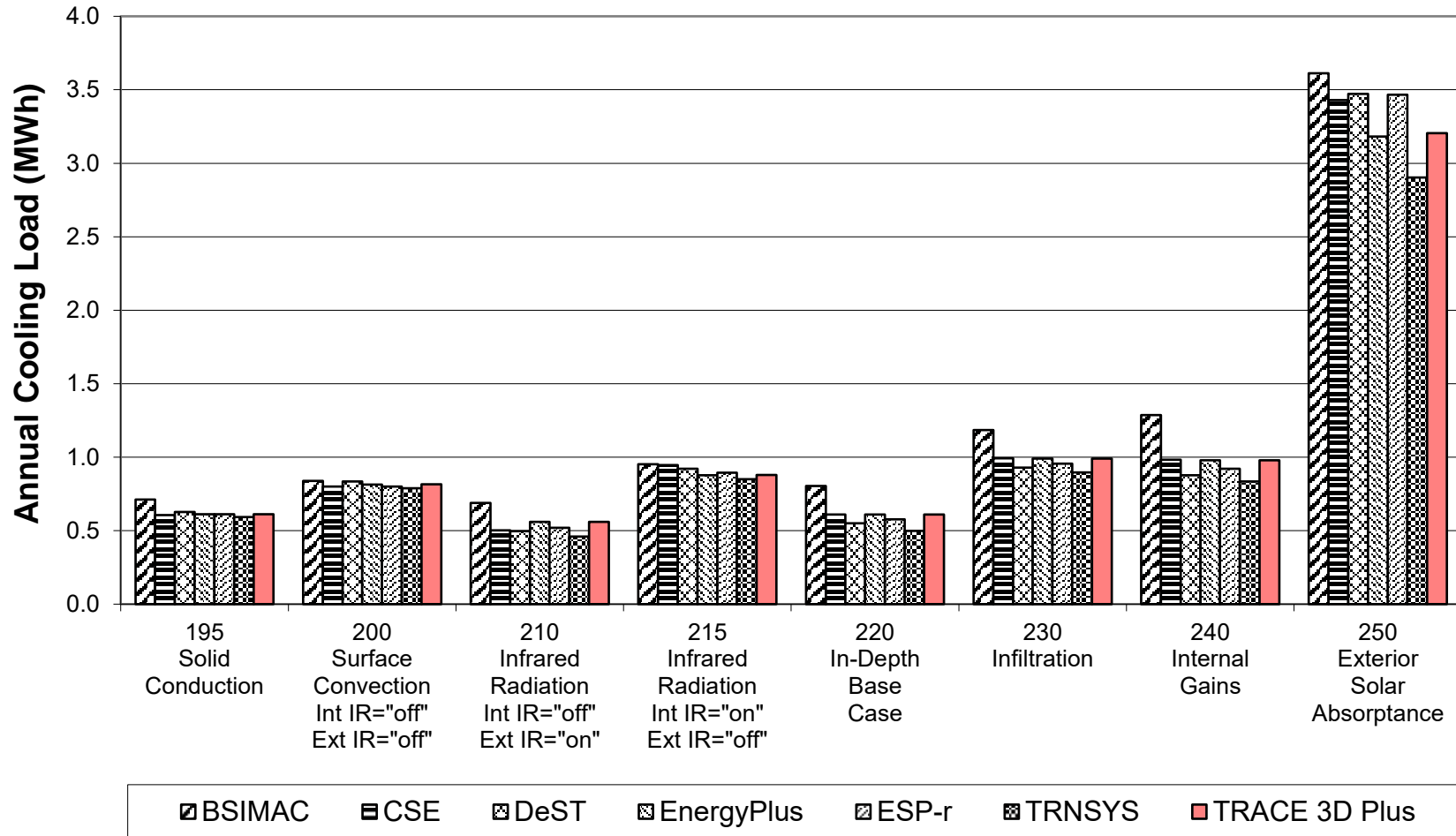
**Figure B8-35. Basic:
 Minimum Hourly Annual Temperature
 Free-Float Cases**



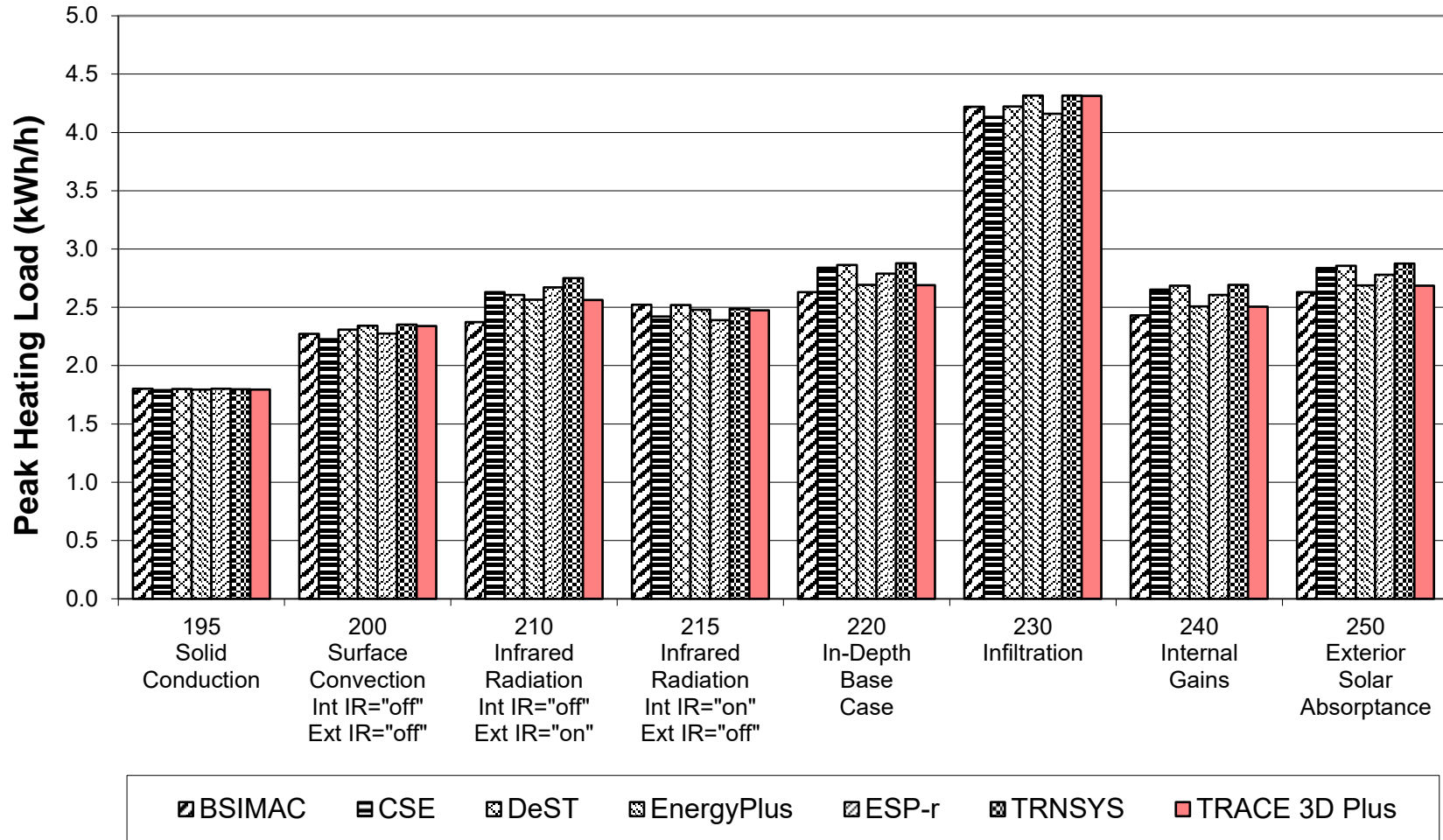
**Figure B8-36. In-Depth:
 Low Mass Cases 195 to 250
 Annual Heating**



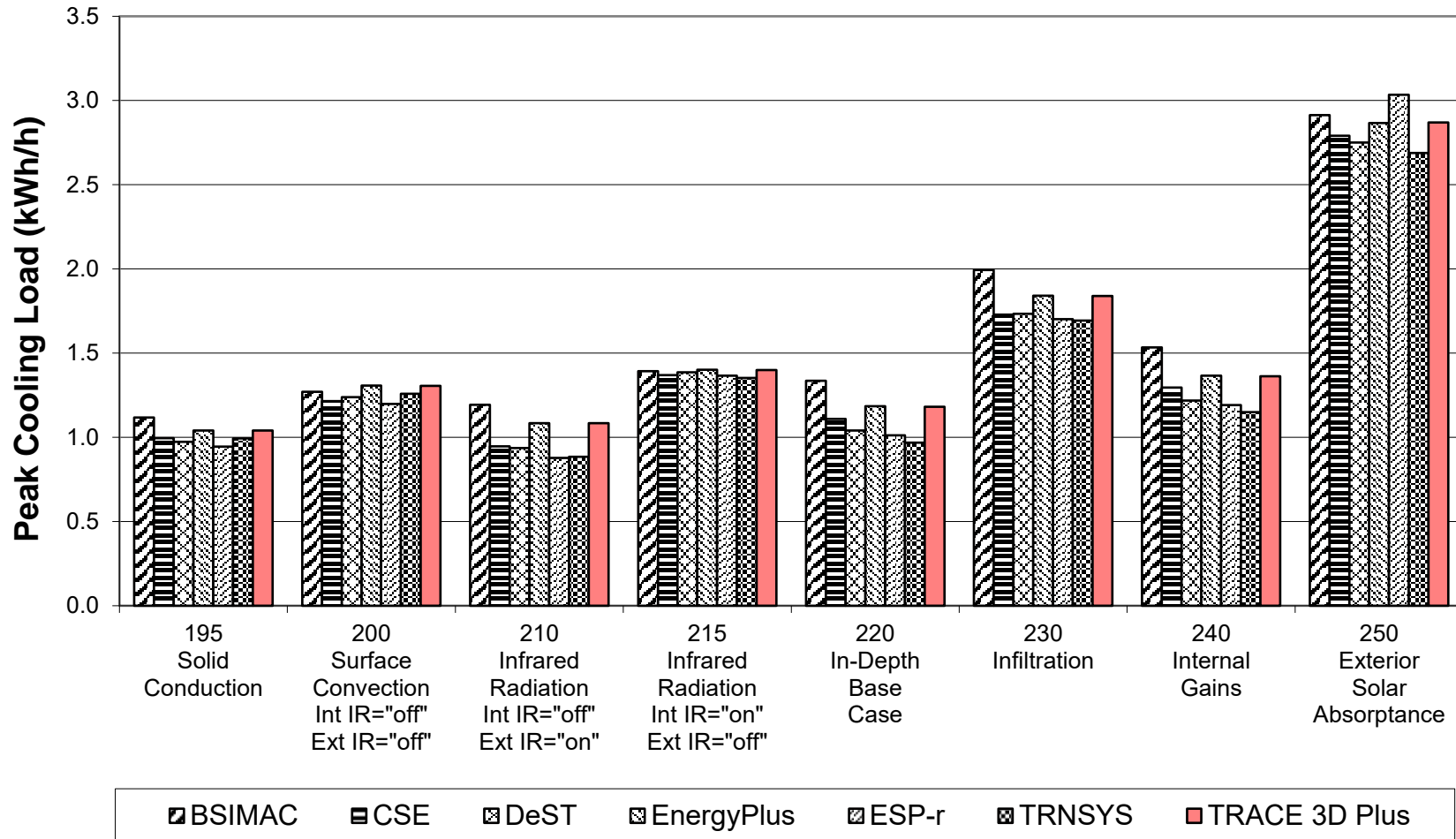
**Figure B8-37. In-Depth:
 Low Mass Cases 195 to 250
 Annual Sensible Cooling**



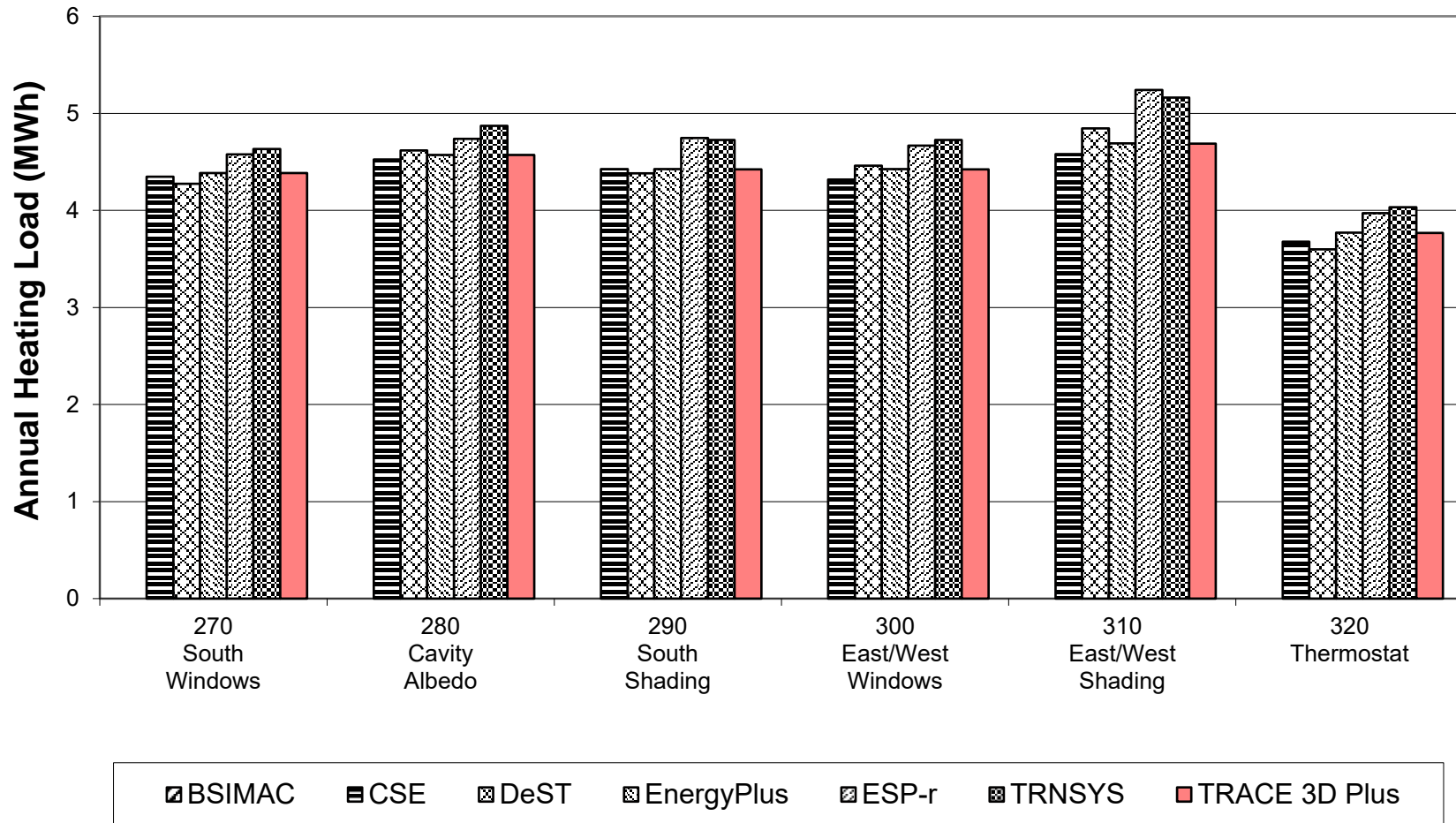
**Figure B8-38. In-Depth:
 Low Mass Cases 195 to 250
 Peak Heating**



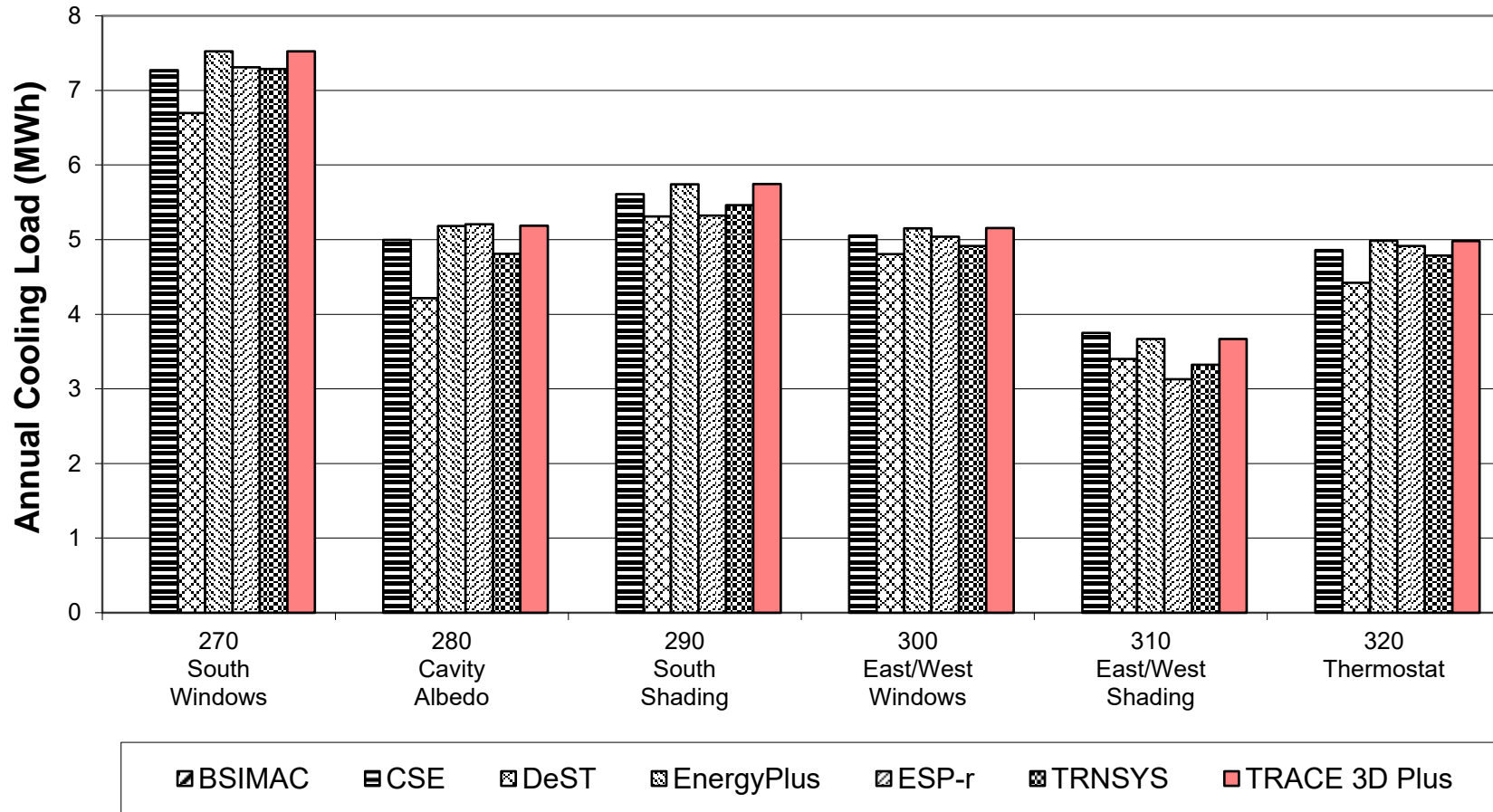
**Figure B8-39. In-Depth:
 Low Mass Cases 195 to 250
 Peak Sensible Cooling**



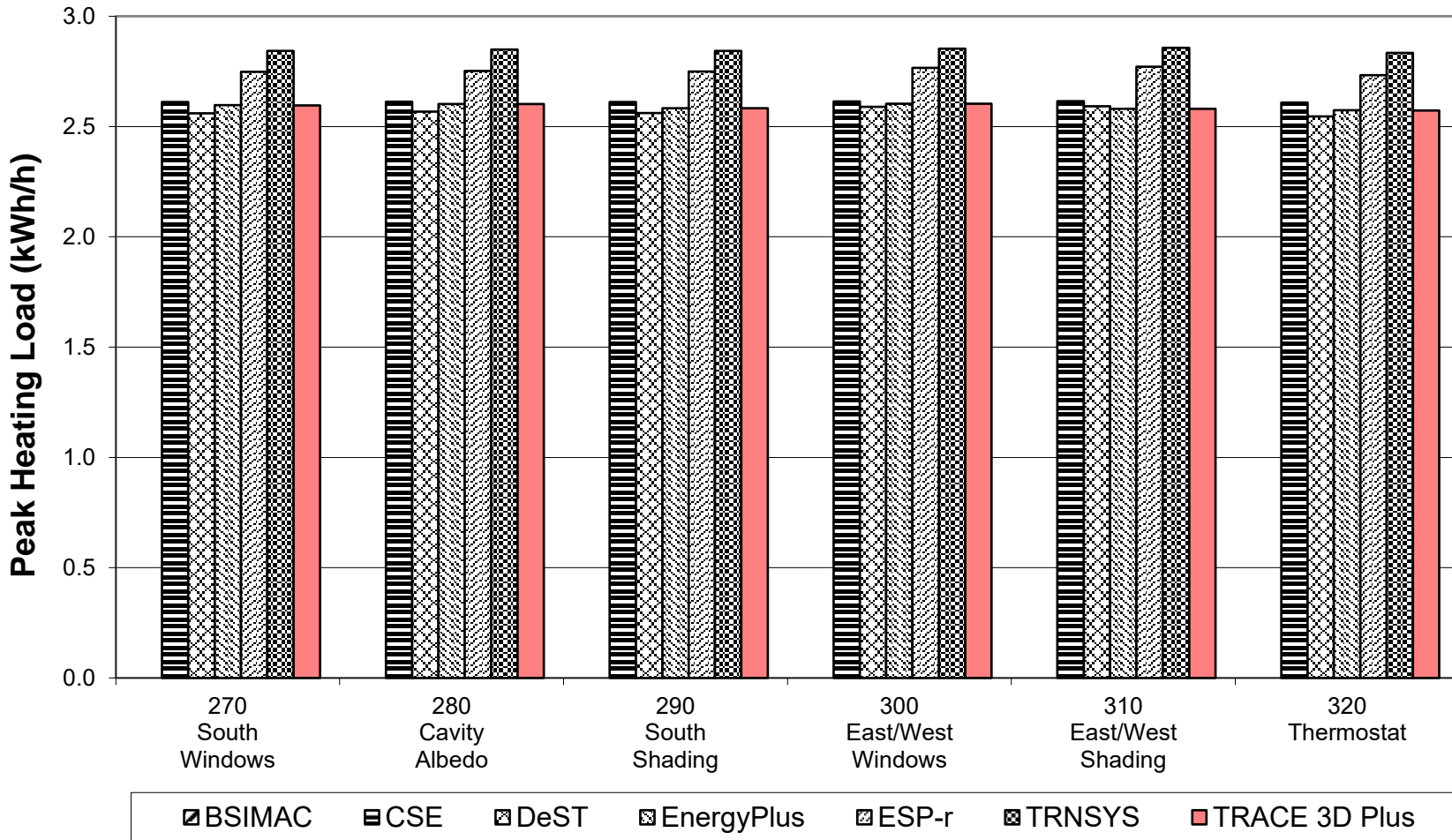
**Figure B8-40. In-Depth:
Low Mass Cases 270 to 320
Annual Heating**



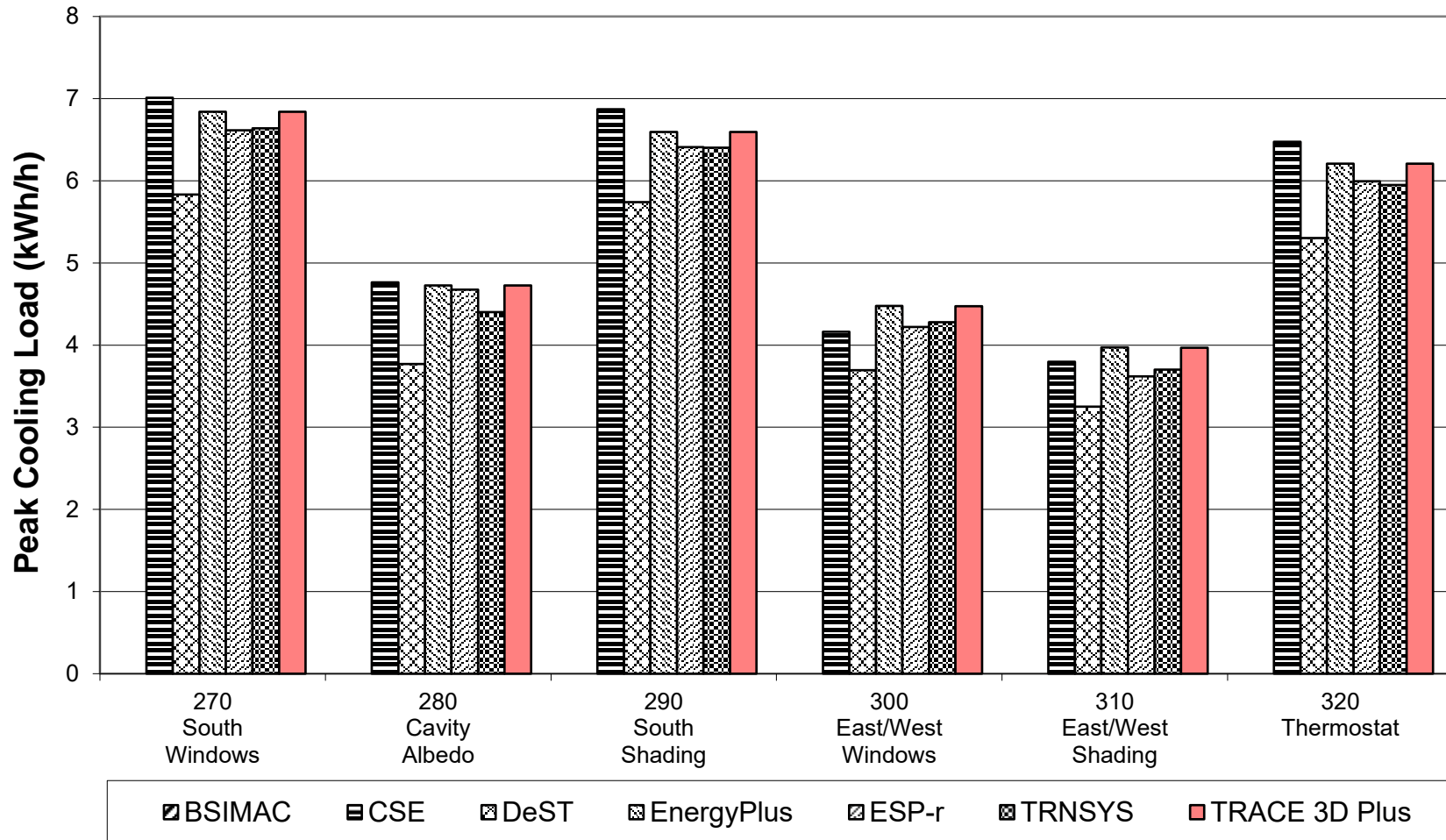
**Figure B8-41. In-Depth:
Low Mass Cases 270 to 320
Annual Sensible Cooling**



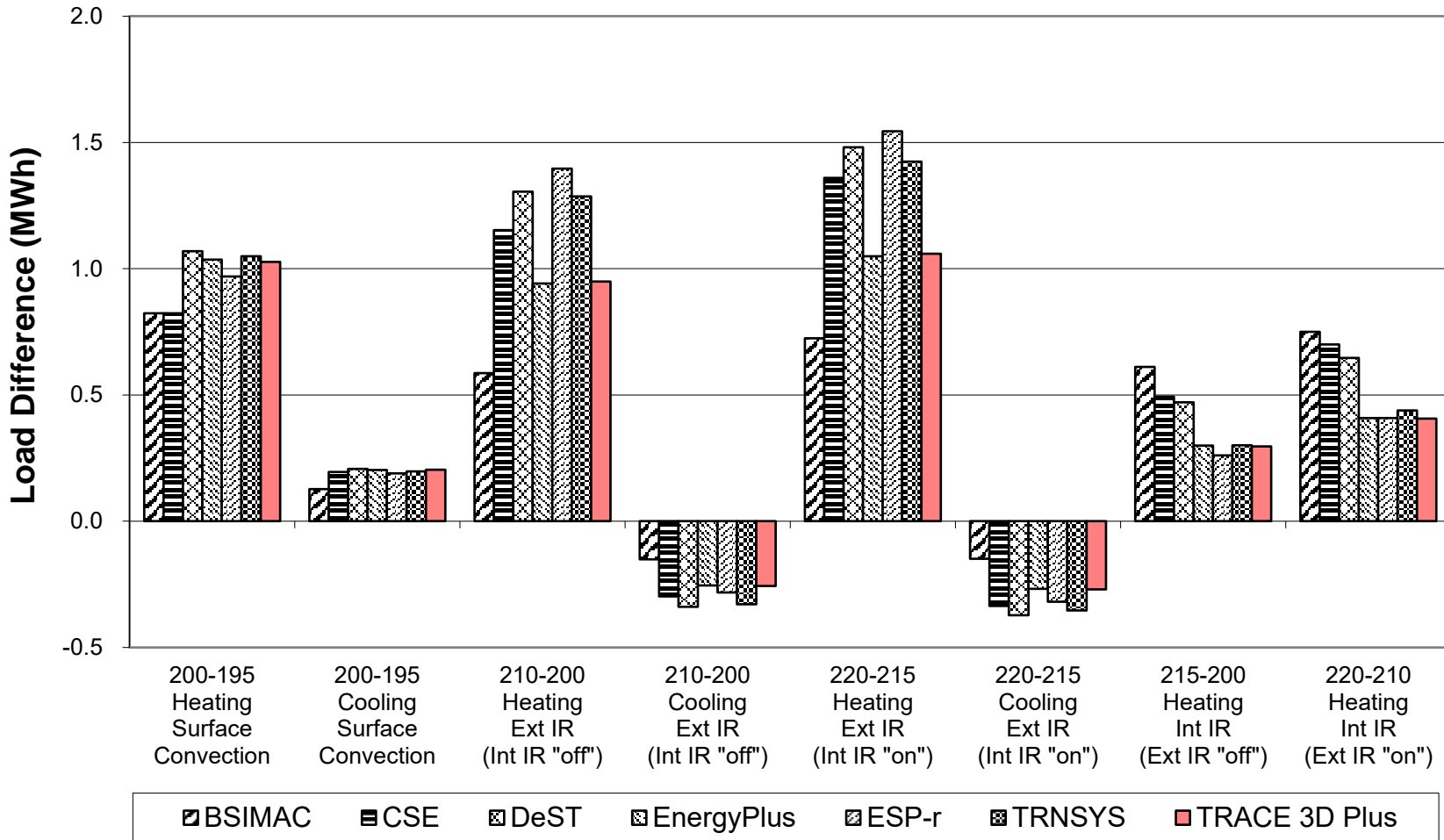
**Figure B8-42. In-Depth:
Low Mass Cases 270 to 320
Peak Heating**



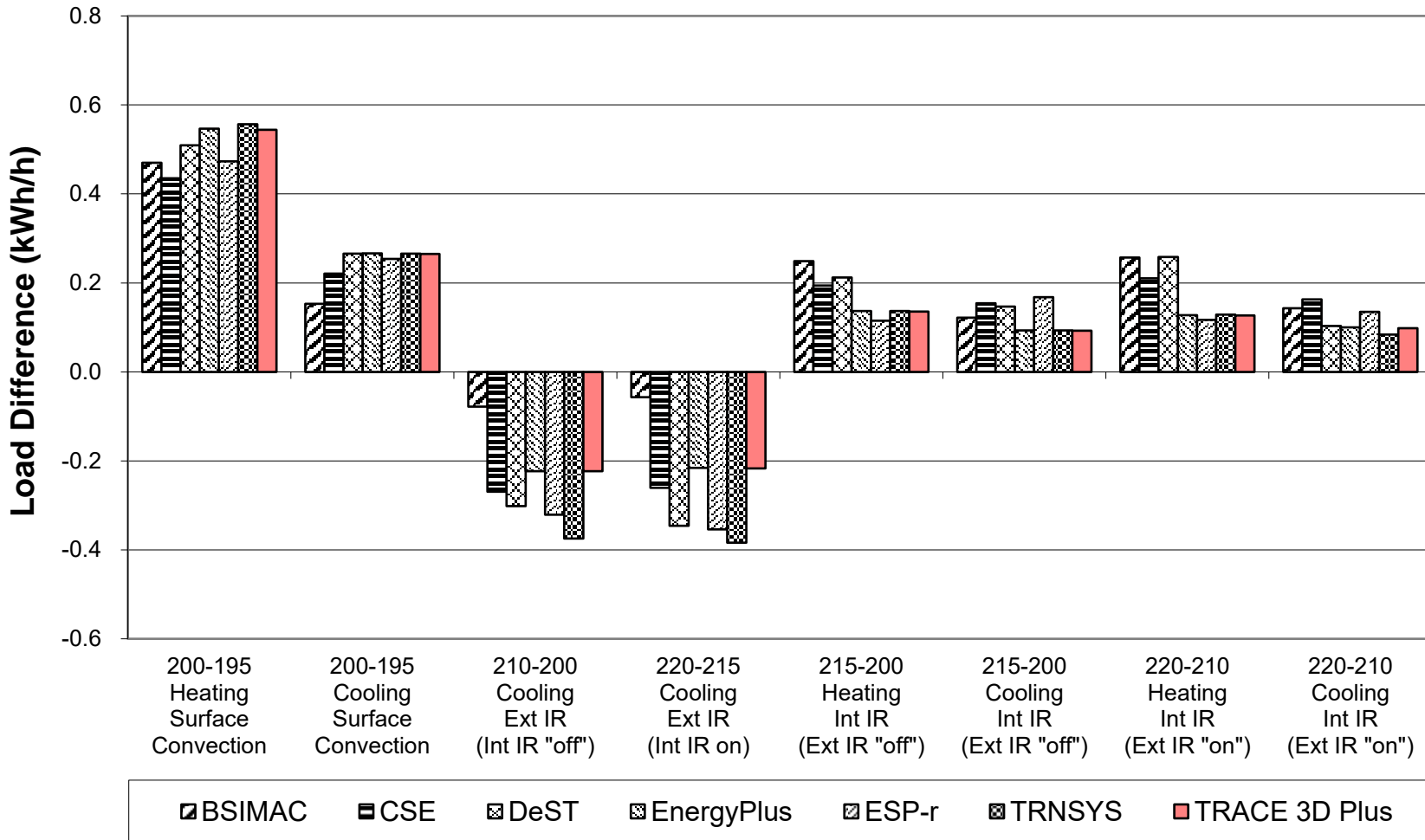
**Figure B8-43. In-Depth:
 Low Mass Cases 270 to 320
 Peak Sensible Cooling**



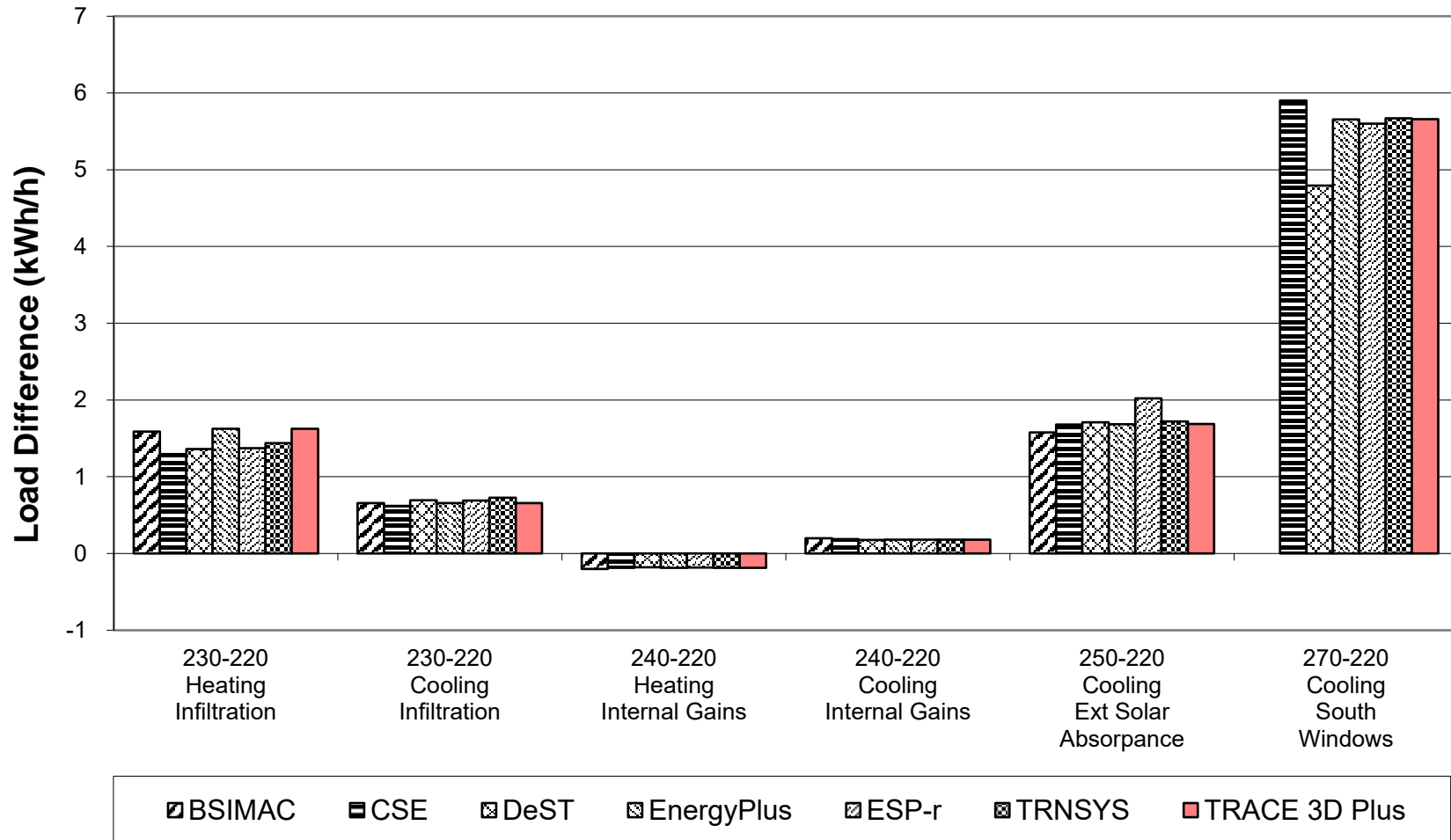
**Figure B8-44. In-Depth:
 Cases 195 to 220 (Delta)
 Annual Heating and Sensible Cooling**



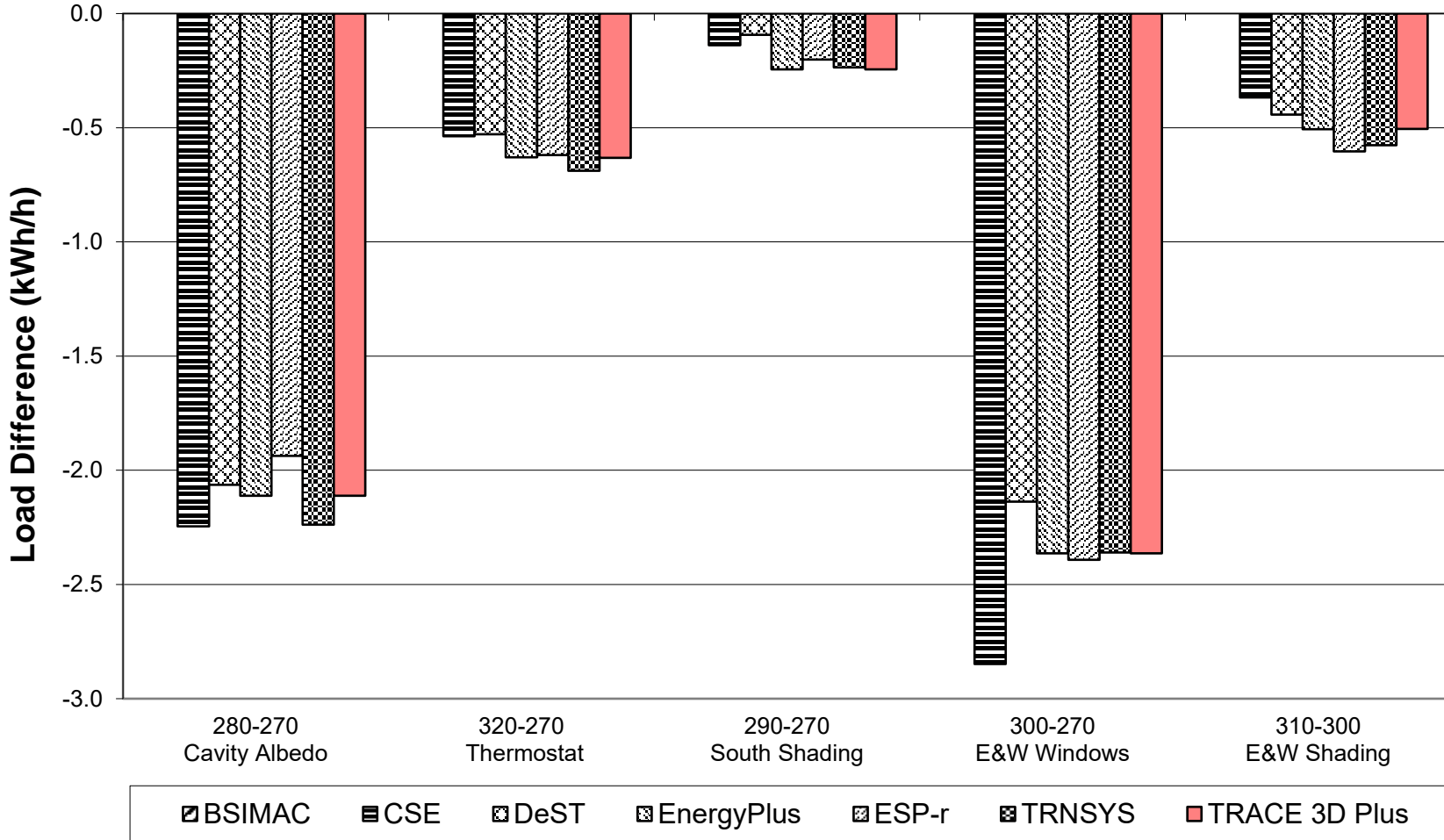
**Figure B8-45. In-Depth:
 Cases 195 to 220 (Delta)
 Peak Heating and Sensible Cooling**



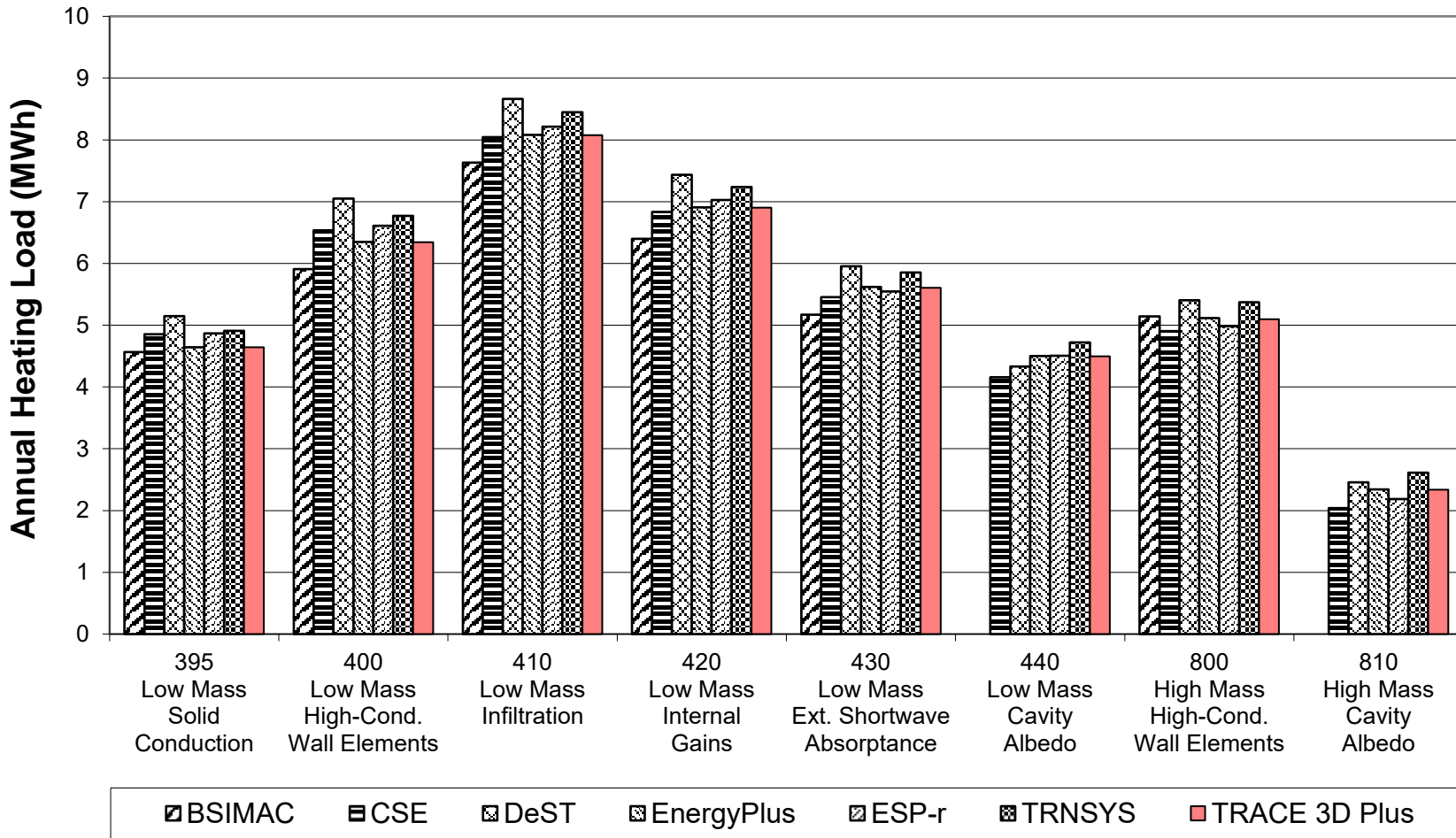
**Figure B8-47. In-Depth:
 Cases 220 to 270 (Delta)
 Peak Heating and Sensible Cooling**



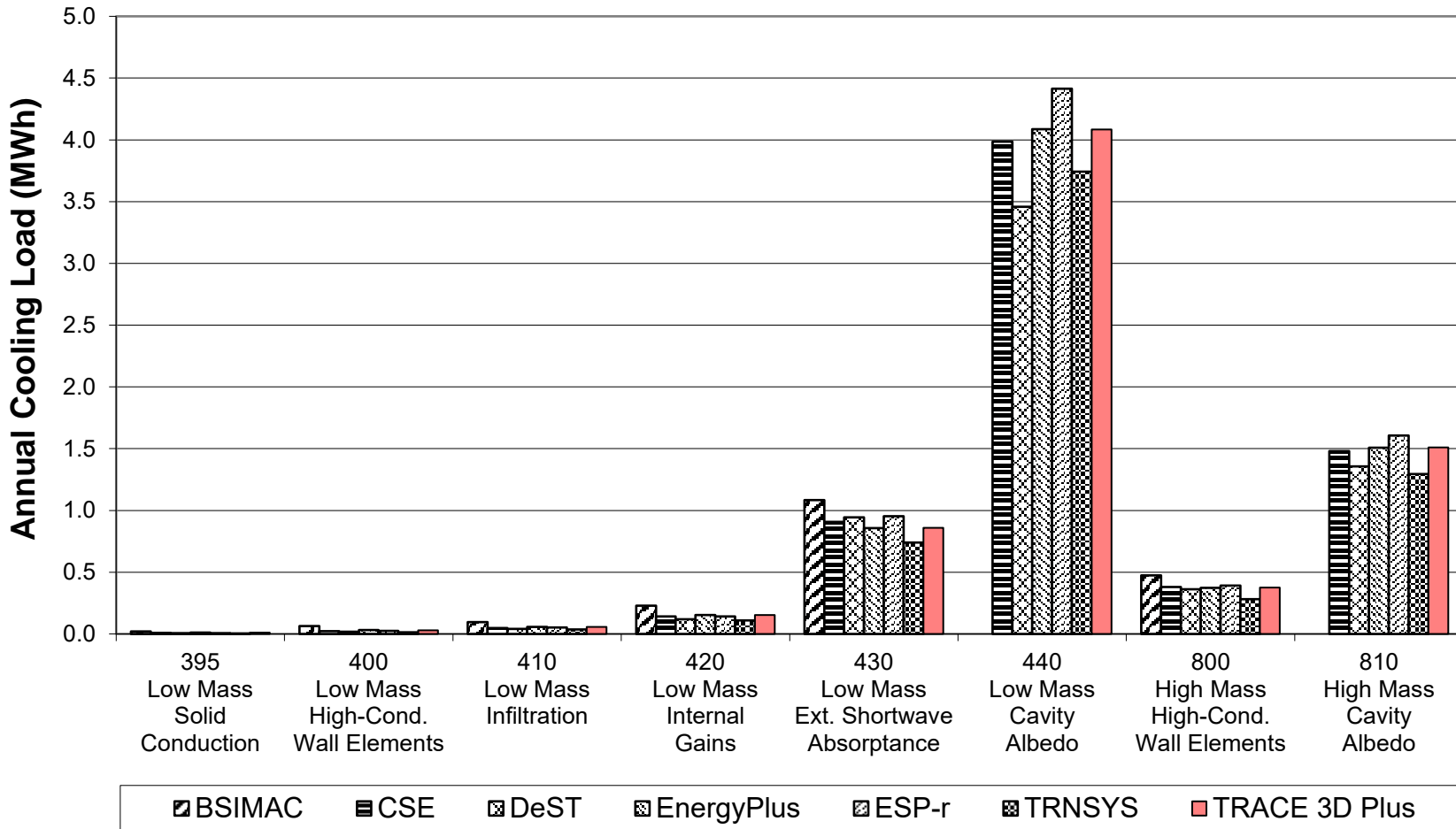
**Figure B8-49. In-Depth:
 Cases 270 to 320 (Delta)
 Peak Sensible Cooling**



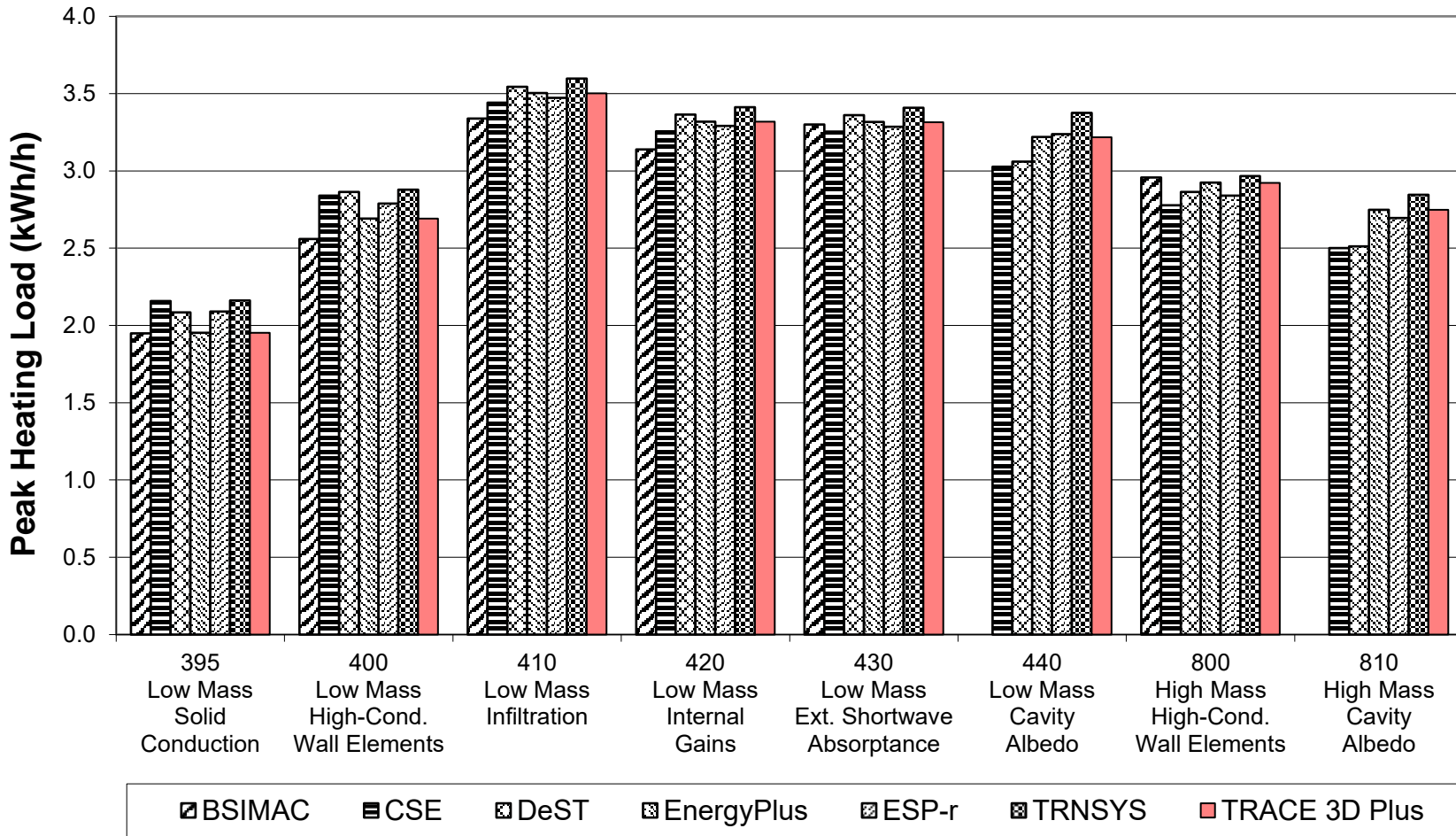
**Figure B8-50. In-Depth:
 Cases 395 to 440, 800, 810
 Annual Heating**



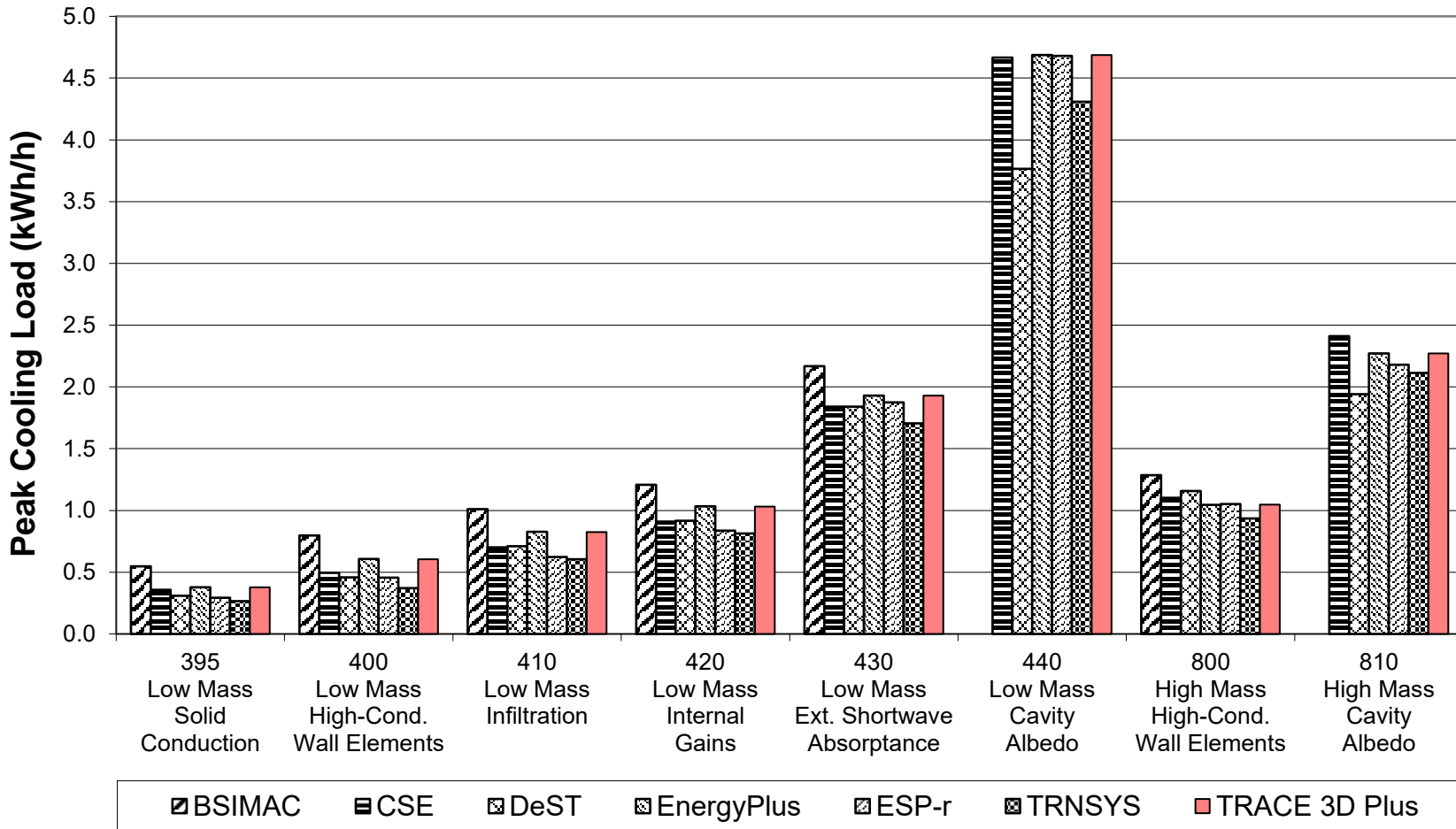
**Figure B8-51. In-Depth:
 Cases 395 to 440, 800, 810
 Annual Sensible Cooling**



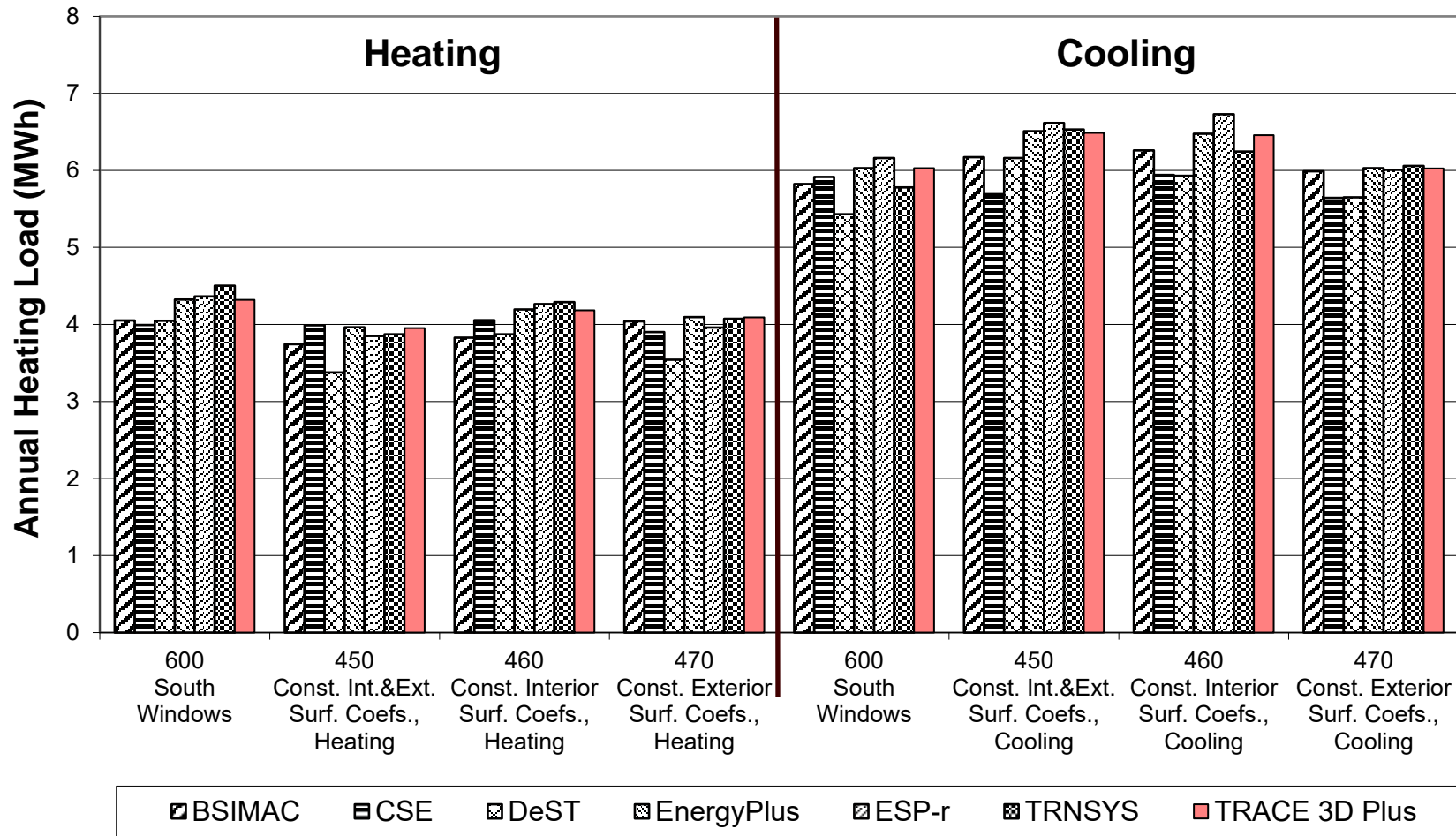
**Figure B8-52. In-Depth:
 Cases 395 to 440, 800, 810
 Peak Heating**



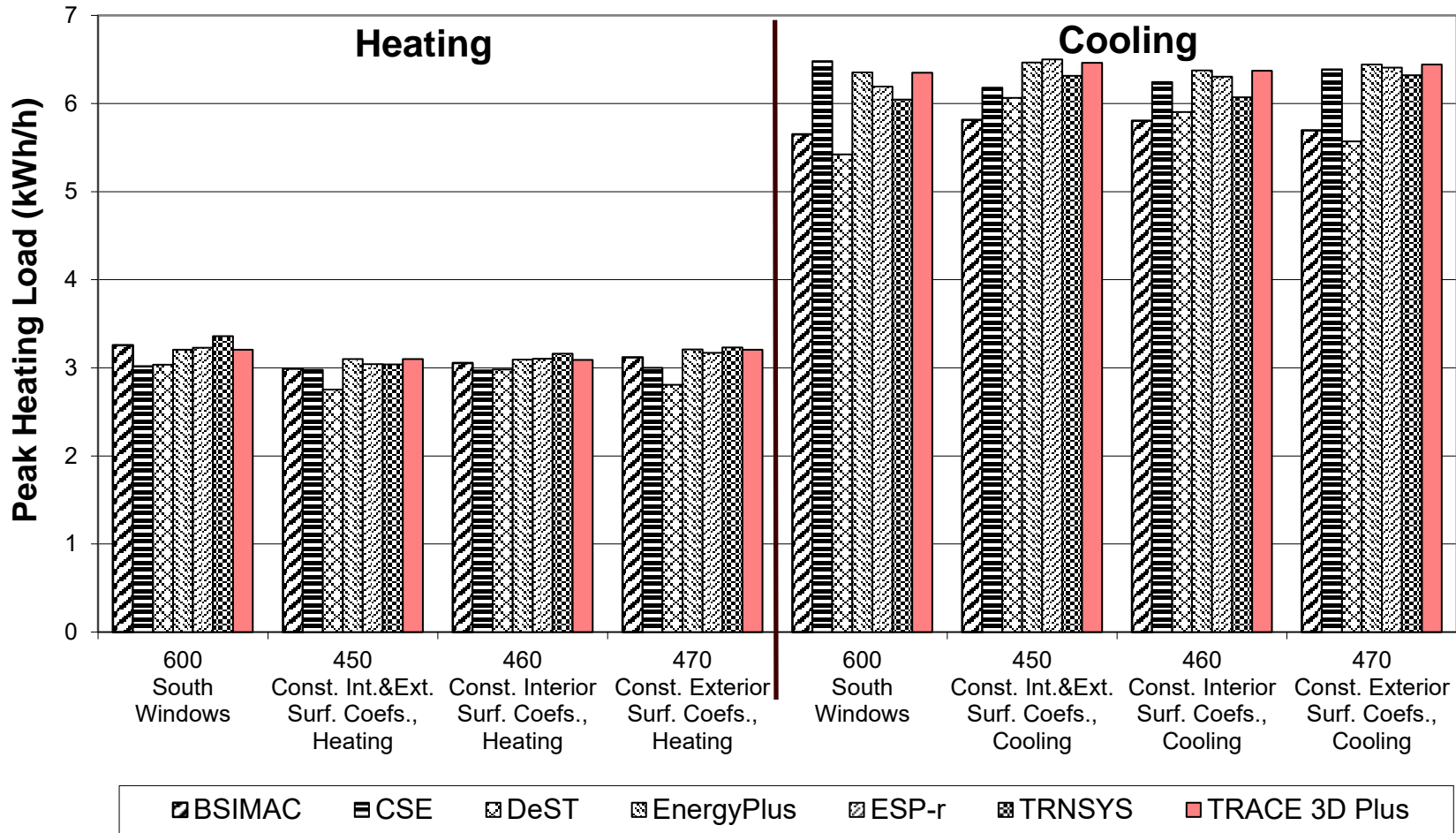
**Figure B8-53. In-Depth:
 Cases 395 to 440, 800, 810
 Peak Sensible Cooling**



**Figure B8-56. 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 B8-59. In-Depth: Surface Heat Transfer
 Cases 450 to 600 (Delta)
 Peak Heating and Sensible Cooling**

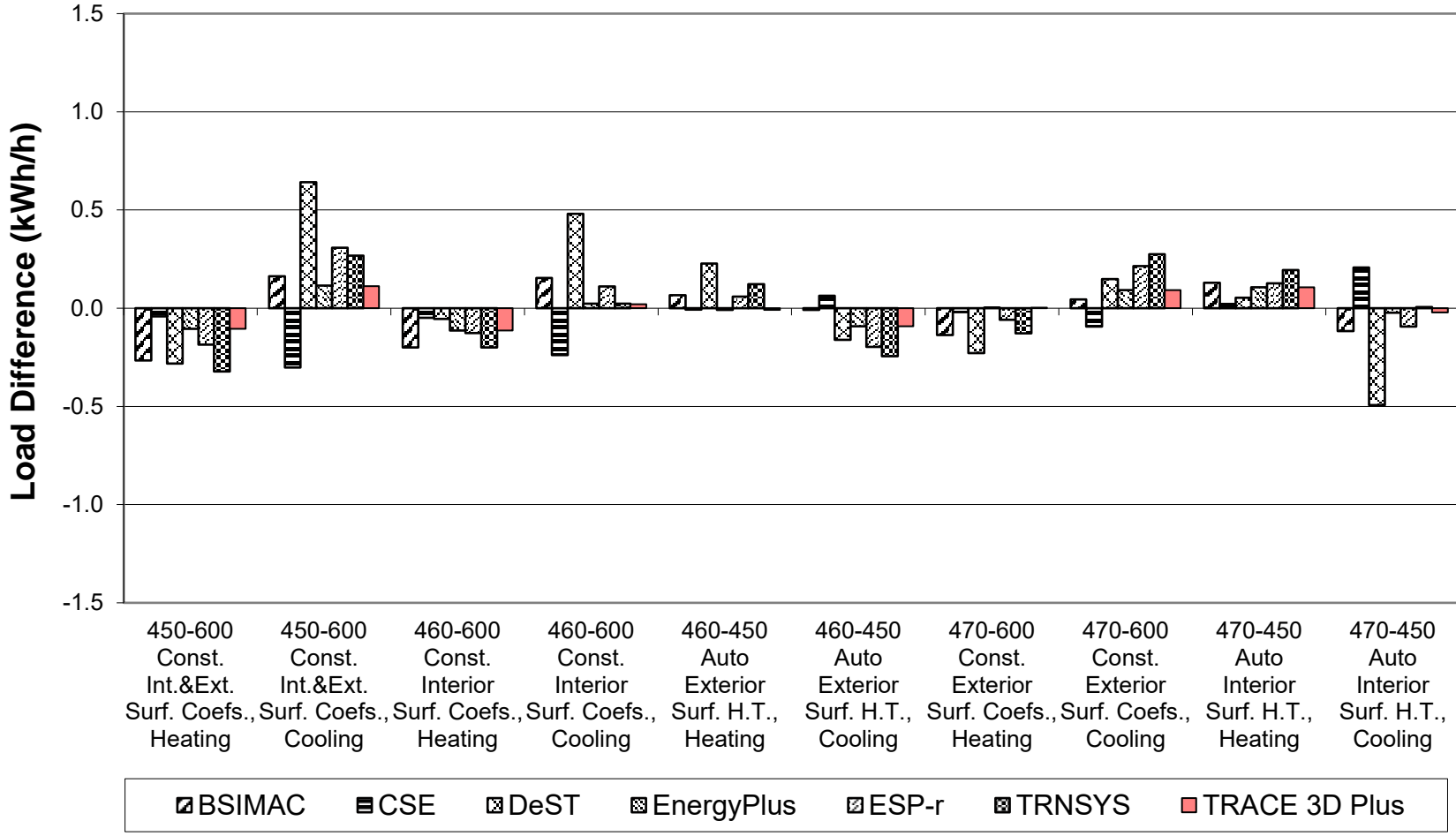


Figure B8-M1.
Monthly Heating
Case 600

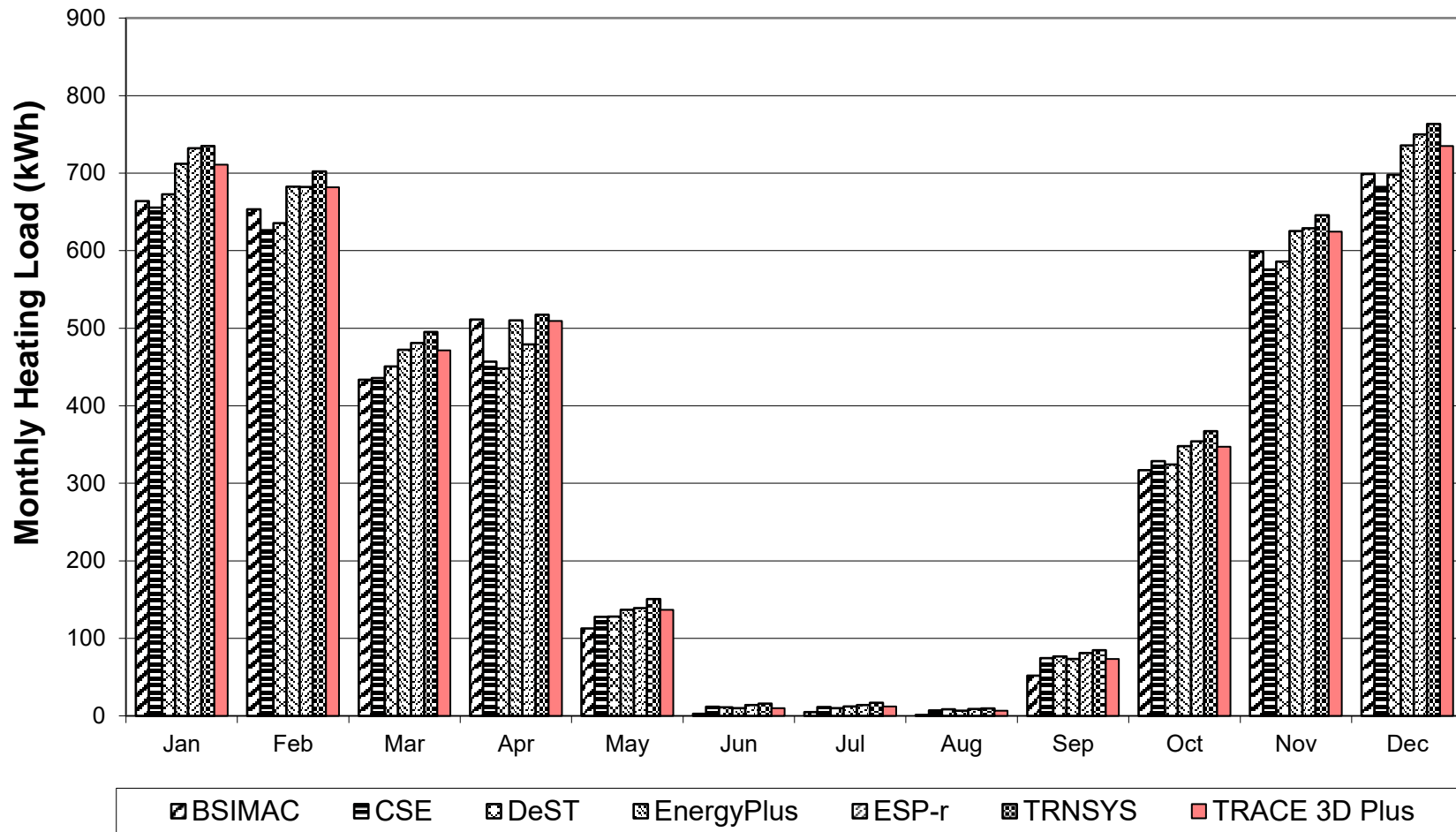


Figure B8-M2.
Monthly Sensible Cooling
Case 600

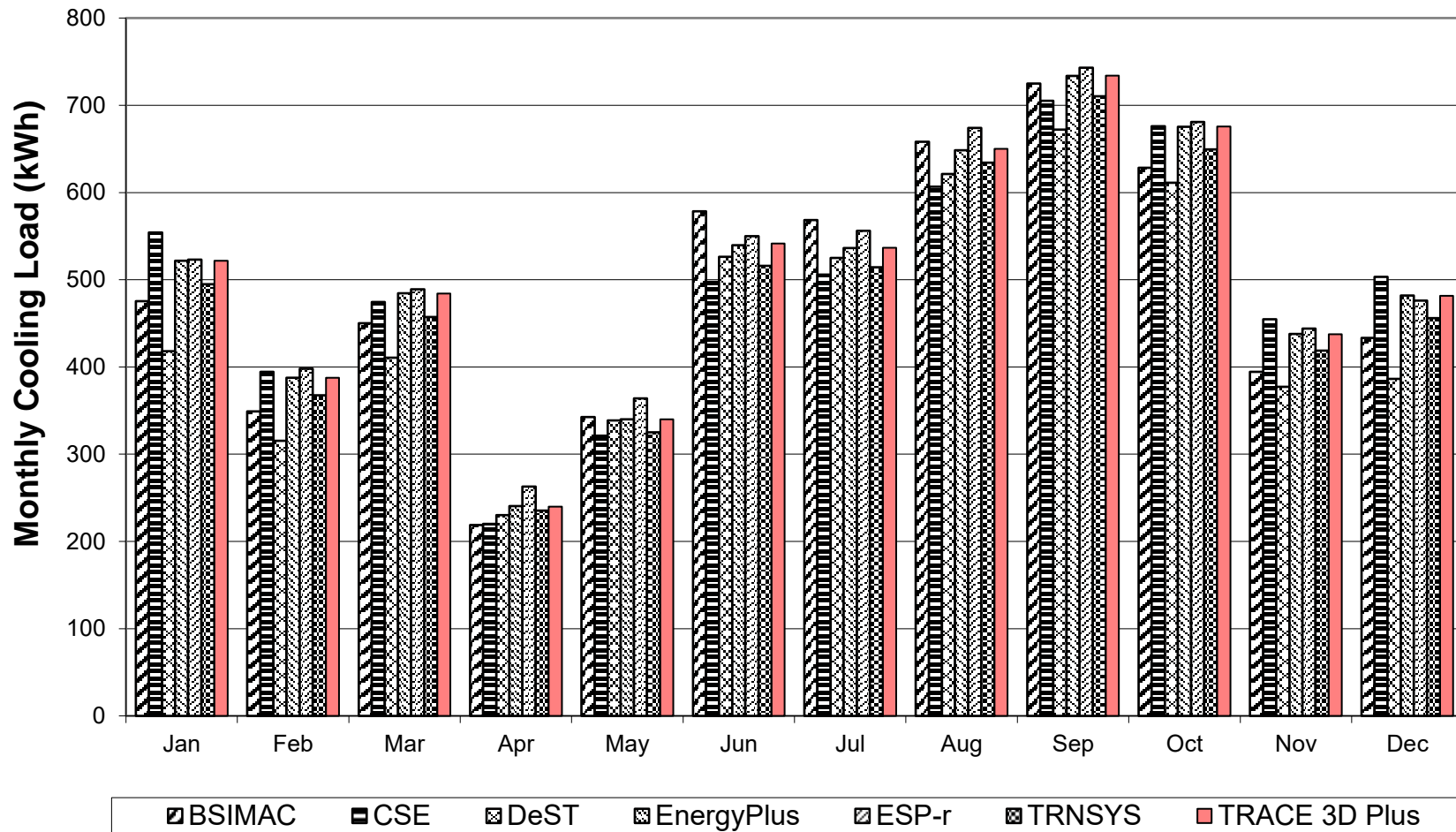


Figure B8-M3.
Monthly Peak Heating
Case 600

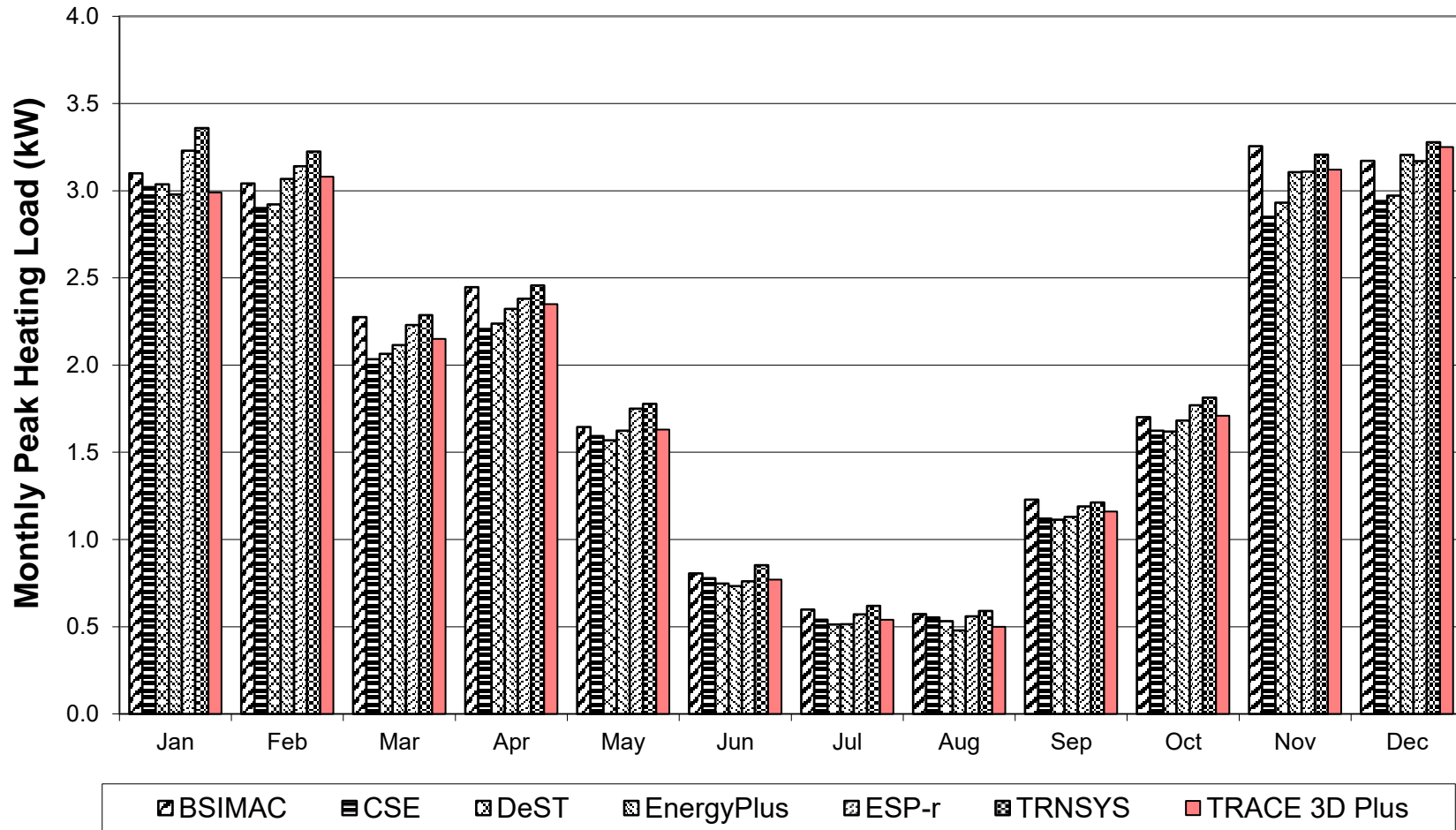


Figure B8-M4.
Monthly Peak Sensible Cooling
Case 600

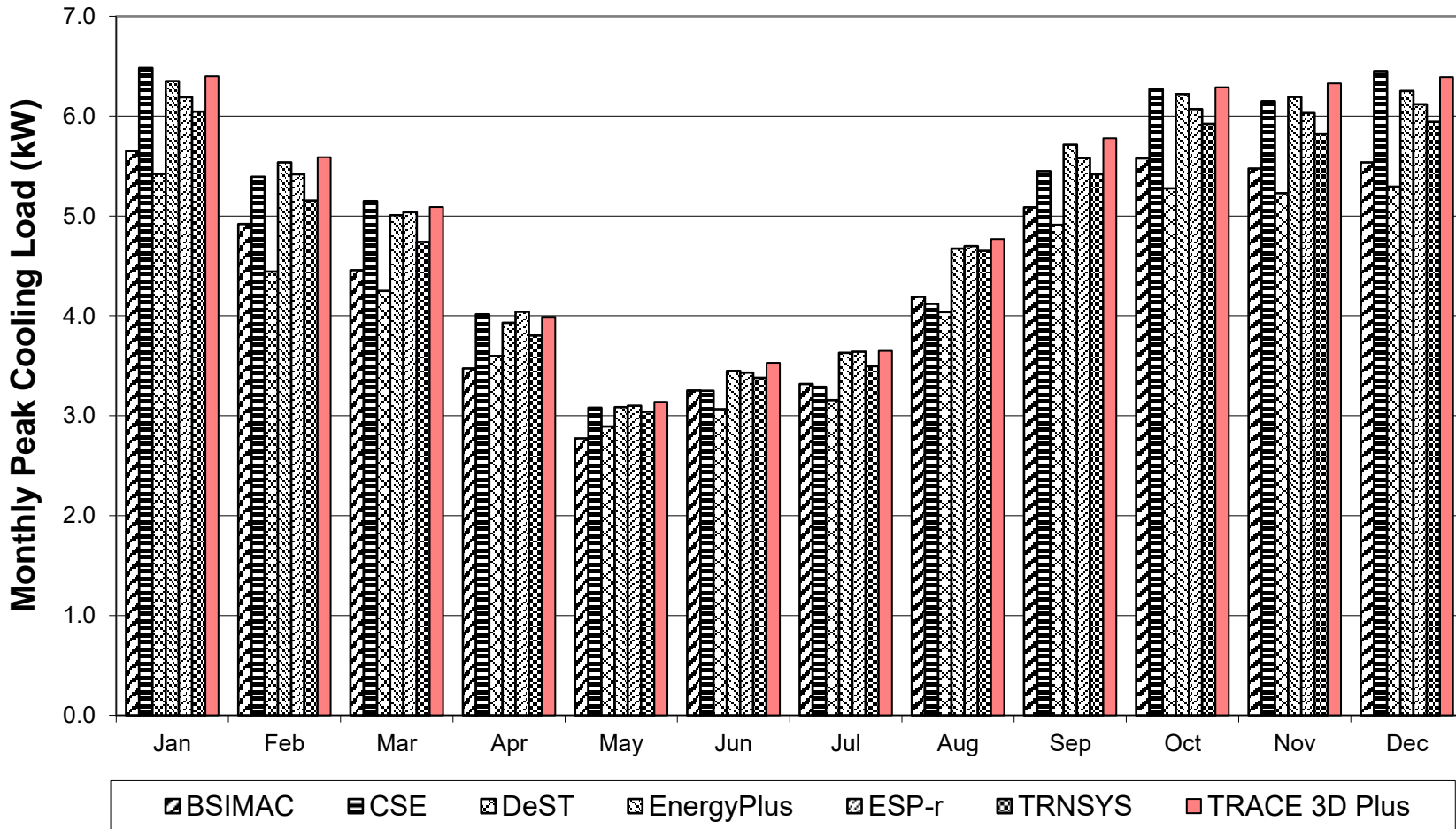


Figure B8-M5.
Monthly Heating
Case 900

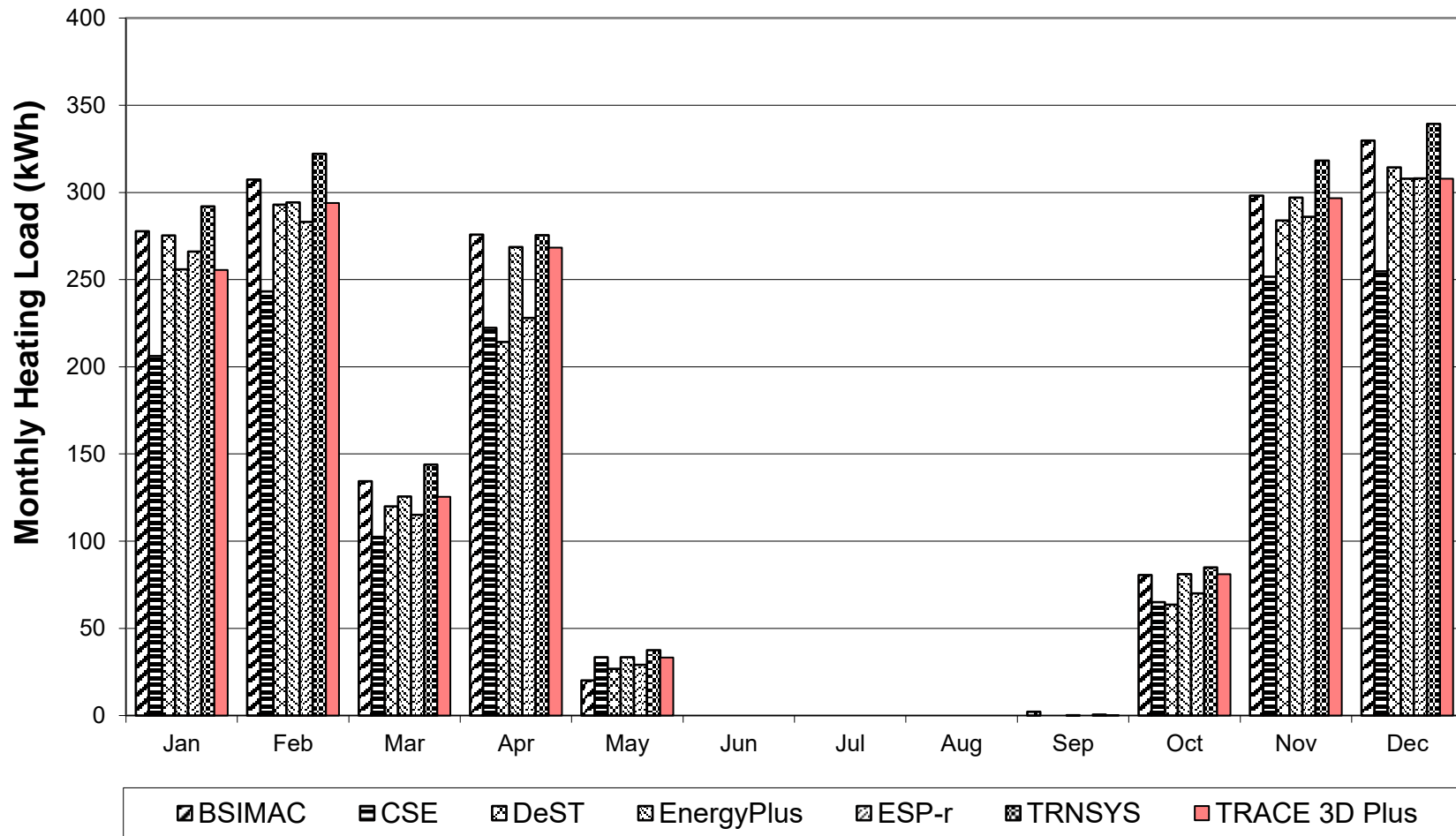


Figure B8-M6.
Monthly Sensible Cooling
Case 900

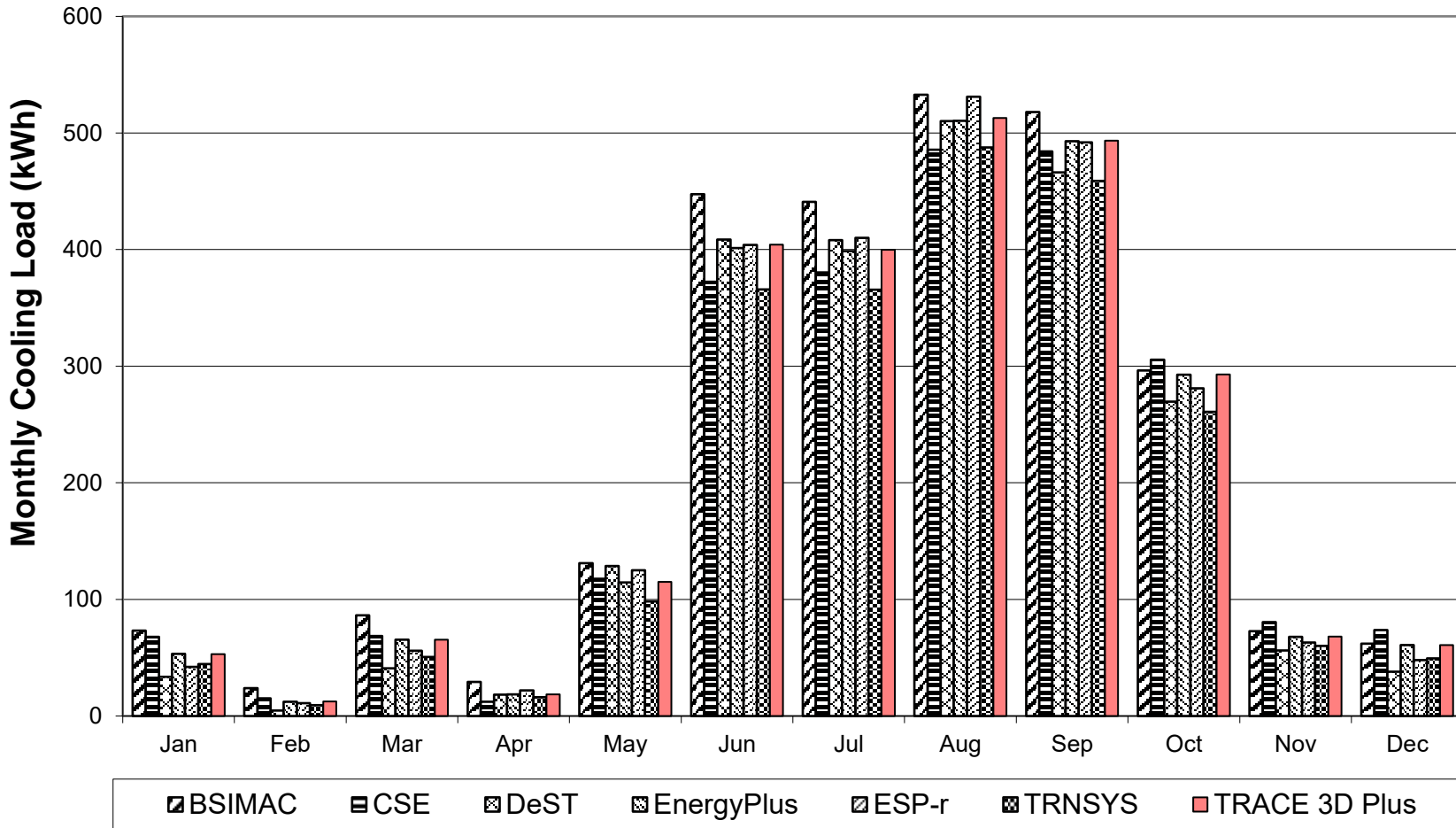


Figure B8-M7.
Monthly Peak Heating
Case 900

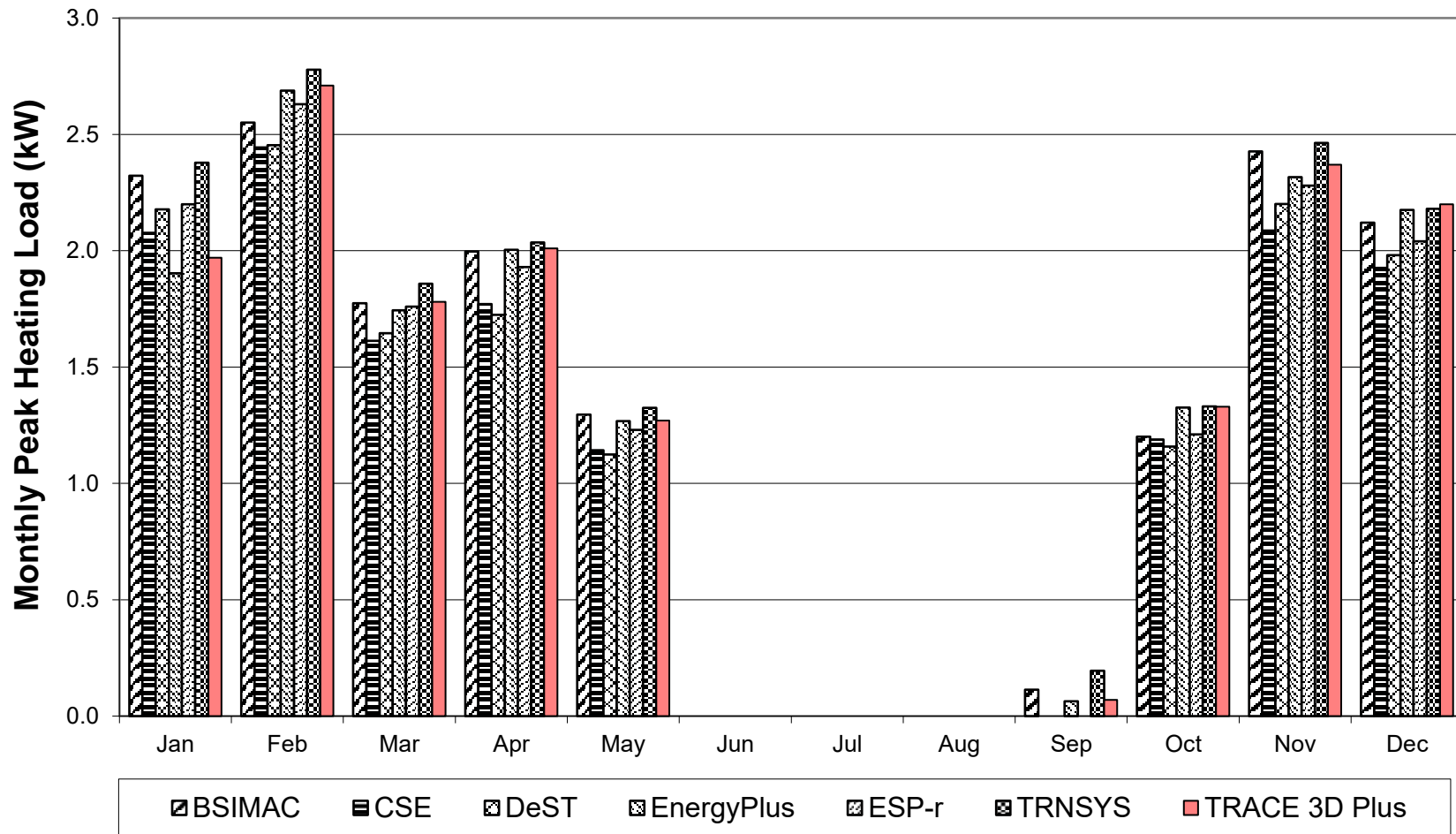


Figure B8-M8.
Monthly Peak Sensible Cooling
Case 900



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

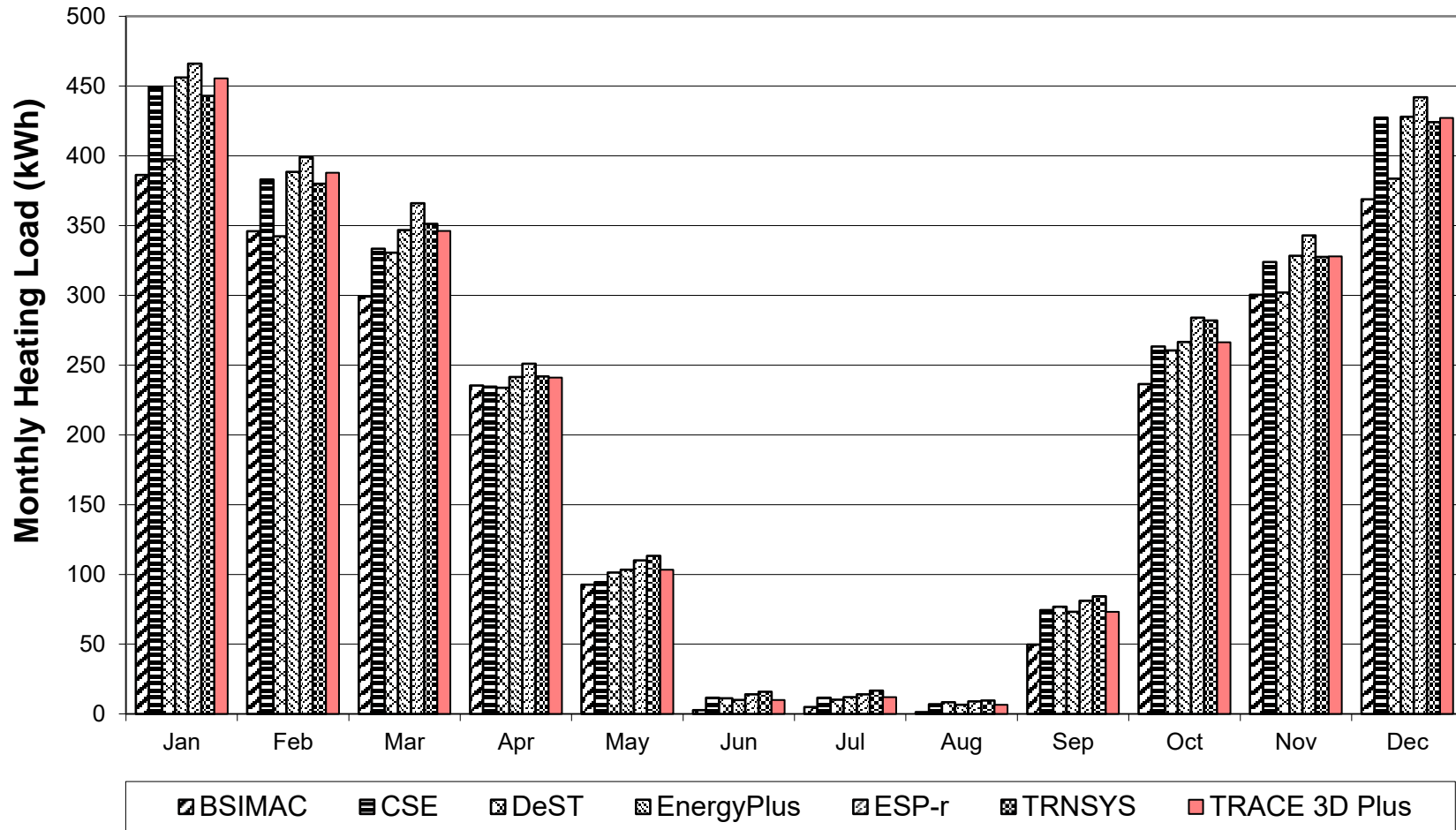


Figure B8-M10.
Monthly Cooling Sensitivity (Delta)
Case 600-900

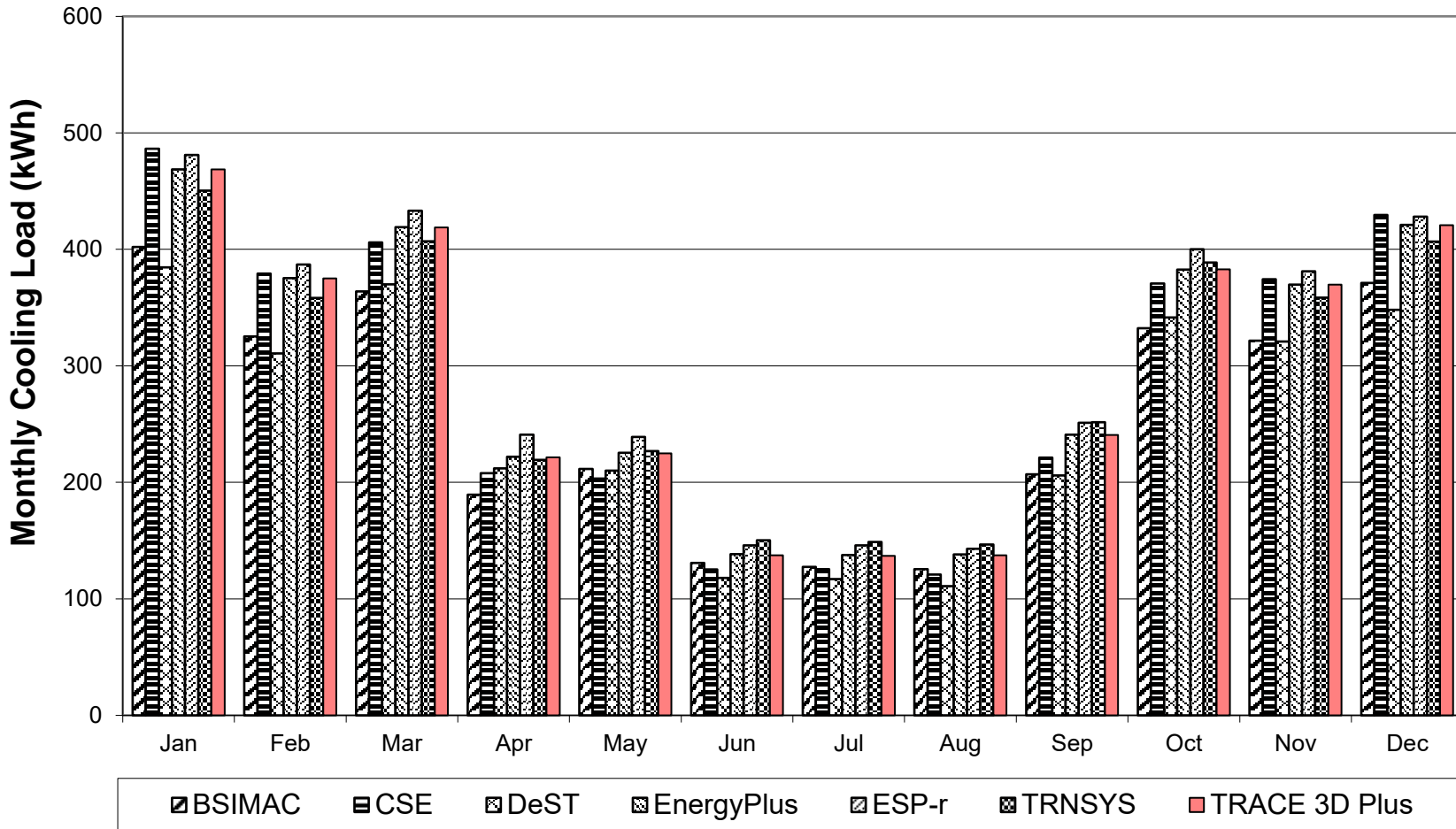


Figure B8-M11.
Monthly Peak Heating Sensitivity (Delta)
Case 600-900

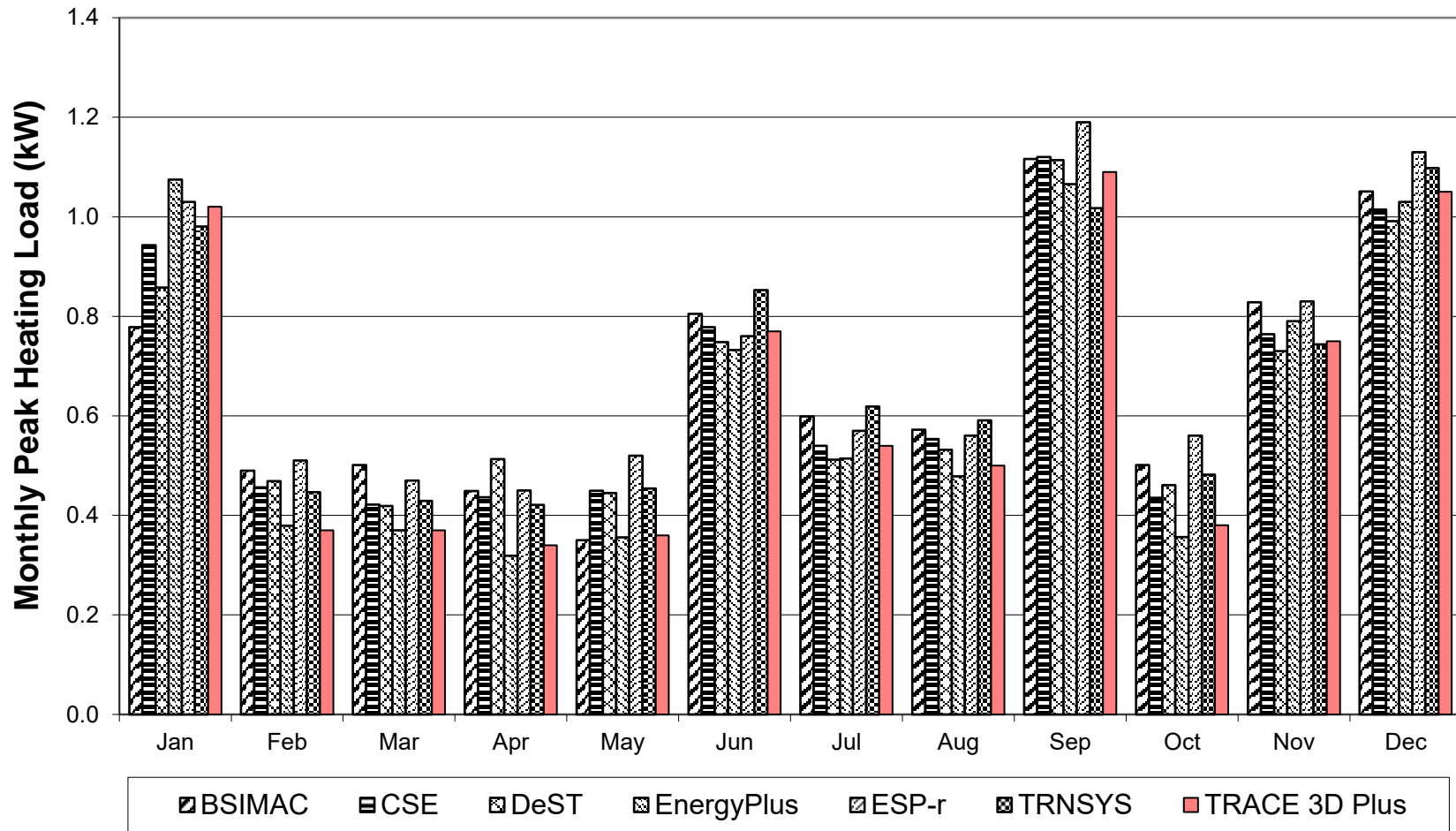


Figure B8-M12.
Monthly Peak Cooling Sensitivity (Delta)
Case 600-900

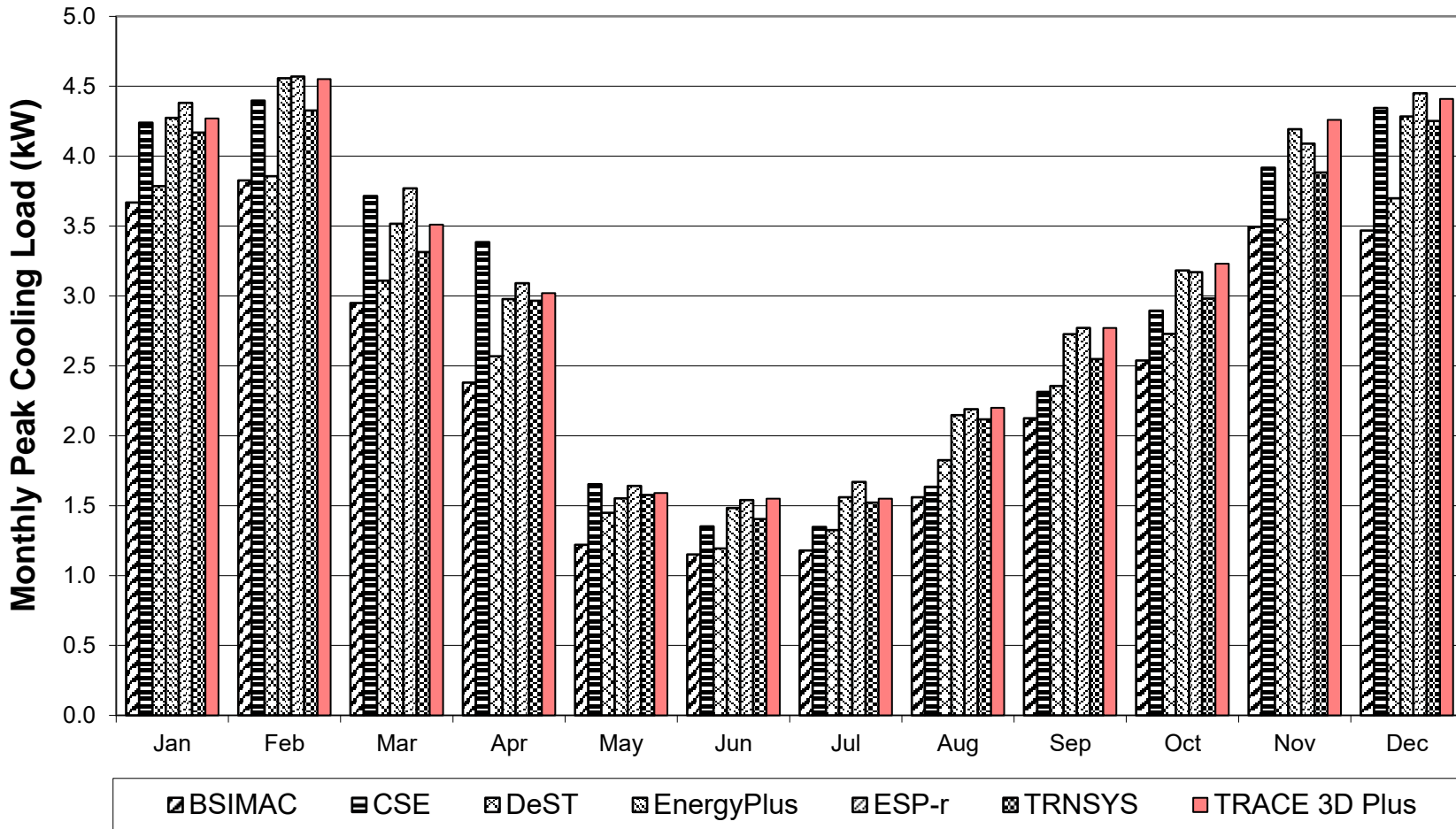


Figure B8-H1. Case 900FF
Annual Hourly Zone Air Temperature Frequency

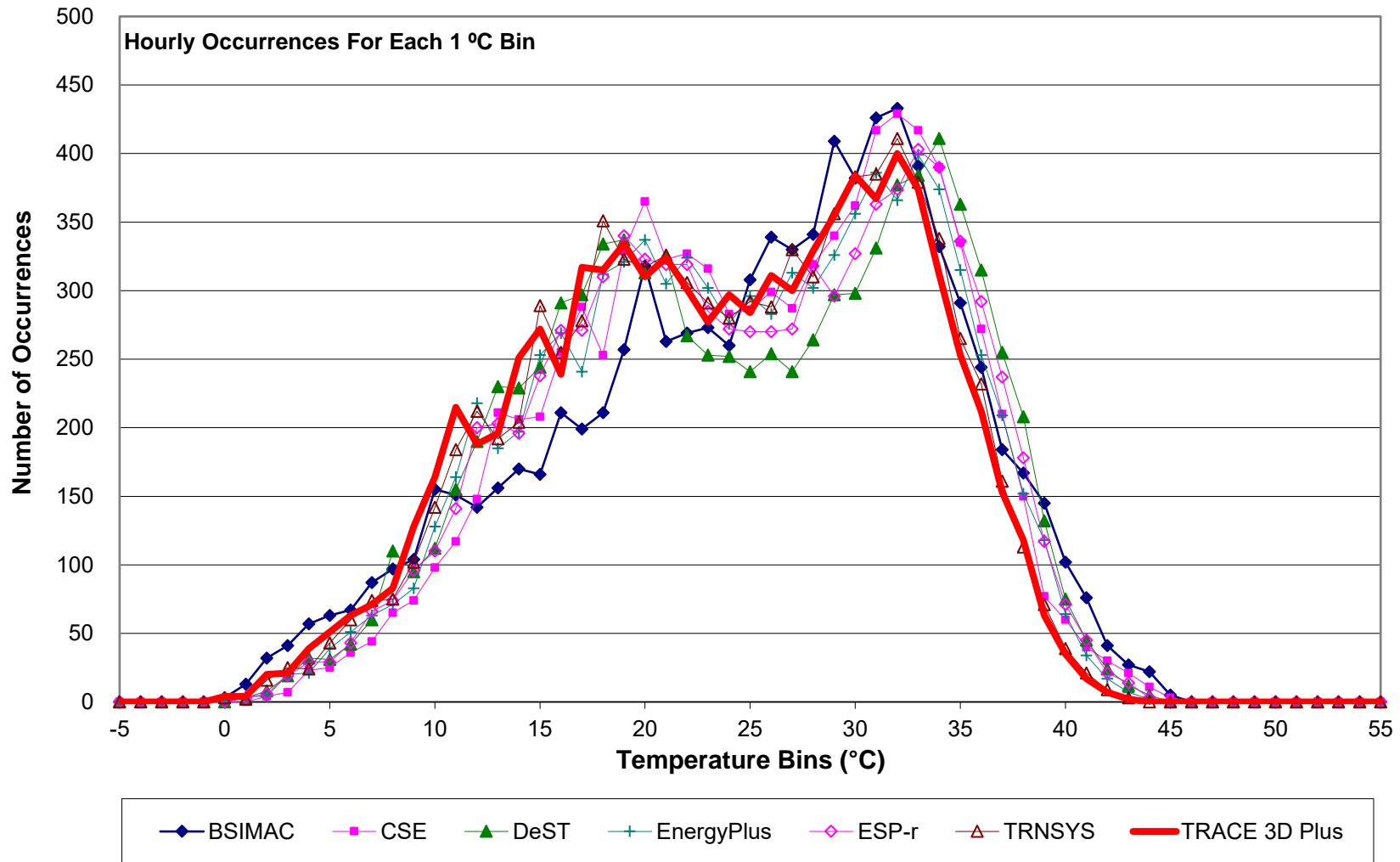


Figure B8-H2. Case 600
Cloudy & Clear Day Hourly Incident Solar
Horizontal (Upward) Facing Surface

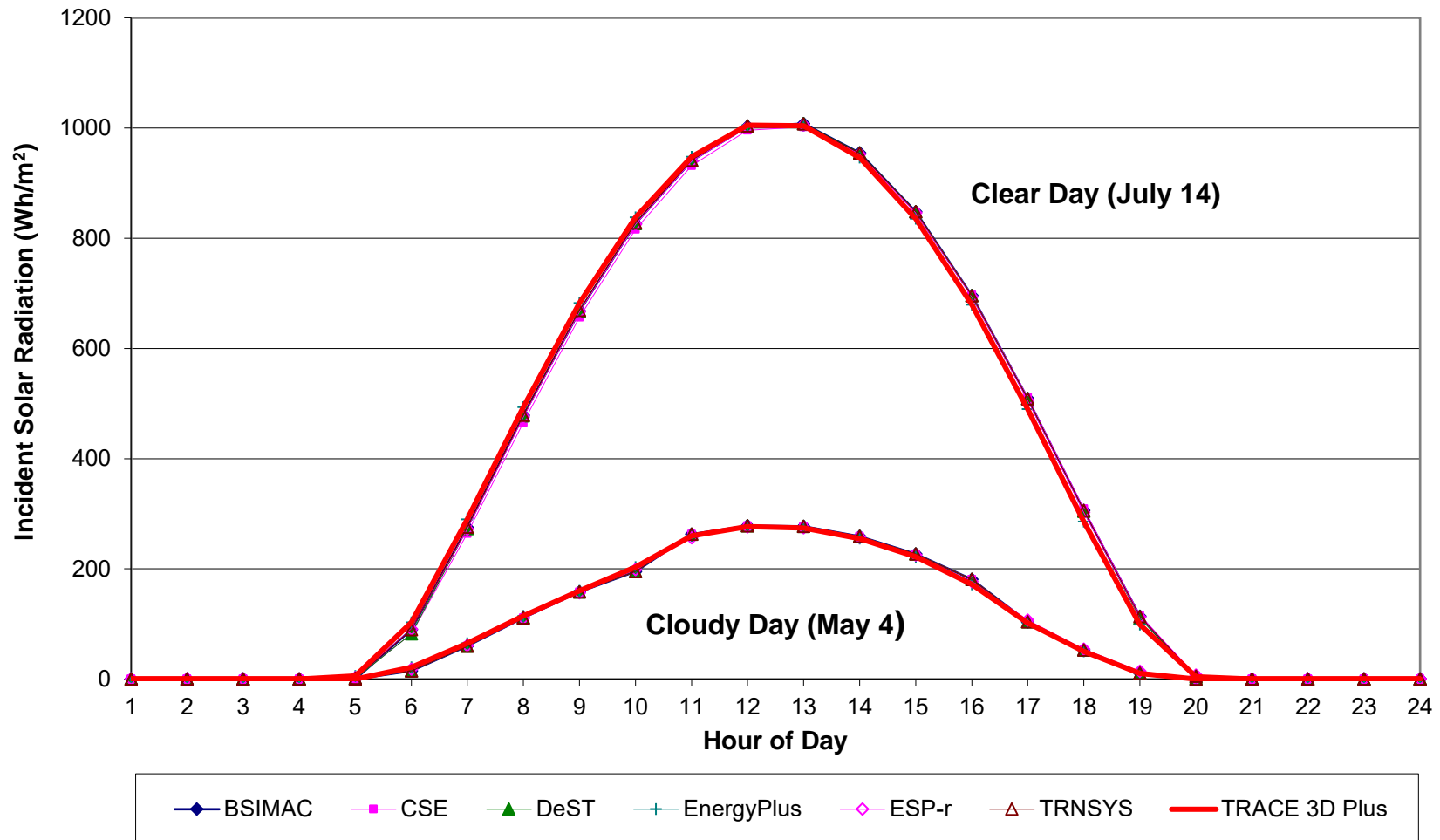


Figure B8-H3. Case 600
Cloudy & Clear Day Hourly Incident Solar
South Facing Surface

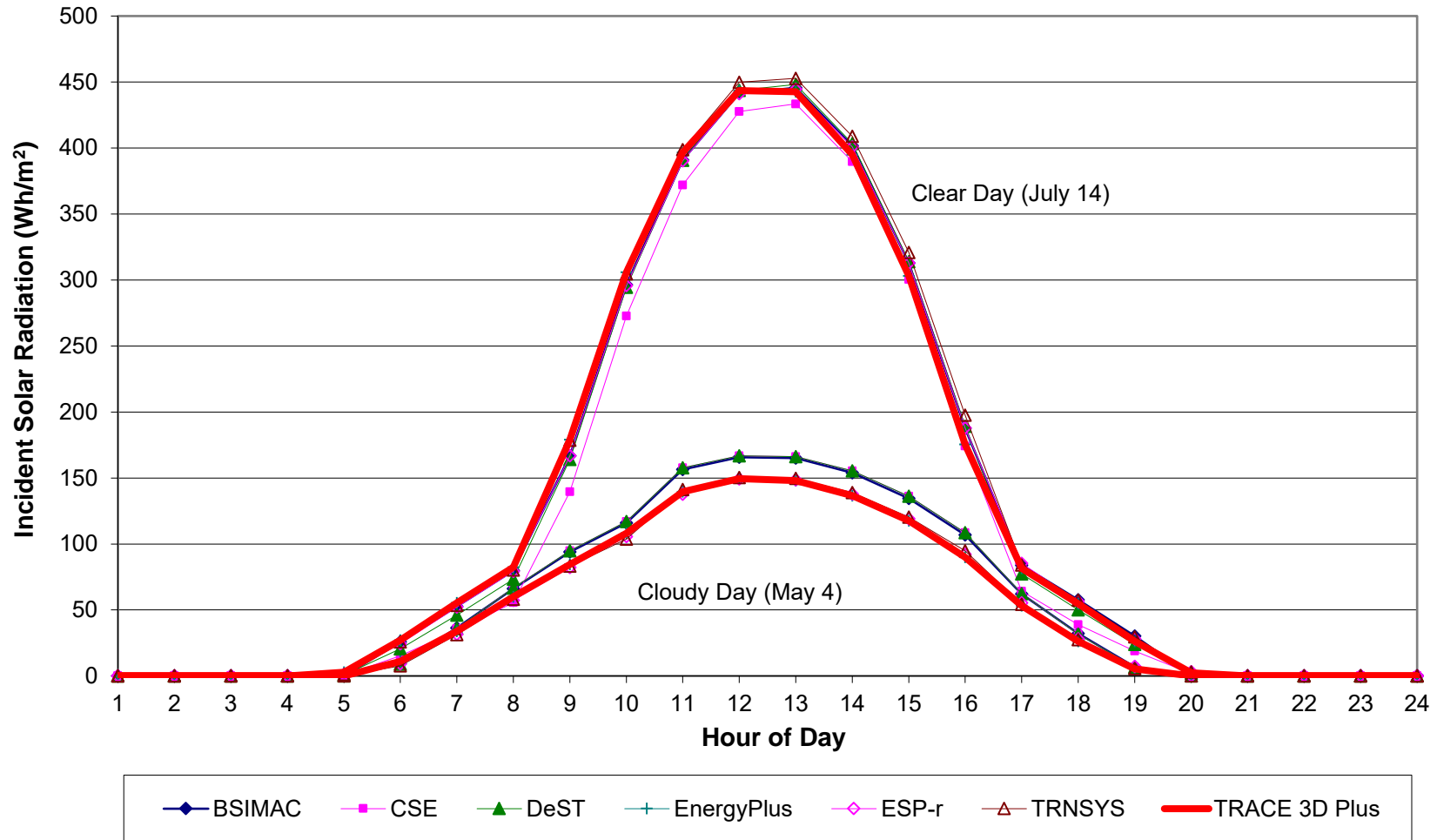


Figure B8-H4. Case 600
Cloudy & Clear Day Hourly Incident Solar
West Facing Surface

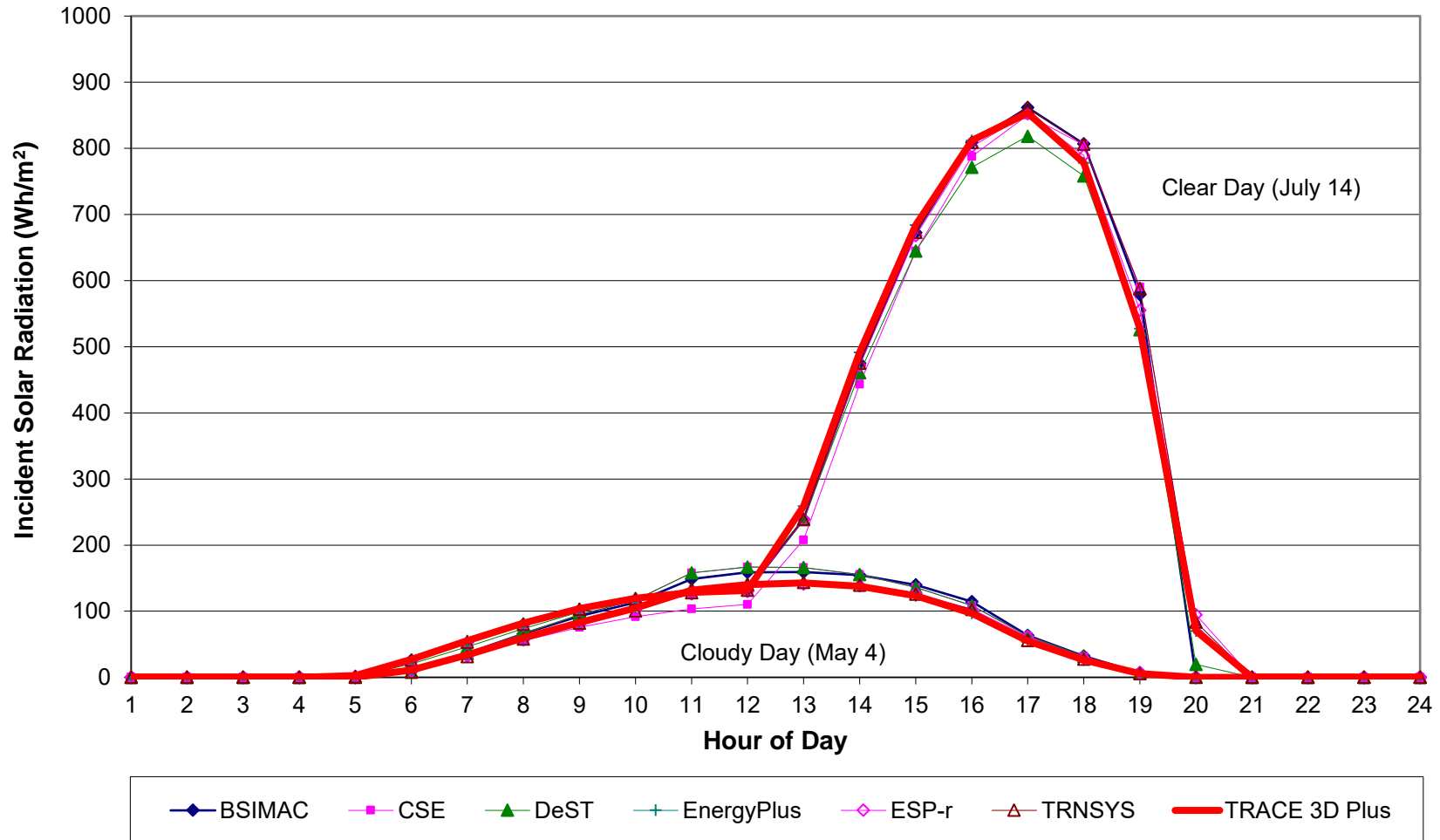


Figure B8-H5. Cases 600, 660, 670
Hourly Transmitted Solar, Clear/Cold Day (Feb 1)
Double-Pane, Low-E, Single-Pane Windows

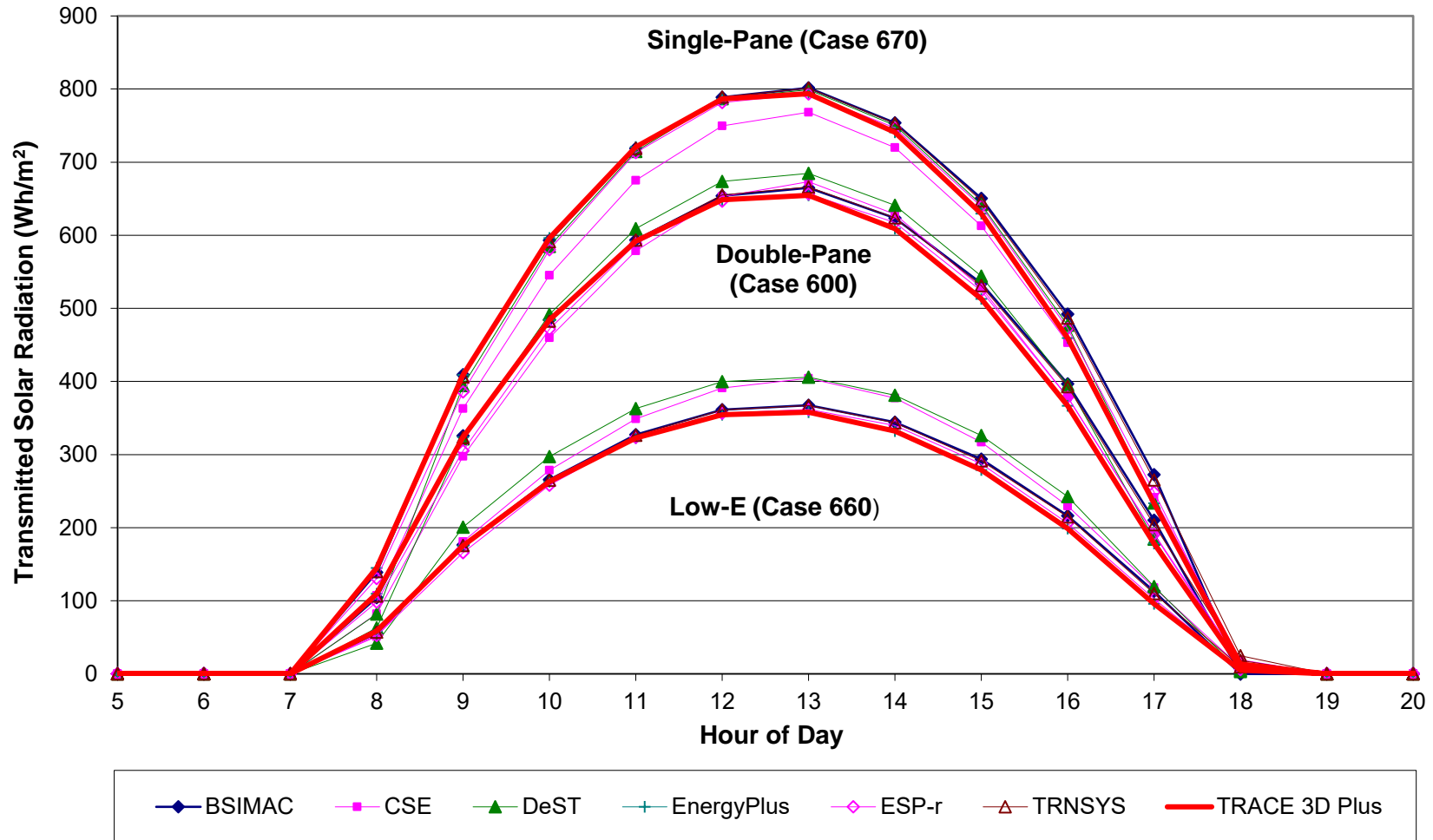


Figure B8-H6. Case 600
Hourly Transmitted Solar, Cloudy Day (May 4)
Double-Pane Windows

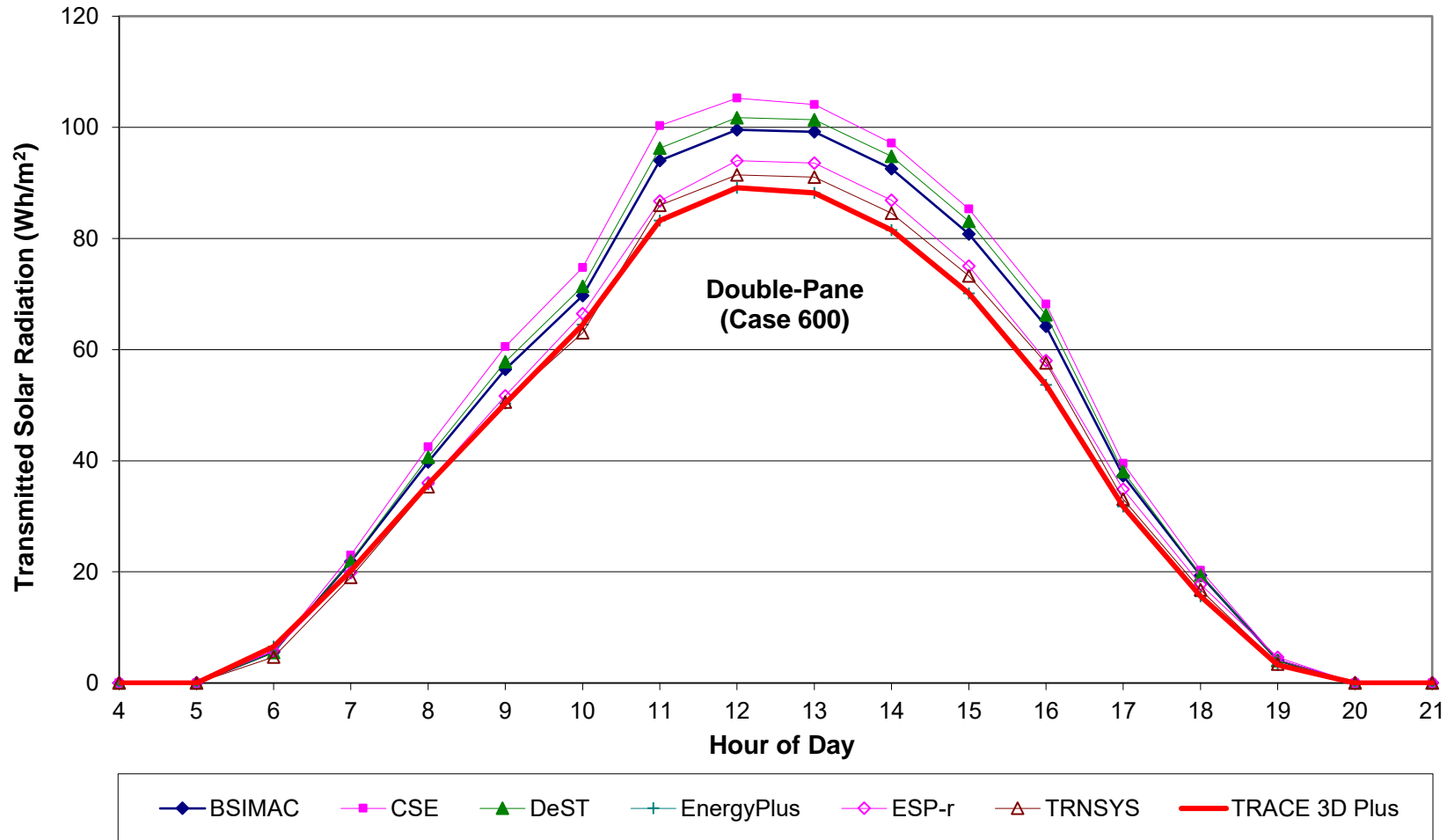


Figure B8-H8. Case 600
Hourly Transmitted Solar, Clear/Hot Day (Jul 14)
Double-Pane Windows

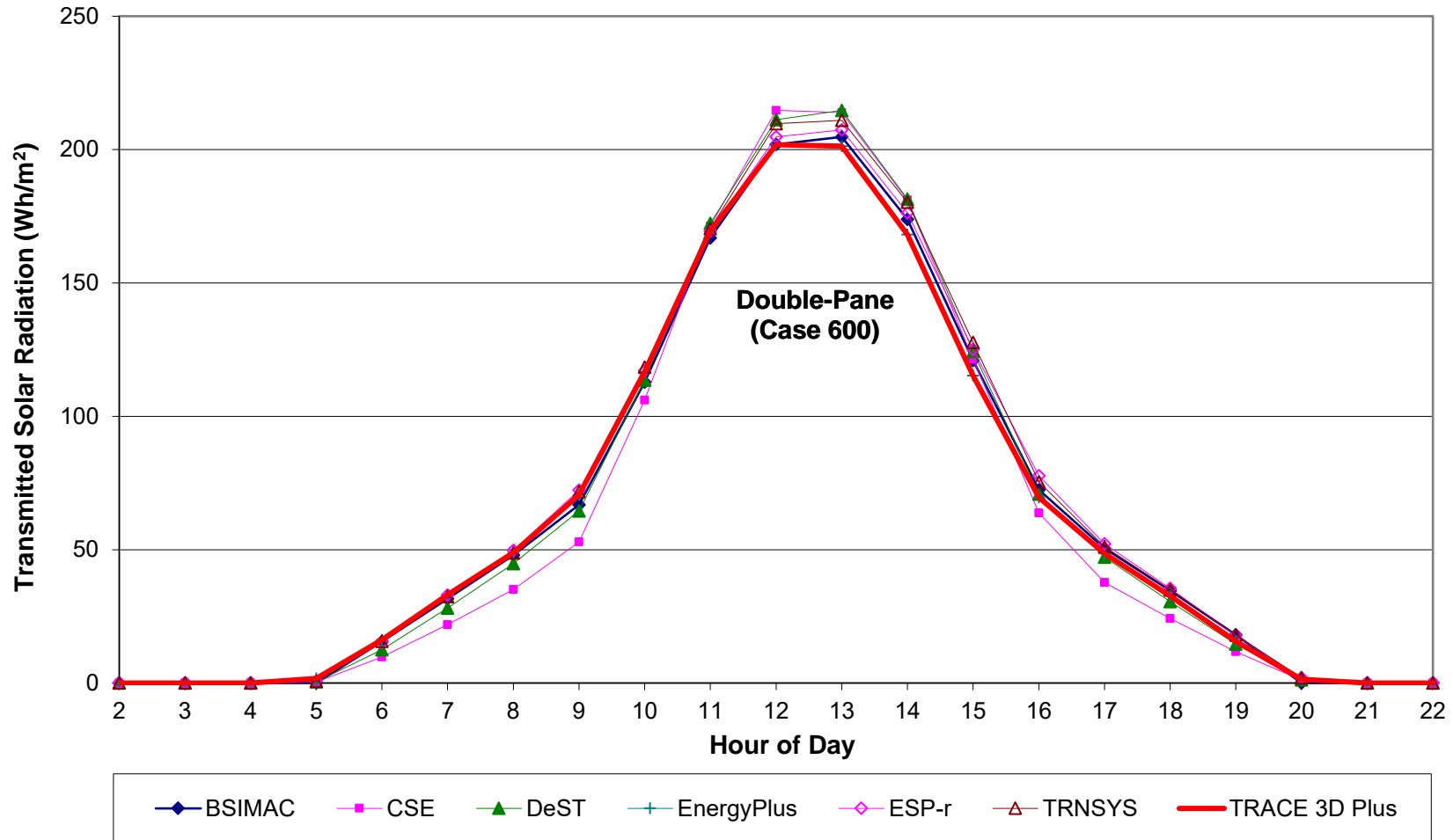


Figure B8-H9. Cases 660, 670
Hourly Transmitted Solar, Clear/Hot Day (Jul 14)
Low-E and Single-Pane Windows

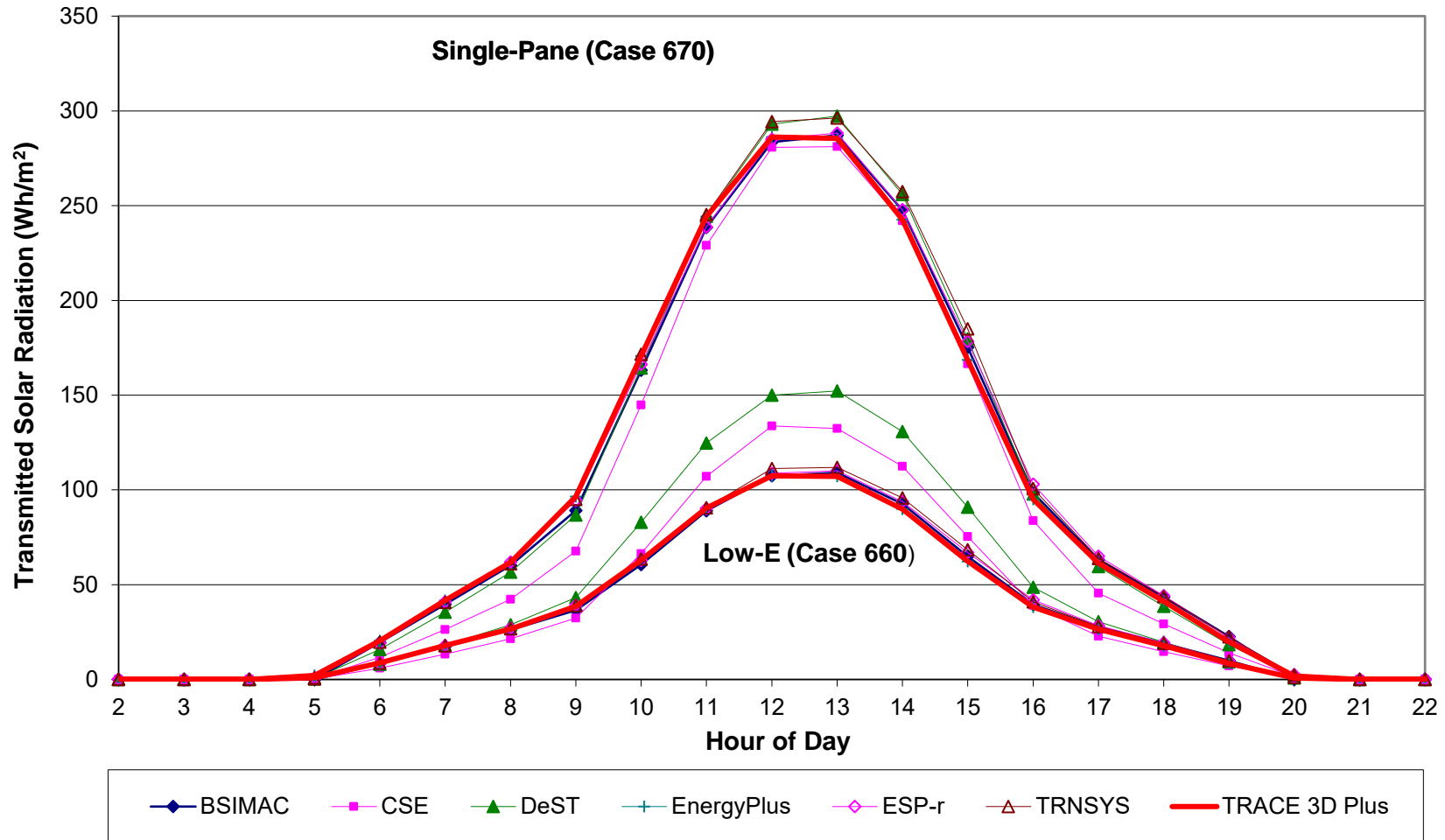


Figure B8-H10.
Hourly Sky Temperatures
Case 600: Clear/Cold, Cloudy Days

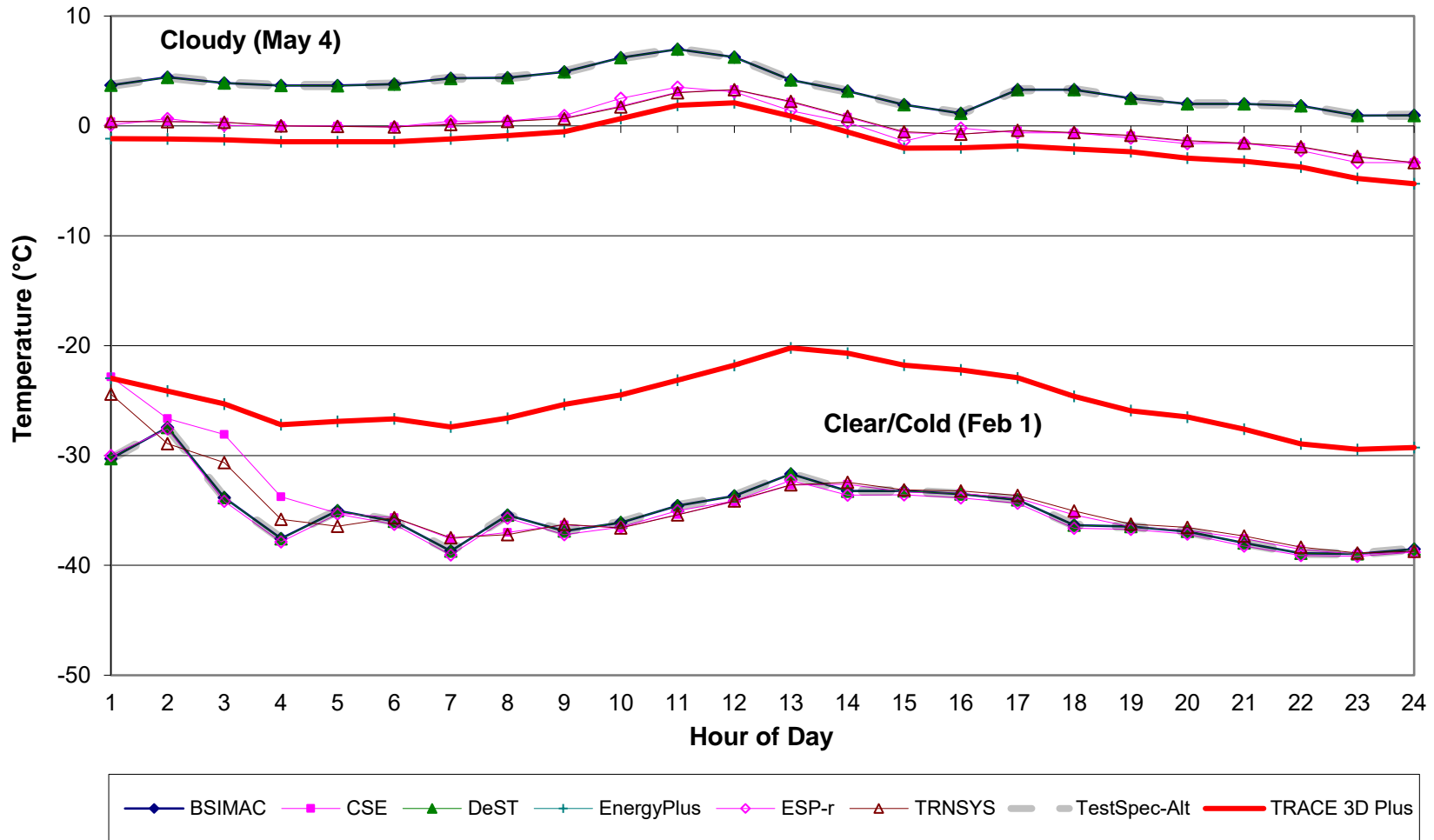


Figure B8-H12.
Hourly Free-Float Temperatures
Clear Cold Day (Feb 1), Cases 600FF and 900FF

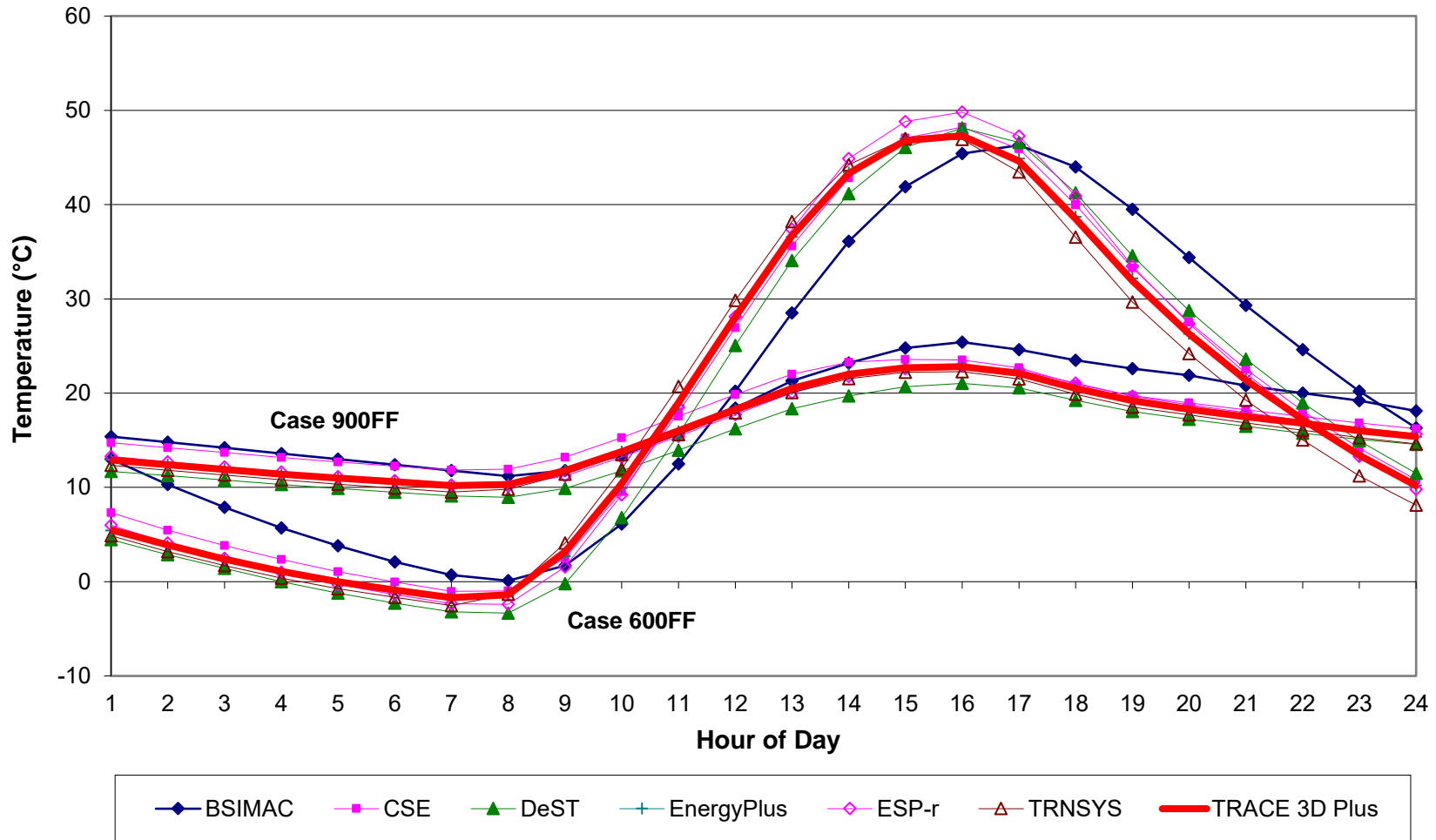


Figure B8-H13.
Hourly Free-Float Temperatures
Clear Hot Day (Jul 14), Cases 650FF and 950FF

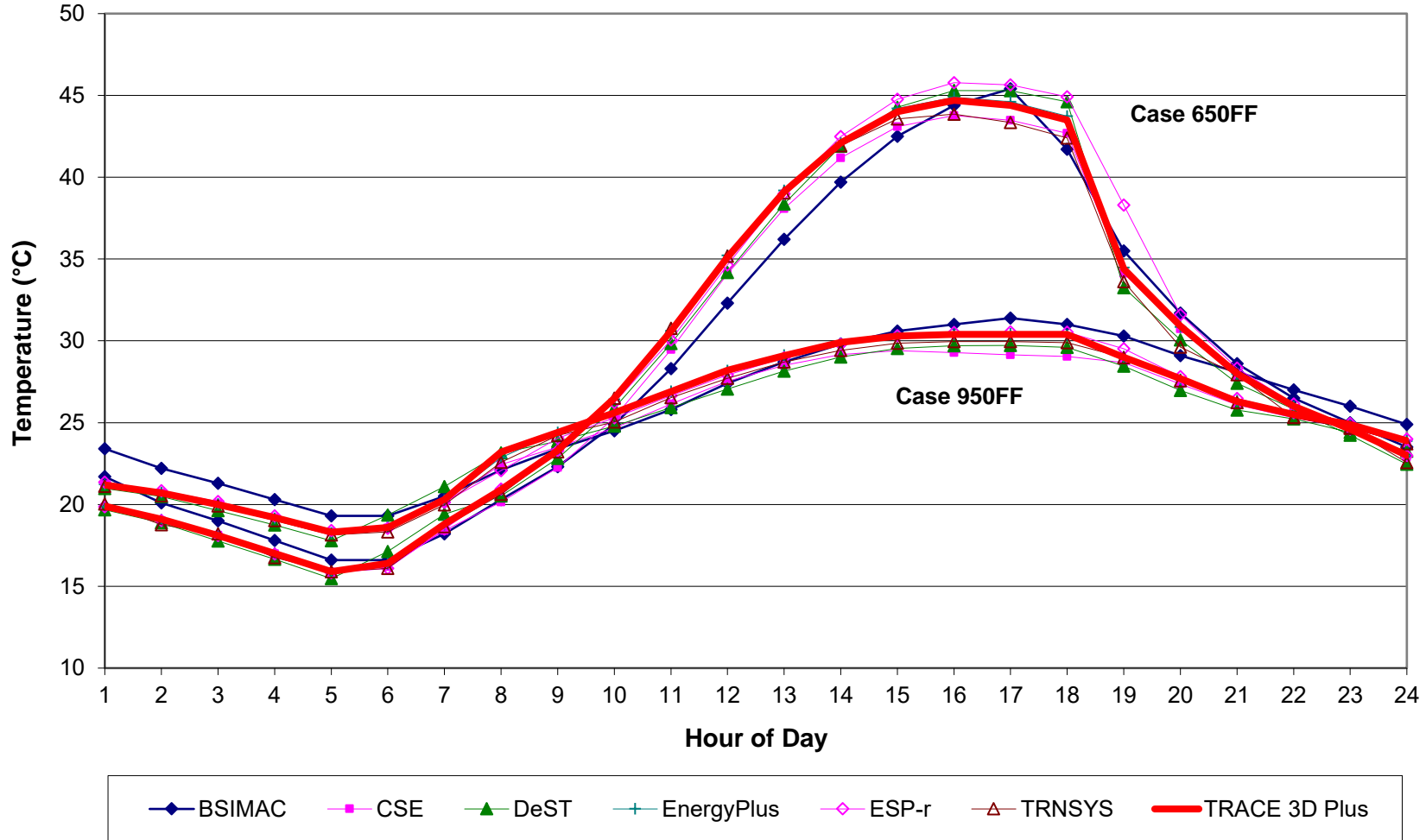


Figure B8-H14.
Hourly Free-Float Temperatures
Clear Cold Day (Feb1), Cases 680FF and 980FF

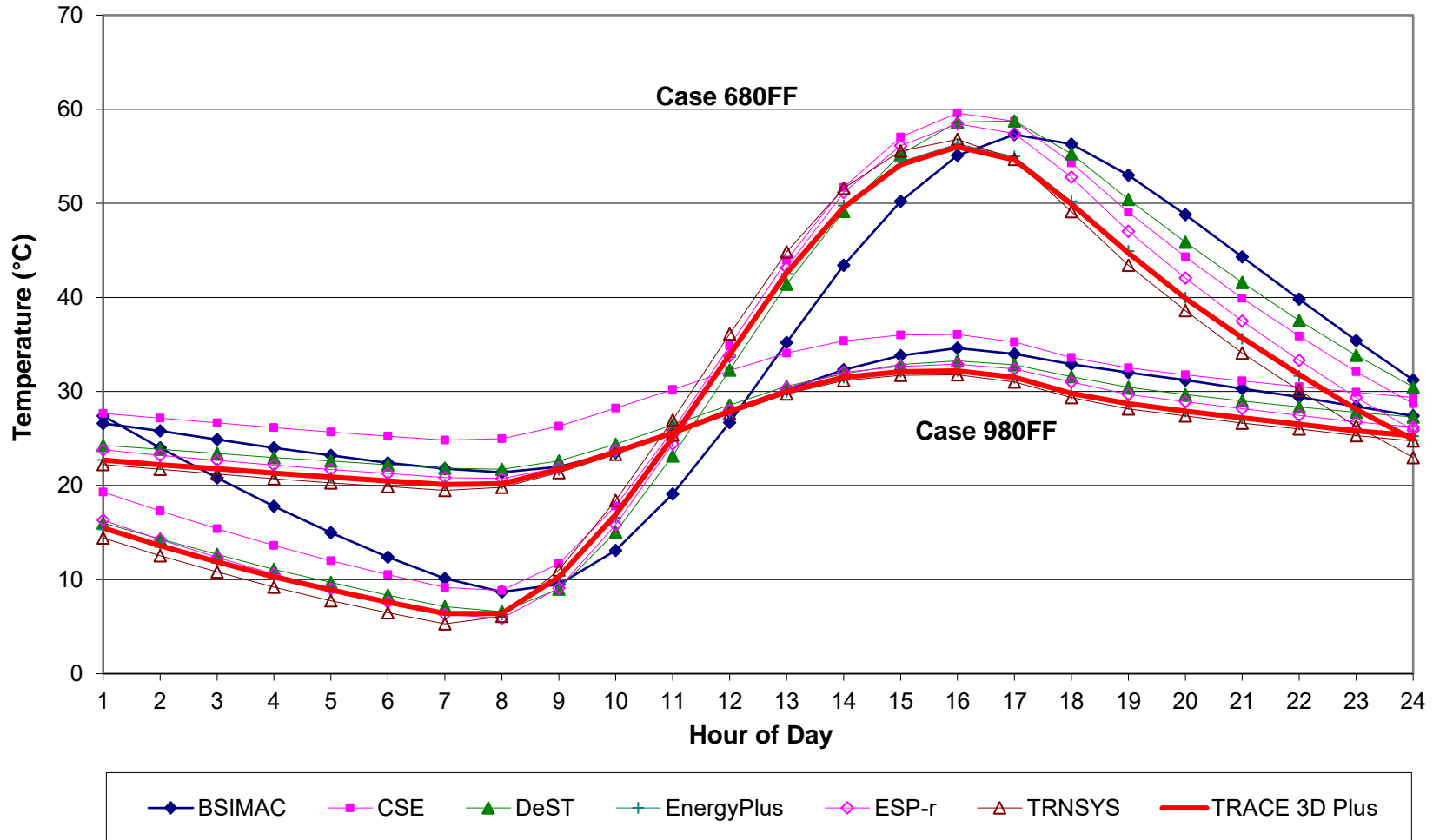


Figure B8-H15. Hourly Loads
Clear Cold Day, Case 600 (Low Mass, Double-Clear Window)
Heating (+), Sensible Cooling (-)

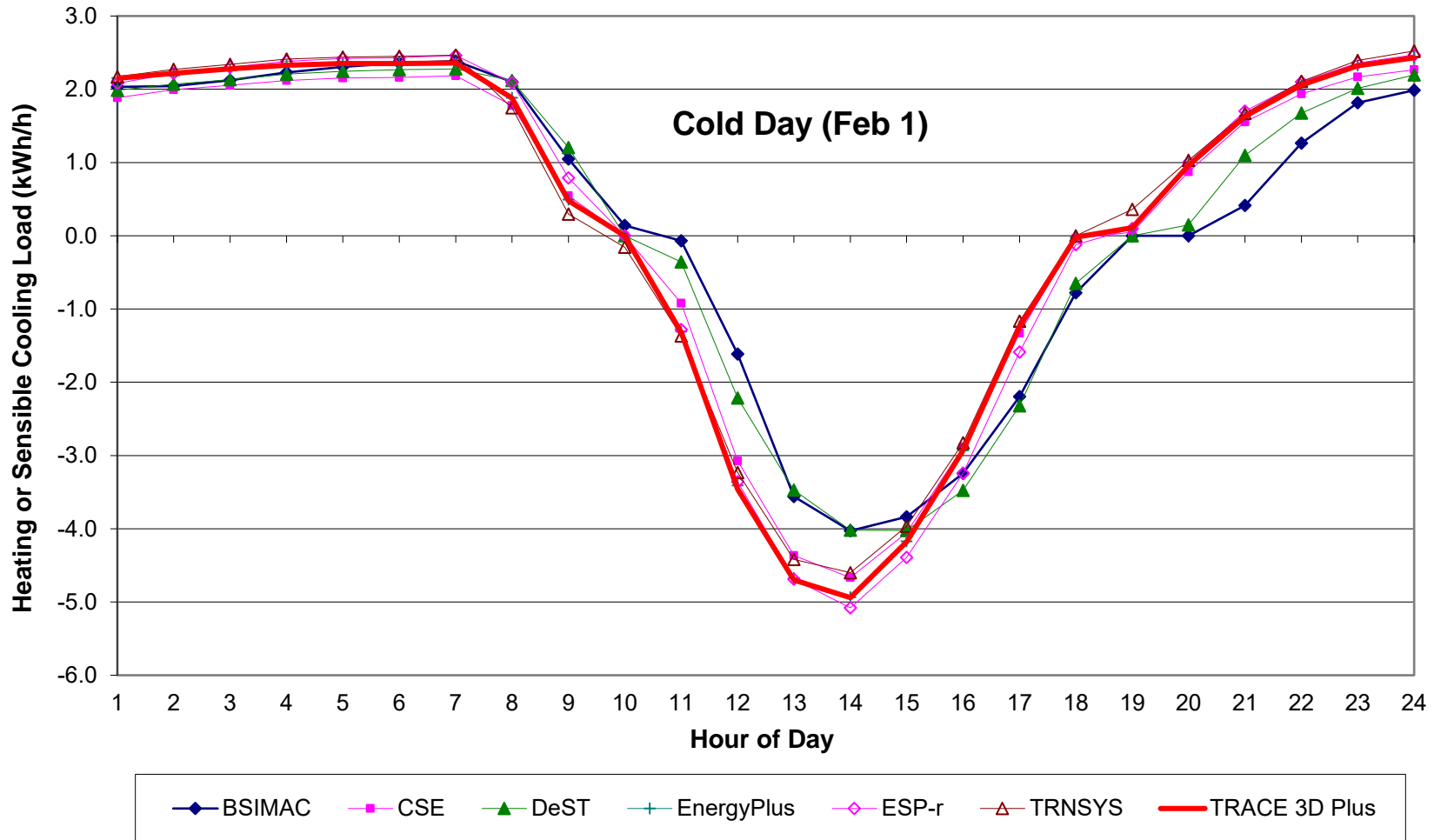


Figure B8-H16. Hourly Loads
Clear Hot Day, Case 600 (Low Mass, Double-Clear Window)
Heating (+), Sensible Cooling (-)

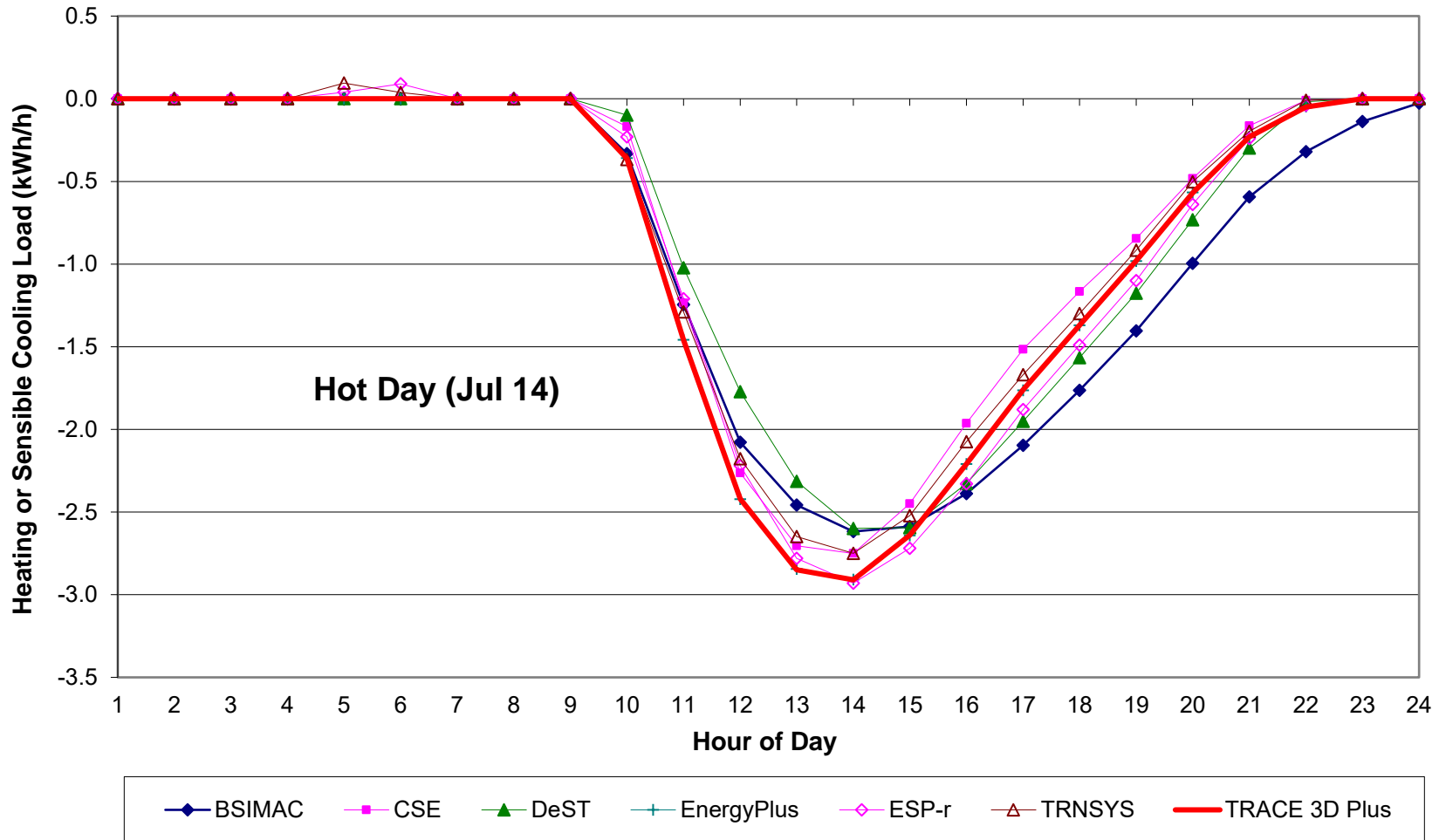


Figure B8-H17. Hourly Loads
Clear Cold Day, Case 640 (Low Mass, Night Setback)
Heating (+), Sensible Cooling (-)

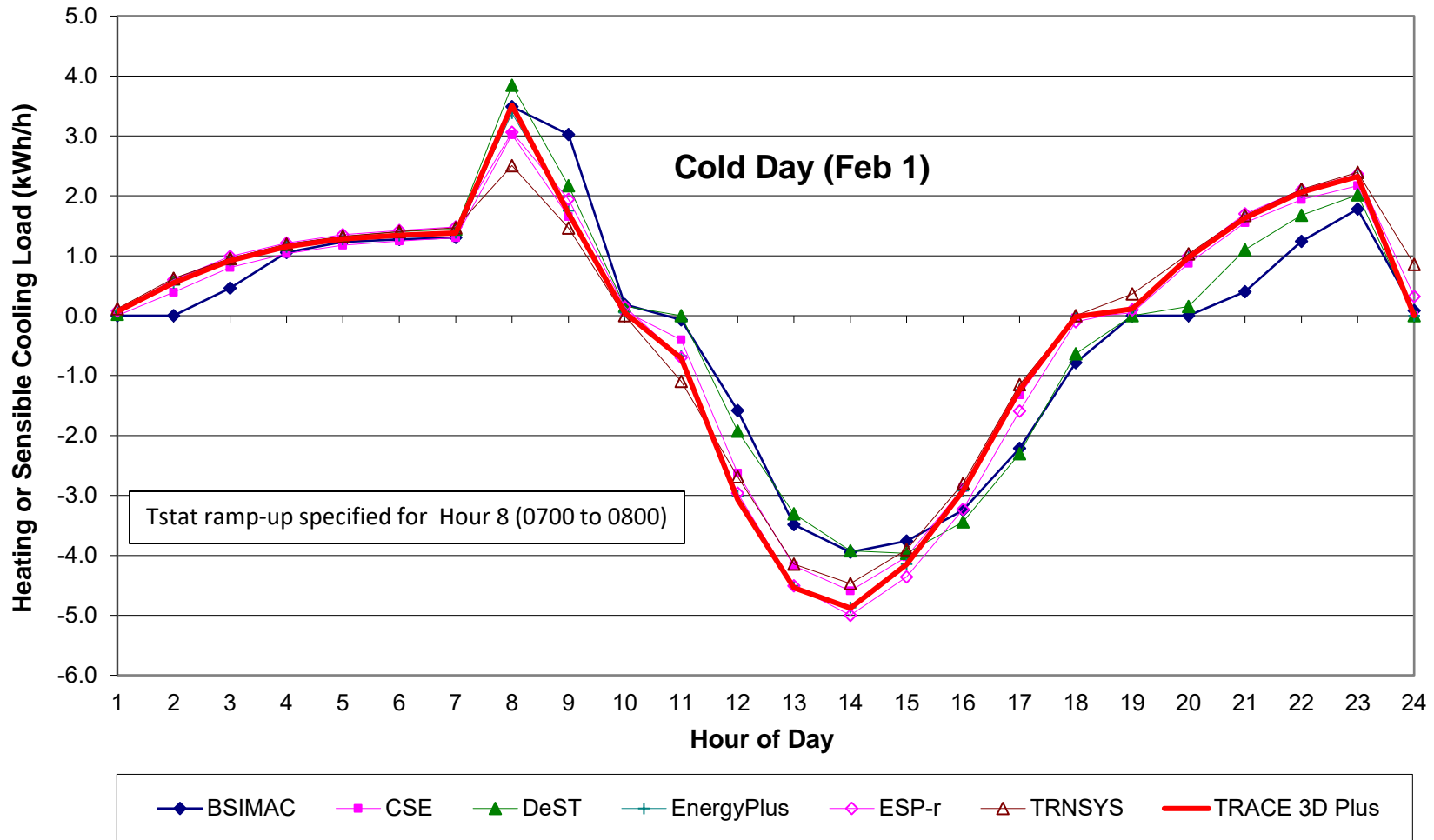


Figure B8-H18.
Hourly Conditioned Zone Temperatures
Clear Cold Day, Case 640

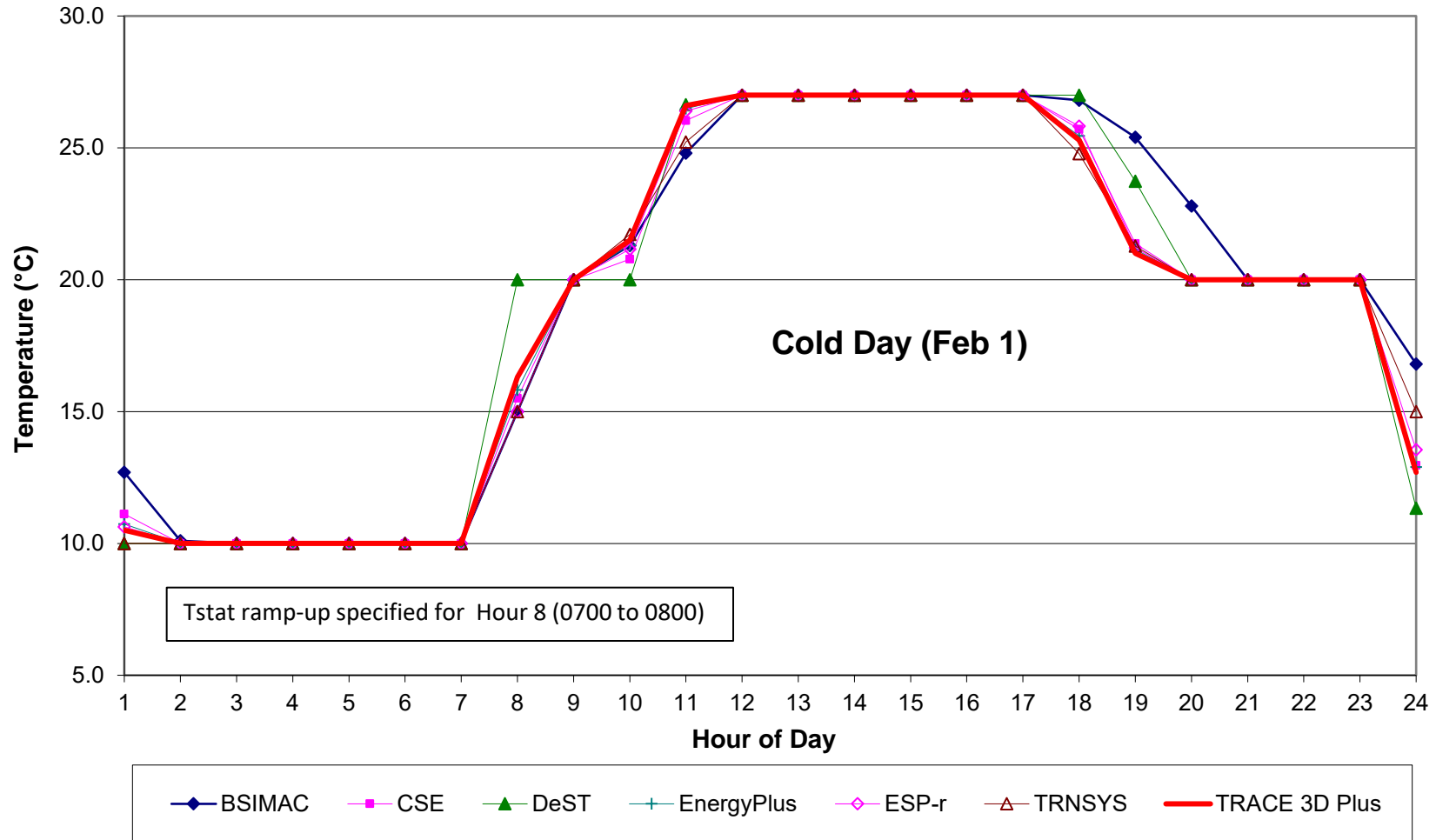


Figure B8-H19. Hourly Loads
Clear Cold Day, Case 940 (High Mass, Night Setback)
Heating (+), Sensible Cooling (-)

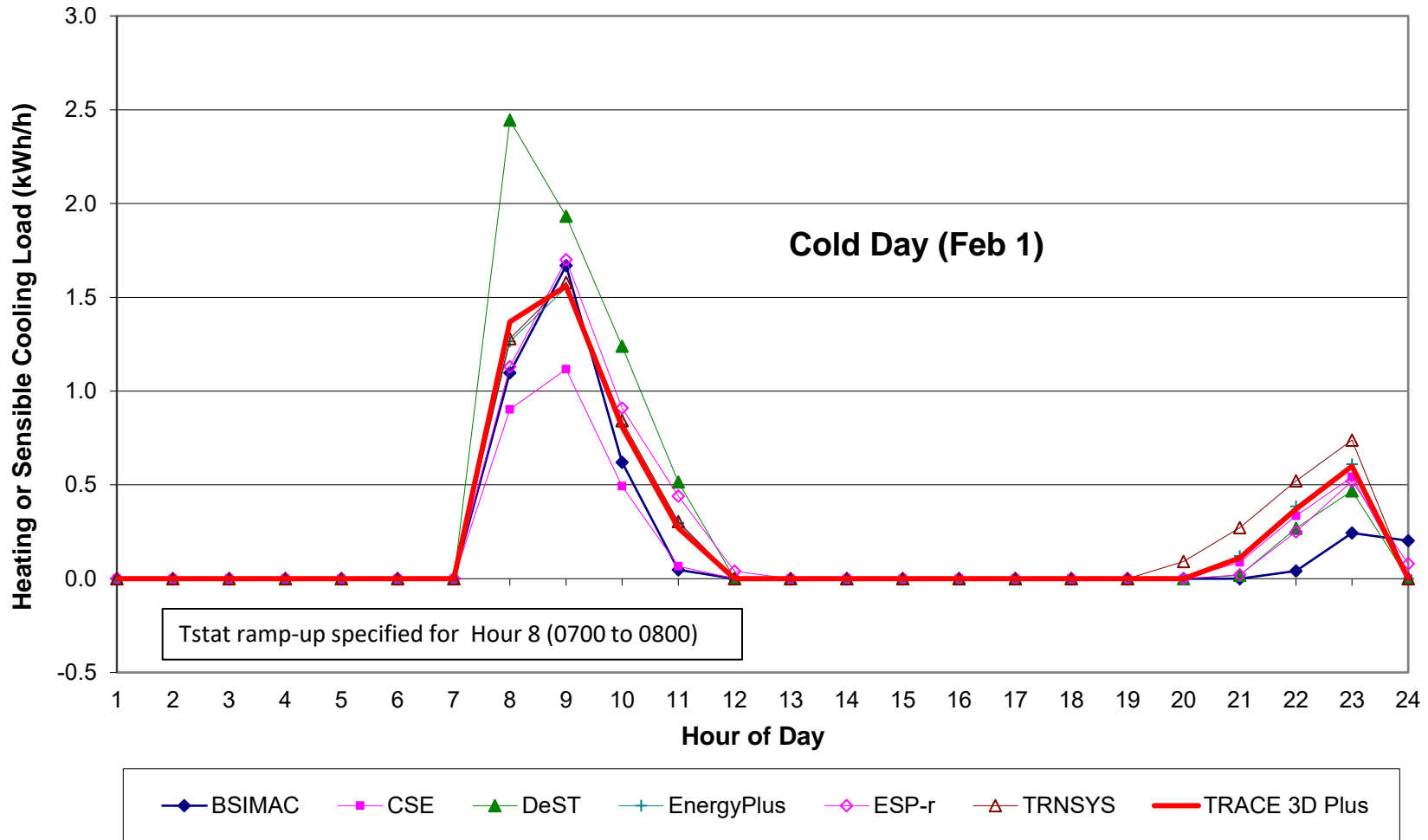


Figure B8-H20.
Hourly Conditioned Zone Temperatures
Clear Cold Day, Case 940

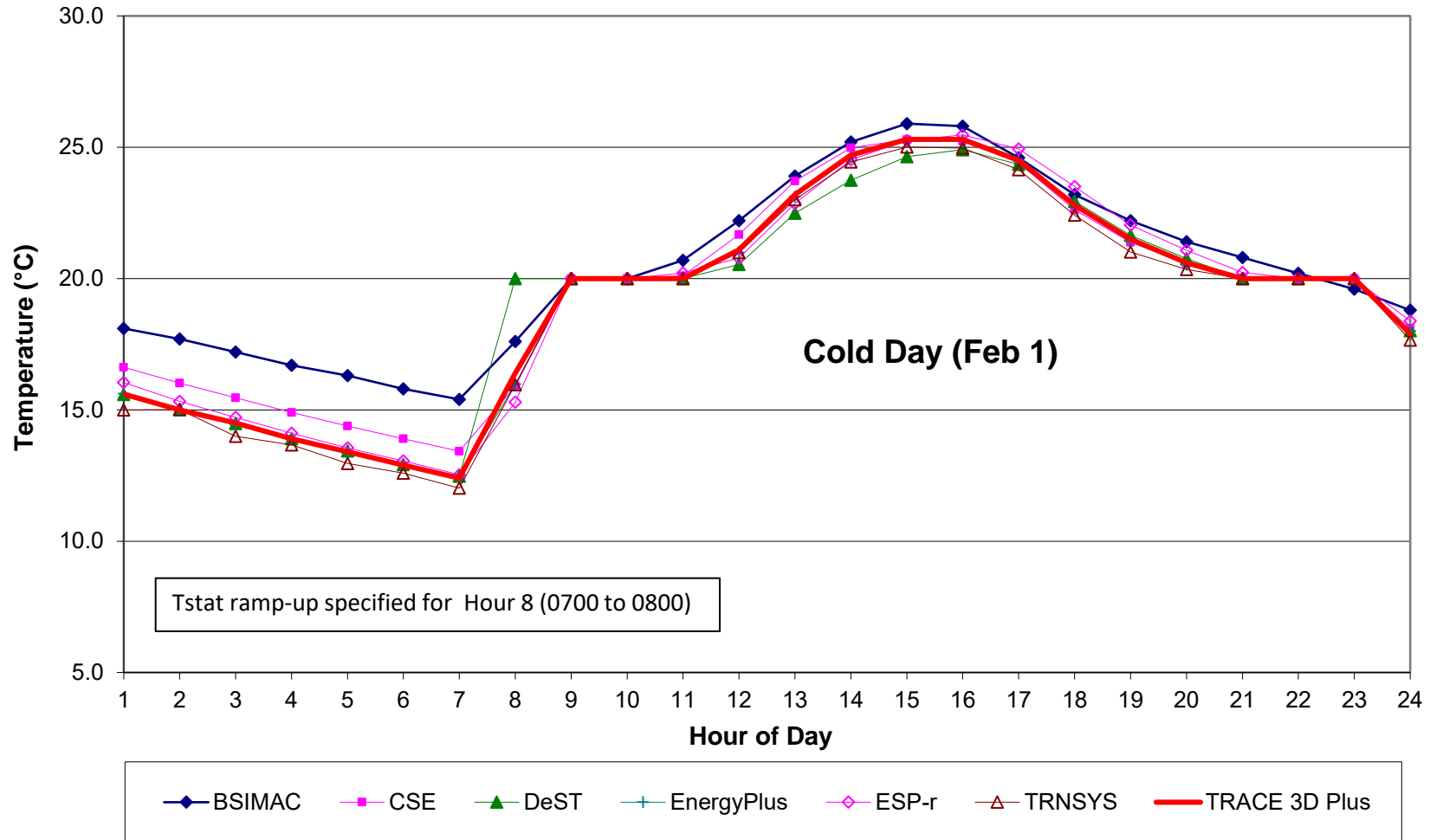


Figure B8-H21. Hourly Loads
Clear Cold Day, Case 660 (Low-E Window)
Heating (+), Sensible Cooling (-)

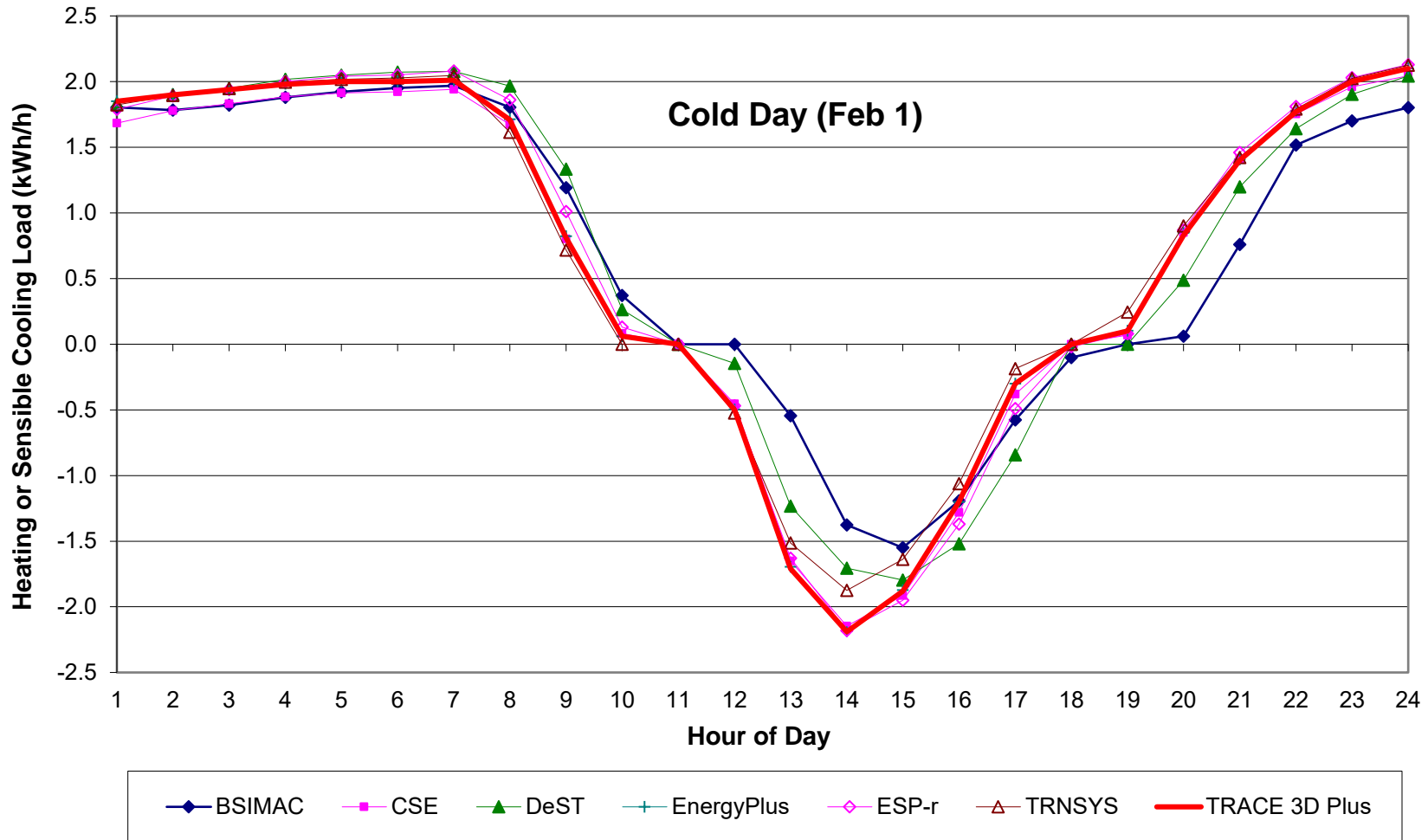


Figure B8-H22. Hourly Loads
Clear Hot Day, Case 660 (Low-E Window)
Heating (+), Sensible Cooling (-)

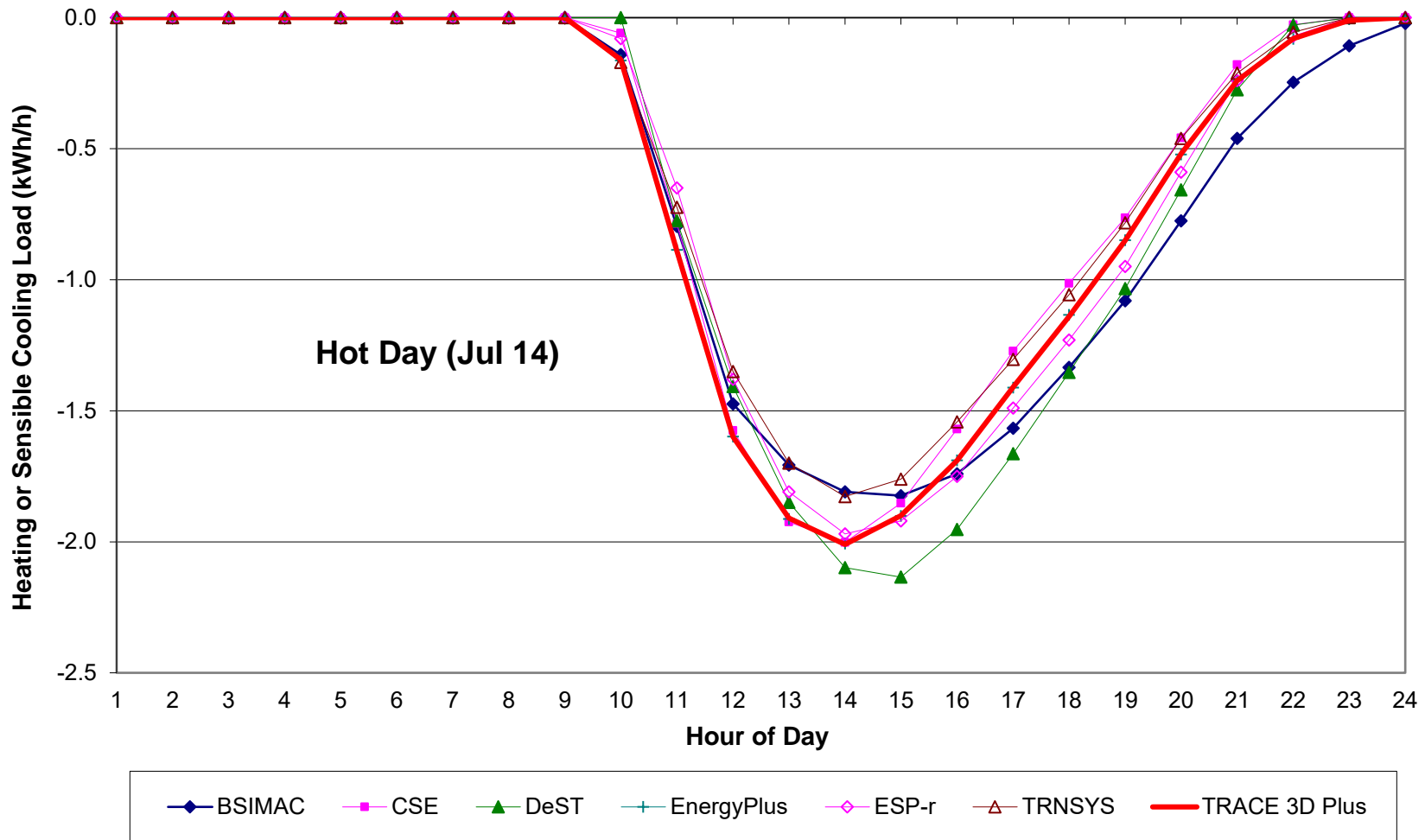


Figure B8-H23. Hourly Loads
Clear Cold Day, Case 670 (Single-Pane Window)
Heating (+), Sensible Cooling (-)

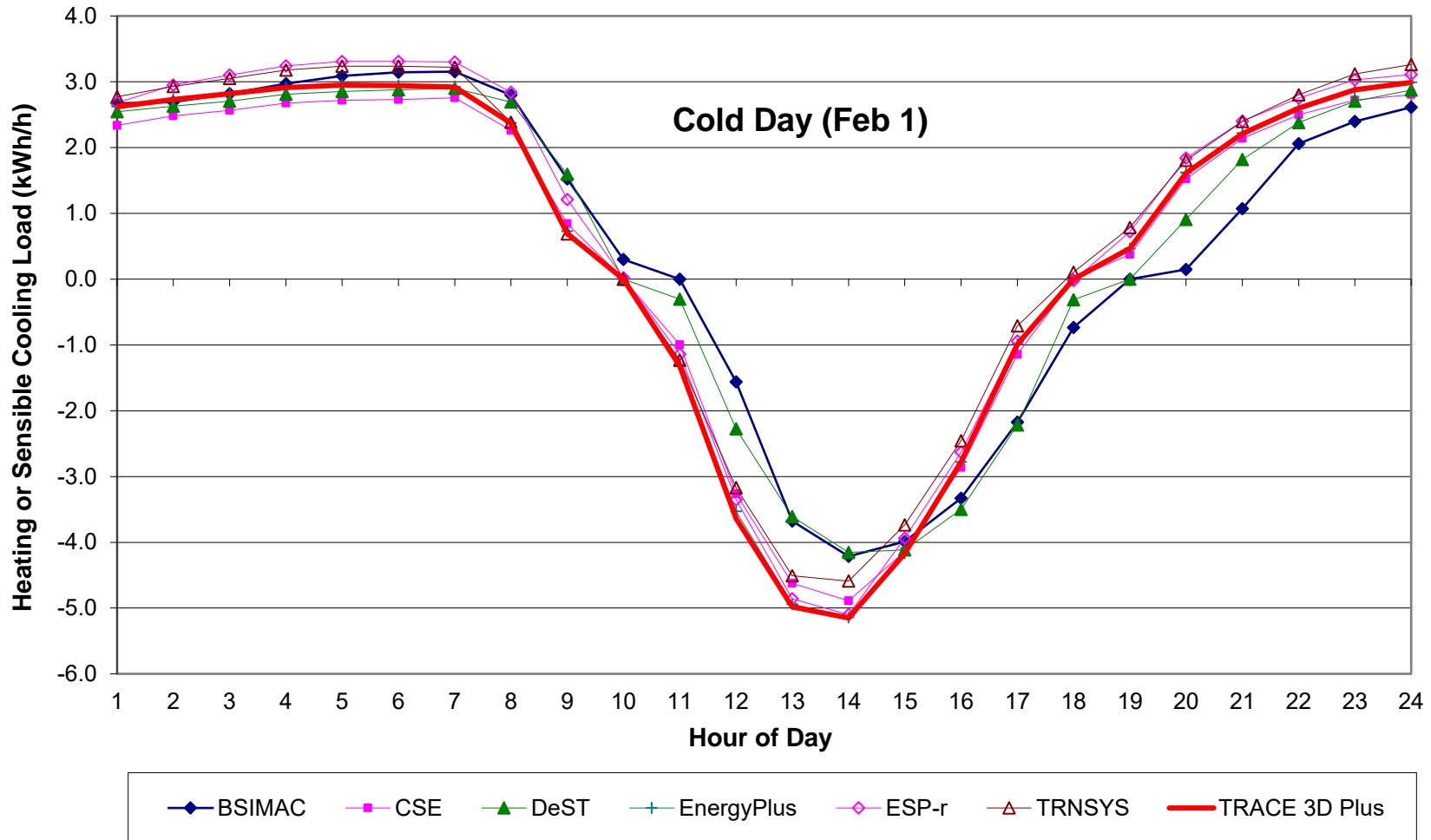


Figure B8-H24. Hourly Loads
Clear Hot Day, Case 670 (Single-Pane Window)
Heating (+), Sensible Cooling (-)

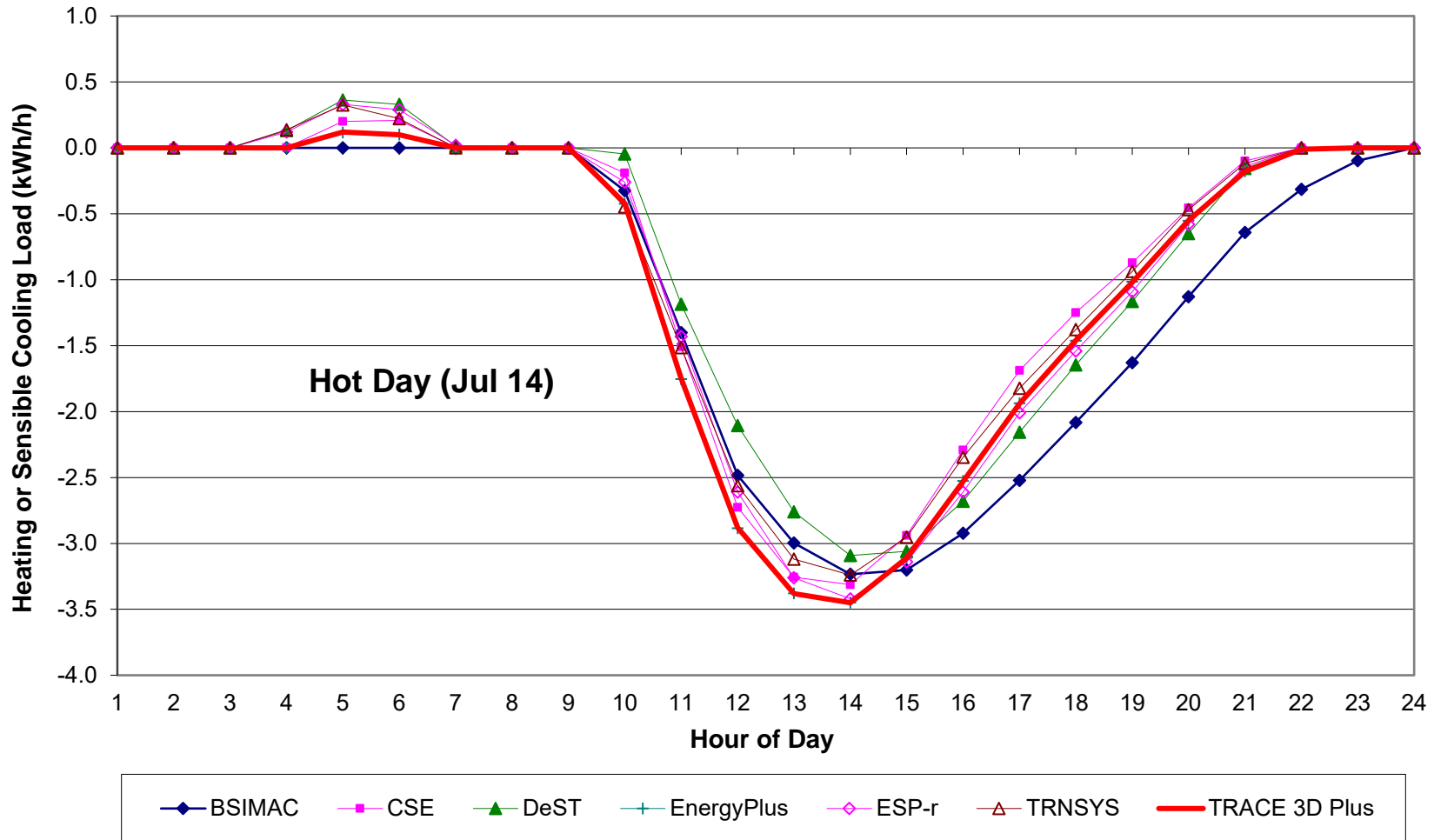


Figure B8-H25. Hourly Loads
Clear Cold Day, Case 680 (Insulation)
Heating (+), Sensible Cooling (-)

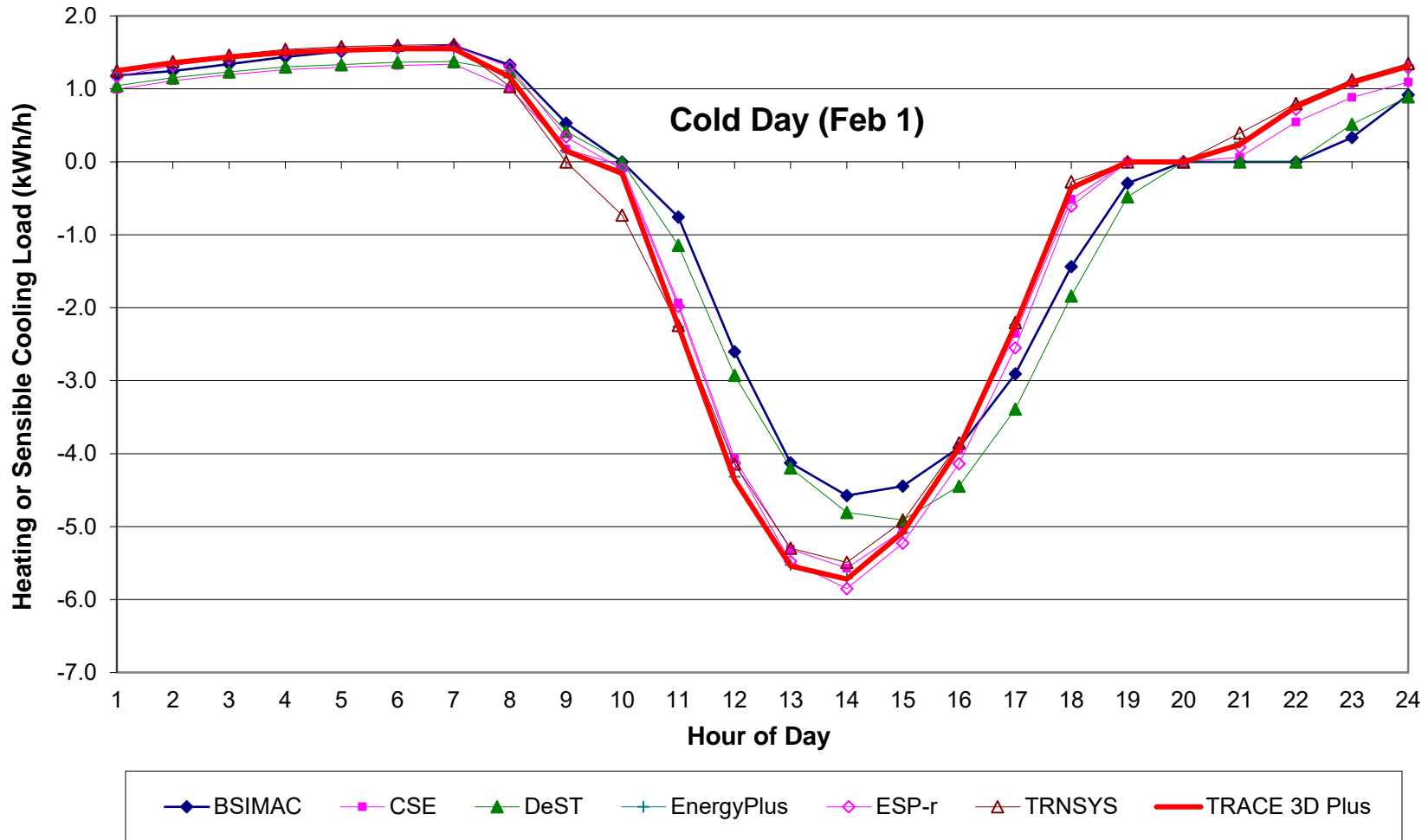


Figure B8-H26. Hourly Loads
Clear Hot Day, Case 680 (Insulation)
Heating (+), Sensible Cooling (-)

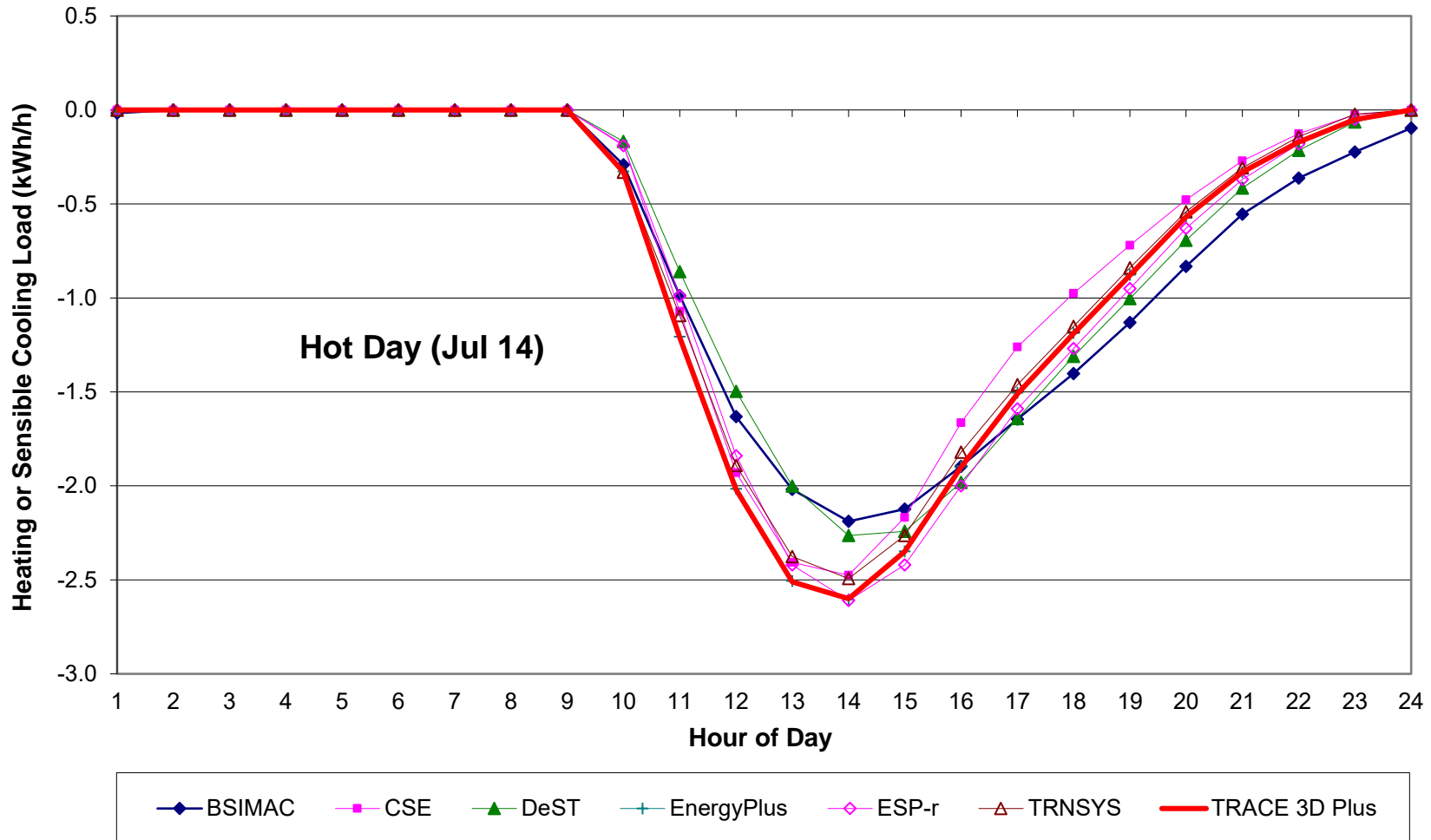


Figure B8-H27. Hourly Loads
Clear Cold Day, Case 685 (20/20 Tstat)
Heating (+), Sensible Cooling (-)

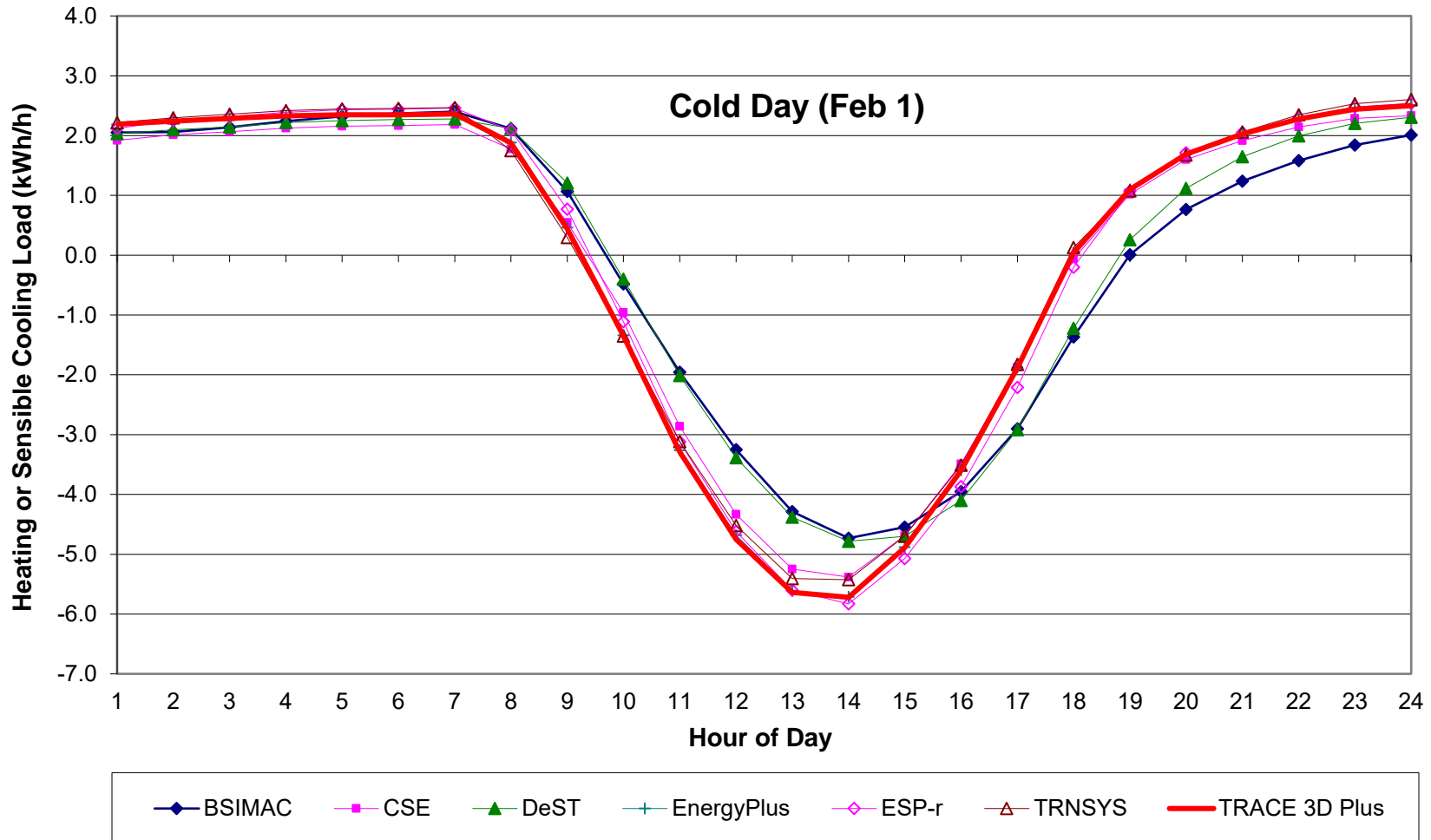


Figure B8-H28. Hourly Loads
Clear Hot Day, Case 685 (20/20 Tstat)
Heating (+), Sensible Cooling (-)

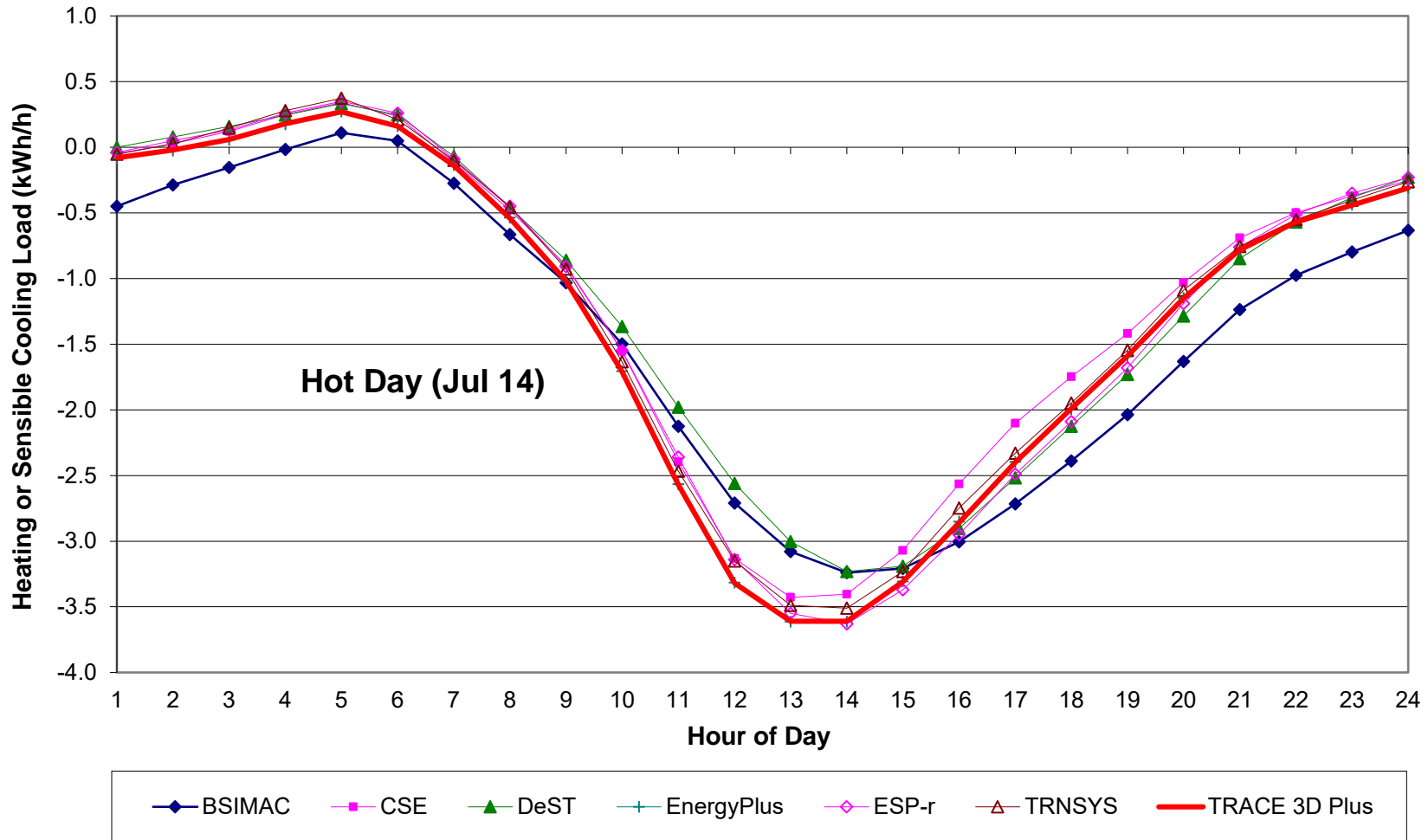


Figure B8-H29. Hourly Loads
Clear Cold Day, Case 695 (20/20, Insulation)
Heating (+), Sensible Cooling (-)

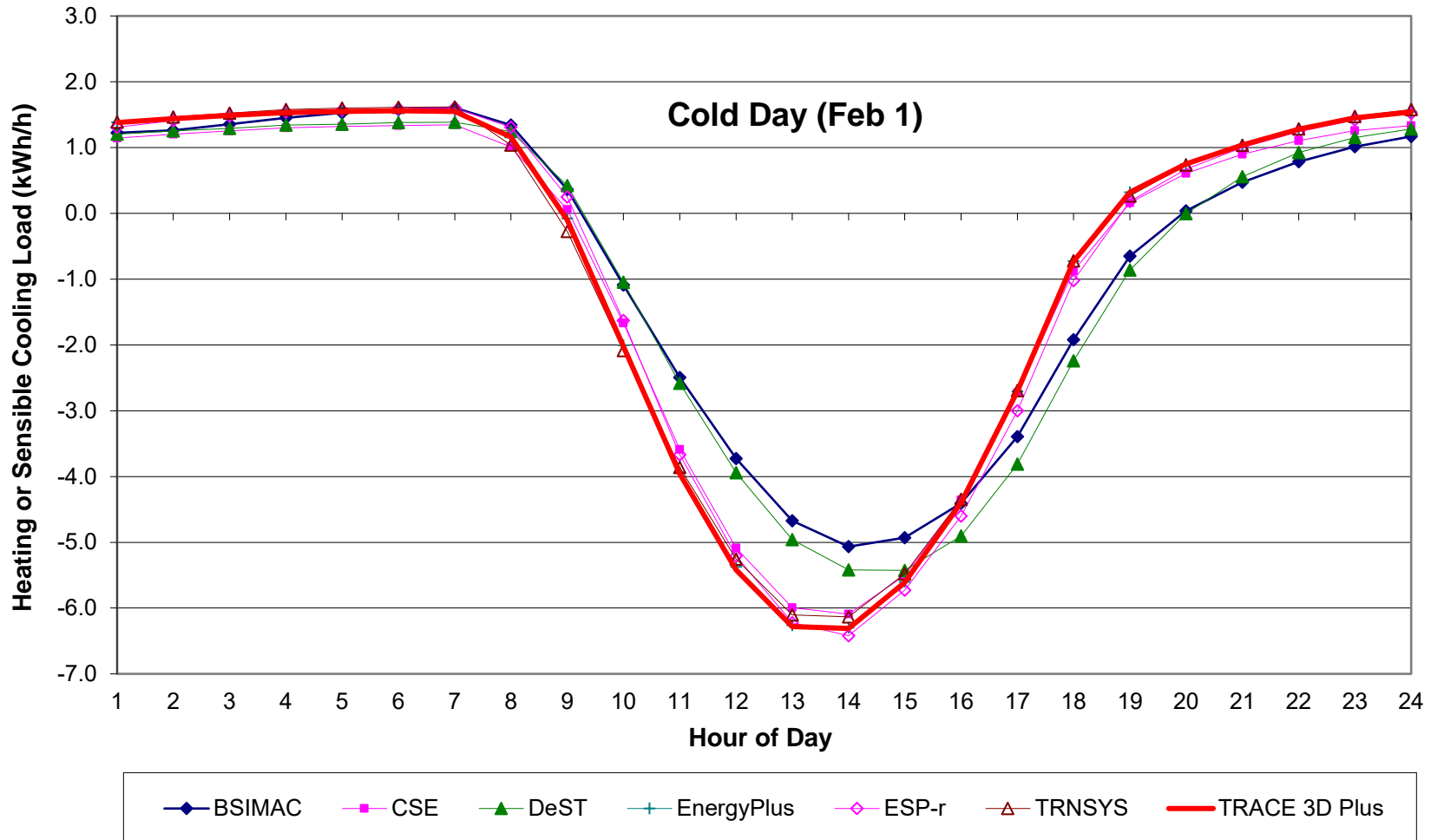


Figure B8-H30. Hourly Loads
Clear Hot Day, Case 695 (20/20, Insulation)
Heating (+), Sensible Cooling (-)

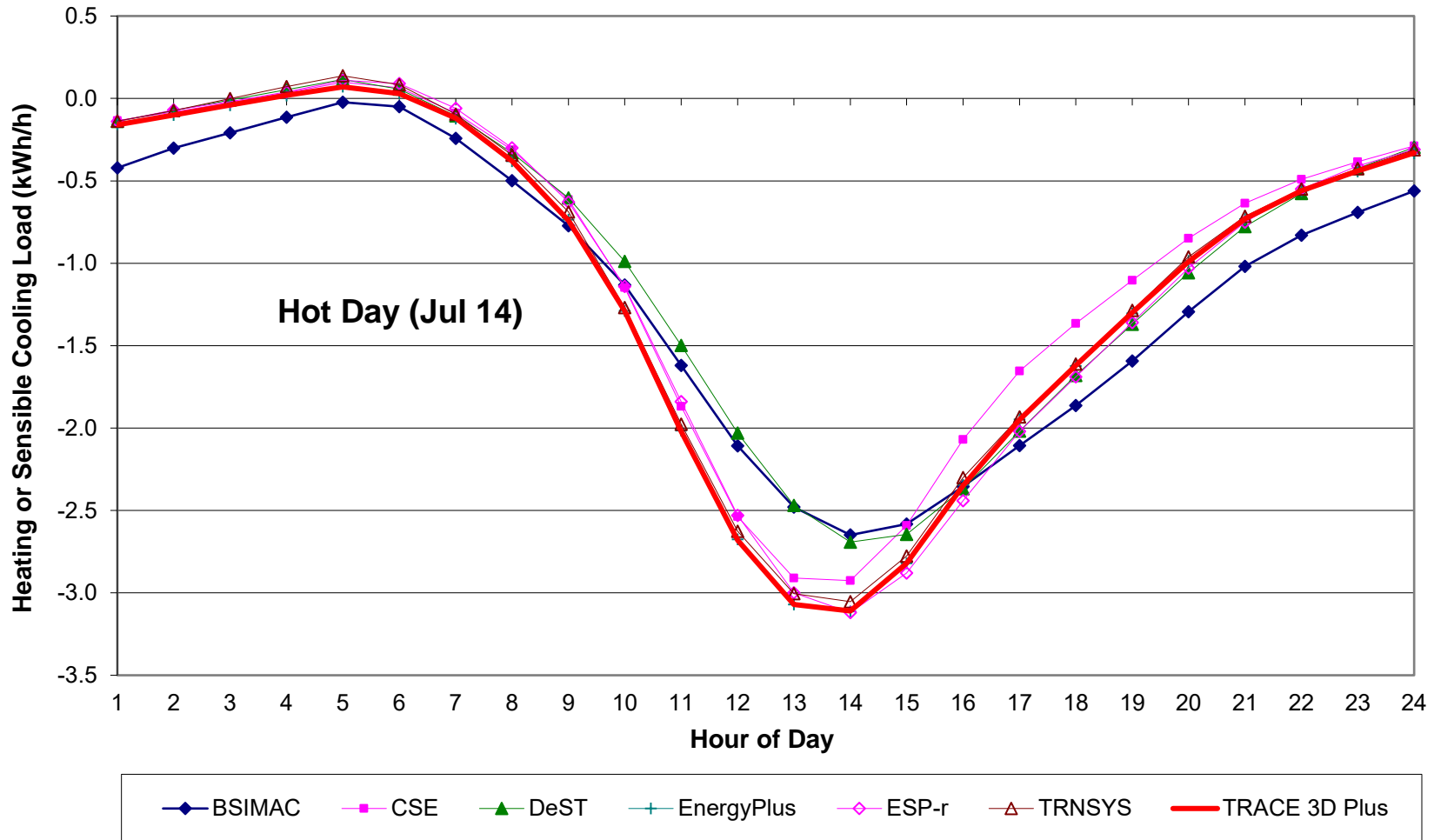


Figure B8-H31. Hourly Loads
Clear Cold Day, Case 900 (High Mass)
Heating (+), Sensible Cooling (-)

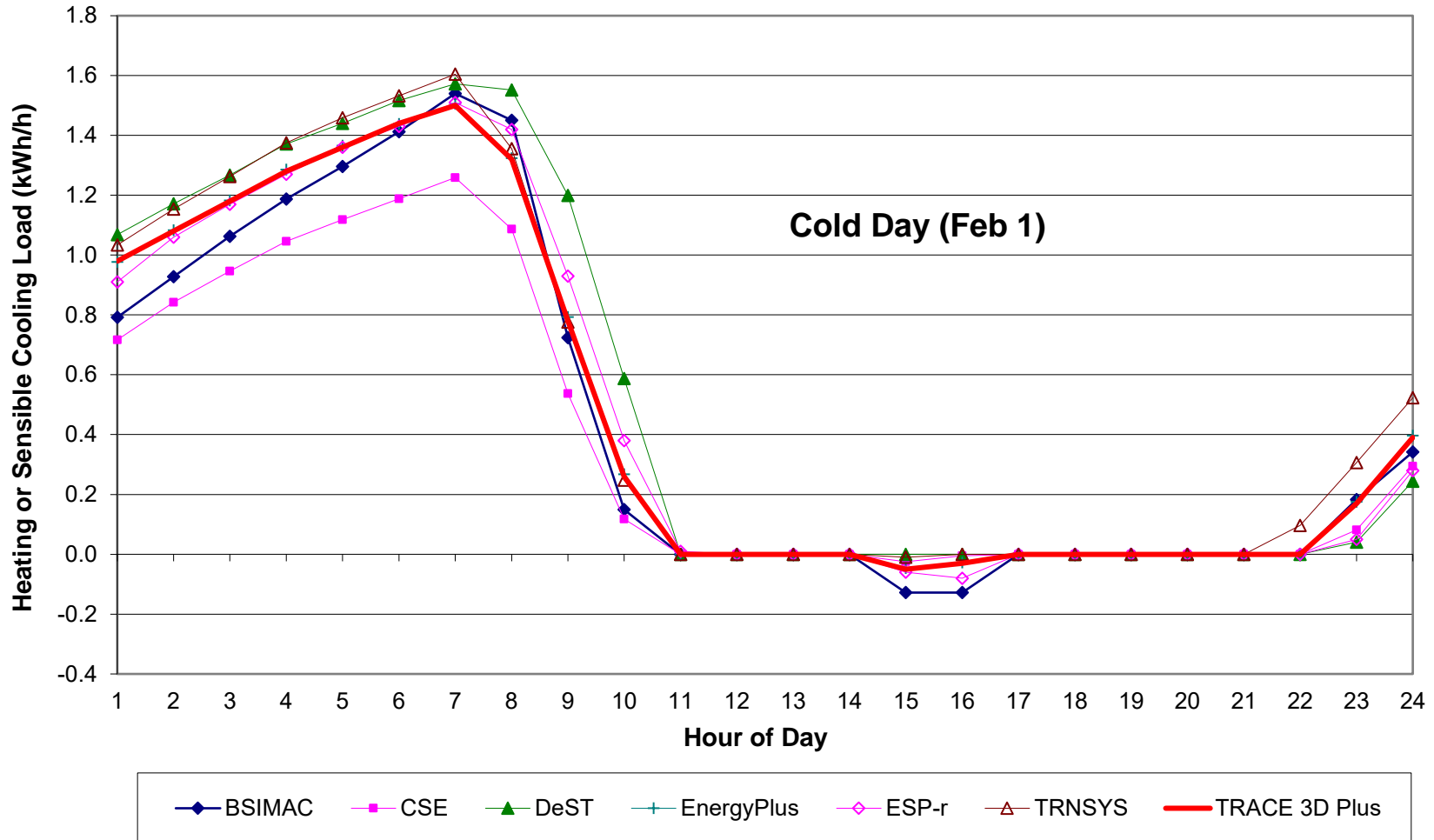


Figure B8-H32. Hourly Loads
Clear Hot Day, Case 900 (High Mass)
Heating (+), Sensible Cooling (-)

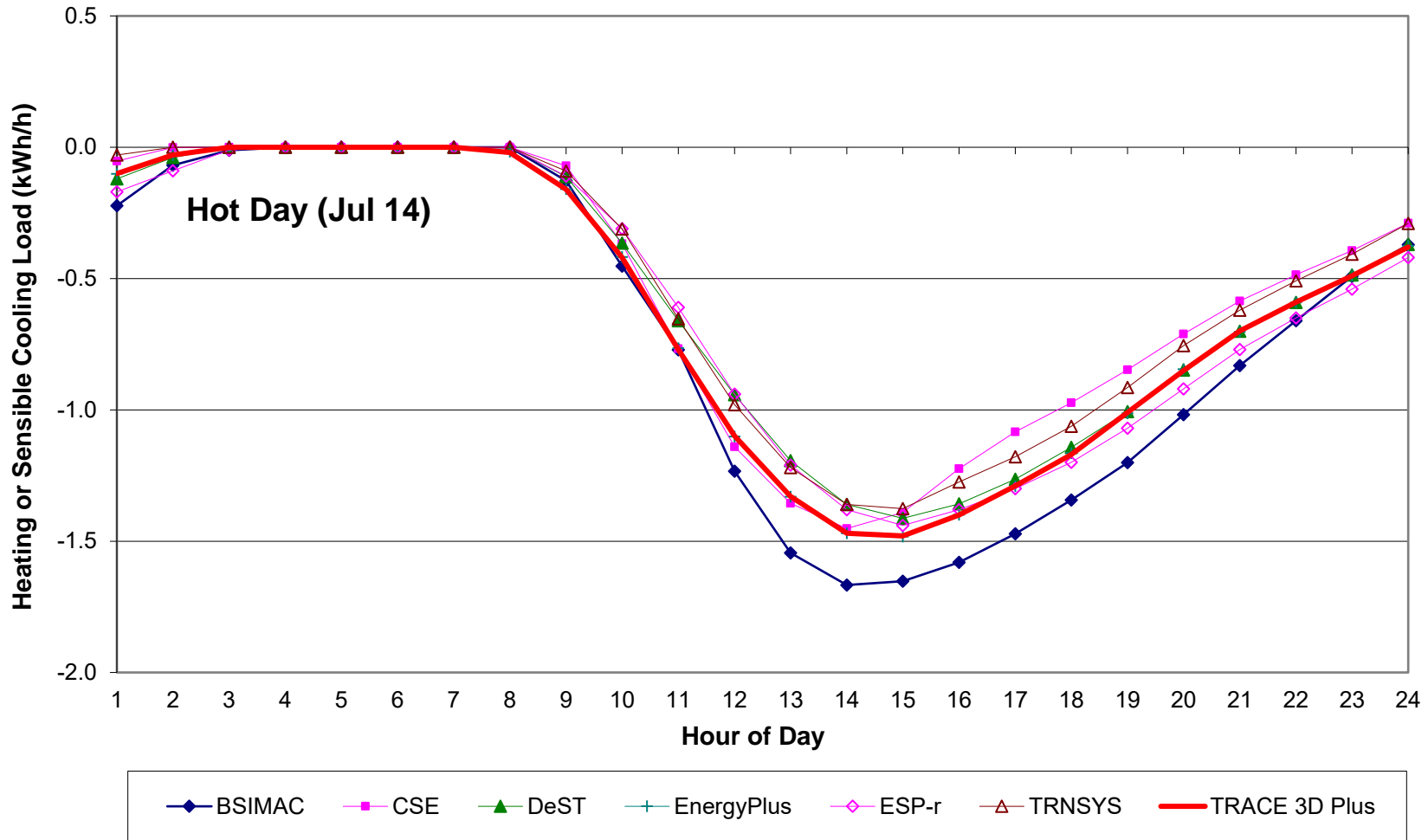


Figure B8-H33. Hourly Loads
Clear Cold Day, Case 980 (High Mass, Insulation)
Heating (+), Sensible Cooling (-)

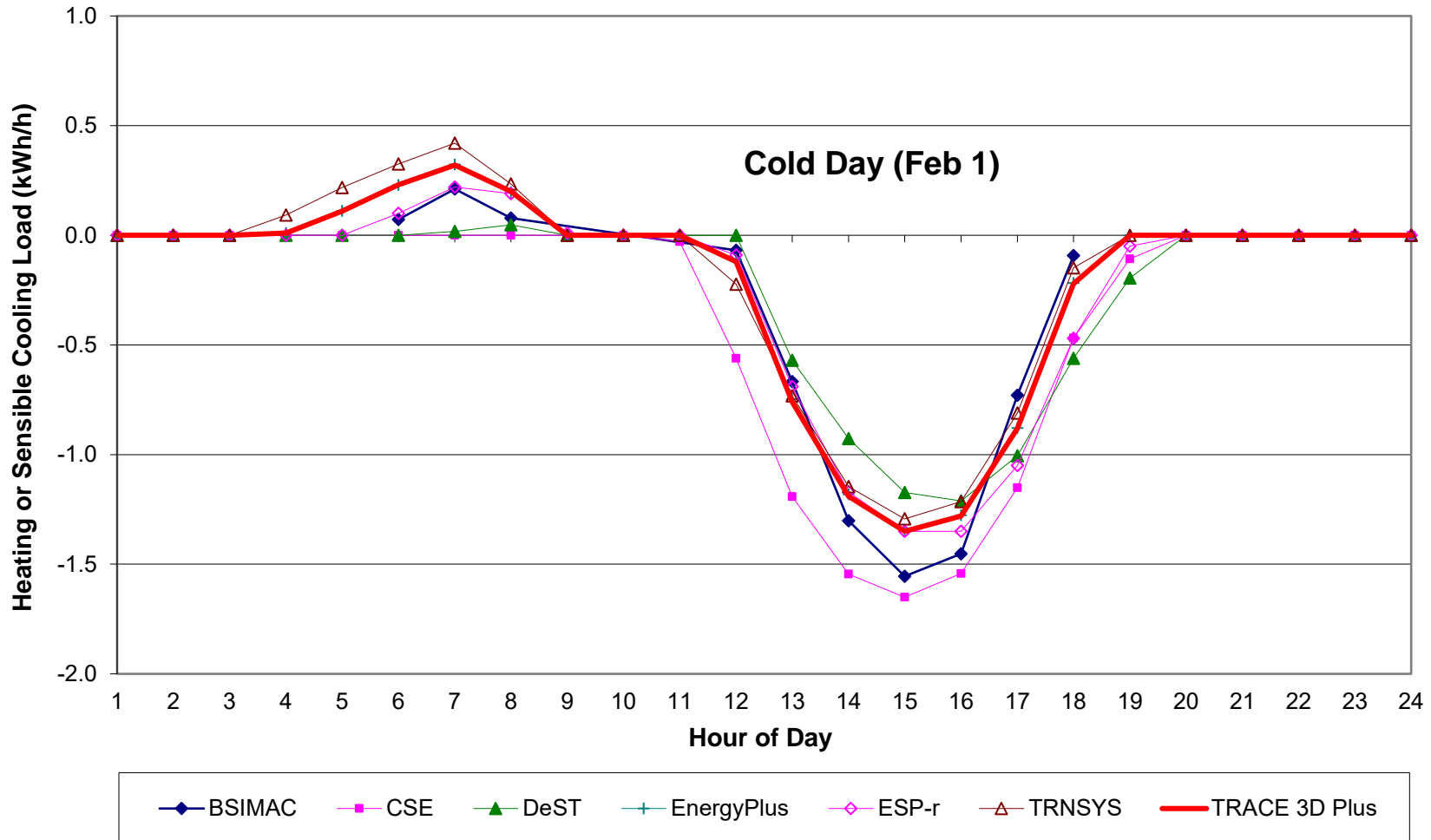


Figure B8-H34. Hourly Loads
Clear Hot Day, Case 980 (High Mass, Insulation)
Heating (+), Sensible Cooling (-)

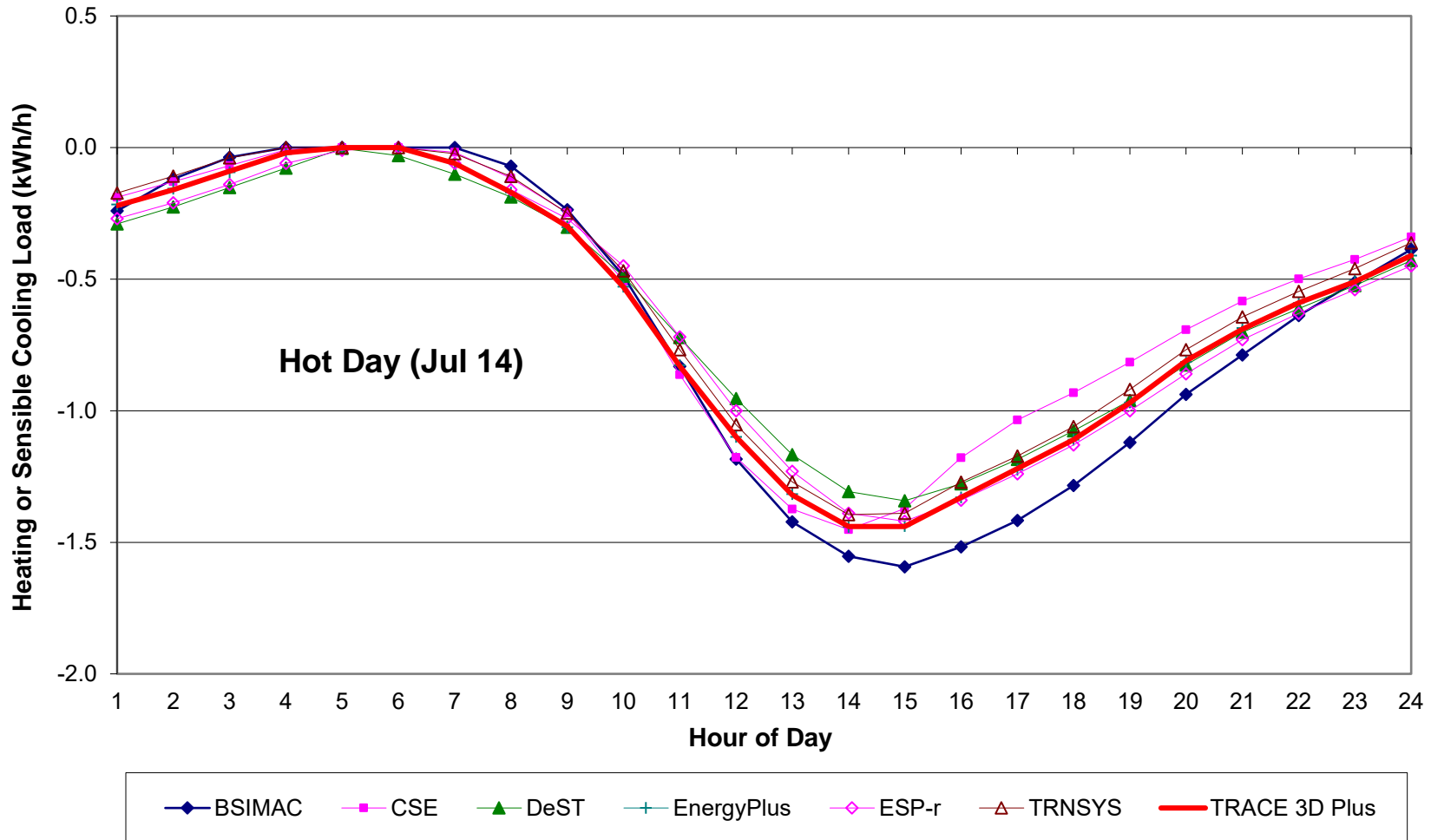


Figure B8-H35. Hourly Loads
Clear Cold Day, Case 985 (High Mass, 20/20 Tstat)
Heating (+), Sensible Cooling (-)

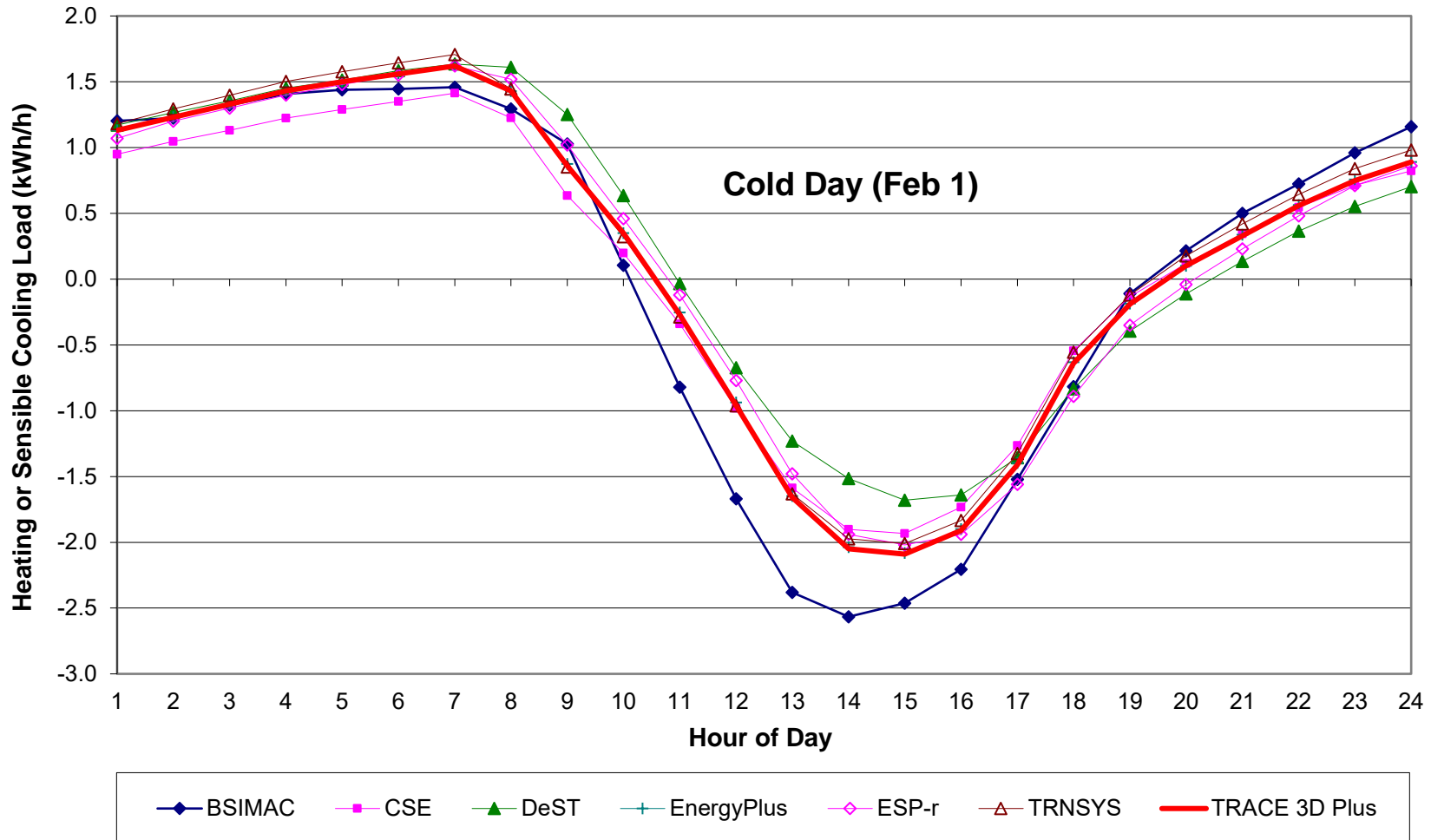


Figure B8-H36. Hourly Loads
Clear Hot Day, Case 985 (High Mass, 20/20 Tstat)
Heating (+), Sensible Cooling (-)

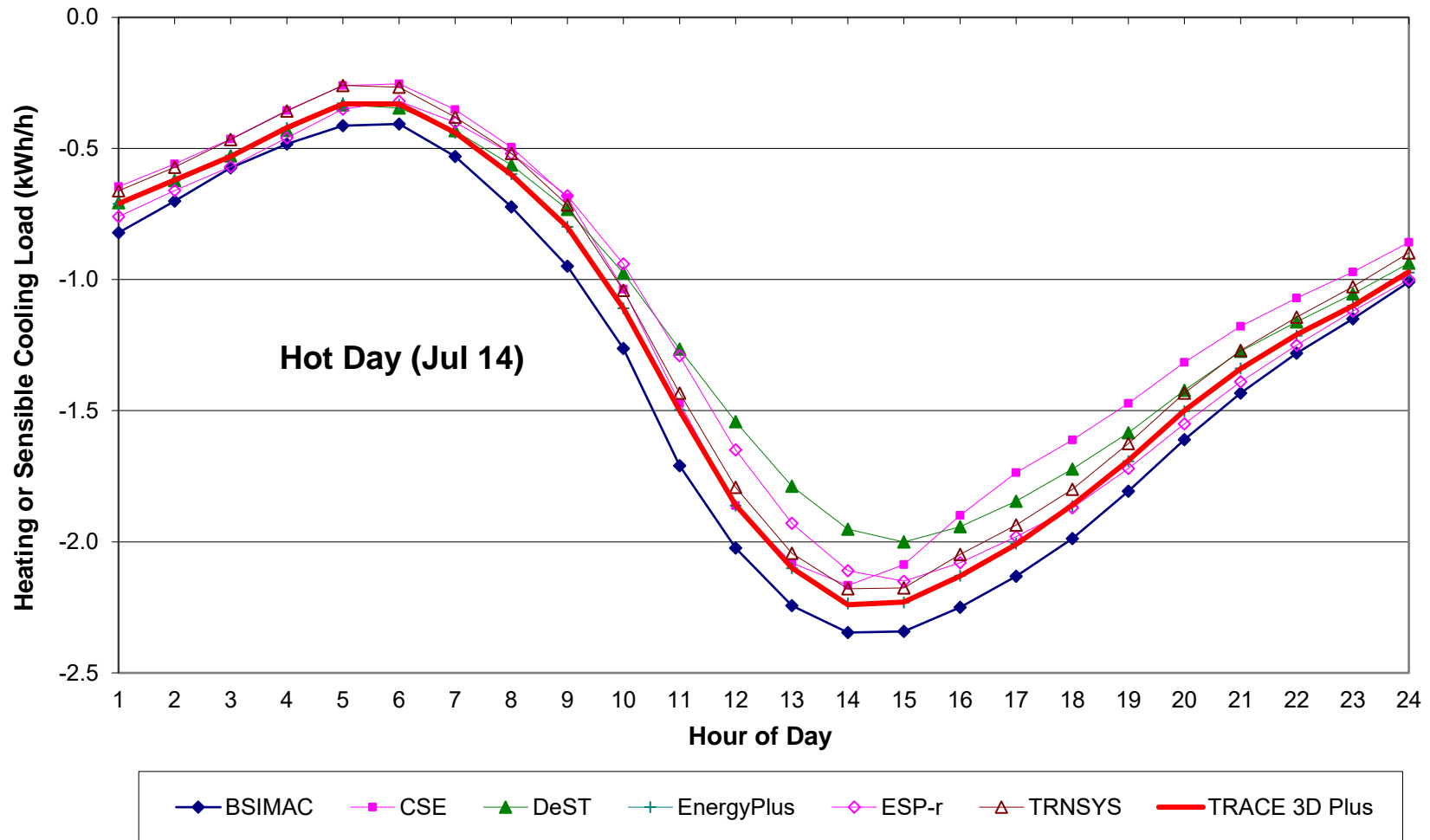


Figure B8-H37. Hourly Loads
Clear Cold Day, Case 995 (High Mass, 20/20, Insulation)
Heating (+), Sensible Cooling (-)

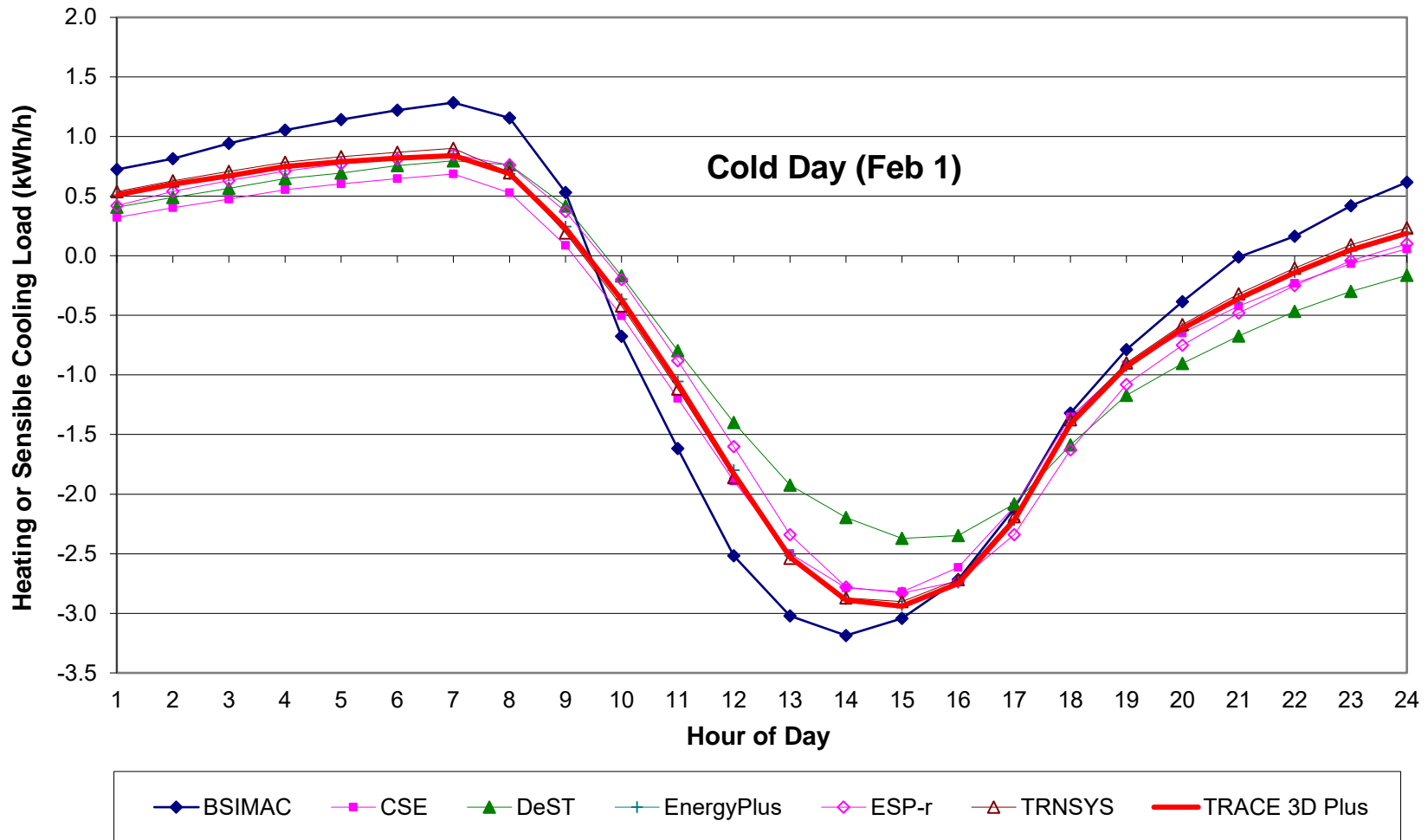
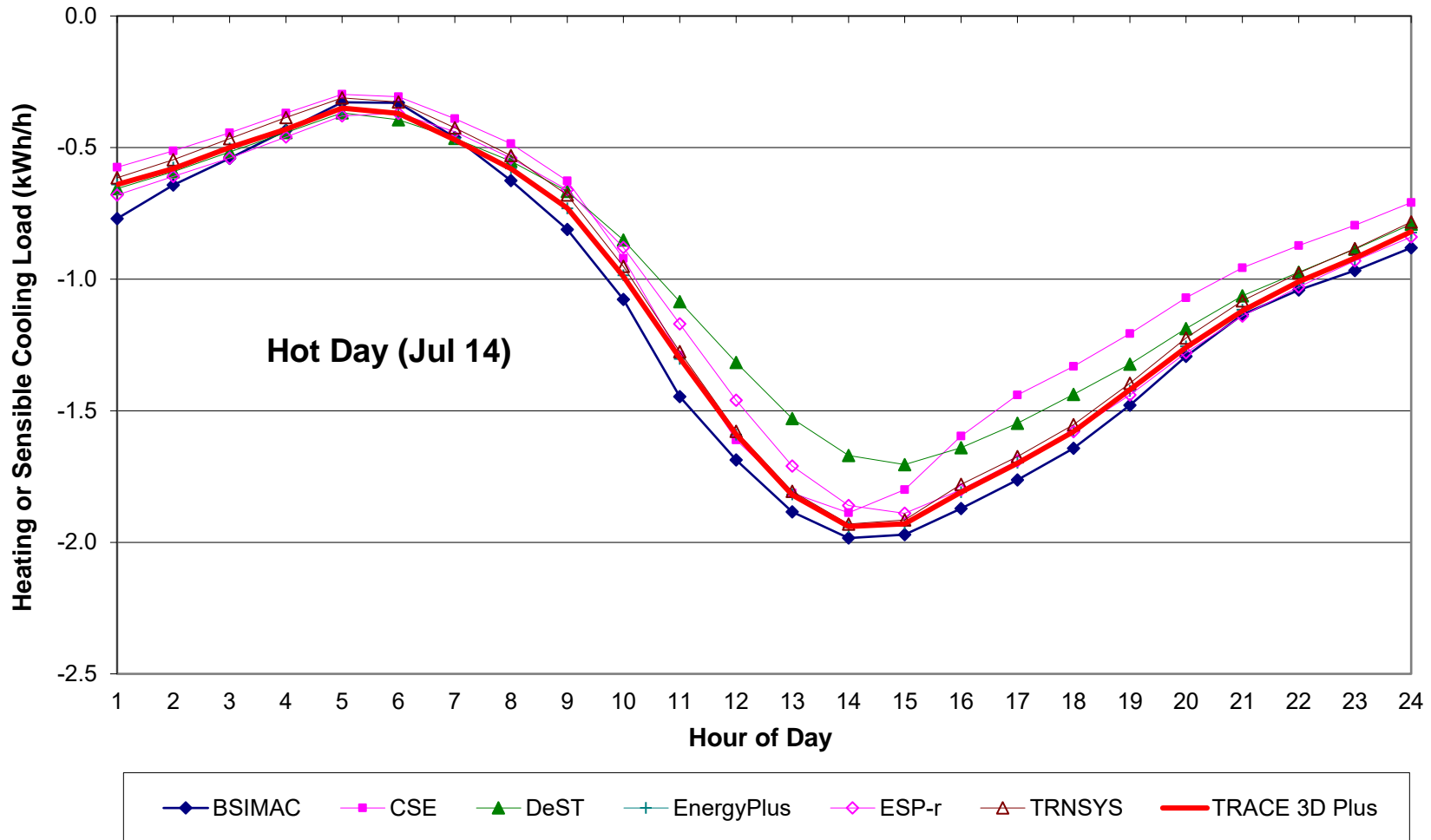


Figure B8-H38. Hourly Loads
Clear Hot Day, Case 995 (High Mass, 20/20, Insulation)
Heating (+), Sensible Cooling (-)



ASHRAE Standard 140-2020
Informative Annex B16, Section B16.5.1

Example Results
for
Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

ASHRAE Standard 140-2020
Participating Organizations and Computer Programs for
Quasi-analytical Solutions and Example Simulation Results
Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

The quasi-analytical solutions and programs used to generate the example simulation results are described in Table B17-1. The first column of Table B17-1 ("Model"), indicates the proper program name and version number, or indicates a quasi-analytical solution.

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

The third column ("Implemented By") indicates the national research facility, university, or industry organization with expertise in building science that performed the simulations or did the quasi-analytical solutions.

The entries in the fourth column are the abbreviations for the simulations and quasi-analytical solutions generally used in the tables and charts which follow.

See Standard 140, Annex B17 for further details.

TABLE B17-1
Participating Organizations and Computer Programs

Model	Authoring Organization	Implemented By	Abbreviation
Quasi-Analytical solution with ideal controller model	Hochschule Technik & Architektur Luzern, Switzerland (HTAL)	Hochschule Technik & Architektur Luzern, Switzerland	HTAL1
Quasi-Analytical solution with realistic controller model	Hochschule Technik & Architektur Luzern, Switzerland	Hochschule Technik & Architektur Luzern, Switzerland	HTAL2
Quasi-Analytical Solution with ideal controller model	Technische Universität Dresden, Germany (TUD)	Technische Universität Dresden, Germany	TUD
CA-SIS V1	Electricité de France, France (EDF)	Electricité de France, France	CA-SIS
CLIM2000 2.1.6	Electricité de France, France	Electricité de France, France	CLM2000
DOE-2.1E-088	LANL/LBNL/ESTSC, ^{a,b,c} USA	CIEMAT, ^d Spain	DOE21E/CIEMAT DOE2.1-E/CIEMAT
DOE-2.1E-133	LANL/LBNL/JJH, ^{a,b,e} USA	NREL/JNA, ^f USA	DOE21E/NREL DOE2.1-E/NREL
ENERGYPLUS 1.0.0.023	LBNL/UIUC/CERL/OSU/GARD Analytics/FSEC/DOE-OBT, ^{a,g,h,i,j,k}	GARD Analytics, USA	E+ EnergyPlus
TRNSYS 14.2-TUD with ideal controller model	University of Wisconsin, USA; Technische Universität Dresden, Ger.	Technische Universität Dresden, Germany	TRN-id TRNSYS-ideal
TRNSYS 14.2-TUD with real controller model	University of Wisconsin, USA; Technische Universität Dresden, Ger.	Technische Universität Dresden, Germany	TRN-re TRNSYS-real

^aLANL: Los Alamos National Laboratory, United States

^bLBNL: Lawrence Berkeley National Laboratory, United States

^cESTSC: Energy Science and Technology Software Center (at Oak Ridge National Laboratory), United States

^dCIEMAT: Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Spain

^eJJH: James J. Hirsch & Associates, United States

^fNREL/JNA: National Renewable Energy Laboratory/J. Neymark & Associates, United States

^gUIUC: University of Illinois Urbana/Champaign, United States

^hCERL: U.S. Army Corps of Engineers, Construction Engineering Research Laboratories, United States

ⁱOSU: Oklahoma State University, United States

^jFSEC: University of Central Florida, Florida Solar Energy Center, United States

^kDOE-OBT: U.S. Department of Energy, Office of Building Technology, State and Community Programs, Energy Efficiency and Renewable Energy, United States

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1

Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

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B16.5.1-5	Zone Loads: Total, Sensible, and Latent	Q-Prt4	A7 – Q59
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ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

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ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.1-1. Space Cooling Electricity Consumption

Energy Consumption, Total (kWh,e)									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) /Analytical*	Min	Max	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane	
CE100	1531	1530	1521	1519	1520	1522	1512	1.2%	1512	1531	1531	1531	1531	1521	
CE110	1077	1089	1061	1065	1069	1067	1061	2.6%	1061	1089	1077	1077	1077	1070	
CE120	1012	1012	1011	1003	1006	1007	1002	1.0%	1002	1012	1011	1011	1011	1009	
CE130	110	109	105	106	109	109	105	4.3%	105	110	110	110	110	109	
CE140	68	69	65	66	68	68	65	5.8%	65	69	69	68	68	68	
CE150	1208	1207	1202	1183	1197	1199	1183	2.1%	1183	1208	1207	1207	1207	1198	
CE160	1140	1139	1138	1107	1132	1137	1107	2.9%	1107	1140	1139	1139	1139	1133	
CE165	1502	1501	1499	1470	1491	1500	1470	2.1%	1470	1502	1500	1500	1500	1492	
CE170	638	638	629	620	635	636	620	2.8%	620	638	638	638	638	636	
CE180	1083	1082	1077	1080	1082	1081	1077	0.5%	1077	1083	1082	1082	1082	1081	
CE185	1544	1543	1541	1547	1540	1542	1538	0.6%	1538	1547	1543	1543	1543	1538	
CE190	164	164	160	160	164	164	160	3.1%	160	165	164	164	164	164	
CE195	250	250	245	246	250	250	245	2.7%	245	252	250	250	250	250	
CE200	1477	1464	1468	1440	1465	1480	1440	2.7%	1440	1480	1477	1477	1477	1474	

Energy Consumption, Compressor (kWh,e)									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) /Analytical*	Min	Max	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane	
CE100	1319	1318	1307	1311	1311	1303	1303	1.2%	1303	1319	1319	1319	1319		
CE110	889	899	866	883	879	876	866	3.7%	866	899	889	889	889		
CE120	840	840	850	838	836	832	832	2.2%	832	850	839	839	839		
CE130	95	94	93	93	94	95	93	2.1%	93	95	94	94	94		
CE140	57	57	55	56	56	57	55	3.9%	55	57	57	56	56		
CE150	1000	999	1007	982	992	987	982	2.5%	982	1007	999	999	999		
CE160	950	949	963	926	947	944	926	3.9%	926	963	949	949	949		
CE165	1283	1281	1291	1256	1280	1272	1256	2.8%	1256	1291	1280	1280	1280		
CE170	531	530	539	523	528	529	523	3.0%	523	539	530	530	530		
CE180	909	908	914	912	907	906	906	0.9%	906	914	908	908	908		
CE185	1340	1339	1343	1344	1337	1334	1334	0.7%	1334	1344	1339	1338	1338		
CE190	138	138	139	138	138	138	138	1.4%	138	139	138	138	138		
CE195	217	217	219	217	216	218	216	1.1%	216	219	217	217	217		
CE200	1250	1239	1249	1218	1253	1253	1218	2.8%	1218	1253	1249	1250	1250		

Energy Consumption, Supply Fan (kWh,e)									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) /Analytical*	Min	Max	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane	
CE100	144	144	145	141	144	144	141	2.9%	141	145	144	144	144	144	
CE110	128	129	133	122	128	128	122	8.5%	122	133	128	128	128	128	
CE120	117	117	110	110	116	117	110	6.3%	110	117	117	117	117	117	
CE130	10	10	8	8	10	10	8	23.1%	8	10	10	10	10	10	
CE140	8	8	7	6	8	8	6	27.2%	6	8	8	8	8	8	
CE150	141	141	133	136	140	141	133	5.7%	133	141	141	141	141	140	
CE160	129	129	119	121	128	129	119	7.8%	119	129	129	129	129	128	
CE165	149	150	142	145	149	149	142	5.6%	142	150	149	149	149	149	
CE170	73	73	61	63	73	73	61	16.1%	61	73	73	73	73	73	
CE180	118	119	111	112	118	118	111	6.9%	111	119	119	119	119	118	
CE185	139	139	135	137	139	139	135	3.0%	135	139	139	139	139	139	
CE190	18	18	14	14	18	18	14	22.9%	14	18	18	18	18	18	
CE195	23	23	18	18	23	23	18	23.3%	18	23	23	23	23	23	
CE200	154	153	149	151	153	155	149	3.5%	149	155	154	155	155	155	

Energy Consumption, Condenser Fan (kWh,e)									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) /Analytical*	Min	Max	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane	
CE100	68	68	68	67	67	67	67	2.0%	67	68	68	68	68	68	
CE110	60	61	62	60	60	59	59	4.9%	59	62	60	60	60	60	
CE120	55	55	51	55	55	54	51	6.5%	51	55	55	55	55	55	
CE130	5	5	4	5	5	5	4	22.7%	4	5	5	5	5	5	
CE140	4	4	3	4	4	4	3	19.3%	3	4	4	4	4	4	
CE150	66	66	62	65	66	65	62	5.6%	62	66	66	66	66	66	
CE160	61	61	56	60	61	60	56	8.4%	56	61	61	61	61	61	
CE165	70	70	67	69	70	69	67	5.1%	67	70	70	70	70	70	
CE170	34	34	29	34	34	34	29	16.1%	29	34	34	34	34	34	
CE180	56	56	52	56	56	55	52	7.1%	52	56	56	56	56	56	
CE185	65	65	63	66	65	65	63	3.9%	63	66	65	65	65	65	
CE190	8	9	7	8	8	9	7	27.7%	7	9	9	9	9	9	
CE195	11	11	8	11	11	11	8	25.2%	8	11	11	11	11	11	
CE200	73	72	70	71	73	73	70	4.1%	70	73	73	73	73	73	

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.1-2. COP: Mean, and (Max-Min)/Mean

Mean COP									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) /Analytical*	Min	Max	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane	
CE100	2.39	2.39	2.43	2.41	2.40	2.40	2.42	1.7%	2.39	2.43	2.39	2.39	2.39	2.40	
CE110	3.38	3.34	3.46	3.41	3.40	3.41	3.43	3.5%	3.34	3.46	3.38	3.38	3.38	3.40	
CE120	3.59	3.59	3.61	3.62	3.61	3.61	3.63	1.1%	3.59	3.63	3.59	3.59	3.59	3.60	
CE130	1.91	1.91	1.98	1.95	1.90	1.92	1.92	3.8%	1.90	1.98	1.89	1.91	1.91	1.90	
CE140	2.77	2.73	2.92	2.85	2.77	2.80	2.80	6.6%	2.73	2.92	2.75	2.77	2.77	2.77	
CE150	3.62	3.63	3.67	3.70	3.65	3.65	3.67	2.2%	3.62	3.70	3.63	3.63	3.63	3.65	
CE160	3.84	3.84	3.87	3.95	3.86	3.85	3.86	2.9%	3.84	3.95	3.83	3.84	3.84	3.85	
CE165	2.92	2.92	2.95	2.99	2.94	2.93	2.94	2.2%	2.92	2.99	2.93	2.93	2.93	2.94	
CE170	3.38	3.39	3.44	3.48	3.40	3.39	3.40	2.9%	3.38	3.48	3.37	3.39	3.39	3.38	
CE180	4.04	4.04	4.08	4.03	4.04	4.05	4.06	1.4%	4.03	4.08	4.04	4.04	4.04	4.04	
CE185	2.85	2.85	2.87	2.82	2.85	2.85	2.86	1.8%	2.82	2.87	2.85	2.85	2.85	2.85	
CE190	3.41	3.41	3.49	3.46	3.39	3.41	3.40	2.7%	3.39	3.49	3.39	3.41	3.41	3.39	
CE195	2.31	2.31	2.36	2.34	2.30	2.32	2.31	2.5%	2.30	2.36	2.29	2.31	2.31	2.30	
CE200	3.62	3.61	3.67	3.71	3.65	3.61	3.61	2.7%	3.61	3.71	3.62	3.62	3.62	3.62	
(Max - Min)/Mean COP									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) /Analytical*	Min	Max	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane	
CE100	0.000	0.001	0.002	0.001	0.003	0.000	0.000	----	0.000	0.003	0.000	0.000	0.000	0.002	
CE110	0.000	0.010	0.002	0.001	0.003	0.000	0.011	----	0.000	0.011	0.000	0.000	0.000	0.002	
CE120	0.000	0.004	0.001	0.001	0.003	0.000	0.012	----	0.000	0.012	0.000	0.000	0.000	0.002	
CE130	0.000	0.038	0.013	0.009	0.004	0.000	0.172	----	0.000	0.172	0.000	0.000	0.000	0.003	
CE140	0.000	0.056	0.011	0.019	0.004	0.000	0.204	----	0.000	0.204	0.000	0.000	0.000	0.003	
CE150	0.003	0.003	0.001	0.005	0.011	0.000	0.009	----	0.000	0.011	0.000	0.001	0.001	0.002	
CE160	0.003	0.005	0.001	0.003	0.011	0.000	0.010	----	0.000	0.011	0.000	0.000	0.000	0.002	
CE165	0.010	0.003	0.001	0.003	0.012	0.000	0.008	----	0.000	0.012	0.000	0.000	0.000	0.003	
CE170	0.000	0.006	0.002	0.004	0.015	0.000	0.043	----	0.000	0.043	0.000	0.000	0.000	0.002	
CE180	0.005	0.002	0.002	0.010	0.029	0.000	0.012	----	0.000	0.029	0.000	0.000	0.000	0.007	
CE185	0.007	0.004	0.002	0.010	0.034	0.000	0.009	----	0.000	0.034	0.000	0.000	0.000	0.009	
CE190	0.000	0.023	0.007	0.019	0.040	0.000	0.101	----	0.000	0.101	0.000	0.000	0.000	0.009	
CE195	0.000	0.017	0.008	0.017	0.043	0.000	0.086	----	0.000	0.086	0.000	0.000	0.000	0.010	
CE200	0.006	0.000	0.000	0.005	0.012	0.000	0.000	----	0.000	0.012	0.000	0.000	0.000	0.001	

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.1-3. Coil Loads: Total, Sensible, and Latent

Coil Load, Total (kWh,thermal)								Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) Min Max /Analytical*			TUD	HTAL1	HTAL2	TRACE 3D Plus Trane
CE100	3800	3800	3841	3794	3798	3800	3798	3794	3841	1.3%	3800	3800	3800	3798
CE110	3765	3766	3804	3756	3763	3765	3763	3756	3804	1.3%	3765	3765	3765	3764
CE120	3749	3749	3763	3739	3747	3748	3747	3739	3763	0.6%	3749	3749	3749	3748
CE130	219	219	216	215	217	219	220	215	220	2.1%	219	219	219	218
CE140	198	198	196	195	196	198	199	195	199	2.0%	198	198	197	197
CE150	4517	4517	4543	4528	4509	4517	4515	4509	4543	0.8%	4518	4517	4518	4509
CE160	4501	4500	4516	4508	4491	4500	4499	4491	4516	0.6%	4501	4500	4500	4491
CE165	4538	4538	4567	4549	4529	4537	4535	4529	4567	0.9%	4537	4537	4538	4529
CE170	2233	2232	2226	2237	2225	2232	2232	2225	2237	0.5%	2232	2232	2233	2225
CE180	4495	4495	4510	4535	4481	4495	4494	4481	4535	1.2%	4495	4495	4494	4473
CE185	4507	4535	4565	4583	4523	4535	4534	4507	4583	1.7%	4535	4535	4534	4509
CE190	578	577	573	579	574	577	578	573	579	1.0%	578	577	578	574
CE195	602	601	595	602	598	601	601	595	602	1.1%	601	601	601	597
CE200	5498	5436	5534	5522	5484	5498	5498	5436	5534	1.8%	5498	5498	5498	5487

Coil Load, Sensible (kWh,thermal)								Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) Min Max /Analytical*			TUD	HTAL1	HTAL2	TRACE 3D Plus Trane
CE100	3800	3800	3841	3794	3798	3800	3798	3794	3841	1.3%	3800	3800	3800	3798
CE110	3765	3766	3804	3756	3763	3765	3763	3756	3804	1.3%	3765	3765	3765	3764
CE120	3749	3749	3763	3739	3747	3748	3747	3739	3763	0.6%	3749	3749	3749	3748
CE130	219	219	216	215	217	219	220	215	220	2.1%	219	219	219	218
CE140	198	198	196	195	196	198	199	195	199	2.0%	198	198	197	197
CE150	3778	3778	3804	3786	3776	3778	3776	3776	3804	0.7%	3778	3778	3779	3776
CE160	3761	3761	3777	3769	3759	3761	3760	3759	3777	0.5%	3761	3761	3761	3759
CE165	3798	3798	3828	3809	3795	3798	3796	3795	3828	0.9%	3798	3798	3799	3796
CE170	1493	1493	1487	1498	1491	1492	1492	1487	1498	0.7%	1493	1493	1493	1492
CE180	1537	1538	1553	1607	1537	1538	1537	1537	1607	4.5%	1538	1538	1538	1537
CE185	1548	1578	1608	1653	1577	1578	1577	1548	1653	6.6%	1578	1578	1578	1577
CE190	208	208	203	212	206	208	208	203	212	4.4%	208	208	208	207
CE195	232	232	226	235	230	231	232	226	235	4.1%	232	232	232	230
CE200	4276	4215	4313	4303	4274	4277	4277	4215	4313	2.3%	4277	4277	4277	4276

Coil Load, Latent (kWh,thermal)								Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) Min Max /Analytical*			TUD	HTAL1	HTAL2	TRACE 3D Plus Trane
CE100	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE110	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE120	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE130	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE140	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE150	739	739	739	742	733	739	739	733	742	1.2%	739	739	739	733
CE160	740	739	739	739	732	739	739	732	740	1.1%	739	739	739	732
CE165	740	739	739	740	733	739	739	733	740	1.0%	739	739	739	733
CE170	740	739	739	739	734	739	739	734	740	0.9%	739	739	739	734
CE180	2958	2957	2957	2928	2944	2957	2957	2928	2958	1.0%	2957	2957	2956	2936
CE185	2959	2957	2957	2930	2946	2957	2957	2930	2959	1.0%	2958	2957	2956	2932
CE190	370	370	370	366	368	370	370	366	370	1.0%	370	370	370	367
CE195	370	370	370	367	368	370	370	367	370	0.9%	370	370	370	367
CE200	1222	1221	1221	1219	1210	1221	1221	1210	1222	1.0%	1221	1221	1221	1210

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

Table B16.5.1-4. Sensible Coil Load minus Zone Load (Fan Heat)

Sensible Coil - Zone Load, (Fan Heat) (kWh,thermal)								Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) Min Max /Analytical*			TUD	HTAL1	HTAL2	TRACE 3D Plus Trane
CE100	144	144	187	139	144	144	142	139	187	33.6%	144	144	144	144
CE110	128	129	168	119	128	128	127	119	168	38.2%	128	128	128	128
CE120	117	117	133	108	116	117	115	108	133	21.8%	117	117	117	117
CE130	10	10	8	8	10	10	10	8	10	27.0%	10	10	10	10
CE140	8	8	7	6	8	8	8	6	8	25.6%	8	8	8	8
CE150	141	141	168	149	140	141	139	139	168	20.2%	141	141	142	141
CE160	129	129	147	137	129	129	128	128	147	14.3%	129	129	129	129
CE165	149	149	181	161	149	149	148	148	181	22.4%	149	149	150	149
CE170	73	73	69	79	73	73	73	69	79	14.2%	74	73	74	73
CE180	117	118	135	188	119	118	118	117	188	60.1%	118	119	118	119
CE185	109	139	171	215	140	139	139	109	215	76.5%	139	139	139	140
CE190	18	18	15	24	18	18	18	15	24	51.0%	18	18	18	18
CE195	23	23	18	28	23	23	23	18	28	40.8%	23	23	23	23
CE200	154	153	193	181	154	155	155	153	193	25.7%	154	155	155	155

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.1-5. Zone Loads: Total, Sensible, and Latent

Zone Load, Total (kWh,thermal)								Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) Min Max /Analytical*			TUD	HTAL1	HTAL2	TRACE 3D Plus Trane
CE100	3656	3656	3654	3655	3654	3656	3656	3654	3656	0.1%	3656	3656	3656	3655
CE110	3637	3637	3636	3637	3636	3637	3637	3636	3637	0.0%	3637	3637	3637	3636
CE120	3632	3632	3630	3632	3631	3632	3631	3630	3632	0.0%	3632	3632	3632	3631
CE130	209	209	207	208	207	209	209	207	209	1.3%	209	209	209	207
CE140	190	190	189	188	188	190	190	188	190	1.1%	190	190	190	189
CE150	4376	4376	4375	4376	4375	4376	4376	4375	4376	0.0%	4376	4376	4376	4369
CE160	4371	4371	4370	4371	4370	4371	4371	4370	4371	0.0%	4371	4371	4371	4363
CE165	4388	4388	4386	4387	4386	4388	4387	4386	4388	0.0%	4388	4388	4388	4380
CE170	2159	2159	2157	2158	2157	2159	2159	2157	2159	0.1%	2159	2159	2159	2152
CE180	4376	4376	4375	4376	4375	4376	4376	4375	4376	0.0%	4376	4376	4376	4363
CE185	4396	4396	4394	4395	4393	4395	4395	4393	4396	0.1%	4396	4396	4396	4384
CE190	557	559	558	558	558	559	559	557	559	0.4%	559	559	559	556
CE195	576	579	577	577	576	578	579	576	579	0.5%	579	579	579	575
CE200	5343	5283	5342	5343	5342	5343	5343	5283	5343	1.1%	5343	5343	5343	5332
Zone Load, Sensible (kWh,thermal)								Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) Min Max /Analytical*			TUD	HTAL1	HTAL2	TRACE 3D Plus Trane
CE100	3656	3656	3654	3655	3654	3656	3656	3654	3656	0.1%	3656	3656	3656	3655
CE110	3637	3637	3636	3637	3636	3637	3637	3636	3637	0.0%	3637	3637	3637	3636
CE120	3632	3632	3630	3632	3631	3632	3631	3630	3632	0.0%	3632	3632	3632	3631
CE130	209	209	207	208	207	209	209	207	209	1.3%	209	209	209	207
CE140	190	190	189	188	188	190	190	188	190	1.1%	190	190	190	189
CE150	3637	3637	3636	3637	3636	3637	3636	3636	3637	0.0%	3637	3637	3637	3636
CE160	3632	3632	3630	3632	3631	3632	3631	3630	3632	0.0%	3632	3632	3632	3631
CE165	3649	3649	3647	3648	3647	3649	3648	3647	3649	0.1%	3649	3649	3649	3647
CE170	1420	1420	1418	1419	1418	1419	1419	1418	1420	0.1%	1420	1420	1420	1418
CE180	1420	1420	1418	1419	1418	1419	1419	1418	1420	0.1%	1420	1420	1420	1418
CE185	1439	1439	1437	1437	1437	1438	1438	1437	1439	0.2%	1439	1439	1439	1437
CE190	190	190	188	188	188	190	190	188	190	1.0%	190	190	190	188
CE195	209	209	207	208	207	209	209	207	209	1.1%	209	209	209	207
CE200	4122	4062	4121	4122	4121	4122	4122	4062	4122	1.5%	4122	4122	4122	4121
Zone Load, Latent (kWh,thermal)								Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) Min Max /Analytical*			TUD	HTAL1	HTAL2	TRACE 3D Plus Trane
CE100	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE110	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE120	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE130	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE140	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE150	739	739	739	739	739	739	739	739	739	0.1%	739	739	739	733
CE160	739	739	739	739	739	739	739	739	739	0.1%	739	739	739	732
CE165	739	739	739	739	739	739	739	739	739	0.1%	739	739	739	733
CE170	739	739	739	739	739	739	739	739	739	0.1%	739	739	739	734
CE180	2957	2957	2957	2958	2957	2957	2957	2957	2958	0.0%	2957	2957	2957	2945
CE185	2957	2957	2957	2958	2957	2957	2957	2957	2958	0.0%	2957	2957	2957	2947
CE190	367	370	370	370	370	370	370	367	370	0.8%	370	370	370	368
CE195	367	370	370	370	370	370	370	367	370	0.8%	370	370	370	368
CE200	1221	1221	1221	1221	1221	1221	1221	1221	1221	0.0%	1221	1221	1221	1211

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

Table B16.5.1-6. Latent Coil Load minus Zone Load (Should be 0)

Latent Coil - Zone Load, (Should be 0) (kWh,thermal)								Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS EDF	CLM2000 EDF	DOE21E CIEMAT	DOE21E NREL	E+ GARD	TRN-id TUD	TRN-re TUD	(Max-Min) Min Max /Analytical*			TUD	HTAL1	HTAL2	TRACE 3D Plus Trane
CE100	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE110	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE120	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE130	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE140	0	0	0	0	0	0	0	0	0	----	0	0	0	0
CE150	0	0	0	2	-7	0	0	-7	2	----	0	0	0	0
CE160	1	0	0	0	-7	0	0	-7	1	----	0	0	0	0
CE165	1	0	0	1	-6	0	0	-6	1	----	0	0	0	0
CE170	1	0	0	-1	-6	0	0	-6	1	----	0	0	0	0
CE180	1	0	0	-30	-13	0	0	-30	1	----	1	0	-1	-9
CE185	2	0	0	-28	-11	0	0	-28	2	----	1	0	-1	-15
CE190	3	0	0	-3	-2	0	0	-3	3	----	0	0	0	-1
CE195	3	0	0	-3	-1	0	0	-3	3	----	0	0	0	-1
CE200	1	0	0	-2	-11	0	0	-11	1	----	0	0	0	0

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.1-7. Sensitivities for Space Cooling Electricity Consumption

Delta Qtot (kWh,e)										Statistics, All Results				Analytical			13-Nov-23
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	(Max-Min)		TRACE 3D Plus							
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD	Min	Max	/Analytical*	TUD	HTAL1	HTAL2	Trane			
CE110-CE100	-454	-441	-460	-454	-451	-455	-450	-460	-441	4.1%	-454	-454	-453	-451			
CE120-CE110	-65	-77	-50	-62	-63	-60	-60	-77	-50	41.2%	-64	-66	-66	-60			
CE120-CE100	-519	-518	-510	-516	-514	-515	-510	-519	-510	1.8%	-518	-520	-520	-511			
CE130-CE100	-1421	-1421	-1415	-1413	-1411	-1414	-1402	-1421	-1402	1.3%	-1420	-1421	-1421	-1412			
CE140-CE130	-42	-40	-40	-40	-41	-41	-41	-42	-40	4.8%	-42	-41	-41	-41			
CE140-CE110	-1009	-1020	-996	-999	-1001	-999	-993	-1020	-993	2.6%	-1007	-1009	-1009	-1002			
CE150-CE110	131	118	141	118	128	132	130	118	141	17.9%	130	129	129	128			
CE160-CE150	-68	-68	-65	-76	-65	-62	-59	-76	-59	25.8%	-66	-67	-68	-65			
CE165-CE160	362	362	362	363	359	363	357	357	363	1.7%	357	360	361	359			
CE170-CE150	-570	-569	-573	-563	-562	-563	-556	-573	-556	3.1%	-565	-569	-569	-562			
CE180-CE150	-125	-125	-125	-103	-115	-118	-112	-125	-103	18.0%	-124	-124	-125	-117			
CE180-CE170	445	444	448	460	447	445	444	444	460	3.6%	442	445	444	445			
CE185-CE180	461	461	464	467	458	460	458	458	467	1.9%	462	461	461	457			
CE190-CE180	-919	-918	-917	-920	-918	-917	-915	-920	-915	0.6%	-917	-918	-918	-917			
CE190-CE140	96	95	95	94	96	96	96	94	96	2.6%	96	96	96	96			
CE195-CE190	86	86	85	86	86	86	86	85	86	2.0%	87	86	86	86			
CE195-CE185	-1294	-1293	-1296	-1301	-1290	-1292	-1287	-1301	-1287	1.1%	-1292	-1293	-1293	-1287			
CE195-CE130	140	141	140	140	142	141	141	140	142	1.5%	142	141	141	141			
CE200-CE100	-54	-66	-53	-79	-55	-42	-32	-79	-32	87.3%	-55	-53	-54	-47			

Del Qcomp (kWh,e)										Statistics, All Results				Analytical			13-Nov-23
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	(Max-Min)		TRACE 3D Plus							
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD	Min	Max	/Analytical*	TUD	HTAL1	HTAL2	Trane			
CE110-CE100	-430	-419	-442	-428		-432	-427	-442	-419	5.3%	-431	-430	-430				
CE120-CE110	-49	-59	-16	-45		-43	-44	-59	-16	87.9%	-47	-50	-50				
CE120-CE100	-479	-478	-457	-473		-475	-471	-479	-457	4.5%	-478	-480	-480				
CE130-CE100	-1224	-1224	-1214	-1218		-1218	-1208	-1224	-1208	1.3%	-1224	-1225	-1225				
CE140-CE130	-38	-37	-38	-37		-38	-38	-38	-37	3.7%	-38	-38	-38				
CE140-CE110	-832	-842	-811	-827		-823	-819	-842	-811	3.7%	-831	-833	-833				
CE150-CE110	111	100	141	99		113	111	99	141	38.3%	111	110	110				
CE160-CE150	-50	-50	-44	-56		-45	-42	-56	-42	27.5%	-49	-50	-50				
CE165-CE160	333	332	329	330		333	328	328	333	1.6%	328	331	331				
CE170-CE150	-469	-469	-468	-459		-464	-458	-469	-458	2.3%	-466	-469	-469				
CE180-CE150	-91	-91	-93	-70		-85	-80	-93	-70	25.0%	-91	-91	-92				
CE180-CE170	378	378	375	389		379	378	375	389	3.6%	375	378	378				
CE185-CE180	431	431	428	432		430	428	428	432	0.9%	432	431	431				
CE190-CE180	-771	-770	-775	-774		-770	-768	-775	-768	0.9%	-770	-770	-770				
CE190-CE140	81	81	85	82		82	82	81	85	4.5%	82	81	81				
CE195-CE190	79	79	79	79		79	80	79	80	0.8%	80	79	79				
CE195-CE185	-1123	-1122	-1124	-1127		-1120	-1116	-1127	-1116	1.0%	-1121	-1122	-1121				
CE195-CE130	122	123	126	124		123	123	122	126	3.0%	123	122	123				
CE200-CE100	-69	-79	-58	-93		-58	-50	-93	-50	62.3%	-70	-69	-69				

Del Q IDfan (kWh,e)										Statistics, All Results				Analytical			13-Nov-23
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	(Max-Min)		TRACE 3D Plus							
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD	Min	Max	/Analytical*	TUD	HTAL1	HTAL2	Trane			
CE110-CE100	-16	-15	-12	-19	-16	-16	-16	-19	-12	41.9%	-16	-16	-16	-16			
CE120-CE110	-11	-12	-23	-12	-11	-11	-11	-23	-11	111.4%	-11	-11	-11	-10			
CE120-CE100	-27	-27	-36	-31	-27	-27	-27	-36	-27	32.2%	-27	-27	-27	-26			
CE130-CE100	-134	-134	-137	-133	-133	-133	-132	-137	-132	3.7%	-134	-134	-134	-133			
CE140-CE130	-2	-2	-1	-2	-2	-2	-2	-2	-1	36.7%	-2	-2	-2	-2			
CE140-CE110	-120	-121	-126	-116	-119	-120	-118	-126	-116	8.3%	-120	-120	-120	-120			
CE150-CE110	13	12	0	14	13	13	13	0	14	106.4%	13	13	13	13			
CE160-CE150	-12	-12	-14	-15	-12	-12	-11	-15	-11	32.6%	-12	-12	-12	-12			
CE165-CE160	20	21	23	24	20	20	20	20	24	21.6%	20	20	20	20			
CE170-CE150	-68	-68	-72	-73	-67	-68	-66	-73	-66	9.7%	-68	-68	-68	-67			
CE180-CE150	-23	-22	-22	-24	-22	-22	-21	-24	-21	12.1%	-22	-23	-23	-22			
CE180-CE170	45	46	49	49	45	45	45	45	49	9.9%	45	45	45	45			
CE185-CE180	21	20	24	25	21	21	21	20	25	24.1%	21	21	21	21			
CE190-CE180	-100	-101	-97	-98	-100	-100	-100	-101	-97	4.3%	-101	-101	-101	-100			
CE190-CE140	10	10	7	8	10	10	10	7	10	28.2%	10	10	10	10			
CE195-CE190	5	5	4	4	5	5	5	4	5	30.8%	5	5	5	5			
CE195-CE185	-116	-116	-117	-119	-116	-117	-116	-119	-116	2.6%	-117	-117	-117	-116			
CE195-CE130	13	13	9	10	12	12	12	9	13	29.1%	12	12	12	12			
CE200-CE100	10	9	4	10	10	11	12	4	12	78.4%	10	11	11	11			

Del Q Odfan (kWh,e)										Statistics, All Results				Analytical			13-Nov-23
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	(Max-Min)		TRACE 3D Plus							
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD	Min	Max	/Analytical*	TUD	HTAL1	HTAL2	Trane			
CE110-CE100	-8	-7	-6	-7		-7	-7	-8	-6	29.9%	-7	-7	-7				
CE120-CE110	-5	-6	-11	-5		-5	-5	-11	-5	114.1%	-5	-5	-5				
CE120-CE100	-13	-13	-17	-12		-13	-13	-17	-12	37.1%	-13	-13	-13				
CE130-CE100	-63	-63	-64	-62		-63	-62	-64	-62	3.7%	-63	-63	-63				
CE140-CE130	-1	-1	-1	-1		-1	-1	-1	-1	37.5%	-1	-1	-1				
CE140-CE110	-56	-57	-59	-56		-56	-56	-59	-56	6.3%	-56	-56	-56				
CE150-CE110	6	5	0	5		6	6	0	6	100.7%	6	6	6				
CE160-CE150	-5	-5	-7	-5		-6	-5	-7	-5	27.1%	-6	-6	-6				
CE165-CE160	9	9	11	9		10	9	9	11	17.3%	9	9	9				
CE170-CE150	-32	-32	-34	-31		-32	-31	-34	-31	8.2%	-32	-32	-32				
CE180-CE150	-10	-10	-10	-9		-11	-10	-11	-9	14.3%	-11	-11	-11				
CE180-CE170	22	22	23	22		21	21	21	23	9.6%	21	21	21				
CE185-CE180	9	9	11	10		10	10	9	11	24.6%	10	10	10				
CE190-CE180	-48	-47	-45	-48		-47	-47	-48	-45	5.5%	-47	-47	-47				
CE190-CE140	4	5	3	4		5	5	3	5	34.5%	5	5	5				
CE195-CE190	3	2	2	3		2	2	2	3	62.1%	2	2	2				
CE195-CE185	-54	-54	-55	-55		-55	-54	-55	-54	2.0%	-55	-55	-55				
CE195-CE130	6	6	4	6		6	6	4	6	27.2%	6	6	6				
CE200-CE100	5	4	2	4		5	6	2	6	77.9%	5	5	5				

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.1-8. Sensitivities for COP and Coil Loads

Delta COP (kWh,t)									Statistics, All Results					Analytical			13-Nov-23	
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	TUD	Min	Max	(Max-Min) /Analytical*	TUD	HTAL1	HTAL2	TRACE 3D Plus			
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD					Trane						
CE110-CE100	0.99	0.95	1.03	1.01	1.00	1.01	1.01	1.01	0.95	1.03	7.6%	0.99	0.99	0.99		1.00		
CE120-CE110	0.21	0.25	0.16	0.21	0.21	0.20	0.20	0.16	0.16	0.25	44.5%	0.21	0.21	0.21		0.20		
CE120-CE100	1.20	1.20	1.18	1.22	1.20	1.20	1.21	1.18	1.22	2.8%		1.20	1.20	1.20		1.19		
CE130-CE100	-0.48	-0.48	-0.46	-0.45	-0.50	-0.48	-0.50	-0.50	-0.45	10.0%		-0.50	-0.48	-0.48		-0.50		
CE140-CE130	0.86	0.83	0.94	0.90	0.87	0.88	0.88	0.83	0.94	13.4%		0.86	0.86	0.86		0.87		
CE140-CE110	-0.61	-0.61	-0.54	-0.56	-0.63	-0.61	-0.63	-0.63	-0.54	13.9%		-0.63	-0.61	-0.61		-0.63		
CE150-CE110	0.24	0.29	0.21	0.29	0.25	0.24	0.25	0.21	0.29	31.9%		0.25	0.25	0.25		0.25		
CE160-CE150	0.22	0.21	0.20	0.25	0.21	0.20	0.19	0.19	0.25	30.4%		0.21	0.21	0.21		0.21		
CE165-CE160	-0.92	-0.92	-0.91	-0.96	-0.92	-0.92	-0.92	-0.96	-0.91	5.5%		-0.90	-0.91	-0.91		-0.92		
CE170-CE150	-0.24	-0.24	-0.23	-0.22	-0.26	-0.26	-0.27	-0.27	-0.22	19.1%		-0.26	-0.24	-0.24		-0.26		
CE180-CE150	0.42	0.41	0.42	0.33	0.39	0.40	0.38	0.33	0.42	22.8%		0.42	0.41	0.41		0.39		
CE180-CE170	0.66	0.65	0.64	0.55	0.65	0.65	0.65	0.55	0.66	16.9%		0.68	0.65	0.65		0.65		
CE185-CE180	-1.19	-1.19	-1.21	-1.20	-1.19	-1.20	-1.20	-1.21	-1.19	1.7%		-1.20	-1.19	-1.19		-1.19		
CE190-CE180	-0.63	-0.63	-0.60	-0.57	-0.65	-0.64	-0.65	-0.65	-0.57	12.7%		-0.66	-0.63	-0.63		-0.65		
CE190-CE140	0.64	0.68	0.57	0.60	0.62	0.61	0.61	0.57	0.68	16.4%		0.64	0.64	0.64		0.62		
CE195-CE190	-1.10	-1.10	-1.13	-1.12	-1.09	-1.09	-1.10	-1.13	-1.09	3.3%		-1.09	-1.10	-1.10		-1.09		
CE195-CE185	-0.54	-0.54	-0.51	-0.49	-0.55	-0.54	-0.55	-0.55	-0.49	12.1%		-0.55	-0.54	-0.54		-0.55		
CE195-CE130	0.40	0.40	0.38	0.38	0.40	0.40	0.39	0.38	0.40	4.2%		0.40	0.40	0.40		0.40		
CE200-CE100	1.23	1.22	1.24	1.30	1.24	1.21	1.19	1.19	1.30	8.9%		1.23	1.23	1.23		1.22		
Del Q coil,t (kWh,t)									Statistics, All Results					Analytical			13-Nov-23	
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	TUD	Min	Max	(Max-Min) /Analytical*	TUD	HTAL1	HTAL2	TRACE 3D Plus			
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD					Trane						
CE110-CE100	-35	-34	-38	-38	-35	-35	-35	-35	-38	-34	12.5%	-35	-35	-35		-35		
CE120-CE110	-16	-17	-40	-16	-16	-16	-16	-16	-40	-16	146.5%	-16	-16	-17		-15		
CE120-CE100	-51	-51	-78	-55	-51	-51	-51	-51	-78	-51	52.7%	-51	-52	-52		-50		
CE130-CE100	-3581	-3581	-3626	-3579	-3581	-3581	-3578	-3626	-3578	1.3%		-3581	-3581	-3581		-3581		
CE140-CE130	-21	-21	-20	-21	-21	-21	-21	-21	-21	-20	4.9%	-21	-21	-22		-21		
CE140-CE110	-3567	-3568	-3608	-3561	-3567	-3567	-3565	-3608	-3561	1.3%		-3567	-3567	-3568		-3567		
CE150-CE110	752	751	739	772	746	752	752	739	772	4.4%		752	752	753		745		
CE160-CE150	-16	-17	-26	-19	-18	-17	-16	-26	-16	59.5%		-17	-17	-18		-18		
CE165-CE160	37	38	51	40	38	37	36	36	51	40.0%		36	37	38		38		
CE170-CE150	-2284	-2285	-2317	-2291	-2284	-2285	-2283	-2317	-2283	1.5%		-2285	-2286	-2286		-2284		
CE180-CE150	-22	-22	-33	7	-28	-22	-21	-33	7	172.5%		-22	-23	-25		-36		
CE180-CE170	2262	2263	2284	2298	2256	2263	2262	2256	2298	1.8%		2263	2263	2261		2248		
CE185-CE180	12	40	55	48	41	40	40	12	55	107.3%		40	40	40		36		
CE190-CE180	-3917	-3918	-3937	-3956	-3907	-3917	-3916	-3956	-3907	1.3%		-3918	-3918	-3916		-3899		
CE190-CE140	380	379	377	384	378	380	379	377	384	1.8%		380	379	380		377		
CE195-CE190	24	24	23	23	23	24	24	23	24	5.8%		24	24	24		23		
CE195-CE185	-3905	-3934	-3970	-3981	-3925	-3934	-3933	-3981	-3905	1.9%		-3934	-3934	-3933		-3912		
CE195-CE130	383	382	379	387	381	382	382	379	387	1.9%		382	382	382		380		
CE200-CE100	1698	1636	1693	1728	1687	1698	1700	1636	1728	5.4%		1697	1697	1697		1688		
Del Q coil,s (kWh,t)									Statistics, All Results					Analytical			13-Nov-23	
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	TUD	Min	Max	(Max-Min) /Analytical*	TUD	HTAL1	HTAL2	TRACE 3D Plus			
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD					Trane						
CE110-CE100	-35	-34	-38	-38	-35	-35	-35	-35	-38	-34	12.5%	-35	-35	-35		-35		
CE120-CE110	-16	-17	-40	-16	-16	-16	-16	-16	-40	-16	146.5%	-16	-16	-17		-15		
CE120-CE100	-51	-51	-78	-55	-51	-51	-51	-51	-78	-51	52.8%	-51	-52	-52		-50		
CE130-CE100	-3581	-3581	-3626	-3579	-3581	-3581	-3578	-3626	-3578	1.3%		-3581	-3581	-3581		-3581		
CE140-CE130	-21	-21	-20	-21	-21	-21	-21	-21	-21	-20	4.9%	-21	-21	-22		-21		
CE140-CE110	-3567	-3568	-3608	-3561	-3567	-3567	-3565	-3608	-3561	1.3%		-3567	-3567	-3568		-3567		
CE150-CE110	13	12	0	30	13	13	13	0	30	228.7%		13	13	14		13		
CE160-CE150	-17	-17	-26	-17	-17	-17	-16	-26	-16	58.9%		-17	-17	-18		-17		
CE165-CE160	37	37	51	40	36	37	36	36	51	40.1%		36	37	38		37		
CE170-CE150	-2285	-2285	-2317	-2288	-2285	-2285	-2283	-2317	-2283	1.5%		-2285	-2286	-2286		-2285		
CE180-CE150	-2241	-2240	-2250	-2179	-2239	-2240	-2239	-2250	-2179	3.2%		-2241	-2240	-2241		-2239		
CE180-CE170	44	45	66	109	46	45	45	44	109	144.8%		45	45	45		46		
CE185-CE180	11	40	55	46	39	40	40	11	55	110.0%		40	40	40		39		
CE190-CE180	-1329	-1330	-1350	-1394	-1331	-1330	-1329	-1394	-1329	4.9%		-1330	-1330	-1330		-1331		
CE190-CE140	10	10	7	18	10	10	9	7	18	100.3%		10	10	11		10		
CE195-CE190	24	24	23	23	23	24	24	23	24	5.7%		24	24	24		23		
CE195-CE185	-1316	-1346	-1382	-1418	-1347	-1346	-1345	-1418	-1316	7.6%		-1346	-1347	-1346		-1347		
CE195-CE130	13	13	10	20	13	12	12	10	20	81.6%		12	12	12		12		
CE200-CE100	476	415	472	509	477	477	479	415	509	19.7%		476	476	476		478		
Del Qcoil,lat (kWh,t)									Statistics, All Results					Analytical			13-Nov-23	
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	TUD	Min	Max	(Max-Min) /Analytical*	TUD	HTAL1	HTAL2	TRACE 3D Plus			
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD					Trane						
CE110-CE100	0	0	0	0	0	0	0	0	0	0	----	0	0	0		0		
CE120-CE110	0	0	0	0	0	0	0	0	0	0	----	0	0	0		0		
CE120-CE100	0	0	0	0	0	0	0	0	0	0	----	0	0	0		0		
CE130-CE100	0	0	0	0	0	0	0	0	0	0	----	0	0	0		0		
CE140-CE130	0	0	0	0	0	0	0	0	0	0	----	0	0	0		0		
CE140-CE110	0	0	0	0	0	0	0	0	0	0	----	0	0	0		0		
CE150-CE110	739	739	739	742	733	739	739	733	742	1.2%		739	739	739		733		
CE160-CE150	1	0	0	-2	-1	0	0	-2	1	----		0	0	0		-1		
CE165-CE160	0	0	0	1	1	0	0	0	1	----		0	0	0		1		
CE170-CE150	1	0	0	-3	1	0	0	-3	1	----		0	0	0		1		
CE180-CE150	2219	2218	2218	2186	2211	2218	2218	2186	2219	1.5%		2218	2218	2217		2203		
CE180-CE170	2218	2218	2218	2189	2210	2218	2218	2189	2218	1.3%		2218	2218	2217		2202		
CE185-CE180	1	0	0	2	2	0	0	0	2	----		0	0	0		-4		
CE190-CE180	-2588	-2587	-2587	-2562	-2576	-2587	-2587	-2588	-2562	----		-2588	-2587	-2586		-2568		
CE190-CE140	370	370	370	366	368	370	370	366	370	1.0%		370	370	370		367		
CE195-CE190	0	0	0	0	0	0	0	0	0	----		0	0	0		0		
CE195-CE185	-2589	-2587	-2587	-2563	-2578	-2587	-2587	-2589	-2563	----		-2588	-2587	-2587		-2565		
CE195-CE130	370	370	370	367	368	370	370	367	370	0.9%		370	370	370		367		
CE200-CE100	1222	1221	1221	1219	1210	1221	1221	1210	1222	1.0%		1221	1221	1221		1210		

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.1
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE100 through CE200

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.1-9. Indoor Drybulb Temperature: Mean and (Max-Min)/Mean

Mean IDB (°C)									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	(Max-Min) /Analytical*	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane			
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD								
CE100	22.2	22.2	22.3	22.3	22.2	22.2	22.6	22.2	22.6	2.0%	22.2	22.2	22.2	22.2	
CE110	22.2	22.2	22.3	22.3	22.2	22.2	22.5	22.2	22.5	1.5%	22.2	22.2	22.2	22.2	
CE120	26.7	26.7	26.8	26.7	26.7	26.7	27.1	26.7	27.1	1.4%	26.7	26.7	26.7	26.7	
CE130	22.2	22.2	22.1	22.1	22.2	22.2	21.6	21.6	22.2	2.5%	22.2	22.2	22.2	22.2	
CE140	22.2	22.2	22.1	22.1	22.2	22.2	21.5	21.5	22.2	3.1%	22.2	22.2	22.2	22.2	
CE150	22.2	22.2	22.3	22.3	22.2	22.2	22.7	22.2	22.7	2.1%	22.2	22.2	22.2	22.2	
CE160	26.7	26.7	26.8	26.7	26.7	26.7	27.0	26.7	27.0	1.1%	26.7	26.7	26.7	26.7	
CE165	23.3	23.3	23.4	23.4	23.3	23.3	23.8	23.3	23.8	2.1%	23.3	23.3	23.3	23.3	
CE170	22.2	22.2	22.2	22.2	22.2	22.2	22.1	22.1	22.2	0.5%	22.2	22.2	22.2	22.2	
CE180	22.2	22.2	22.3	22.3	22.2	22.2	22.3	22.2	22.3	0.6%	22.2	22.2	22.2	22.2	
CE185	22.2	22.2	22.3	22.3	22.2	22.2	22.4	22.2	22.4	0.8%	22.2	22.2	22.2	22.2	
CE190	22.2	22.2	22.1	22.1	22.2	22.2	21.9	21.9	22.2	1.1%	22.2	22.2	22.2	22.2	
CE195	22.2	22.2	22.1	22.1	22.2	22.2	22.0	22.0	22.2	0.9%	22.2	22.2	22.2	22.2	
CE200	26.7	26.7	26.8	26.8	26.7	26.7	26.7	26.7	26.8	0.4%	26.7	26.7	26.7	26.7	

(Max - Min)/Mean IDB (°C)									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	(Max-Min) /Analytical*	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane			
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD								
CE100	0.000	0.000	0.000	0.000	0.000	0.000	0.049	0.000	0.049	----	0.000	0.000	0.002	0.000	
CE110	0.000	0.000	0.000	0.000	0.000	0.000	0.048	0.000	0.048	----	0.000	0.000	0.002	0.000	
CE120	0.000	0.000	0.000	0.000	0.000	0.000	0.077	0.000	0.077	----	0.000	0.000	0.002	0.000	
CE130	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.000	0.056	----	0.000	0.000	0.001	0.000	
CE140	0.000	0.000	0.000	0.000	0.000	0.000	0.069	0.000	0.069	----	0.000	0.000	0.002	0.000	
CE150	0.000	0.000	0.000	0.000	0.000	0.000	0.054	0.000	0.054	----	0.000	0.000	0.002	0.000	
CE160	0.000	0.000	0.000	0.000	0.000	0.000	0.045	0.000	0.045	----	0.000	0.000	0.002	0.000	
CE165	0.000	0.000	0.000	0.000	0.000	0.000	0.051	0.000	0.051	----	0.000	0.000	0.002	0.000	
CE170	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.000	0.050	----	0.000	0.000	0.001	0.000	
CE180	0.000	0.000	0.000	0.000	0.000	0.000	0.035	0.000	0.035	----	0.000	0.000	0.001	0.000	
CE185	0.000	0.000	0.000	0.000	0.000	0.000	0.021	0.000	0.021	----	0.000	0.000	0.001	0.000	
CE190	0.000	0.000	0.000	0.000	0.000	0.000	0.028	0.000	0.028	----	0.000	0.000	0.001	0.000	
CE195	0.000	0.000	0.000	0.000	0.000	0.000	0.023	0.000	0.023	----	0.000	0.000	0.001	0.000	
CE200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	----	0.000	0.000	0.000	0.007	

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

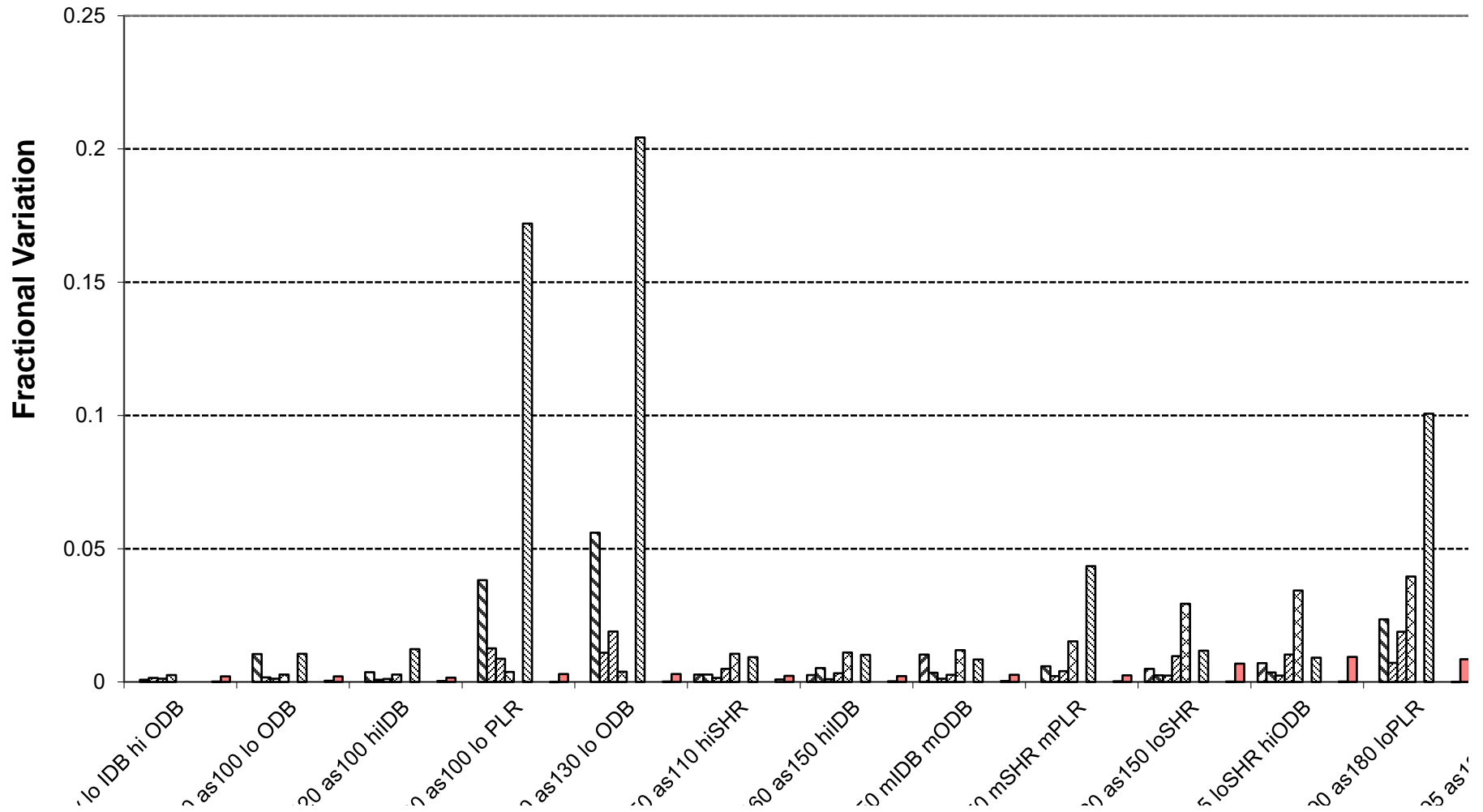
Table B16.5.1-10. Humidity Ratio: Mean and (Max-Min)/Mean

Mean Humidity Ratio									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	(Max-Min) /Analytical*	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane			
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD								
CE100	0.0075	0.0069	0.0076	0.0074	0.0075	0.0075	0.0075	0.0069	0.0076	9.4%	0.0074	0.0073	0.0073	0.0074	
CE110	0.0066	0.0069	0.0070	0.0064	0.0066	0.0066	0.0066	0.0064	0.0070	9.8%	0.0065	0.0064	0.0064	0.0065	
CE120	0.0080	0.0070	0.0078	0.0078	0.0080	0.0080	0.0080	0.0070	0.0080	13.2%	0.0079	0.0079	0.0079	0.0077	
CE130	0.0075	0.0069	0.0076	0.0073	0.0075	0.0075	0.0075	0.0069	0.0076	9.4%	0.0074	0.0073	0.0073	0.0074	
CE140	0.0065	0.0069	0.0071	0.0064	0.0066	0.0066	0.0066	0.0064	0.0071	10.2%	0.0065	0.0064	0.0064	0.0065	
CE150	0.0083	0.0085	0.0082	0.0083	0.0084	0.0083	0.0085	0.0082	0.0085	4.0%	0.0082	0.0082	0.0082	0.0084	
CE160	0.0102	0.0101	0.0097	0.0099	0.0103	0.0101	0.0102	0.0097	0.0103	5.8%	0.0100	0.0099	0.0099	0.0102	
CE165	0.0093	0.0099	0.0090	0.0092	0.0094	0.0093	0.0095	0.0090	0.0099	9.2%	0.0093	0.0092	0.0092	0.0093	
CE170	0.0106	0.0107	0.0105	0.0105	0.0106	0.0105	0.0105	0.0105	0.0107	2.2%	0.0104	0.0105	0.0105	0.0105	
CE180	0.0164	0.0164	0.0166	0.0164	0.0162	0.0163	0.0164	0.0162	0.0166	2.6%	0.0162	0.0162	0.0162	0.0161	
CE185	0.0162	0.0171	0.0164	0.0162	0.0161	0.0162	0.0163	0.0161	0.0171	6.4%	0.0161	0.0161	0.0161	0.0160	
CE190	0.0160	0.0161	0.0163	0.0159	0.0159	0.0159	0.0157	0.0157	0.0163	3.5%	0.0158	0.0159	0.0159	0.0158	
CE195	0.0156	0.0164	0.0158	0.0155	0.0154	0.0155	0.0153	0.0153	0.0164	7.0%	0.0154	0.0154	0.0154	0.0154	
CE200	0.0114	0.0115	0.0109	0.0111	0.0115	0.0113	0.0113	0.0109	0.0115	5.1%	0.0111	0.0111	0.0111	0.0111	

(Max - Min)/Mean Humidity Ratio									Statistics, All Results			Analytical			13-Nov-23
Case	CA-SIS	CLM2000	DOE21E	DOE21E	E+	TRN-id	TRN-re	(Max-Min) /Analytical*	TUD	HTAL1	HTAL2	TRACE 3D Plus Trane			
	EDF	EDF	CIEMAT	NREL	GARD	TUD	TUD								
CE100	0.000	0.022	0.000	0.000	0.001	0.000	0.000	0.0000	0.0217	----	0.000	0.000	0.000	0.000	
CE110	0.000	0.022	0.014	0.000	0.000	0.000	0.000	0.0000	0.0217	----	0.000	0.000	0.000	0.000	
CE120	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.0000	0.0005	----	0.000	0.000	0.000	0.000	
CE130	0.000	0.010	0.000	0.000	0.001	0.000	0.000	0.0000	0.0101	----	0.000	0.000	0.000	0.000	
CE140	0.000	0.012	0.014	0.000	0.001	0.000	0.000	0.0000	0.0142	----	0.000	0.000	0.000	0.000	
CE150	0.012	0.000	0.000	0.000	0.013	0.000	0.013	0.0000	0.0132	----	0.000	0.000	0.000	0.011	
CE160	0.020	0.000	0.010	0.010	0.013	0.000	0.011	0.0000	0.0196	----	0.000	0.000	0.000	0.011	
CE165	0.011	0.001	0.011	0.000	0.013	0.000	0.013	0.0000	0.0131	----	0.000	0.000	0.000	0.011	
CE170	0.000	0.000	0.010	0.000	0.011	0.000	0.024	0.0000	0.0238	----	0.000	0.000	0.001	0.010	
CE180	0.018	0.000	0.012	0.012	0.010	0.000	0.040	0.0000	0.0402	----	0.000	0.000	0.001	0.009	
CE185	0.012	0.006	0.018	0.012	0.011	0.000	0.025	0.0000	0.0246	----	0.000	0.000	0.001	0.009	
CE190	0.000	0.000	0.018	0.019	0.014	0.000	0.031	0.0000	0.0312	----	0.000	0.000	0.001	0.014	
CE195	0.000	0.006	0.019	0.019	0.014	0.000	0.024	0.0000	0.0241	----	0.000	0.000	0.001	0.014	
CE200	0.018	0.000	0.009	0.009	0.013	0.000	0.000	0.0000	0.0175	----	0.000	0.000	0.000	0.014	

* ABS[(Max-Min) / (Mean of Analytical Solutions)]

Figure B16.5.1-2.
HVAC BESTEST: (Maximum - Minimum)/Mean COP



**Figure B16.5.1-5.
 HVAC BESTEST: Total Space Cooling Electricity Sensitivities**

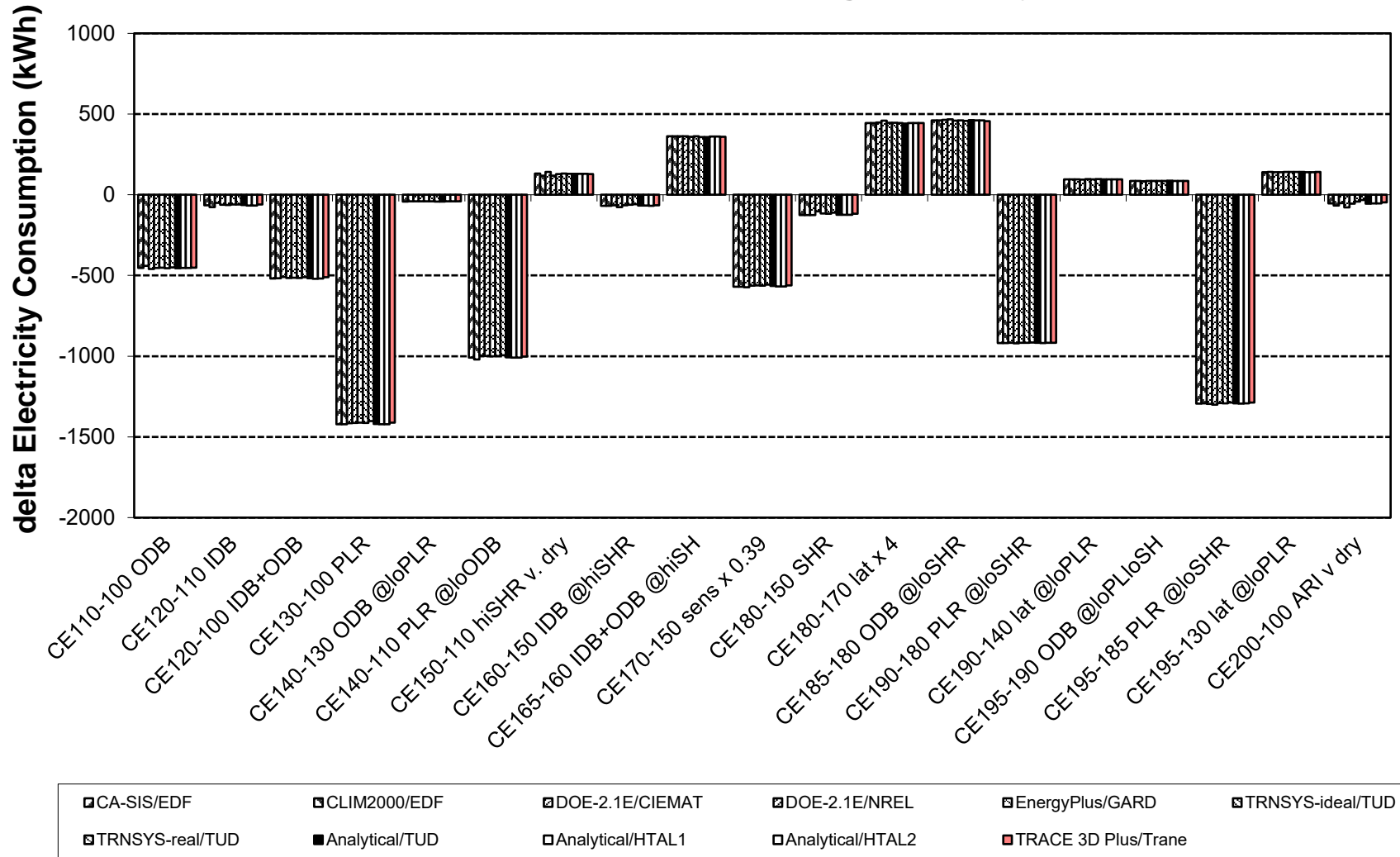


Figure B16.5.1-21.
HVAC BESTEST: (Maximum - Minimum)/Mean Indoor Humidity Ratio

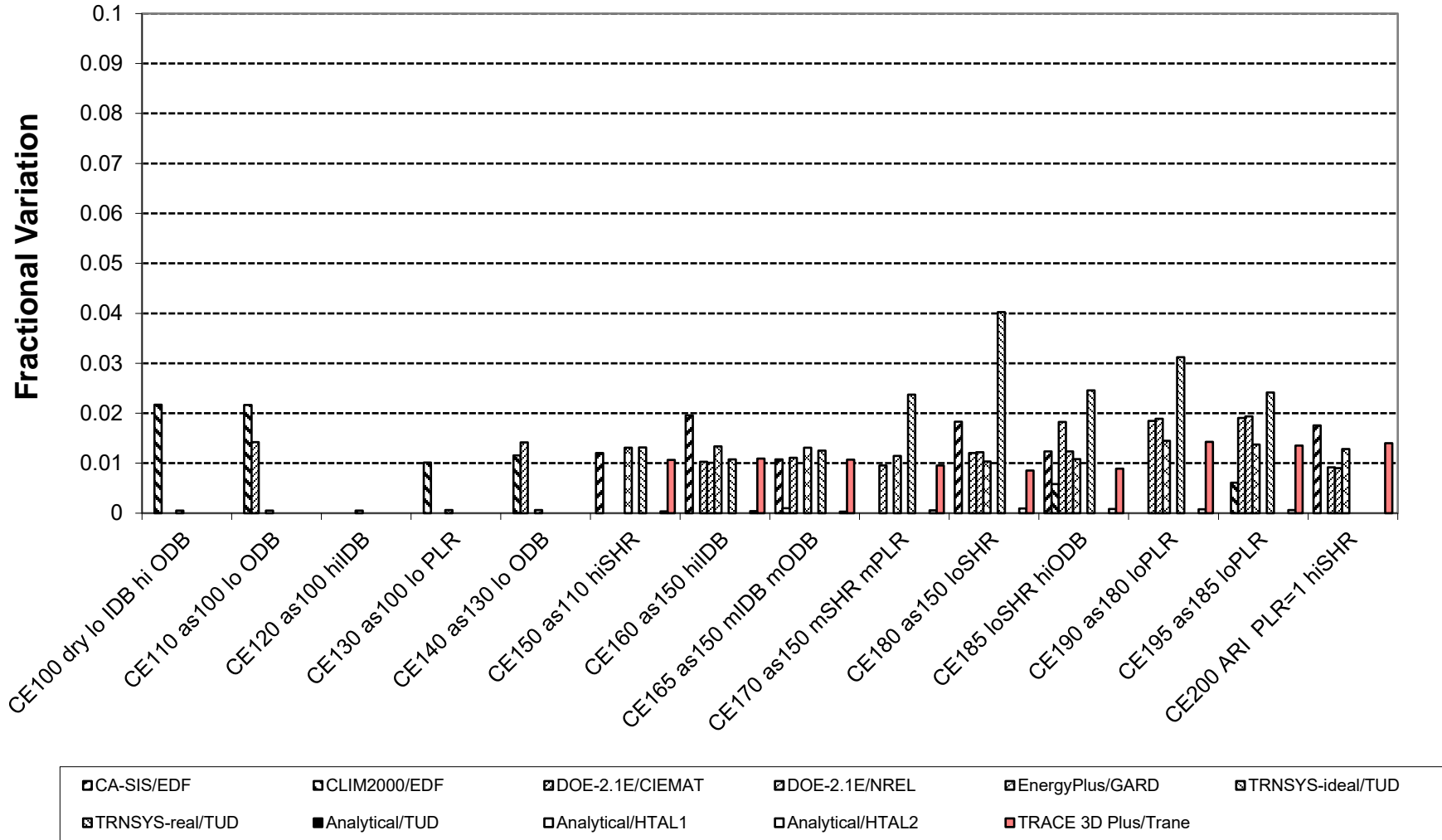
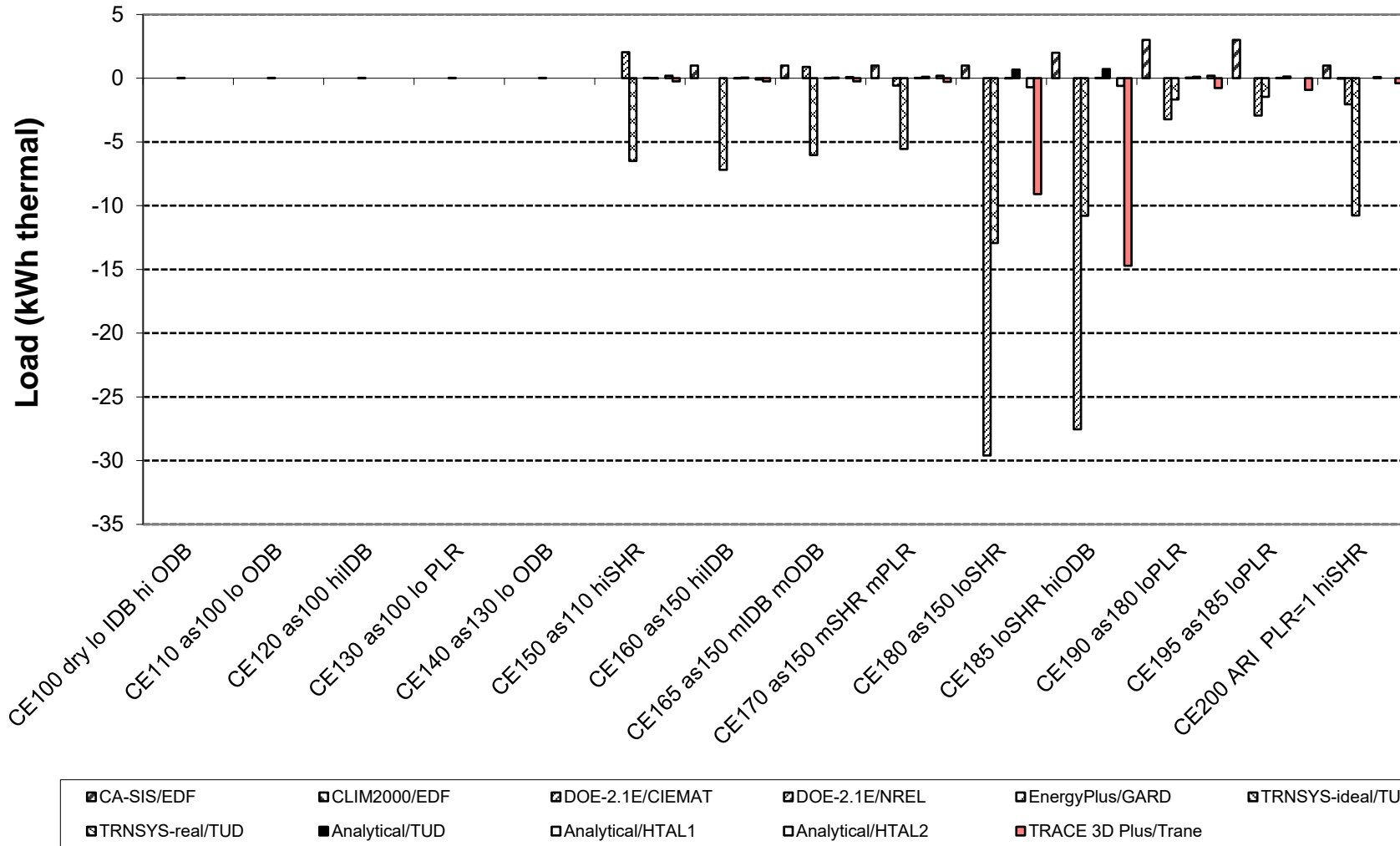


Figure B16.5.1-26.
HVAC BESTEST: Latent Coil Load - Latent Zone Load (Should = 0)



ASHRAE Standard 140-2020
Informative Annex B16, Section B16.5.2

Example Results
for
Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

ASHRAE Standard 140-2020
Participating Organizations and Computer Programs for
Quasi-analytical Solutions and Example Simulation Results
Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

The quasi-analytical solutions and programs used to generate the example simulation results are described in Table B17-2. The first column of Table B17-2 ("Model"), indicates the proper program name and version number, or indicates a quasi-analytical solution.

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

The third column ("Implemented By") indicates the national research facility, university, or industry organization with expertise in building science that performed the simulations or did the quasi-analytical solutions.

The entries in the fourth column are the abbreviations for the simulations and quasi-analytical solutions generally used in the tables and charts which follow.

See Standard 140, Annex B17 for further details.

TABLE B17-2
Participating Organizations and Computer Programs

Model	Authoring Organization	Implemented By	Abbreviation
CODYRUN/LGIMAT	Université de la Reunion Island, France	Université de la Reunion Island, France	CODYRUN/UR
DOE-2.1E version 120 (ESTSC release)	LANL/LBNL/ESTSC/JJH, ^{a,b,c,d} United States	NREL/JNA, ^e United States	DOE-2.1E-E/NREL DOE21E-E
DOE-2.2 NT42j	LBNL/JJH, ^{b,d} United States	NREL/JNA, ^e United States	DOE-2.2/NREL
EnergyPlus 1.1.0.020	LBNL/UIUC/CERL/OSU/GARD Analytics/FSEC/DOE-BT, ^{b,f,g,h,i,j} United States	GARD Analytics, United States	EnergyPlus/GARD
HOT3000/ESP-r	CETC/ESRU, ^{k,l} Canada/United Kingdom	CETC, ^k Canada	HOT3000/NRCan
TRNSYS 14.2-TUD with real controller model	University of Wisconsin, USA; Technische Universität Dresden, Germany	Technische Universität Dresden, Germany	TRNSYS/TUD

^aLANL: Los Alamos National Laboratory, United States

^bLBNL: Lawrence Berkeley National Laboratory, United States

^cESTSC: Energy Science and Technology Software Center (at Oak Ridge National Laboratory), United States

^dJJH: James J. Hirsch & Associates, United States

^eNREL/JNA: National Renewable Energy Laboratory/J. Neymark & Associates, United States

^fUIUC: University of Illinois Urbana/Champaign, United States

^gCERL: U.S. Army Corps of Engineers, Construction Engineering Research Laboratories, United States

^hOSU: Oklahoma State University, United States

ⁱFSEC: University of Central Florida, Florida Solar Energy Center, United States

^jDOE-BT: U.S. Department of Energy, Office of Building Technologies, Energy Efficiency and Renewable Energy, United States

^kCETC: CANMET Energy Technology Centre, Natural Resources Canada, Canada

^lESRU: Energy Systems Research Unit, University of Strathclyde, Scotland, United Kingdom

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Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

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Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

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Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-1. Annual Space Cooling Electricity Consumption (Total, Compressor)

Energy Consumption, Total (kWh,e)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	35634	34750	34755	34746	34976	35070	34746	35634	34988	2.5%	35035
CE310	39973	39379	39384	39290	39520	39608	39290	39973	39526	1.7%	39446
CE320	40060	38745	38792	39079	39401	39457	38745	40060	39256	3.3%	39299
CE330	40963	39708	39438	40143	40535	40330	39438	40963	40186	3.8%	40441
CE340	40619	39358	39265	39783	40065	39947	39265	40619	39840	3.4%	40057
CE350	32237	30547	30548	31145	31587	31742	30547	32237	31301	5.4%	31421
CE360	55299	54064	54016	54705	54843	55068	54016	55299	54666	2.3%	54930
CE400	32045	30846	30876	31013		31413	30846	32045	31239	3.8%	30671
CE410	32078	31668	31699			31503	31503	32078	31737	1.8%	30671
CE420	33387	32530	32910	32736		33208	32530	33387	32954	2.6%	32984
CE430	32538	31932	31811	31772		31818	31772	32538	31974	2.4%	32127
CE440	33691	33032	32973	33032		33248	32973	33691	33195	2.2%	33302
CE500	22338	22817	22822	23035	22323	23138	22323	23138	22745	3.6%	23055
CE500 May-Sep	17391	17872	17870	17996	17435	18051	17391	18051	17769	3.7%	18031
CE510 May-Sep	34609	35971	35970	35732	34849	35845	34609	35971	35496	3.8%	35785
CE520	24987	25389	25390	25017	25131	25781	24987	25781	25282	3.1%	25794
CE522	23544	24293	24307	24078	23620	24360	23544	24360	24034	3.4%	24366
CE525	20321	20408	20421	20702	20242	21323	20242	21323	20569	5.3%	20759
CE530	17281	17540	17537	17742	17442	17875	17281	17875	17570	3.4%	18454
CE540	19430	19878	19874	19061	19537	20164	19061	20164	19657	5.6%	20237
CE545	15687	15802	15791	16636	15791	16339	15687	16636	16008	5.9%	17044

Energy Consumption, Compressor (kWh,e)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	22354	21569	21573		21770	21876	21569	22354	21828	3.6%	
CE310	26340	25813	25817		25937	26053	25813	26340	25992	2.0%	
CE320	26433	25250	25294		25846	25912	25250	26433	25747	4.6%	
CE330	27300	26172	25925		26928	26775	25925	27300	26620	5.2%	
CE340	26963	25829	25745		26473	26400	25745	26963	26282	4.6%	
CE350	19317	17802	17801		18738	18891	17801	19317	18510	8.2%	
CE360	40106	38999	38955		39697	39941	38955	40106	39540	2.9%	
CE400	19179	18106	18131			18629	18106	19179	18511	5.8%	
CE410	19204	18823	18850			18685	18685	19204	18891	2.8%	
CE420	20359	19596	19934			20214	19596	20359	20026	3.8%	
CE430	19599	19059	18951			18966	18951	19599	19144	3.4%	
CE440	20629	20042	19989			20249	19989	20629	20227	3.2%	
CE500	17854	18473	18478		17858	18522	17854	18522	18237	3.7%	
CE500 May-Sep	13942	14508	14506		13989	14491	13942	14508	14287	4.0%	
CE510 May-Sep	27748	28811	28810		27902	28721	27748	28811	28398	3.7%	
CE520	19521	20121	20126		19655	20185	19521	20185	19922	3.3%	
CE522	18620	19407	19418		18690	19281	18620	19418	19083	4.2%	
CE525	16558	16880	16893		16507	17443	16507	17443	16856	5.6%	
CE530	13657	14127	14124		13856	14172	13657	14172	13987	3.7%	
CE540	15021	15680	15677		15164	15664	15021	15680	15441	4.3%	
CE545	12622	12967	12957		12751	13215	12622	13215	12902	4.6%	

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-2. Annual Space Cooling Electricity Consumption (Supply Fan, Condenser Fan)

Energy Consumption, Supply Fan (kWh,e)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	10880	10880	10880	10862	10880	10880	10862	10880	10877	0.2%	10862
CE310	10880	10880	10880	10862	10880	10880	10862	10880	10877	0.2%	10862
CE320	10880	10880	10880	10862	10880	10880	10862	10880	10877	0.2%	10862
CE330	10880	10880	10880	10862	10880	10880	10862	10880	10877	0.2%	10862
CE340	10880	10880	10880	10862	10880	10880	10862	10880	10877	0.2%	10862
CE350	10880	10880	10880	10862	10880	10880	10862	10880	10877	0.2%	10862
CE360	10880	10880	10880	10862	10880	10880	10862	10880	10877	0.2%	10862
CE400	10880	10880	10880	10862		10880	10862	10880	10876	0.2%	10862
CE410	10880	10880	10880			10880	10880	10880	10880	0.0%	10862
CE420	10880	10880	10880	10862		10880	10862	10880	10876	0.2%	10862
CE430	10880	10880	10880	10862		10880	10862	10880	10876	0.2%	10862
CE440	10880	10880	10880	10862		10880	10862	10880	10876	0.2%	10862
CE500	2564	2369	2369	2628	2553	2639	2369	2639	2520	10.7%	2629
CE500 May-Sep	1972	1837	1837	2029	1970	2035	1837	2035	1947	10.2%	2031
CE510 May-Sep	3923	4099	4099	4063	3972	4073	3923	4099	4038	4.4%	4064
CE520	3125	2874	2871	3019	3131	3200	2871	3200	3037	10.8%	3140
CE522	2816	2704	2707	2843	2819	2904	2704	2904	2799	7.1%	2878
CE525	2152	1886	1885	2180	2136	2221	1885	2221	2077	16.2%	2191
CE530	2072	1833	1833	2090	2051	2117	1833	2117	1999	14.2%	2320
CE540	2522	2258	2258	2309	2500	2573	2258	2573	2403	13.1%	2561
CE545	1753	1501	1501	1871	1739	1786	1501	1871	1692	21.9%	2107

Energy Consumption, Condenser Fan (kWh,e)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	2400	2301	2302		2326	2323	2301	2400	2331	4.3%	
CE310	2754	2686	2687		2703	2691	2686	2754	2704	2.5%	
CE320	2747	2615	2618		2675	2681	2615	2747	2667	4.9%	
CE330	2784	2656	2633		2727	2693	2633	2784	2699	5.6%	
CE340	2776	2649	2640		2713	2684	2640	2776	2692	5.1%	
CE350	2040	1865	1867		1969	1970	1865	2040	1942	9.0%	
CE360	4313	4185	4181		4266	4272	4181	4313	4243	3.1%	
CE400	1986	1860	1865			1902	1860	1986	1903	6.6%	
CE410	1994	1965	1969			1936	1936	1994	1966	3.0%	
CE420	2149	2054	2096			2115	2054	2149	2103	4.5%	
CE430	2059	1993	1980			1970	1970	2059	2001	4.5%	
CE440	2182	2110	2104			2120	2104	2182	2129	3.7%	
CE500	1920	1975	1975		1912	1976	1912	1976	1952	3.3%	
CE500 May-Sep	1477	1527	1527		1476	1524	1476	1527	1506	3.4%	
CE510 May-Sep	2938	3061	3061		2974	3050	2938	3061	3017	4.1%	
CE520	2340	2394	2393		2345	2396	2340	2396	2374	2.4%	
CE522	2108	2182	2182		2111	2174	2108	2182	2151	3.4%	
CE525	1611	1642	1643		1599	1663	1599	1663	1632	3.9%	
CE530	1552	1580	1580		1536	1585	1536	1585	1567	3.1%	
CE540	1888	1940	1939		1872	1926	1872	1940	1913	3.5%	
CE545	1312	1334	1333		1302	1337	1302	1337	1324	2.7%	

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

Table B16.5.2-3. Weather Data Checks, CE300 Only

Variable	TRNSYS	DOE-2.2	DOE21E-E	EnergyPlus	CODYRUN	HOT3000	Statistics, All Results				TRACE 3D Plus Trane
	TUD	NREL	NREL	GARD	UR	NRCan	Min	Max	Mean	(Max-Min) /Mean*	
Annual Mean Output											
ODB (°C)	19.91	19.89	19.89	19.91	19.91	19.91	19.89	19.91	19.91	0.1%	19.91
OHR (kg/kg)	0.01164	0.01160	0.01160	0.01159	0.01165	0.01160	0.01159	0.01165	0.01161	0.5%	0.01161
Annual Hourly Integrated Maxima											
ODB (°C)	34.70	35.00	35.00	34.78	35.00	35.00	34.70	35.00	34.91	0.9%	34.78
OHR (kg/kg)	0.02188	0.02250	0.02250	0.02184	0.02241	0.02230	0.02184	0.02250	0.02224	3.0%	0.02187

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

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Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-4. Annual Space Cooling Coil Loads (Total, Sensible)

Total Sensible + Latent (kWh,thermal)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	80427	77283	77292	77318	77745	78257	77283	80427	78054	4.0%	78395
CE310	99342	97395	97412	96448	97296	97261	96448	99342	97526	3.0%	97417
CE320	99792	96356	96493	96084	97141	96957	96084	99792	97137	3.8%	97200
CE330	105013	100730	100993	102211	103713	102008	100730	105013	102445	4.2%	103719
CE340	102728	99028	99223	99709	100676	99753	99028	102728	100186	3.7%	101108
CE350	69388	63736	63635	65790	66860	67389	63635	69388	66133	8.7%	66915
CE360	162974	159807	159854	161248	161200	162168	159807	162974	161209	2.0%	162209
CE400	68793	64918	65025	65414		66898	64918	68793	66209	5.9%	63746
CE410	68673	66780	66844			66175	66175	68673	67118	3.7%	63746
CE420	72609	69611	70882	70349		71803	69611	72609	71051	4.2%	71285
CE430	69756	67641	67219	67141		67200	67141	69756	67792	3.9%	68456
CE440	73711	71380	71181	71417		72029	71181	73711	71944	3.5%	72444
CE500	63357	65996	65992	65571	63105	65614	63105	65996	64939	4.5%	65571
CE500 May-Sep	48443	50693	50690	50354	48440	50357	48440	50693	49830	4.5%	50357
CE510 May-Sep	108974	114018	114015	112793	108979	112781	108974	114018	111927	4.5%	112796
CE520	63422	66571	66565	66088	63212	66146	63212	66571	65334	5.1%	66213
CE522	63389	66373	66372	65851	63157	65900	63157	66373	65174	4.9%	65888
CE525	63293	65399	65395	64973	63002	65155	63002	65399	64536	3.7%	64991
CE530	45046	46634	46631	46944	44875	47002	44875	47002	46189	4.6%	47174
CE540	45113	47130	47126	47297	44980	47462	44980	47462	46518	5.3%	47522
CE545	44981	46240	46236	46612	44775	46668	44775	46668	45919	4.1%	46852

Sensible Coil Load (kWh,thermal)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	56662	55797	55805	55252	55209	55191	55191	56662	55653	2.6%	55299
CE310	56256	56301	56313	55225	55185	55083	55083	56313	55727	2.2%	55269
CE320	62859	62697	62747	62043	62009	62734	62009	62859	62515	1.4%	61675
CE330	63083	63311	63328	63779	62649	61822	61822	63779	62995	3.1%	63045
CE340	63033	63053	63111	62886	62381	61406	61406	63111	62645	2.7%	62455
CE350	50371	47684	47677	48545	48589	48768	47677	50371	48606	5.5%	48675
CE360	134977	134920	134940	135287	134206	134697	134206	135287	134838	0.8%	134897
CE400	41952	41419	41437	40688		41181	40688	41952	41335	3.1%	41581
CE410	45677	47659	47660			45585	45585	47660	46645	4.4%	41581
CE420	50390	49666	50612	49524		49984	49524	50612	50035	2.2%	49550
CE430	47863	47731	47454	46739		46143	46143	47863	47186	3.6%	47108
CE440	50876	50593	50492	50060		49785	49785	50876	50361	2.2%	50150
CE500	45044	47650	47646	47491	44874	47530	44874	47650	46706	5.9%	47490
CE500 May-Sep	34443	36596	36593	36476	34448	36480	34443	36596	35839	6.0%	36479
CE510 May-Sep	77489	82306	82303	81566	77499	81563	77489	82306	80454	6.0%	81570
CE520	45110	48102	48096	47986	44977	48059	44977	48102	47055	6.6%	48108
CE522	45076	47962	47961	47758	44924	47795	44924	47962	46913	6.5%	47793
CE525	44979	47218	47213	46930	44775	47110	44775	47218	46371	5.3%	46943
CE530	45046	46574	46570	46944	44874	47002	44874	47002	46168	4.6%	47174
CE540	45112	47023	47019	47288	44977	47460	44977	47460	46480	5.3%	47522
CE545	44981	46214	46210	46612	44775	46668	44775	46668	45910	4.1%	46852

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

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Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-5. Annual Space Cooling Coil Loads (Latent)

Case	Latent Coil Load(kWh,thermal)						Statistics, All Results				TRACE 3D Plus Trane
	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	23765	21487	21487	22066	22535	23067	21487	23765	22401	10.2%	23097
CE310	43086	41094	41099	41222	42111	42178	41094	43086	41798	4.8%	42148
CE320	36932	33659	33746	34040	35133	34224	33659	36932	34622	9.5%	35525
CE330	41929	37419	37666	38433	41063	40186	37419	41929	39449	11.4%	40675
CE340	39695	35974	36113	36823	38296	38346	35974	39695	37541	9.9%	38654
CE350	19017	16052	15958	17245	18271	18621	15958	19017	17527	17.5%	18239
CE360	27997	24887	24914	25961	26994	27470	24887	27997	26371	11.8%	27312
CE400	26840	23498	23588	24726		25717	23498	26840	24874	13.4%	22165
CE410	22996	19121	19184			20590	19121	22996	20473	18.9%	22165
CE420	22219	19945	20270	20826		21855	19945	22219	21023	10.8%	21735
CE430	21893	19909	19765	20403		21057	19765	21893	20605	10.3%	21348
CE440	22835	20788	20689	21357		22244	20689	22835	21583	9.9%	22294
CE500	18313	18346	18346	18080	18231	18084	18080	18346	18233	1.5%	18081
CE500 May-Sep	14000	14097	14097	13879	13991	13877	13877	14097	13990	1.6%	13878
CE510 May-Sep	31485	31712	31712	31226	31480	31217	31217	31712	31472	1.6%	31226
CE520	18312	18470	18470	18101	18235	18087	18087	18470	18279	2.1%	18105
CE522	18313	18411	18410	18093	18233	18104	18093	18411	18261	1.7%	18095
CE525	18314	18182	18182	18044	18227	18045	18044	18314	18165	1.5%	18049
CE530	0	61	61	0	1	0	0	61	20	297.1%	0
CE540	1	107	107	9	3	2	1	107	38	278.2%	0
CE545	0	25	25	0	0	0	0	25	9	300.0%	0

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

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Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-6. Various Annual Means (COP2, IDB)

COP2							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	3.249	3.238	3.237	3.237	3.226	3.230	3.226	3.249	3.236	0.7%	3.243
CE310	3.415	3.417	3.417	3.393	3.397	3.380	3.380	3.417	3.403	1.1%	3.408
CE320	3.420	3.458	3.457	3.405	3.406	3.390	3.390	3.458	3.423	2.0%	3.418
CE330	3.491	3.494	3.536	3.491	3.497	3.460	3.460	3.536	3.495	2.2%	3.507
CE340	3.454	3.477	3.496	3.448	3.450	3.420	3.420	3.496	3.457	2.2%	3.463
CE350	3.249	3.241	3.235	3.244	3.229	3.230	3.229	3.249	3.238	0.6%	3.255
CE360	3.669	3.701	3.706	3.678	3.667	3.660	3.660	3.706	3.680	1.2%	3.681
CE400	3.250	3.251	3.252	3.246		3.260	3.246	3.260	3.252	0.4%	3.218
CE410	3.240	3.212	3.211			3.210	3.210	3.240	3.218	0.9%	3.218
CE420	3.226	3.215	3.218	3.216		3.210	3.210	3.226	3.217	0.5%	3.222
CE430	3.221	3.213	3.211	3.211		3.210	3.210	3.221	3.213	0.3%	3.219
CE440	3.231	3.222	3.222	3.221		3.220	3.220	3.231	3.223	0.4%	3.228
CE500	3.204	3.227	3.227	3.213	3.192	3.200	3.192	3.227	3.211	1.1%	3.210
CE500 May-Sep	3.142	3.161	3.162	3.154	3.132	3.140	3.132	3.162	3.148	0.9%	3.147
CE510 May-Sep	3.551	3.577	3.577	3.562	3.530	3.550	3.530	3.577	3.558	1.3%	3.556
CE520	2.901	2.957	2.956	3.004	2.873	2.920	2.873	3.004	2.935	4.5%	2.923
CE522	3.058	3.074	3.073	3.101	3.036	3.070	3.036	3.101	3.069	2.1%	3.066
CE525	3.484	3.531	3.528	3.508	3.480	3.410	3.410	3.531	3.490	3.5%	3.500
CE530	2.962	2.969	2.969	2.999	2.916	2.980	2.916	2.999	2.966	2.8%	2.924
CE540	2.668	2.675	2.675	2.823	2.640	2.690	2.640	2.823	2.695	6.8%	2.688
CE545	3.228	3.233	3.236	3.157	3.186	3.200	3.157	3.236	3.207	2.5%	3.137

IDB (°C)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE300	23.62	24.06	24.06	24.09	24.08	23.99	23.62	24.09	23.98	1.9%	24.09
CE310	23.76	24.11	24.06	24.09	24.09	24.01	23.76	24.11	24.02	1.5%	24.10
CE320	23.90	24.39	24.39	24.25	24.33	24.53	23.90	24.53	24.30	2.6%	24.27
CE330	23.88	24.28	24.28	24.27	24.30	24.18	23.88	24.30	24.20	1.7%	24.31
CE340	23.88	24.28	24.28	24.30	24.31	24.21	23.88	24.31	24.21	1.8%	24.32
CE350	25.66	26.17	26.17	26.24	26.27	26.15	25.66	26.27	26.11	2.3%	26.22
CE360	25.36	25.61	25.56	25.32	25.48	25.37	25.32	25.61	25.45	1.1%	25.43
CE400	24.13	24.06	24.06	24.09		23.99	23.99	24.13	24.06	0.6%	24.09
CE410	24.12	24.06	24.06			23.99	23.99	24.12	24.06	0.5%	24.09
CE420	23.93	24.06	24.06	24.09		23.99	23.93	24.09	24.02	0.7%	24.09
CE430	23.99	24.06	24.06	24.09		23.99	23.99	24.09	24.04	0.4%	24.09
CE440	23.91	24.06	24.06	24.09		23.99	23.91	24.09	24.02	0.7%	24.09
CE500	20.23	20.67	20.56	20.38	21.10	22.86	20.23	22.86	20.97	12.5%	20.59
CE500 May-Sep	24.57	25.00	25.00	24.98	25.00	25.00	24.57	25.00	24.93	1.7%	25.00
CE510 May-Sep	25.82	25.11	25.11	24.96	25.00	25.00	24.96	25.82	25.17	3.4%	25.00
CE520	13.52	13.78	13.72	13.58	14.14	14.89	13.52	14.89	13.94	9.9%	13.71
CE522	16.95	17.28	17.22	17.00	17.73	18.70	16.95	18.70	17.48	10.0%	17.17
CE525	26.84	27.39	27.28	27.10	27.77	30.69	26.84	30.69	27.85	13.8%	27.40
CE530	20.03	20.61	20.56	20.59	21.10	22.86	20.03	22.86	20.96	13.5%	20.59
CE540	13.29	13.78	13.72	13.79	14.14	14.98	13.29	14.98	13.95	12.1%	13.71
CE545	26.61	27.33	27.28	27.31	27.72	30.69	26.61	30.69	27.82	14.7%	27.40

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-7. Various Annual Means (Humidity Ratio, Zone Relative Humidity)

Humidity Ratio (kg/kg)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	Trane
CE300	0.0091	0.0092	0.0092	0.0093	0.0092	0.0092	0.0091	0.0093	0.0092	2.4%	0.0091
CE310	0.0111	0.0113	0.0113	0.0113	0.0112	0.0111	0.0111	0.0113	0.0112	2.0%	0.0111
CE320	0.0100	0.0101	0.0101	0.0101	0.0100	0.0099	0.0099	0.0101	0.0100	2.1%	0.0100
CE330	0.0097	0.0099	0.0099	0.0100	0.0098	0.0099	0.0097	0.0100	0.0099	2.3%	0.0099
CE340	0.0098	0.0099	0.0099	0.0100	0.0099	0.0099	0.0098	0.0100	0.0099	1.9%	0.0099
CE350	0.0097	0.0100	0.0100	0.0099	0.0098	0.0098	0.0097	0.0100	0.0099	3.0%	0.0098
CE360	0.0085	0.0087	0.0087	0.0088	0.0086	0.0086	0.0085	0.0088	0.0086	3.1%	0.0086
CE400	0.0098	0.0100	0.0100	0.0101		0.0100	0.0098	0.0101	0.0100	2.9%	0.0098
CE410	0.0097	0.0095	0.0095			0.0095	0.0095	0.0097	0.0096	2.5%	0.0098
CE420	0.0093	0.0094	0.0094	0.0094		0.0093	0.0093	0.0094	0.0094	2.0%	0.0093
CE430	0.0093	0.0094	0.0094	0.0095		0.0094	0.0093	0.0095	0.0094	1.9%	0.0094
CE440	0.0092	0.0093	0.0093	0.0093		0.0092	0.0092	0.0093	0.0093	1.9%	0.0092
CE500	0.0098			0.0094	0.0102	0.0107	0.0094	0.0107	0.0100	13.2%	0.0092
CE500 May-Sep	0.0110	0.0114	0.0114	0.0113	0.0113	0.0109	0.0109	0.0114	0.0112	4.5%	0.0110
CE510 May-Sep	0.0114	0.0114	0.0114	0.0113	0.0113	0.0109	0.0109	0.0114	0.0113	4.4%	0.0110
CE520	0.0067			0.0060	0.0070	0.0076	0.0060	0.0076	0.0068	23.1%	0.0060
CE522	0.0082			0.0076	0.0086	0.0090	0.0076	0.0090	0.0083	16.8%	0.0075
CE525	0.0137			0.0138	0.0140	0.0151	0.0137	0.0151	0.0141	9.8%	0.0135
CE530	0.0062			0.0067	0.0058	0.0067	0.0058	0.0067	0.0064	14.4%	0.0029
CE540	0.0045			0.0043	0.0039	0.0046	0.0039	0.0046	0.0043	17.9%	0.0029
CE545	0.0062			0.0067	0.0067	0.0072	0.0062	0.0072	0.0067	14.8%	0.0029

Relative Humidity (%)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	Trane
CE300	48.61	48.26	48.28	48.59	47.83	47.93	47.83	48.61	48.25	1.6%	47.85
CE310	58.33	58.51	58.53	58.55	57.84	57.80	57.80	58.55	58.26	1.3%	57.81
CE320	52.01	51.21	51.25	51.84	51.10	49.94	49.94	52.01	51.22	4.0%	51.34
CE330	50.84	50.58	50.65	51.18	50.08	50.70	50.08	51.18	50.67	2.2%	50.49
CE340	51.09	50.69	50.73	51.15	50.30	50.78	50.30	51.15	50.79	1.7%	50.56
CE350	45.48	45.45	45.55	45.17	44.32	44.56	44.32	45.55	45.09	2.7%	44.59
CE360	41.03	41.49	41.49	42.37	40.87	41.21	40.87	42.37	41.41	3.6%	41.28
CE400	50.77	52.21	52.25	52.55		52.01	50.77	52.55	51.96	3.4%	51.16
CE410	50.50	49.65	49.63			49.75	49.63	50.50	49.88	1.7%	51.16
CE420	48.78	49.14	48.97	49.40		48.76	48.76	49.40	49.01	1.3%	48.76
CE430	48.82	49.17	49.30	49.60		49.17	48.82	49.60	49.21	1.6%	48.94
CE440	48.33	48.46	48.57	48.83		48.23	48.23	48.83	48.48	1.2%	48.18
CE500	66.53			59.20	65.94	63.73	59.20	66.53	63.85	11.5%	57.55
CE500 May-Sep	57.05	57.47	57.47	57.32	57.07	55.13	55.13	57.47	56.92	4.1%	55.48
CE510 May-Sep	54.70	57.36	57.36	57.44	57.06	55.24	54.70	57.44	56.53	4.8%	55.58
CE520	69.87			61.40	70.23	72.17	61.40	72.17	68.42	15.7%	60.70
CE522	68.68			60.75	68.23	68.11	60.75	68.68	66.44	11.9%	59.33
CE525	61.47			54.99	60.14	57.37	54.99	61.47	58.49	11.1%	53.31
CE530	46.73			48.97	41.45	39.60	39.60	48.97	44.19	21.2%	21.38
CE540	48.52			46.31	40.05	43.82	40.05	48.52	44.67	19.0%	30.16
CE545	36.62			38.63	36.87	29.20	29.20	38.63	35.33	26.7%	16.85

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-8. f(ODB) Sensitivity CE500 and CE530, April 30 and June 25 (Energy, Coil Loads)

Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Statistics, All Results				TRACE 3D Plus Trane
							Min	Max	Mean	(Max-Min) /Mean*	
Energy Consumption, Compr. + Both Fans (Wh,e)											
CE500Apr30	3893	3975	3975	4029	3901	4073	3893	4073	3974	4.5%	4020
CE500Jun25	5045	5204	5204	5229	5067	5230	5045	5230	5163	3.6%	5244
Del CE500	1152	1229	1229	1200	1165	1157	1152	1229	1189	6.5%	1225
CE530Apr30	3023	3062	3062	3101	3092	3144	3023	3144	3081	3.9%	3221
CE530Jun25	3894	3978	3978	4029	3935	4043	3894	4043	3976	3.7%	4196
Del CE530	871	916	916	927	843	899	843	927	896	9.4%	975
Energy Consumption, Compressor (Wh,e)											
CE500Apr30	3015	3120	3120		3020	3159	3015	3159	3087	4.7%	
CE500Jun25	4084	4264	4263		4106	4239	4084	4264	4191	4.3%	
Del CE500	1069	1144	1144		1086	1080	1069	1144	1105	6.7%	
CE530Apr30	2311	2390	2390		2378	2411	2311	2411	2376	4.2%	
CE530Jun25	3118	3243	3243		3166	3248	3118	3248	3204	4.1%	
Del CE530	807	853	853		787	837	787	853	827	8.0%	
Energy Consumption, Condenser Fan (Wh,e)											
CE500Apr30	376	389	389		377	391	376	391	385	3.9%	
CE500Jun25	411	426	426		411	424	411	426	420	3.6%	
Del CE500	35	37	37		34	33	33	37	35	12.0%	
CE530Apr30	305	311	311		305	314	305	314	309	3.1%	
CE530Jun25	332	340	340		329	340	329	340	336	3.2%	
Del CE530	28	28	29		24	26	24	29	27	17.0%	
Energy Consumption, Supply Fan (Wh,e)											
CE500Apr30	502	467	466	519	504	522	466	522	497	11.2%	518
CE500Jun25	550	514	514	566	549	566	514	566	543	9.5%	567
Del CE500	47	48	48	47	45	44	44	48	47	8.5%	49
CE530Apr30	407	361	361	412	408	419	361	419	395	14.8%	453
CE530Jun25	444	396	396	450	440	454	396	454	430	13.6%	502
Del CE530	37	35	35	38	32	35	32	38	35	16.0%	49
Sensible + Latent Coil Load (Wh,th)											
CE500Apr30	13186	13733	13733	13655	13170	13673	13170	13733	13525	4.2%	13655
CE500Jun25	13188	13838	13837	13733	13198	13727	13188	13838	13587	4.8%	13734
Del CE500	2	105	104	78	29	54	2	105	62	165.3%	79
CE530Apr30	9353	9721	9721	9775	9365	9798	9353	9798	9622	4.6%	9817
CE530Jun25	9376	9761	9761	9835	9388	9834	9376	9835	9659	4.8%	9888
Del CE530	23	40	39	60	22	36	22	60	37	102.8%	71
Sensible Coil Load (Wh,th)											
CE500Apr30	9375	9925	9925	9884	9365	9902	9365	9925	9729	5.8%	9884
CE500Jun25	9378	9981	9981	9953	9388	9946	9378	9981	9771	6.2%	9954
Del CE500	3	56	56	69	22	44	3	69	42	158.2%	70
CE530Apr30	9353	9721	9721	9775	9365	9798	9353	9798	9622	4.6%	9817
CE530Jun25	9376	9761	9761	9835	9388	9834	9376	9835	9659	4.8%	9888
Del CE530	23	40	39	60	22	36	22	60	37	102.9%	71
Latent Coil Load (Wh,th)											
CE500Apr30	3811	3808	3808	3772	3804	3770	3770	3811	3795	1.1%	3771
CE500Jun25	3810	3856	3856	3781	3810	3780	3780	3856	3816	2.0%	3780
Del CE500	-1	48	48	9	6	10	-1	48	20	242.3%	9
CE530Apr30	0	0	0	0	0	0	0	0	0	----	0
CE530Jun25	0	0	0	0	0	0	0	0	0	----	0
Del CE530	0	0	0	0	0	0	0	0	0	----	0

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-9. f(ODB) Sensitivity CE500 and CE530, April 30 and June 25 (COP2, Zone Conditions)

Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Statistics, All Results				TRACE 3D Plus Trane
							Min	Max	Mean	(Max-Min) /Mean*	
Humidity Ratio (kg/kg)											
CE500Apr30	0.0107	0.0110	0.0110	0.0110	0.0109	0.0160	0.0107	0.0160	0.0118	45.3%	0.0106
CE500Jun25	0.0112	0.0115	0.0115	0.0115	0.0115	0.0110	0.0110	0.0115	0.0114	4.4%	0.0111
Del CE500	0.0005	0.0005	0.0005	0.0005	0.0005	-0.0050	-0.0050	0.0005	-0.0004	1334.8%	0.0005
CE530Apr30	0.0062	0.0071	0.0071	0.0068	0.0055	0.0067	0.0055	0.0071	0.0066	24.6%	0.0029
CE530Jun25	0.0062	0.0078	0.0078	0.0068	0.0055	0.0067	0.0055	0.0078	0.0068	34.2%	0.0029
Del CE530	0.0000	0.0007	0.0007	0.0000	0.0000	0.0000	0.0000	0.0007	0.0002	304.5%	0.0000
COP2											
CE500Apr30	3.845	3.914	3.914	3.850	3.837	3.850	3.837	3.914	3.868	2.0%	3.899
CE500Jun25	2.931	2.951	2.951	2.943	2.921	2.940	2.921	2.951	2.939	1.0%	2.936
Del CE500	-0.914	-0.963	-0.963	-0.907	-0.916	-0.910	-0.963	-0.907	-0.929	6.1%	-0.963
CE530Apr30	3.543	3.599	3.599	3.441	3.460	3.590	3.441	3.599	3.539	4.5%	3.546
CE530Jun25	2.720	2.724	2.724	2.780	2.690	2.740	2.690	2.780	2.730	3.3%	2.677
Del CE530	-0.823	-0.874	-0.875	-0.662	-0.770	-0.850	-0.875	-0.662	-0.809	26.3%	-0.869
ODB (°C)											
CE500Apr30	16.79	16.83	16.83	16.81	16.88	16.96	16.79	16.96	16.85	1.0%	16.81
CE500Jun25	29.52	29.50	29.50	29.52	29.52	29.50	29.50	29.52	29.51	0.1%	29.52
Del CE500	12.73	12.67	12.67	12.70	12.63	12.54	12.54	12.73	12.66	1.5%	12.70
CE530Apr30	16.79	16.83	16.83	16.81	16.88	16.96	16.79	16.96	16.85	1.0%	16.81
CE530Jun25	29.52	29.50	29.50	29.52	29.52	29.50	29.50	29.52	29.51	0.1%	29.52
Del CE530	12.73	12.67	12.67	12.70	12.63	12.54	12.54	12.73	12.66	1.5%	12.70
EDB (°C)											
CE500Apr30	24.64	24.94	24.94	24.98	25.00	25.00	24.64	25.00	24.92	1.4%	25.00
CE500Jun25	24.55	25.00	25.00	24.98	25.00	25.00	24.55	25.00	24.92	1.8%	18.88
Del CE500	-0.09	0.06	0.06	0.00	0.00	0.00	-0.09	0.06	0.00	4740.8%	-6.12
CE530Apr30	24.37	24.94	24.67	25.00	25.00	25.00	24.37	25.00	24.83	2.6%	25.00
CE530Jun25	24.35	24.94	24.94	25.00	25.00	25.00	24.35	25.00	24.87	2.6%	11.45
Del CE530	-0.01	0.00	0.28	0.00	0.00	0.00	-0.01	0.28	0.04	651.2%	-13.55

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-10. Hourly Integrated Maxima (Total Cooling System Energy Consumption and Total Coil Load)

Energy Consumption, Compressor + Both Fans (Wh,e)													Statistics, All Results				TRACE 3D Plus								
Case	TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour					
	TUD	Date	Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*								
CE300	11626	20-Jul	15	11564	20-Jul	15	11602	20-Jul	15	11900	20-Jul	15	11932	20-Jul	15	11548	11932	11695	3.3%	12000	20-Jul	15			
CE310	12594	20-Jul	15	12583	20-Jul	15	12595	20-Jul	15	12541	20-Jul	15	12653	20-Jul	15	12162	16-Aug	16	12162	12653	12521	3.9%	12564	20-Jul	15
CE320	13028	20-Jul	15	12916	20-Jul	15	12981	20-Jul	15	12954	20-Jul	15	13104	20-Jul	15	12875	20-Jul	14	12875	13104	12976	1.8%	12975	20-Jul	15
CE330	13347	20-Jul	15	13212	20-Jul	15	13407	20-Jul	15	13314	20-Jul	15	13467	20-Jul	15	13335	20-Jul	15	13212	13467	13347	1.9%	13358	20-Jul	15
CE340	13181	20-Jul	15	13158	20-Jul	15	13190	20-Jul	15	13134	20-Jul	15	13277	20-Jul	15	13101	20-Jul	14	13101	13277	13174	1.3%	13169	20-Jul	15
CE350	11627	20-Jul	15	11654	20-Jul	15	11602	20-Jul	15	11900	20-Jul	15	11932	20-Jul	15	11546	20-Jul	15	11546	11932	11710	3.3%	12000	20-Jul	15
CE360	12770	20-Jul	15	12736	20-Jul	15	12726	20-Jul	15	12744	20-Jul	15	12863	20-Jul	15	12762	20-Jul	14	12726	12863	12767	1.1%	12778	20-Jul	15
CE400	11628	20-Jul	15	11564	20-Jul	15	11677	18-Sep	15	11900	20-Jul	15				11519	20-Jul	15	11519	11900	11658	3.3%	12000	20-Jul	15
CE410	11628	20-Jul	15	11564	20-Jul	15	11602	20-Jul	15						11549	20-Jul	15	11549	11628	11586	0.7%	12000	20-Jul	15	
CE420	11626	20-Jul	15	11564	20-Jul	15	11602	20-Jul	15	11900	20-Jul	15			11548	20-Jul	15	11548	11900	11648	3.0%	12000	20-Jul	15	
CE430	11626	20-Jul	15	11564	20-Jul	15	11602	20-Jul	15	11900	20-Jul	15			11548	20-Jul	15	11548	11900	11648	3.0%	12000	20-Jul	15	
CE440	11626	20-Jul	15	11564	20-Jul	15	11602	20-Jul	15	11900	20-Jul	15			11461	16-Aug	16	11461	11900	11631	3.8%	12000	20-Jul	15	
CE500	10166	20-Jul	15	10431	20-Jul	15	10425	20-Jul	15	10399	20-Jul	15	10177	20-Jul	15	10274	4-Jun	15	10166	10431	10312	2.6%	10433	20-Jul	15
CE510	11205	20-Jul	15	11590	20-Jul	15	11587	20-Jul	15	11410	20-Jul	15	11186	20-Jul	15	11344	20-Jul	14	11186	11590	11387	3.5%	11449	20-Jul	15
CE520	11035	20-Jul	15	10989	20-Jul	15	11014	20-Jul	15	11101	20-Jul	15	11044	20-Jul	15	10684	4-Jun	15	10684	11101	10978	3.8%	11262	20-Jul	15
CE522	10431	20-Jul	15	10972	20-Jul	15	10966	20-Jul	15	10762	20-Jul	15	10639	20-Jul	15	10747	16-Aug	15	10431	10972	10753	5.0%	10898	20-Jul	15
CE525	9367	20-Jul	15	9538	20-Jul	15	9531	20-Jul	15	9570	20-Jul	15	9419	20-Jul	15	9585	16-Aug	15	9367	9585	9502	2.3%	9582	20-Jul	15
CE530	8028	20-Jul	15	8059	20-Jul	15	8055	20-Jul	15	8171	20-Jul	15	7992	20-Jul	15	8089	16-Aug	15	7992	8171	8066	2.2%	8433	20-Jul	15
CE540	8699	20-Jul	15	8943	20-Jul	15	8939	20-Jul	15	8677	20-Jul	15	8846	20-Jul	15	8985	16-Aug	15	8677	8985	8848	3.5%	9110	20-Jul	15
CE545	7205	20-Jul	15	7350	20-Jul	15	7346	20-Jul	15	7763	20-Jul	15	7351	20-Jul	15	7471	4-Jun	15	7205	7763	7414	7.5%	7891	20-Jul	15
Sensible + Latent Coil Load (Wh,th)													Statistics, All Results				TRACE 3D Plus								
Case	TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour					
	TUD	Date	Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*								
CE300	32174	08-Jul	15	31401	20-Jul	15	31455	20-Jul	15	32733	20-Jul	15	32502	20-Jul	15	32072	20-Jul	15	31401	32733	32056	4.2%	33073	20-Jul	15
CE310	37328	03-Sep	15	36750	3-Sep	16	37033	3-Sep	16	37126	17-Sep	15	37261	3-Sep	15	36991	3-Sep	16	36750	37328	37082	1.6%	37371	17-Sep	15
CE320	40318	03-Sep	16	53813	2-Oct	9	53823	2-Oct	9	39765	3-Sep	16	39904	3-Sep	16	39920	3-Sep	16	39765	53823	44590	31.5%	40009	2-Oct	10
CE330	43492	02-Oct	9	43628	2-Oct	9	64572	2-Oct	9	43445	2-Oct	9	43978	2-Oct	9	42415	10-Jul	11	42415	64572	46922	47.2%	43602	2-Oct	9
CE340	41652	02-Oct	10	50819	2-Oct	9	59549	2-Oct	9	41328	2-Oct	10	41366	3-Sep	15	41132	3-Sep	16	41132	59549	45974	40.1%	41629	2-Oct	10
CE350	32092	08-Jul	15	31401	20-Jul	15	31454	20-Jul	15	32733	20-Jul	15	32502	20-Jul	15	32077	20-Jul	15	31401	32733	32043	4.2%	33074	20-Jul	15
CE360	38857	02-Oct	10	40613	2-Oct	9	41019	2-Oct	9	38460	2-Oct	11	38322	2-Oct	10	38451	2-Oct	10	38322	41019	39287	6.9%	38668	3-Sep	13
CE400	41179	16-Sep	15	40543	18-Sep	14	49838	18-Sep	15	40728	16-Sep	15			40774	16-Sep	14	40543	49838	42612	21.8%	37854	25-Oct	16	
CE410	32092	08-Jul	15	31401	20-Jul	15	31455	20-Jul	15						32073	20-Jul	15	31401	32092	31755	2.2%	37854	25-Oct	16	
CE420	32174	08-Jul	15	31401	20-Jul	15	31455	20-Jul	15	32733	20-Jul	15			32072	20-Jul	15	31401	32733	31967	4.2%	33073	20-Jul	15	
CE430	32174	08-Jul	15	31401	20-Jul	15	31455	20-Jul	15	32733	20-Jul	15			32072	20-Jul	15	31401	32733	31967	4.2%	33073	20-Jul	15	
CE440	32174	08-Jul	15	31401	20-Jul	15	31455	20-Jul	15	32733	20-Jul	15			31777	8-Jul	16	31401	32733	31908	4.2%	33073	20-Jul	15	
CE500	27486	28-Oct	15	27707	16-Aug	16	27706	16-Aug	16	27646	29-Jun	16	26567	29-Jun	16	27555	29-Jun	15	26567	27707	27444	4.2%	27656	29-Jun	16
CE510	30593	29-Apr	19	31188	20-Jul	15	31188	20-Jul	15	31178	17-Jun	14	29948	17-Jun	14	31097	17-Jun	13	29948	31188	30865	4.0%	31223	27-Apr	1
CE520	27330	28-Sep	15	27878	14-Aug	16	27878	23-Jul	16	27653	29-Jun	16	26675	20-Jul	16	28343	23-May	15	26675	28343	27626	6.0%	27731	29-Jun	16
CE522	27384	12-Mai	15	27868	16-Aug	16	27866	16-Aug	16	27659	29-Jun	16	26514	29-Jun	16	27636	29-Jun	15	26514	27868	27488	4.9%	27699	29-Jun	16
CE525	27740	26-Jul	16	27466	8-Jul	16	27466	8-Jul	16	27577	29-Jun	16	26683	29-Jun	16	27462	29-Jun	15	26683	27740	27399	3.9%	27565	29-Jun	16
CE530	19834	29-Mai	15	19576	24-Apr	16	19575	24-Apr	16	19639	20-Jul	15	18776	4-Jun	15	19626	8-Jul	15	18776	19834	19504	5.4%	19737	20-Jul	15
CE540	19575	30-Aug	16	19766	24-Apr	16	19766	24-Apr	16	19726	20-Jul	15	18794	4-Jun	15	19799	16-Aug	15	18794	19799	19571	5.1%	19842	20-Jul	15
CE545	20075	17-Jun	16	19475	24-Apr	16	19474	24-Apr	16	19540	20-Jul	15	18764	20-Jul	15	19497	4-Jun	15	18764	20075	19471	6.7%	19639	20-Jul	15

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-11. Hourly Integrated Maxima (Sensible Coil Load and Latent Coil Load)

Sensible Coil Load (Wh,th)													Statistics, All Results				TRACE 3D Plus								
Case	TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour					
	TUD	Date	Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*								
CE300	23277	20-Jul	16	23203	20-Jul	15	23205	20-Jul	15	23531	20-Jul	15	23457	20-Jul	15	22908	4-Jun	15	22908	23531	23264	2.7%	23533	20-Jul	15
CE310	23094	10-Sep	16	23080	10-Sep	16	23119	4-Jun	16	23276	11-Jul	16	23078	10-Sep	15	22649	13-Jun	16	22649	23276	23049	2.7%	23222	11-Jul	16
CE320	31316	24-Apr	16	31119	24-Apr	16	31072	24-Apr	16	31972	24-Apr	15	31134	3-Jun	16	30967	24-Apr	15	30967	31972	31263	3.2%	31405	24-Apr	16
CE330	33226	14-Jun	14	33410	14-Jun	14	34490	14-Jun	15	34765	14-Jun	15	33997	24-Apr	16	33421	9-Sep	14	33226	34765	33885	4.5%	34701	14-Jun	14
CE340	32829	24-Apr	15	32086	16-May	16	32086	16-May	16	32888	24-Apr	15	32940	24-Apr	16	32180	24-Apr	15	32086	32940	32501	2.6%	32651	16-May	16
CE350	23278	29-Jul	15	23203	20-Jul	15	23205	20-Jul	15	23531	20-Jul	15	23457	20-Jul	15	22876	10-Jul	15	22876	23531	23258	2.8%	23535	20-Jul	15
CE360	32061	24-Apr	16	32111	24-Apr	16	32065	24-Apr	16	32621	24-Apr	16	31981	24-Apr	16	32179	24-Apr	15	31981	32621	32170	2.0%	32420	24-Apr	16
CE400	23278	29-Jul	15	23203	20-Jul	15	23205	20-Jul	15	23531	20-Jul	15				22877	8-Jul	16	22877	23531	23219	2.8%	23533	20-Jul	15
CE410	23266	10-Sep	16	23203	20-Jul	15	23205	20-Jul	15							22893	29-Jul	15	22893	23266	23142	1.6%	23533	20-Jul	15
CE420	23277	20-Jul	16	23203	20-Jul	15	23205	20-Jul	15	23531	20-Jul	15				22893	29-Jul	15	22893	23531	23222	2.7%	23533	20-Jul	15
CE430	23277	20-Jul	16	23203	20-Jul	15	23205	20-Jul	15	23531	20-Jul	15				22893	29-Jul	15	22893	23531	23222	2.7%	23533	20-Jul	15
CE440	23277	20-Jul	16	23203	20-Jul	15	23205	20-Jul	15	23531	20-Jul	15				22875	16-Aug	16	22875	23531	23218	2.8%	23533	20-Jul	15
CE500	19549	28-Oct	15	20009	4-Jun	16	20008	10-Sep	16	19849	20-Jul	15	18776	4-Jun	15	19818	29-Jul	15	18776	20009	19668	6.3%	19845	20-Jul	15
CE510	21729	29-Apr	19	22513	11-Jul	15	22513	11-Jul	15	22290	20-Jul	15	21121	4-Jun	13	22269	20-Jul	14	21121	22513	22073	6.3%	22294	29-Jul	17
CE520	19416	28-Sep	15	20159	26-May	16	20154	26-May	16	19999	20-Jul	15	18969	20-Jul	16	20378	23-May	15	18969	20378	19846	7.1%	20059	20-Jul	16
CE522	19489	12-Mai	15	20137	11-Jul	16	20135	11-Jul	16	19934	20-Jul	15	18785	4-Jun	15	19920	16-Aug	15	18785	20137	19733	6.9%	19947	20-Jul	15
CE525	19703	26-Jul	16	19850	24-Apr	16	19850	24-Apr	16	19664	20-Jul	15	18759	4-Jun	15	19661	4-Jun	15	18759	19850	19581	5.6%	19659	20-Jul	15
CE530	19834	29-Mai	15	19576	24-Apr	16	19575	24-Apr	16	19639	20-Jul	15	18776	4-Jun	15	19626	8-Jul	15	18776	19834	19504	5.4%	19737	20-Jul	15
CE540	19575	30-Aug	16	19766	24-Apr	16	19766	24-Apr	16	19726	20-Jul	15	18794	4-Jun	15	19799	16-Aug	15	18794	19799	19571	5.1%	19842	20-Jul	15
CE545	20075	17-Jun	16	19475	24-Apr	16	19474	24-Apr	16	19540	20-Jul	15	18759	4-Jun	15	19497	4-Jun	15	18759	20075	19470	6.8%	19639	20-Jul	15
Latent Coil Load (Wh,th)													Statistics, All Results				TRACE 3D Plus								
Case	TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour					
	TUD	Date	Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*								
CE300	9636	03-Sep	16	9304	3-Sep	15	9394	3-Sep	15	10235	10-Jul	13	10375	3-Sep	15	10392	3-Sep	15	9304	10392	9889	11.0%	10537	10-Jul	13
CE310	15907	03-Sep	15	15139	3-Sep	15	15270	3-Sep	15	16275	4-Aug	15	16112	4-Aug	15	16077	3-Sep	16	15139	16275	15797	7.2%	16552	4-Aug	15
CE320	23147	02-Oct	10	31497	2-Oct	9	31503	2-Oct	9	22195	2-Oct	10	21697	17-Sep	12	21929	1-Oct	20	21697	31503	25328	38.7%	22660	2-Oct	10
CE330	27825	18-Sep	16	26941	18-Sep	15	40809	2-Oct	9	27134	18-Sep	16	28184	18-Sep	15	27488	18-Sep	15	26941	40809	29730	46.6%	27596	18-Sep	16
CE340	24848	02-Oct	9	30451	2-Oct	9	36011	2-Oct	9	23911	2-Oct	10	24225	3-Sep	17	23794	1-Oct	20	23794	36011	27207	44.9%	24431	2-Oct	10
CE350	9751	01-Oct	13	9303	3-Sep	15	9393	3-Sep	15	10235	10-Jul	13	10755	2-Oct	8	11603	3-Aug	7	9303	11603	10173	22.6%	10538	10-Jul	13
CE360	9275	02-Oct	10	10026	2-Oct	9	10336	2-Oct	9	8520	2-Oct	11	8859	3-Sep	17	8934	3-Sep	17	8520	10336	9325	19.5%	8815	2-Oct	11
CE400	27075	16-Sep	15	25578	18-Sep	14	32396	18-Sep	15	26317	16-Sep	14				26645	16-Sep	14	25578	32396	27602	24.7%	22857	17-Jun	16
CE410	11139	16-Sep	15	9304	3-Sep	15	9391	3-Sep	15							10377	9-Sep	15	9304	11139	10053	18.3%	22857	17-Jun	16
CE420	9751	01-Oct	13	9304	3-Sep	15	9394	3-Sep	15	10235	10-Jul	13				10394	3-Sep	15	9304	10394	9816	11.1%	10537	10-Jul	13
CE430	9636	03-Sep	16	11105	24-Oct	14	11101	21-May	15	11074	24-Oct	13				10394	3-Sep	15	9636	11105	10662	13.8%	11378	24-Oct	13
CE440	9636	03-Sep	16	9304	3-Sep	15	9391	3-Sep	15	10235	10-Jul	13				10139	3-Sep	15	9304	10235	9741	9.6%	10537	10-Jul	13
CE500	7965	06-Oct	15	7733	3-Sep	15	7733	3-Sep	15	7839	29-Jun	16	7805	29-Jun	16	7762	29-Jun	15	7733	7965	7806	3.0%	7849	29-Jun	16
CE510	8893	15-Sep	11	8723	2-Oct	9	8723	2-Oct	9	8955	17-Jun	14	8850	17-Jun	14	8874	17-Jun	13	8723	8955	8836	2.6%	9223	27-Apr	1
CE520	7914	28-Sep	15	7785	3-Sep	15	7785	3-Sep	15	7699	29-Jun	16	7726	30-Jun	16	7964	23-May	15	7699	7964	7812	3.4%	7736	29-Jun	16
CE522	7907	02-Mai	15	7760	3-Sep	15	7760	3-Sep	15	7770	29-Jun	16	7743	29-Jun	16	7745	29-Jun	15	7743	7907	7781	2.1%	7796	29-Jun	16
CE525	8037	26-Jul	16	7663	3-Sep	15	7663	3-Sep	15	7947	29-Jun	16	7938	29-Jun	16	7820	29-Jun	15	7663	8037	7845	4.8%	7934	29-Jun	16
CE530	0	18-Jun	16	0	0-Jan	0	0	0-Jan	0	1	16-Mar	10	179	11-Mar	11	36	1-Nov	20	0	179	36	497.3%	0	1-Jan	1
CE540	627	11-Mar	10	0	0-Jan	0	0	0-Jan	0	1655	11-Mar	10	845	11-Mar	10	1181	11-Mar	10	0	1655	718	230.5%	0	1-Jan	1
CE545	0	01-Jul	16	0	0-Jan	0	0	0-Jan	0	0	23-May	15	4	20-Jul	15	0	1-Jan	1	0	4	1	600.0%	0	1-Jan	1

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-12. Hourly Integrated Maxima and Minima (COP2)

Maximum COP2													Statistics, All Results				TRACE 3D Plus		
TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour
Case	TUD	Date Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*			
CE300	4.168	16-Apr 3	3.869	30-Apr 16	3.857	30-Apr 16	3.925	30-Apr 15	3.871	30-Apr 16	3.880	30-Apr 16	3.857	4.168	3.928	7.9%	4.105	18-Oct	6
CE310	4.143	30-Apr 15	4.141	30-Apr 16	4.128	30-Apr 16	4.173	30-Apr 15	4.128	30-Apr 15	4.120	30-Apr 15	4.120	4.173	4.139	1.3%	4.467	18-Oct	6
CE320	4.168	16-Apr 3	5.143	2-Oct 9	4.967	2-Oct 9	3.940	16-Sep 15	3.943	16-Sep 15	4.380	18-Dec 3	3.940	5.143	4.424	27.2%	4.171	18-Oct	6
CE330	4.168	16-Apr 3	4.109	17-Jun 16	5.595	2-Oct 9	4.071	16-Sep 14	4.122	17-Jun 16	4.050	17-Jun 16	4.050	5.595	4.353	35.5%	4.105	18-Oct	6
CE340	4.168	16-Apr 3	4.621	2-Oct 9	5.339	2-Oct 9	3.987	16-Sep 15	4.017	16-Sep 16	3.950	16-Sep 16	3.950	5.339	4.347	32.0%	4.105	18-Oct	6
CE350	4.168	16-Apr 3	3.889	27-Apr 5	3.863	5-Oct 3	4.555	13-Oct 1	3.932	4-Oct 24	3.880	30-Apr 16	3.863	4.555	4.048	17.1%	3.992	30-Apr	8
CE360	4.401	05-Oct 1	4.428	4-Oct 24	4.427	4-Oct 24	4.455	4-Oct 24	4.432	4-Oct 24	4.440	4-Oct 24	4.401	4.455	4.431	1.2%	4.839	18-Oct	6
CE400	4.077	16-Sep 15	4.088	17-Jun 16	4.776	18-Sep 15	4.071	16-Sep 14			4.050	17-Jun 16	4.050	4.776	4.212	17.2%	4.094	17-Jun	16
CE410	3.888	30-Apr 15	3.903	30-Apr 15	3.855	30-Apr 16					3.840	21-May 15	3.840	3.903	3.871	1.6%	4.094	17-Jun	16
CE420	3.781	27-Sep 16	3.807	21-May 15	3.759	27-Sep 15	3.821	21-May 15			3.940	21-May 13	3.759	3.940	3.822	4.7%	4.013	18-Oct	6
CE430	3.781	27-Sep 16	3.805	24-Oct 15	3.759	27-Sep 15	3.793	21-May 16			3.930	30-Apr 13	3.759	3.930	3.814	4.5%	4.013	18-Oct	6
CE440	3.883	12-Dec 7	3.774	27-Sep 15	3.759	27-Sep 15	3.802	21-May 15			3.810	30-Apr 15	3.759	3.883	3.806	3.3%	4.013	18-Oct	6
CE500	4.275	13-Oct 1	7.367	11-Mar 10	5.301	13-Oct 9	4.198	16-Mar 10	4.185	16-Mar 10	4.140	30-Apr 16	4.140	7.367	4.911	65.7%	4.425	11-Apr	9
CE510	4.693	05-Oct 1	7.367	11-Mar 10	5.301	13-Oct 9	4.685	5-Oct 1	4.690	4-Oct 24	4.530	4-May 3	4.530	7.367	5.211	54.4%	4.994	20-Apr	5
CE520	3.814	30-Apr 15	4.896	16-Mar 10	4.652	16-Mar 10	3.938	30-Apr 15	3.802	30-Apr 16	3.840	30-Apr 16	3.802	4.896	4.157	26.3%	3.991	11-Apr	9
CE522	3.986	16-Mar 10	6.233	11-Mar 10	5.678	11-Mar 10	4.042	30-Apr 15	3.986	30-Apr 16	4.000	30-Apr 16	3.986	6.233	4.654	48.3%	4.219	11-Apr	9
CE525	4.718	13-Oct 1	6.325	12-Apr 9	6.031	16-Mar 10	4.704	16-Mar 10	4.638	16-Mar 10	4.400	16-Mar 10	4.400	6.325	5.136	37.5%	4.865	11-Apr	9
CE530	4.006	02-Nov 1	3.981	11-Mar 10	3.850	13-Oct 9	3.925	16-Mar 10	3.840	16-Mar 10	3.880	16-Mar 10	3.840	4.006	3.914	4.2%	3.996	11-Apr	9
CE540	3.456	30-Apr 15	3.456	30-Apr 16	3.455	30-Apr 16	3.696	16-Mar 10	3.667	11-Mar 22	3.690	17-Oct 5	3.455	3.696	3.570	6.7%	3.666	11-Apr	9
CE545	4.250	16-Mar 10	4.275	16-Mar 10	4.428	16-Mar 10	4.166	16-Mar 10	4.156	16-Mar 10	4.170	16-Mar 10	4.156	4.428	4.241	6.4%	4.315	11-Apr	9

Minimum COP2													Statistics, All Results				TRACE 3D Plus		
TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour
Case	TUD	Date Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*			
CE300	2.793	24-Apr 17	2.798	1-Dec 14	2.801	1-Dec 12	2.782	13-Jun 17	2.786	13-Jun 17	2.810	14-Jun 12	2.782	2.810	2.795	1.0%	2.775	13-Jun	17
CE310	2.865	01-Dec 15	2.850	1-Dec 14	2.851	1-Dec 12	2.893	1-Dec 15	2.873	1-Dec 15	2.870	1-Dec 14	2.850	2.893	2.867	1.5%	2.815	15-Mar	15
CE320	2.825	31-Mar 14	2.801	1-Dec 14	2.805	1-Dec 15	2.842	31-Mar 15	2.815	31-Mar 15	2.830	31-Mar 14	2.801	2.842	2.820	1.4%	2.781	15-Mar	15
CE330	2.825	31-Mar 14	2.798	1-Dec 14	2.801	1-Dec 12	2.844	31-Mar 15	2.823	31-Mar 15	2.840	31-Mar 14	2.798	2.844	2.822	1.6%	2.781	15-Mar	15
CE340	2.825	31-Mar 14	2.798	1-Dec 14	2.801	1-Dec 12	2.844	31-Mar 15	2.823	31-Mar 15	2.840	31-Mar 14	2.798	2.844	2.822	1.6%	2.781	15-Mar	15
CE350	2.790	24-Apr 17	2.798	1-Dec 14	2.801	1-Dec 12	2.782	13-Jun 17	2.786	13-Jun 17	2.810	14-Jun 12	2.782	2.810	2.794	1.0%	2.775	13-Jun	17
CE360	2.825	31-Mar 14	2.799	1-Dec 14	2.801	1-Dec 12	2.844	31-Mar 15	2.823	31-Mar 15	2.840	31-Mar 14	2.799	2.844	2.822	1.6%	2.781	15-Mar	15
CE400	2.782	31-Mar 19	2.734	3-Dec 15	2.735	3-Dec 13	2.782	13-Jun 17			2.810	14-Jun 12	2.734	2.810	2.768	2.7%	2.775	13-Jun	17
CE410	2.786	24-Apr 17	2.798	1-Dec 14	2.801	1-Dec 12					2.810	14-Jun 12	2.786	2.810	2.799	0.9%	2.775	13-Jun	17
CE420	2.793	24-Apr 17	2.798	1-Dec 14	2.801	1-Dec 12	2.782	13-Jun 17			2.810	14-Jun 12	2.782	2.810	2.797	1.0%	2.775	13-Jun	17
CE430	2.771	30-Mar 19	2.734	3-Dec 13	2.735	3-Dec 13	2.782	13-Jun 17			2.810	14-Jun 12	2.734	2.810	2.766	2.7%	2.775	13-Jun	17
CE440	2.782	31-Mar 19	2.734	3-Dec 13	2.735	3-Dec 13	2.782	13-Jun 17			2.810	8-Apr 13	2.734	2.810	2.769	2.7%	2.775	13-Jun	17
CE500	2.685	30-Jul 12	2.693	29-Jul 12	2.652	30-Mar 17	2.705	30-Jul 12	2.666	30-Jul 12	2.710	29-Jul 12	2.652	2.710	2.685	2.2%	2.694	26-Apr	18
CE510	2.888	31-Mar 15	2.817	5-Apr 17	2.652	30-Mar 17	2.865	31-Mar 18	2.882	31-Mar 15	2.900	31-Mar 14	2.652	2.900	2.834	8.8%	2.694	26-Apr	18
CE520	2.442	30-Jul 12	2.463	5-Apr 17	2.394	5-Apr 17	2.532	30-Jul 12	2.333	29-Jan 10	2.470	30-Jul 12	2.333	2.532	2.439	8.1%	2.406	26-Apr	18
CE522	2.569	08-Jul 17	2.572	29-Jul 12	2.562	31-Mar 17	2.613	30-Jul 12	2.429	30-Mar 17	2.590	29-Jul 12	2.429	2.613	2.556	7.2%	2.555	26-Apr	18
CE525	2.911	14-Jul 17	2.939	30-Jul 12	2.814	31-Mar 17	2.940	30-Jul 12	2.894	29-Jul 12	2.900	29-Jul 12	2.814	2.940	2.900	4.3%	2.933	30-Jul	12
CE530	2.501	30-Jul 12	2.495	29-Jul 12	2.498	29-Jul 12	2.532	30-Jul 12	2.473	29-Jul 12	2.520	29-Jul 12	2.473	2.532	2.503	2.3%	2.464	30-Jul	12
CE540	2.253	30-Jul 12	2.261	29-Jul 12	2.262	30-Jul 12	2.383	30-Jul 12	2.143	5-Apr 20	2.280	29-Jul 12	2.143	2.383	2.264	10.6%	2.275	30-Jul	12
CE545	2.733	14-Jul 17	2.720	29-Jul 12	2.722	30-Jul 12	2.660	30-Jul 12	2.692	29-Jul 12	2.720	29-Jul 12	2.660	2.733	2.708	2.7%	2.636	30-Jul	12

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-13. Hourly Integrated Maxima and Minima (IDB)

Maximum IDB (°C)														Statistics, All Results				TRACE 3D Plus							
Case	TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour					
	TUD	Date	Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*								
CE300	26.20	07-Jul	15	25.11	22-Apr	15	25.11	22-Apr	15	25.00	23-Sep	8	25.05	21-Feb	17	26.19	3-Nov	15	25.00	26.20	25.44	4.7%	25.01	11-Oct	16
CE310	27.08	20-Jul	15	26.89	20-Jul	16	26.72	20-Jul	16	26.47	20-Jul	16	26.62	20-Jul	15	27.19	8-Jul	15	26.47	27.19	26.83	2.7%	26.55	20-Jul	16
CE320	32.36	20-Jul	15	31.61	8-Jul	16	31.50	8-Jul	16	31.71	20-Jul	15	32.32	20-Jul	15	31.65	8-Jul	15	31.50	32.36	31.86	2.7%	31.81	20-Jul	15
CE330	32.23	20-Jul	15	31.72	8-Jul	16	32.00	20-Jul	16	31.07	8-Jul	16	31.90	20-Jul	15	31.30	8-Jul	15	31.07	32.23	31.70	3.7%	31.56	20-Jul	15
CE340	32.31	20-Jul	15	31.61	8-Jul	16	31.56	8-Jul	16	31.50	20-Jul	15	32.15	20-Jul	15	31.58	8-Jul	15	31.50	32.31	31.78	2.5%	31.74	20-Jul	15
CE350	34.58	01-Oct	24	34.94	23-Jun	24	34.94	24-Jun	24	35.00	1-Oct	2	35.00	21-Apr	1	35.00	21-Apr	2	34.58	35.00	34.91	1.2%	35.00	11-Oct	3
CE360	33.76	10-Jul	13	32.78	20-Jul	15	32.56	20-Jul	16	32.51	10-Jul	13	33.00	20-Jul	15	33.13	10-Jul	12	32.51	33.76	32.96	3.8%	32.81	10-Jul	13
CE400	27.11	16-Sep	15	27.56	16-Sep	16	28.83	18-Sep	16	26.91	16-Sep	16				26.04	15-Aug	15	26.04	28.83	27.29	10.2%	25.07	25-Oct	15
CE410	26.83	23-Oct	15	25.11	22-Apr	15	25.11	22-Apr	15							26.19	3-Nov	15	25.11	26.83	25.81	6.6%	25.07	25-Oct	15
CE420	26.20	07-Jul	15	25.11	22-Apr	15	25.11	22-Apr	15	25.00	23-Sep	8				26.23	20-Oct	15	25.00	26.23	25.53	4.8%	25.01	11-Oct	16
CE430	27.20	01-Nov	16	25.11	22-Apr	15	25.11	22-Apr	15	25.00	18-May	19				26.45	23-Oct	15	25.00	27.20	25.77	8.5%	25.01	11-Oct	16
CE440	27.05	28-Apr	15	25.11	22-Apr	15	25.11	22-Apr	15	25.00	24-Apr	19				26.26	23-Oct	15	25.00	27.05	25.71	7.9%	25.01	11-Oct	16
CE500	25.81	30-Apr	15	25.11	21-Apr	16	25.11	21-Apr	16	25.00	31-Mar	18	25.02	30-Mar	17	25.00	11-Mar	11	25.00	25.81	25.17	3.2%	25.01	18-Apr	19
CE510	26.10	09-Jul	15	25.11	21-Apr	3	25.11	21-Apr	3	25.00	31-Mar	18	25.02	30-Mar	17	25.00	24-Apr	12	25.00	26.10	25.22	4.4%	25.01	29-Jul	16
CE520	16.12	15-Aug	15	16.11	16-Aug	16	15.94	10-Jul	16	15.00	16-Apr	1	15.98	20-Jul	15	18.62	4-Jun	16	15.00	18.62	16.30	22.2%	15.28	20-Jul	16
CE522	21.01	16-Jul	15	20.11	21-Apr	15	20.11	21-Apr	15	20.00	16-Apr	20	20.05	13-Mar	22	20.93	21-Apr	15	20.00	21.01	20.37	5.0%	20.01	9-Nov	5
CE525	36.08	10-Mai	16	35.06	21-Apr	16	35.06	21-Apr	16	35.00	11-Mar	12	35.00	11-Mar	10	35.00	11-Mar	11	35.00	36.08	35.20	3.1%	35.00	29-Jul	18
CE530	26.12	04-Jun	15	25.06	21-Apr	16	25.06	21-Apr	16	25.00	30-Mar	17	25.02	30-Mar	17	25.00	11-Mar	11	25.00	26.12	25.21	4.4%	25.01	18-Apr	19
CE540	16.15	21-Sep	16	15.11	31-May	16	15.11	31-May	16	15.00	25-Mar	8	15.05	28-Jan	20	15.00	11-Mar	10	15.00	16.15	15.24	7.5%	15.01	15-Apr	24
CE545	35.67	20-Jul	15	35.00	21-Apr	15	35.00	21-Apr	15	35.00	9-Jul	22	35.00	11-Mar	10	35.00	11-Mar	11	35.00	35.67	35.11	1.9%	35.00	14-Jul	18

Minimum IDB (°C)														Statistics, All Results				TRACE 3D Plus							
Case	TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour					
	TUD	Date	Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*								
CE300	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6	8.00	6-Jan	5	6.99	6-Jan	5	6.99	8.89	8.23	23.1%	8.77	6-Jan	6
CE310	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6	8.00	6-Jan	5	6.99	6-Jan	5	6.99	8.89	8.23	23.1%	8.77	6-Jan	6
CE320	7.93	06-Jan	6	10.83	6-Jan	7	10.78	6-Jan	7	7.75	6-Jan	6	8.00	6-Jan	5	6.99	6-Jan	5	6.99	10.83	8.71	44.1%	7.80	6-Jan	6
CE330	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6	8.00	6-Jan	5	6.99	6-Jan	5	6.99	8.89	8.23	23.1%	8.77	6-Jan	6
CE340	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6	8.00	6-Jan	5	6.99	6-Jan	5	6.99	8.89	8.23	23.1%	8.77	6-Jan	6
CE350	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6	8.00	6-Jan	5	6.99	6-Jan	5	6.99	8.89	8.23	23.1%	8.77	6-Jan	6
CE360	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6	8.00	6-Jan	5	6.99	6-Jan	5	6.99	8.89	8.23	23.1%	8.77	6-Jan	6
CE400	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6				6.99	6-Jan	5	6.99	8.89	8.27	23.0%	8.77	6-Jan	6
CE410	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6							6.99	6-Jan	5	6.99	8.89	8.16	23.3%	8.77	6-Jan	6
CE420	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6				6.99	6-Jan	5	6.99	8.89	8.27	23.0%	8.77	6-Jan	6
CE430	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6				6.99	6-Jan	5	6.99	8.89	8.27	23.0%	8.77	6-Jan	6
CE440	7.93	06-Jan	6	8.89	6-Jan	6	8.83	6-Jan	6	8.72	6-Jan	6				7.00	6-Jan	5	7.00	8.89	8.27	22.8%	8.77	6-Jan	6
CE500	8.43	20-Dec	22	8.17	20-Dec	12	7.94	20-Dec	11	8.94	21-Dec	2	8.54	20-Dec	20	24.04	15-Apr	5	7.94	24.04	11.01	146.2%	9.08	20-Dec	24
CE510	8.43	20-Dec	22	8.17	20-Dec	12	7.94	20-Dec	11	8.94	21-Dec	2	8.54	20-Dec	20	24.04	15-Apr	5	7.94	24.04	11.01	146.2%	9.08	20-Dec	24
CE520	8.31	20-Dec	22	8.11	20-Dec	12	7.89	20-Dec	12	8.83	21-Dec	1	8.51	20-Dec	20	13.57	1-Nov	7	7.89	13.57	9.20	61.7%	8.94	20-Dec	24
CE522	8.41	20-Dec	22	8.17	20-Dec	12	7.94	20-Dec	11	8.90	21-Dec	1	8.54	20-Dec	20	15.98	12-Apr	19	7.94	15.98	9.66	83.3%	9.02	20-Dec	24
CE525	8.44	20-Dec	22	8.17	20-Dec	13	7.94	20-Dec	12	9.01	21-Dec	2	8.54	20-Dec	20	33.01	1-Apr	8	7.94	33.01	12.52	200.2%	9.18	21-Dec	1
CE530	8.42	20-Dec	22	8.17	20-Dec	12	7.94	20-Dec	11	8.94	21-Dec	2	8.54	20-Dec	20	24.04	15-Apr	5	7.94	24.04	11.01	146.3%	9.08	20-Dec	24
CE540	8.23	20-Dec	22	8.11	20-Dec	12	7.89	20-Dec	12	8.83	21-Dec	1	8.51	20-Dec	20	14.95	19-Dec	1	7.89	14.95	9.42	74.9%	8.94	20-Dec	24
CE545	8.45	20-Dec	22	8.17	20-Dec	13	7.94	20-Dec	12	9.01	21-Dec	2	8.54	20-Dec	20	33.01	1-Apr	8	7.94	33.01	12.52	200.2%	9.18	21-Dec	1

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-14. Hourly Integrated Maxima and Minima (Zone Humidity Ratio)

Maximum Humidity Ratio														Statistics, All Results				TRACE 3D Plus						
TRNSYS			DOE-2.2			DOE21E-E			EnergyPlus			CODYRUN			HOT3000			(Max-Min)				TRACE 3D Plus		
Case	TUD	Date Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*	Trane	Date	Hour					
CE300	0.0133	16-Nov 17	0.0138	16-Nov 16	0.0137	16-Nov 16	0.0136	16-Nov 17	0.0135	16-Nov 16	0.0134	16-Nov 16	0.0133	0.0138	0.0135	3.8%	0.0135	16-Nov	17					
CE310	0.0158	01-Oct 23	0.0188	15-Oct 9	0.0189	15-Oct 9	0.0156	1-Oct 8	0.0154	2-Oct 8	0.0157	2-Oct 8	0.0154	0.0189	0.0167	20.8%	0.0155	1-Oct	8					
CE320	0.0180	10-Jul 13	0.0177	10-Jul 12	0.0176	10-Jul 12	0.0178	10-Jul 13	0.0175	10-Jul 12	0.0177	10-Jul 12	0.0175	0.0180	0.0177	2.7%	0.0177	1-Oct	11					
CE330	0.0177	10-Jul 12	0.0178	2-Oct 9	0.0177	10-Jul 13	0.0179	10-Jul 12	0.0170	10-Jul 13	0.0177	10-Jul 12	0.0170	0.0179	0.0176	5.0%	0.0178	10-Jul	12					
CE340	0.0179	10-Jul 13	0.0177	10-Jul 12	0.0174	10-Jul 12	0.0178	10-Jul 12	0.0173	10-Jul 13	0.0177	10-Jul 12	0.0173	0.0179	0.0176	3.4%	0.0177	10-Jul	12					
CE350	0.0168	01-Oct 24	0.0199	2-Aug 22	0.0199	2-Aug 22	0.0172	2-Oct 1	0.0165	2-Oct 2	0.0166	2-Oct 1	0.0165	0.0199	0.0178	19.2%	0.0169	2-Oct	1					
CE360	0.0134	10-Jul 13	0.0138	16-Nov 16	0.0137	16-Nov 16	0.0139	10-Jul 13	0.0135	16-Nov 16	0.0134	16-Nov 16	0.0134	0.0139	0.0136	3.4%	0.0135	16-Nov	17					
CE400	0.0169	05-Apr 22	0.0170	5-Apr 21	0.0170	5-Apr 21	0.0169	5-Apr 22			0.0173	22-Apr 6	0.0169	0.0173	0.0170	2.5%	0.0169	5-Apr	22					
CE410	0.0168	05-Apr 22	0.0169	2-Apr 5	0.0169	2-Apr 5					0.0173	22-Apr 6	0.0168	0.0173	0.0170	2.7%	0.0169	5-Apr	22					
CE420	0.0143	02-Apr 10	0.0147	1-Apr 21	0.0141	17-Apr 3	0.0146	2-Apr 18			0.0147	2-Apr 18	0.0141	0.0147	0.0145	4.1%	0.0146	2-Apr	18					
CE430	0.0162	02-Apr 5	0.0156	2-Apr 4	0.0156	2-Apr 4	0.0161	2-Apr 5			0.0158	2-Apr 5	0.0156	0.0162	0.0159	4.0%	0.0161	2-Apr	5					
CE440	0.0133	16-Nov 17	0.0138	16-Nov 16	0.0137	16-Nov 16	0.0136	16-Nov 17			0.0134	16-Nov 16	0.0133	0.0138	0.0136	3.6%	0.0135	16-Nov	17					
CE500	0.0117	11-Jul 15	0.0119	20-Jul 15	0.0118	6-Apr 10	0.0117	20-Jul 15	0.0117	20-Jul 15	0.0115	11-Mar 10	0.0115	0.0119	0.0117	3.4%	0.0114	20-Jul	15					
CE510	0.0119	07-Sep 15	0.0119	20-Jul 15	0.0119	20-Jul 15	0.0117	20-Jul 15	0.0117	20-Jul 15	0.0115	11-Mar 10	0.0115	0.0119	0.0118	3.4%	0.0114	20-Jul	15					
CE520	0.0075	07-Sep 15	0.0077	10-Jul 16	0.0078	29-Mar 10	0.0070	20-Jul 15	0.0076	20-Jul 15	0.0106	5-Jan 16	0.0070	0.0106	0.0080	44.5%	0.0071	20-Jul	16					
CE522	0.0094	20-Jul 16	0.0095	4-Jun 15	0.0138	6-Apr 10	0.0091	20-Jul 15	0.0094	20-Jul 15	0.0107	1-Jan 2	0.0091	0.0138	0.0103	45.4%	0.0090	20-Jul	15					
CE525	0.0179	10-Mai 16	0.0180	20-Jul 15	0.0180	20-Jul 15	0.0185	20-Jul 15	0.0176	20-Jul 15	0.0173	20-Jul 15	0.0173	0.0185	0.0179	6.6%	0.0178	20-Jul	15					
CE530	0.0070	01-Jan 1	0.0081	20-Jul 15	0.0081	20-Jul 15	0.0068	11-Mar 1	0.0055	1-Apr 1	0.0068	26-Oct 9	0.0055	0.0081	0.0070	37.1%	0.0029	31-Dec	4					
CE540	0.0061	01-Jan 1	0.0050	4-Jun 13	0.0063	8-Apr 8	0.0068	11-Mar 1	0.0033	1-Apr 1	0.0063	11-Mar 9	0.0033	0.0068	0.0056	62.6%	0.0029	31-Dec	9					
CE545	0.0070	01-Jan 1	0.0122	20-Jul 15	0.0122	20-Jul 15	0.0068	31-Dec 7	0.0067	1-Apr 1	0.0076	5-Nov 9	0.0067	0.0122	0.0087	63.0%	0.0029	31-Dec	11					

Minimum Humidity Ratio														Statistics, All Results				TRACE 3D Plus						
TRNSYS			DOE-2.2			DOE21E-E			EnergyPlus			CODYRUN			HOT3000			(Max-Min)				TRACE 3D Plus		
Case	TUD	Date Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*	Trane	Date	Hour					
CE300	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3	0.0020	11-Jan 3	0.0020	5-Jan 6	0.0017	0.0020	0.0019	14.5%	0.0019	11-Jan	3					
CE310	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	5-Jan 7	0.0020	5-Jan 7	0.0020	5-Jan 7	0.0017	0.0020	0.0019	17.1%	0.0019	5-Jan	7					
CE320	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3	0.0020	11-Jan 3	0.0020	5-Jan 6	0.0017	0.0020	0.0019	14.5%	0.0019	11-Jan	3					
CE330	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3	0.0020	11-Jan 3	0.0020	5-Jan 6	0.0017	0.0020	0.0019	14.5%	0.0019	11-Jan	3					
CE340	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3	0.0020	11-Jan 3	0.0020	5-Jan 6	0.0017	0.0020	0.0019	14.5%	0.0019	11-Jan	3					
CE350	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3	0.0020	11-Jan 3	0.0020	5-Jan 6	0.0017	0.0020	0.0019	14.5%	0.0019	11-Jan	3					
CE360	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3	0.0020	11-Jan 3	0.0020	5-Jan 6	0.0017	0.0020	0.0019	14.5%	0.0019	11-Jan	3					
CE400	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3			0.0020	5-Jan 6	0.0017	0.0020	0.0018	14.7%	0.0019	11-Jan	3					
CE410	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24					0.0020	5-Jan 6	0.0017	0.0020	0.0018	14.9%	0.0019	11-Jan	3					
CE420	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3			0.0020	5-Jan 6	0.0017	0.0020	0.0018	14.7%	0.0019	11-Jan	3					
CE430	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3			0.0020	5-Jan 6	0.0017	0.0020	0.0018	14.7%	0.0019	11-Jan	3					
CE440	0.0019	11-Jan 3	0.0017	4-Jan 24	0.0017	4-Jan 24	0.0019	11-Jan 3			0.0020	5-Jan 7	0.0017	0.0020	0.0018	14.7%	0.0019	11-Jan	3					
CE500	0.0068	20-Dec 22					0.0070	20-Dec 12	0.0069	20-Dec 20	0.0103	2-Nov 2	0.0068	0.0103	0.0078	44.7%	0.0071	20-Dec	12					
CE510	0.0068	20-Dec 22					0.0070	20-Dec 12	0.0069	20-Dec 20	0.0105	2-Apr 22	0.0068	0.0105	0.0078	47.0%	0.0071	20-Dec	12					
CE520	0.0061	26-Nov 2					0.0065	10-Nov 9	0.0065	27-Nov 23	0.0066	1-Nov 7	0.0061	0.0066	0.0064	7.3%	0.0065	28-Nov	2					
CE522	0.0068	20-Dec 22					0.0070	20-Dec 12	0.0069	20-Dec 20	0.0078	2-Apr 21	0.0068	0.0078	0.0071	14.1%	0.0070	20-Dec	12					
CE525	0.0068	20-Dec 22					0.0070	20-Dec 12	0.0069	20-Dec 20	0.0154	2-Nov 2	0.0068	0.0154	0.0090	94.7%	0.0071	20-Dec	12					
CE530	0.0062	01-Apr 1					0.0067	18-Oct 12	0.0055	1-Nov 21	0.0066	1-Apr 5	0.0055	0.0067	0.0063	20.5%	0.0029	31-Mar	8					
CE540	0.0041	05-Oct 3					0.0038	18-Oct 9	0.0033	29-Apr 23	0.0042	15-Oct 5	0.0033	0.0042	0.0038	24.6%	0.0029	31-Mar	23					
CE545	0.0062	01-Apr 1					0.0068	1-Apr 2	0.0067	20-Jul 15	0.0070	1-Apr 8	0.0062	0.0070	0.0067	11.9%	0.0029	30-Mar	22					

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-15. Hourly Integrated Maxima and Minima (Relative Humidity)

Maximum Relative Humidity														Statistics, All Results				TRACE 3D Plus				
Case	TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour		
	TUD	Date	Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*					
CE300	68.79	16-Nov	17	69.35	16-Nov	16	68.85	16-Nov	16	68.37	16-Nov	17	67.44	16-Nov	16	67.44	69.35	68.47	2.8%	67.65	16-Nov	17
CE310	77.70	02-Oct	4	100.18	15-Oct	9	100.70	15-Oct	9	78.64	2-Oct	8	77.00	12-Jun	8	78.19	2-Oct	8	27.8%	77.67	2-Oct	8
CE320	81.84	18-Sep	10	83.41	2-Oct	9	83.67	22-Apr	18	82.97	18-Sep	10	83.00	3-Sep	17	81.88	16-Sep	20	2.2%	82.61	18-Sep	10
CE330	76.66	22-Sep	20	78.46	2-Oct	9	77.94	18-Sep	9	76.88	3-Sep	10	76.00	10-Jun	18	78.70	2-Sep	12	3.5%	76.52	22-Sep	20
CE340	79.93	18-Sep	10	81.37	18-Sep	9	81.26	22-Apr	18	80.80	18-Sep	10	80.00	3-Sep	17	80.25	16-Sep	20	1.8%	80.40	18-Sep	10
CE350	68.79	16-Nov	17	81.12	7-Aug	21	81.12	7-Aug	21	68.37	16-Nov	17	70.00	2-Oct	8	72.65	3-Aug	7	17.3%	67.65	16-Nov	17
CE360	68.79	16-Nov	17	69.35	16-Nov	16	68.85	16-Nov	16	68.37	16-Nov	17	68.00	16-Nov	16	67.44	16-Nov	16	2.8%	67.65	16-Nov	17
CE400	83.75	05-Apr	22	85.57	5-Apr	21	85.57	5-Apr	21	84.64	5-Apr	22				83.75	22-Apr	6	3.0%	84.56	5-Apr	22
CE410	83.22	05-Apr	22	84.79	2-Apr	5	84.79	2-Apr	5							86.18	22-Apr	6	3.5%	84.56	5-Apr	22
CE420	70.84	02-Apr	10	74.51	17-Apr	7	71.53	17-Apr	3	73.28	2-Apr	18				73.85	2-Apr	18	5.0%	73.28	2-Apr	18
CE430	80.71	02-Apr	5	78.43	2-Apr	4	78.43	2-Apr	4	80.74	2-Apr	5				78.94	2-Apr	5	2.9%	80.72	2-Apr	5
CE440	68.72	16-Nov	17	69.35	16-Nov	16	68.85	16-Nov	16	68.37	16-Nov	17				67.51	16-Nov	16	2.7%	67.65	16-Nov	17
CE500	100.00	21-Nov	24							100.00	21-Nov	9	100.00	14-Nov	5	60.08	1-Apr	5	44.3%	100.00	22-Nov	8
CE510	100.00	21-Nov	24							100.00	21-Nov	9	100.00	14-Nov	5	57.51	1-Apr	5	47.5%	100.00	22-Nov	8
CE520	90.23	20-Dec	22							93.81	20-Dec	11	95.00	20-Dec	17	71.77	16-Aug	17	26.5%	92.82	20-Dec	11
CE522	100.00	18-Dec	8							100.00	15-Dec	22	100.00	15-Dec	1	71.32	5-Apr	17	30.9%	100.00	16-Dec	5
CE525	100.00	12-Nov	20							100.00	12-Nov	19	100.00	11-Nov	23	51.12	1-Apr	8	55.7%	100.00	17-Nov	8
CE530	91.04	20-Dec	22							96.16	20-Dec	11	79.00	20-Dec	8	36.01	20-Apr	21	79.6%	40.80	20-Dec	11
CE540	61.28	20-Dec	22							55.18	20-Dec	11	47.00	20-Dec	6	39.96	18-Apr	18	41.9%	41.21	20-Dec	11
CE545	90.88	20-Dec	22							96.23	20-Dec	11	97.00	20-Dec	4	24.14	24-Dec	1	94.5%	40.54	20-Dec	11

Minimum Relative Humidity														Statistics, All Results				TRACE 3D Plus				
Case	TRNSYS			DOE-2.2		DOE21E-E		EnergyPlus		CODYRUN		HOT3000		(Max-Min)				Trane	Date	Hour		
	TUD	Date	Hour	NREL	Date Hour	NREL	Date Hour	GARD	Date Hour	UR	Date Hour	NRCan	Date Hour	Min	Max	Mean	/Mean*					
CE300	13.33	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	14.40	6-Nov	6	15.00	6-Nov	5	14.94	6-Nov	8	22.3%	14.38	6-Nov	6
CE310	13.39	06-Nov	6	11.97	6-Nov	4	11.97	6-Nov	4	15.50	6-Nov	8	16.00	6-Nov	8	15.93	6-Nov	8	28.5%	14.42	6-Nov	6
CE320	13.33	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	14.64	6-Nov	6	15.00	6-Nov	5	12.92	20-Dec	5	22.8%	14.60	6-Nov	6
CE330	13.33	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	14.40	6-Nov	6	15.00	6-Nov	5	14.94	6-Nov	8	22.3%	14.38	6-Nov	6
CE340	13.33	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	14.40	6-Nov	6	15.00	6-Nov	5	14.94	6-Nov	8	22.3%	14.38	6-Nov	6
CE350	13.33	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	14.40	6-Nov	6	15.00	6-Nov	5	14.94	6-Nov	8	22.3%	14.38	6-Nov	6
CE360	13.33	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	14.40	6-Nov	6	15.00	6-Nov	5	14.94	6-Nov	8	22.3%	14.38	6-Nov	6
CE400	13.21	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	13.93	6-Nov	6				14.57	6-Nov	5	19.8%	14.04	6-Nov	6
CE410	13.21	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4							14.58	6-Nov	5	20.2%	14.04	6-Nov	6
CE420	13.21	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	13.93	6-Nov	6				14.59	6-Nov	5	19.9%	14.04	6-Nov	6
CE430	13.21	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	13.93	6-Nov	6				14.58	6-Nov	5	19.9%	14.04	6-Nov	6
CE440	13.21	06-Nov	5	11.97	6-Nov	4	11.97	6-Nov	4	13.93	6-Nov	6				14.54	6-Nov	5	19.6%	14.04	6-Nov	6
CE500	53.41	30-Apr	15							55.17	30-Apr	4	54.00	4-Oct	24	52.83	5-Oct	1	4.3%	52.66	20-Apr	6
CE510	52.09	04-Oct	23							55.29	4-May	3	54.00	4-Oct	23	53.15	4-May	4	6.0%	52.70	20-Apr	6
CE520	61.27	25-Nov	24							61.73	27-Nov	24	61.00	27-Nov	22	61.90	20-Jul	15	1.5%	61.37	28-Nov	2
CE522	58.51	30-Apr	15							59.18	30-Apr	4	60.00	4-Oct	23	57.97	5-Oct	1	3.4%	57.17	20-Apr	6
CE525	45.53	30-Apr	15							47.85	5-Oct	2	44.00	4-May	4	44.40	5-Oct	1	8.5%	45.31	20-Apr	6
CE530	29.59	04-Jun	15							34.03	18-Apr	18	28.00	1-Apr	10	33.68	1-Apr	13	19.2%	14.53	18-Apr	19
CE540	36.47	21-Sep	16							36.00	28-Sep	16	31.00	1-Apr	1	39.74	5-Oct	1	24.4%	27.01	28-Sep	18
CE545	17.12	20-Jul	15							19.23	18-Apr	17	19.00	1-Apr	10	20.14	1-Apr	12	16.0%	8.18	18-Apr	17

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-16. June 28 Hourly Output - Case CE300

TRNSYS-TUD Hour	Energy Consumption		Evaporator Coil Load			Zone Hum.	COP2	ODB (°C)	EDB (°C)	EWB (°C)	OHR (kg/kg)
	Compressor (Wh)	Cond Fan (Wh)	Total (Wh)	Sensible (Wh)	Latent (Wh)	Ratio (kg/kg)					
1	2056	257	8132	6189	1942	0.0091	3.517	18.05	23.41	16.96	0.0113
2	2054	257	8116	6202	1914	0.0090	3.513	18.05	23.37	16.90	0.0113
3	2054	257	8128	6194	1934	0.0091	3.517	18.05	23.38	16.94	0.0113
4	1830	230	7224	5549	1676	0.0090	3.507	17.80	23.37	16.86	0.0111
5	2029	256	8105	6319	1786	0.0088	3.546	17.50	23.35	16.70	0.0106
6	1839	230	7131	5686	1445	0.0087	3.447	18.30	23.42	16.57	0.0106
7	2667	309	9711	7597	2115	0.0092	3.263	22.20	24.04	17.32	0.0121
8	3553	384	12121	9558	2563	0.0095	3.079	26.10	24.57	17.79	0.0122
9	4365	458	14556	11758	2798	0.0097	3.018	28.05	25.09	17.97	0.0115
10	4441	458	14639	11506	3133	0.0101	2.988	28.90	25.28	18.40	0.0124
11	5000	506	16374	12342	4032	0.0104	2.974	30.00	25.36	18.82	0.0138
12	5317	529	17248	12810	4438	0.0107	2.950	30.85	25.59	19.12	0.0140
13	6189	617	20498	16816	3682	0.0101	3.012	30.85	26.53	18.84	0.0123
14	6211	616	20234	17284	2951	0.0098	2.964	31.40	26.56	18.55	0.0115
15	7922	781	26687	22882	3805	0.0096	3.066	31.95	26.78	18.55	0.0121
16	7965	781	26723	22285	4438	0.0097	3.055	32.20	26.56	18.67	0.0133
17	5421	529	17231	13048	4183	0.0108	2.896	31.95	26.20	19.40	0.0145
18	5410	529	17506	12721	4785	0.0112	2.947	31.40	26.23	19.77	0.0152
19	5260	529	17662	12491	5171	0.0111	3.051	29.70	25.70	19.58	0.0151
20	4880	506	16990	11655	5335	0.0110	3.154	27.75	25.17	19.37	0.0157
21	3939	409	13540	8882	4658	0.0111	3.114	27.20	24.65	19.44	0.0169
22	3924	410	13565	8880	4684	0.0112	3.130	26.95	24.74	19.48	0.0169
23	4123	434	14531	9449	5082	0.0112	3.189	26.40	24.67	19.47	0.0169
24	3877	410	13692	8807	4885	0.0113	3.194	26.10	24.73	19.57	0.0171

DOE-2.2 Hour	Energy Consumption		Evaporator Coil Load			Zone Hum.	COP2	ODB (°C)	EDB (°C)	EWB (°C)	OHR (kg/kg)
	Compressor (Wh)	Cond Fan (Wh)	Total (Wh)	Sensible (Wh)	Latent (Wh)	Ratio (kg/kg)					
1	1897	237	7552	5889	1663	0.0094	3.539	17.78	23.83	17.34	0.0114
2	1941	240	7630	6070	1560	0.0093	3.499	18.33	23.94	17.29	0.0112
3	1897	237	7550	5881	1669	0.0094	3.538	17.78	23.83	17.34	0.0114
4	1891	237	7534	5878	1656	0.0094	3.540	17.78	23.83	17.34	0.0114
5	1697	215	6798	5675	1123	0.0089	3.555	17.22	23.78	16.85	0.0103
6	2126	259	8136	6439	1698	0.0092	3.411	19.44	24.11	17.30	0.0113
7	3198	352	11076	8342	2734	0.0100	3.120	25.00	24.94	18.39	0.0133
8	3135	332	10291	9070	1221	0.0094	2.968	27.22	25.28	17.78	0.0109
9	4528	469	14786	11873	2913	0.0099	2.959	28.89	25.56	18.36	0.0117
10	4651	479	15340	12039	3301	0.0103	2.990	28.89	25.56	18.68	0.0125
11	5434	537	17455	12812	4643	0.0109	2.923	31.11	25.89	19.48	0.0148
12	5019	498	16215	12612	3603	0.0108	2.939	30.56	25.83	19.23	0.0134
13	6040	597	19723	17139	2584	0.0101	2.972	31.11	25.94	18.56	0.0115
14	6420	633	20808	17638	3170	0.0100	2.950	31.67	26.06	18.60	0.0121
15	7671	751	25387	22196	3191	0.0098	3.014	32.22	26.11	18.46	0.0119
16	8190	800	27581	22528	5053	0.0100	3.068	32.22	26.17	18.84	0.0144
17	5715	561	18205	13599	4605	0.0107	2.901	31.67	26.06	19.35	0.0146
18	5536	544	17933	12830	5103	0.0112	2.950	31.11	25.94	19.75	0.0157
19	4711	481	16012	11876	4137	0.0110	3.084	28.33	25.50	19.32	0.0143
20	4859	504	17082	11532	5550	0.0114	3.185	27.22	25.33	19.76	0.0164
21	3913	405	13435	9302	4133	0.0113	3.111	27.22	25.33	19.76	0.0164
22	3825	399	13280	8974	4307	0.0114	3.144	26.67	25.22	19.80	0.0167
23	3750	395	13192	8787	4404	0.0115	3.183	26.11	25.11	19.84	0.0169
24	3880	407	13724	8799	4925	0.0117	3.201	26.11	25.11	20.14	0.0178

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-16. June 28 Hourly Output - Case CE300 (continued)

DOE-2.1E-E Hour	Energy Consumption		Evaporator Coil Load			Zone Hum.	COP2	ODB (°C)	EDB (°C)	EWB (°C)	OHR (kg/kg)
	Compressor (Wh)	Cond Fan (Wh)	Total (Wh)	Sensible (Wh)	Latent (Wh)	Ratio (kg/kg)					
1	1894	237	7545	5887	1658	0.0094	3.541	17.78	23.83	17.34	0.0114
2	1941	241	7627	6067	1560	0.0093	3.495	18.33	23.94	17.29	0.0112
3	1894	237	7546	5878	1668	0.0094	3.541	17.78	23.83	17.37	0.0114
4	1890	236	7528	5873	1655	0.0094	3.541	17.78	23.83	17.37	0.0114
5	1694	215	6753	5672	1081	0.0090	3.537	17.22	23.78	16.94	0.0103
6	2133	259	8185	6439	1747	0.0092	3.422	19.44	24.11	17.30	0.0113
7	3223	353	11233	8348	2885	0.0098	3.141	25.00	24.94	18.23	0.0133
8	3145	335	10272	9069	1203	0.0094	2.952	27.22	25.28	17.78	0.0109
9	4526	467	14844	11875	2969	0.0099	2.973	28.89	25.56	18.28	0.0117
10	4655	478	15393	12041	3352	0.0102	2.999	28.89	25.56	18.60	0.0125
11	5456	536	17605	12818	4787	0.0107	2.938	31.11	25.89	19.33	0.0148
12	5015	498	16188	12611	3577	0.0108	2.936	30.56	25.83	19.23	0.0134
13	6036	600	19621	17135	2486	0.0102	2.957	31.11	25.94	18.64	0.0115
14	6429	635	20819	17639	3180	0.0100	2.947	31.67	26.06	18.60	0.0121
15	7683	754	25393	22197	3196	0.0098	3.010	32.22	26.11	18.46	0.0119
16	8222	803	27721	22533	5188	0.0098	3.072	32.22	26.17	18.76	0.0144
17	5696	556	18245	13600	4644	0.0107	2.918	31.67	26.06	19.35	0.0146
18	5531	541	17978	12832	5146	0.0112	2.961	31.11	25.94	19.68	0.0157
19	4689	479	15914	11871	4043	0.0111	3.079	28.33	25.50	19.40	0.0143
20	4855	503	17120	11534	5586	0.0113	3.195	27.22	25.33	19.76	0.0164
21	3918	406	13445	9303	4142	0.0113	3.109	27.22	25.33	19.76	0.0164
22	3823	399	13285	8974	4311	0.0114	3.147	26.67	25.22	19.80	0.0167
23	3748	394	13192	8787	4405	0.0115	3.185	26.11	25.11	19.84	0.0169
24	3880	407	13754	8800	4955	0.0117	3.208	26.11	25.11	20.06	0.0178

EnergyPlus Hour	Energy Consumption		Evaporator Coil Load			Zone Hum.	COP2	ODB (°C)	EDB (°C)	EWB (°C)	OHR (kg/kg)
	Compressor (Wh) *	Cond Fan (Wh) *	Total (Wh)	Sensible (Wh)	Latent (Wh)	Ratio (kg/kg)					
1	2119		7472	5811	1661	0.0094	3.527	17.99	23.95		0.0112
2	2131		7494	5853	1641	0.0094	3.516	18.11	23.96		0.0113
3	2113		7447	5809	1637	0.0094	3.525	17.99	23.95		0.0112
4	2075		7332	5744	1588	0.0093	3.534	17.80	23.92		0.0111
5	1997		7091	5614	1477	0.0092	3.550	17.43	23.86		0.0105
6	2142		7425	6015	1410	0.0090	3.467	18.58	24.03		0.0106
7	2870		9216	7532	1684	0.0093	3.212	22.90	24.68		0.0123
8	3499		10609	8757	1853	0.0096	3.033	26.38	25.21		0.0118
9	4682		14032	11767	2265	0.0098	2.997	28.26	25.49		0.0116
10	4948		14778	11996	2781	0.0102	2.987	28.90	25.59		0.0124
11	5407		15905	12488	3417	0.0106	2.942	30.28	25.79		0.0140
12	5632		16522	12671	3851	0.0109	2.933	30.79	25.87		0.0138
13	7133		21588	17401	4187	0.0104	3.027	30.91	25.88		0.0120
14	6983		20678	17592	3086	0.0100	2.961	31.48	25.97		0.0115
15	8572		26133	22481	3652	0.0098	3.049	32.01	26.05		0.0121
16	8733		26665	22557	4107	0.0099	3.053	32.20	26.08		0.0135
17	5718		16345	13061	3283	0.0106	2.858	31.89	26.04		0.0145
18	5881		17193	12870	4324	0.0112	2.924	31.33	25.95		0.0153
19	5555		16878	12170	4708	0.0113	3.038	29.35	25.65		0.0149
20	5259		16536	11556	4981	0.0113	3.144	27.61	25.39		0.0159
21	4326		13445	9063	4383	0.0116	3.108	27.20	25.33		0.0168
22	4279		13387	8953	4434	0.0116	3.129	26.89	25.29		0.0168
23	4173		13191	8753	4437	0.0116	3.161	26.33	25.20		0.0168
24	4152		13196	8674	4522	0.0117	3.178	26.10	25.17		0.0171

* For EnergyPlus results, the reported compressor energy includes the condenser fan energy.

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-16. June 28 Hourly Output - Case CE300 (continued)

CODYRUN Hour	Energy Consumption		Evaporator Coil Load			Zone Hum.	COP2	ODB (°C)	EDB (°C)	EWB (°C)	OHR (kg/kg)
	Compressor (Wh)	Cond Fan (Wh)	Total (Wh)	Sensible (Wh)	Latent (Wh)	Ratio (kg/kg)					
1	1886	237	7472	5788	1684	0.0093	3.520	17.80	23.92	17.16	0.0111
2	1964	244	7707	5961	1747	0.0093	3.490	18.30	24.00	17.24	0.0115
3	1881	236	7445	5788	1657	0.0092	3.517	17.80	23.92	17.12	0.0111
4	1878	236	7432	5788	1644	0.0092	3.516	17.80	23.92	17.10	0.0111
5	1756	224	7000	5580	1420	0.0090	3.535	17.20	23.83	16.79	0.0102
6	2075	253	7915	6341	1574	0.0090	3.400	19.40	24.16	17.03	0.0110
7	3035	334	10450	8277	2173	0.0095	3.102	25.00	25.00	17.91	0.0131
8	3303	352	10813	9038	1775	0.0093	2.958	27.20	25.33	17.65	0.0111
9	4483	463	14631	11971	2660	0.0097	2.958	28.90	25.59	18.12	0.0120
10	4594	472	15099	11971	3128	0.0100	2.980	28.90	25.59	18.44	0.0128
11	5238	516	16722	12731	3991	0.0106	2.906	31.10	25.91	19.14	0.0148
12	5066	504	16258	12559	3699	0.0106	2.919	30.60	25.84	18.94	0.0133
13	6442	642	21090	17422	3669	0.0100	2.977	31.10	25.91	18.33	0.0113
14	6523	645	21067	17629	3438	0.0098	2.939	31.70	26.00	18.27	0.0117
15	8000	785	26636	22491	4145	0.0096	3.032	32.20	26.08	18.24	0.0124
16	8169	799	27416	22491	4925	0.0097	3.057	32.20	26.08	18.56	0.0142
17	5306	519	16702	12939	3763	0.0104	2.867	31.70	26.00	19.06	0.0147
18	5381	528	17312	12729	4582	0.0109	2.930	31.10	25.91	19.46	0.0157
19	4791	492	16232	11761	4470	0.0109	3.072	28.30	25.50	19.20	0.0145
20	4809	498	16867	11381	5486	0.0113	3.178	27.20	25.33	19.65	0.0169
21	3939	408	13484	9036	4447	0.0113	3.102	27.20	25.33	19.71	0.0169
22	3852	402	13322	8864	4459	0.0114	3.132	26.70	25.25	19.70	0.0168
23	3752	395	13139	8656	4482	0.0114	3.168	26.10	25.16	19.69	0.0169
24	3794	399	13323	8656	4666	0.0115	3.177	26.10	25.16	19.81	0.0173

HOT3000 Hour	Energy Consumption		Evaporator Coil Load			Zone Hum.	COP2	ODB (°C)	EDB (°C)	EWB (°C)	OHR (kg/kg)
	Compressor (Wh)	Cond Fan (Wh)	Total (Wh)	Sensible (Wh)	Latent (Wh)	Ratio (kg/kg)					
1	1943	241	7668	5870	1798	0.0093	3.511	17.80	23.94	17.30	0.0111
2	1951	241	7674	5872	1803	0.0093	3.502	18.30	23.94	17.31	0.0114
3	1902	237	7528	5783	1745	0.0092	3.519	17.80	23.90	17.24	0.0111
4	1845	231	7317	5683	1634	0.0091	3.524	17.80	23.84	17.08	0.0111
5	1914	239	7514	5955	1559	0.0090	3.490	17.20	23.98	17.01	0.0102
6	2507	293	9223	7312	1911	0.0092	3.295	19.40	24.58	17.54	0.0110
7	3171	343	10770	8647	2123	0.0095	3.065	25.00	25.16	17.99	0.0131
8	3434	361	11186	9299	1888	0.0094	2.948	27.20	25.45	17.96	0.0110
9	4489	461	14744	11923	2821	0.0097	2.979	28.90	25.58	18.33	0.0120
10	4853	489	15882	12287	3595	0.0102	2.973	28.90	25.74	18.85	0.0127
11	5164	508	16615	12562	4053	0.0106	2.929	31.10	25.86	19.19	0.0148
12	5005	497	16030	12561	3468	0.0104	2.914	30.60	25.86	18.87	0.0132
13	6455	639	21180	17431	3749	0.0100	2.986	31.10	25.94	18.52	0.0113
14	6503	640	21055	17609	3447	0.0097	2.948	31.70	26.02	18.44	0.0117
15	8041	785	27070	22350	4719	0.0098	3.067	32.20	26.13	18.65	0.0123
16	8134	794	27623	22292	5331	0.0098	3.094	32.20	26.03	18.80	0.0142
17	5212	510	16551	12739	3812	0.0103	2.893	31.70	25.94	19.11	0.0147
18	5122	507	16830	12181	4649	0.0109	2.990	31.10	25.70	19.39	0.0156
19	4832	493	16635	11541	5095	0.0110	3.124	28.30	25.41	19.53	0.0145
20	4875	501	17131	11359	5772	0.0114	3.187	27.20	25.33	19.74	0.0168
21	3936	406	13525	8931	4593	0.0114	3.115	27.20	25.29	19.74	0.0168
22	3844	399	13356	8747	4609	0.0114	3.148	26.70	25.21	19.79	0.0168
23	3807	397	13343	8647	4697	0.0114	3.173	26.10	25.16	19.84	0.0168
24	3664	386	12973	8360	4613	0.0115	3.203	26.10	25.04	19.77	0.0173

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-16. June 28 Hourly Output - Case CE300 (continued)

TRACE 3D Plus Hour	Energy Consumption		Evaporator Coil Load			Zone Hum.	COP2	ODB (°C)	EDB (°C)	EWB (°C)	OHR (kg/kg)
	Compressor (Wh)	Cond Fan (Wh)	Total (Wh)	Sensible (Wh)	Latent (Wh)	Ratio (kg/kg)					
1	2156		7614	5823	1790	0.0092	3.531	17.99	23.95	17.27	0.0112
2	2170		7640	5866	1774	0.0092	3.521	18.11	23.96	17.25	0.0113
3	2151		7591	5822	1769	0.0092	3.529	17.99	23.95	17.25	0.0112
4	2113		7475	5756	1719	0.0092	3.538	17.80	23.92	17.19	0.0111
5	2034		7228	5625	1603	0.0090	3.554	17.43	23.86	17.03	0.0105
6	2184		7573	6027	1546	0.0089	3.467	18.58	24.03	16.99	0.0106
7	2930		9406	7546	1860	0.0092	3.210	22.90	24.68	17.52	0.0123
8	3575		10831	8769	2062	0.0095	3.030	26.38	25.21	17.94	0.0118
9	4775		14292	11781	2511	0.0096	2.993	28.26	25.49	18.05	0.0116
10	5033		15021	12012	3008	0.0100	2.984	28.90	25.59	18.42	0.0124
11	5491		16148	12507	3642	0.0104	2.941	30.28	25.80	18.91	0.0139
12	5714		16760	12688	4072	0.0107	2.933	30.79	25.87	19.19	0.0138
13	7232		21872	17406	4465	0.0101	3.024	30.91	25.89	18.76	0.0120
14	7085		20932	17600	3332	0.0097	2.955	31.48	25.98	18.33	0.0115
15	8690		26437	22487	3950	0.0095	3.042	32.01	26.06	18.30	0.0121
16	8845		26956	22566	4390	0.0096	3.048	32.20	26.09	18.48	0.0135
17	5799		16552	13084	3468	0.0103	2.854	31.89	26.04	18.95	0.0145
18	5960		17432	12890	4542	0.0109	2.925	31.33	25.96	19.46	0.0153
19	5624		17103	12189	4914	0.0111	3.041	29.35	25.66	19.50	0.0149
20	5323		16768	11579	5190	0.0111	3.150	27.61	25.39	19.52	0.0160
21	4377		13637	9086	4551	0.0113	3.115	27.20	25.33	19.77	0.0168
22	4331		13586	8975	4610	0.0114	3.137	26.89	25.29	19.80	0.0168
23	4223		13389	8776	4613	0.0114	3.170	26.33	25.20	19.79	0.0168
24	4202		13396	8697	4699	0.0114	3.188	26.10	25.17	19.84	0.0171

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-17. Delta Annual Space Cooling Electricity Consumptions (Total, Compressor)

Total (kWh,e)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean (Max-Min) /Mean*		
CE310-CE300	4340	4629	4629	4545	4543	4538	4340	4629	4537	6.4%	4410
CE320-CE300	4426	3995	4037	4333	4424	4387	3995	4426	4267	10.1%	4263
CE330-CE300	5330	4958	4683	5398	5559	5260	4683	5559	5198	16.8%	5405
CE330-CE320	904	963	646	1064	1134	873	646	1134	931	52.5%	1142
CE340-CE300	4986	4608	4510	5037	5089	4877	4510	5089	4851	11.9%	5021
CE330-CE340	344	350	173	360	470	383	173	470	347	85.6%	384
CE350-CE300	-3397	-4203	-4207	-3601	-3390	-3328	-4207	-3328	-3688	23.8%	-3615
CE360-CE300	19665	19314	19261	19959	19867	19998	19261	19998	19677	3.7%	19894
CE400-CE300	-3589	-3904	-3879	-3733		-3657	-3904	-3589	-3752	8.4%	-4365
CE410-CE300	-3555	-3082	-3056			-3567	-3567	-3056	-3315	15.4%	-4365
CE420-CE300	-2247	-2220	-1845	-2010		-1862	-2247	-1845	-2037	19.7%	-2052
CE430-CE300	-3096	-2818	-2944	-2973		-3252	-3252	-2818	-3017	14.4%	-2908
CE440-CE300	-1942	-1718	-1782	-1714		-1822	-1942	-1714	-1796	12.7%	-1733
CE500-CE300	-13296	-11933	-11933	-11711	-12653	-11932	-13296	-11711	-12243	12.9%	-11981
CE510-CE500	17218	18099	18100	17736	17414	17794	17218	18100	17727	5.0%	17754
CE525-CE520	-4666	-4981	-4969	-4316	-4889	-4458	-4981	-4316	-4713	14.1%	-5035
CE530-CE500	-5057	-5277	-5285	-5293	-4880	-5263	-5293	-4880	-5176	8.0%	-4600
CE545-CE540	-3743	-4076	-4083	-2425	-3745	-3825	-4083	-2425	-3650	45.4%	-3193

Compressor (kWh,e)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean (Max-Min) /Mean*		
CE310-CE300	3986	4244	4244		4167	4177	3986	4244	4164	6.2%	
CE320-CE300	4080	3681	3721		4076	4036	3681	4080	3919	10.2%	
CE330-CE300	4946	4603	4352		5158	4899	4352	5158	4792	16.8%	
CE330-CE320	867	922	631		1082	863	631	1082	873	51.6%	
CE340-CE300	4609	4260	4172		4703	4524	4172	4703	4454	11.9%	
CE330-CE340	337	343	180		455	375	180	455	338	81.4%	
CE350-CE300	-3037	-3767	-3772		-3032	-2985	-3772	-2985	-3319	23.7%	
CE360-CE300	17752	17430	17382		17927	18065	17382	18065	17711	3.9%	
CE400-CE300	-3175	-3463	-3442			-3247	-3463	-3175	-3332	8.7%	
CE410-CE300	-3149	-2746	-2723			-3191	-3191	-2723	-2952	15.9%	
CE420-CE300	-1995	-1973	-1639			-1662	-1995	-1639	-1817	19.6%	
CE430-CE300	-2755	-2510	-2622			-2910	-2910	-2510	-2699	14.8%	
CE440-CE300	-1724	-1527	-1584			-1627	-1724	-1527	-1616	12.2%	
CE500-CE300	-4499	-3096	-3095		-3912	-3354	-4499	-3095	-3591	39.1%	
CE510-CE500	13806	14303	14304		13913	14230	13806	14304	14111	3.5%	
CE525-CE520	-2963	-3241	-3233		-3148	-2742	-3241	-2742	-3066	16.3%	
CE530-CE500	-4197	-4346	-4354		-4002	-4350	-4354	-4002	-4250	8.3%	
CE545-CE540	-2399	-2713	-2720		-2413	-2449	-2720	-2399	-2539	12.6%	

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-18. Delta Annual Space Cooling Electricity Consumptions (Fans)

Supply Fan (kWh,e)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	0	0	0	0	0	0	0	0	0	----	0
CE320-CE300	0	0	0	0	0	0	0	0	0	----	0
CE330-CE300	0	0	0	0	0	0	0	0	0	----	0
CE330-CE320	0	0	0	0	0	0	0	0	0	----	0
CE340-CE300	0	0	0	0	0	0	0	0	0	----	0
CE330-CE340	0	0	0	0	0	0	0	0	0	----	0
CE350-CE300	0	0	0	0	0	0	0	0	0	----	0
CE360-CE300	0	0	0	0	0	0	0	0	0	----	0
CE400-CE300	0	0	0	0	0	0	0	0	0	----	0
CE410-CE300	0	0	0	0	0	0	0	0	0	----	0
CE420-CE300	0	0	0	0	0	0	0	0	0	----	0
CE430-CE300	0	0	0	0	0	0	0	0	0	----	0
CE440-CE300	0	0	0	0	0	0	0	0	0	----	0
CE500-CE300	-8316	-8511	-8511	-8234	-8327	-8241	-8511	-8234	-8357	3.3%	-8233
CE510-CE500	1951	2262	2262	2034	2002	2038	1951	2262	2092	14.9%	2034
CE525-CE520	-973	-988	-986	-839	-996	-979	-996	-839	-960	16.3%	-949
CE530-CE500	-491	-536	-536	-538	-502	-522	-538	-491	-521	9.0%	-309
CE545-CE540	-769	-757	-757	-438	-762	-787	-787	-438	-712	49.0%	-453

Condenser Fan (kWh,e)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	354	385	385		376	368	354	385	374	8.4%	
CE320-CE300	346	314	316		348	358	314	358	337	13.1%	
CE330-CE300	383	355	331		401	370	331	401	368	19.0%	
CE330-CE320	37	41	15		53	12	12	53	32	128.8%	
CE340-CE300	376	348	338		386	361	338	386	362	13.3%	
CE330-CE340	7	7	-7		15	9	-7	15	6	352.1%	
CE350-CE300	-360	-436	-435		-358	-353	-436	-353	-388	21.4%	
CE360-CE300	1913	1884	1879		1940	1949	1879	1949	1913	3.7%	
CE400-CE300	-414	-441	-437			-421	-441	-414	-428	6.3%	
CE410-CE300	-406	-336	-333			-387	-406	-333	-366	20.1%	
CE420-CE300	-252	-247	-206			-208	-252	-206	-228	20.1%	
CE430-CE300	-341	-308	-322			-353	-353	-308	-331	13.6%	
CE440-CE300	-218	-191	-198			-203	-218	-191	-203	13.4%	
CE500-CE300	-481	-326	-327		-415	-347	-481	-326	-379	40.8%	
CE510-CE500	1461	1534	1534		1499	1526	1461	1534	1511	4.8%	
CE525-CE520	-729	-752	-750		-746	-733	-752	-729	-742	3.1%	
CE530-CE500	-368	-395	-395		-376	-391	-395	-368	-385	7.0%	
CE545-CE540	-576	-606	-606		-571	-589	-606	-571	-589	6.0%	

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-19. Delta Annual Cooling Coil Loads

Sensible Coil Load (kWh,th)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	-405	504	508	-27	-24	-108	-405	508	75	1224.5%	-30
CE320-CE300	6197	6900	6942	6791	6799	7543	6197	7543	6862	19.6%	6376
CE330-CE300	6422	7514	7523	8527	7440	6631	6422	8527	7343	28.7%	7746
CE330-CE320	224	614	581	1735	641	-912	-912	1735	480	550.9%	1370
CE340-CE300	6371	7257	7306	7634	7171	6215	6215	7634	6992	20.3%	7156
CE330-CE340	51	258	217	893	269	416	51	893	351	240.2%	590
CE350-CE300	-6291	-8112	-8128	-6707	-6621	-6423	-8128	-6291	-7047	26.1%	-6623
CE360-CE300	78315	79123	79135	80035	78996	79506	78315	80035	79185	2.2%	79598
CE400-CE300	-14709	-14378	-14368	-14564		-14010	-14709	-14010	-14406	4.9%	-13718
CE410-CE300	-10985	-8138	-8145			-9606	-10985	-8138	-9219	30.9%	-13718
CE420-CE300	-6272	-6131	-5193	-5728		-5207	-6272	-5193	-5706	18.9%	-5748
CE430-CE300	-8798	-8066	-8351	-8513		-9048	-9048	-8066	-8555	11.5%	-8190
CE440-CE300	-5786	-5204	-5313	-5192		-5406	-5786	-5192	-5380	11.0%	-5149
CE500-CE300	-11618	-8147	-8159	-7761	-10335	-7661	-11618	-7661	-8947	44.2%	-7809
CE510-CE500	43046	45710	45710	45091	43051	45083	43046	45710	44615	6.0%	45091
CE525-CE520	-131	-884	-882	-1057	-202	-949	-1057	-131	-684	135.4%	-1166
CE530-CE500	2	-1076	-1076	-547	0	-528	-1076	2	-538	200.6%	-316
CE545-CE540	-130	-809	-809	-676	-202	-792	-809	-130	-570	119.1%	-670

Latent Coil Load(kWh,th)							Statistics, All Results				TRACE 3D Plus Trane
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	19321	19607	19612	19156	19576	19111	19111	19612	19397	2.6%	19051
CE320-CE300	13167	12173	12259	11974	12597	11157	11157	13167	12221	16.4%	12429
CE330-CE300	18164	15932	16179	16367	18528	17119	15932	18528	17048	15.2%	17578
CE330-CE320	4997	3760	3919	4393	5931	5962	3760	5962	4827	45.6%	5149
CE340-CE300	15930	14488	14625	14757	15760	15279	14488	15930	15140	9.5%	15557
CE330-CE340	2234	1445	1553	1610	2768	1840	1445	2768	1908	69.3%	2021
CE350-CE300	-4748	-5435	-5529	-4821	-4264	-4446	-5529	-4264	-4874	26.0%	-4857
CE360-CE300	4232	3401	3427	3895	4459	4403	3401	4459	3970	26.7%	4216
CE400-CE300	3075	2012	2101	2660		2650	2012	3075	2500	42.5%	-931
CE410-CE300	-769	-2366	-2303			-2477	-2477	-769	-1979	86.3%	-931
CE420-CE300	-1546	-1542	-1217	-1240		-1212	-1546	-1212	-1351	24.7%	-1361
CE430-CE300	-1872	-1577	-1722	-1663		-2010	-2010	-1577	-1769	24.5%	-1749
CE440-CE300	-930	-699	-798	-709		-823	-930	-699	-792	29.1%	-802
CE500-CE300	-5452	-3141	-3141	-3986	-4304	-4983	-5452	-3141	-4168	55.5%	-5016
CE510-CE500	17485	17615	17615	17348	17488	17340	17340	17615	17482	1.6%	17348
CE525-CE520	2	-288	-288	-58	-9	-42	-288	2	-114	255.0%	-56
CE530-CE500	-18313	-18285	-18286	-18080	-18230	-18084	-18313	-18080	-18213	1.3%	-18081
CE545-CE540	-1	-81	-81	-9	-3	-2	-81	-1	-30	272.0%	0

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-20. Delta Various Annual Means (COP2, IDB)

COP2							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	Trane
CE310-CE300	0.166	0.180	0.180	0.155	0.171	0.150	0.150	0.180	0.167	18.0%	0.165
CE320-CE300	0.171	0.220	0.220	0.168	0.180	0.160	0.160	0.220	0.186	32.3%	0.175
CE330-CE300	0.242	0.256	0.299	0.253	0.271	0.230	0.230	0.299	0.259	26.7%	0.264
CE330-CE320	0.071	0.036	0.079	0.086	0.091	0.070	0.036	0.091	0.072	76.3%	0.088
CE340-CE300	0.205	0.240	0.258	0.210	0.223	0.190	0.190	0.258	0.221	30.9%	0.220
CE330-CE340	0.036	0.017	0.041	0.043	0.048	0.040	0.017	0.048	0.037	82.5%	0.043
CE350-CE300	0.000	0.003	-0.002	0.006	0.003	0.000	-0.002	0.006	0.002	498.6%	0.012
CE360-CE300	0.420	0.463	0.468	0.441	0.440	0.430	0.420	0.468	0.444	10.9%	0.438
CE400-CE300	0.001	0.014	0.015	0.009		0.030	0.001	0.030	0.014	210.3%	-0.025
CE410-CE300	-0.010	-0.025	-0.027			-0.020	-0.027	-0.010	-0.020	84.0%	-0.025
CE420-CE300	-0.023	-0.022	-0.020	-0.021		-0.020	-0.023	-0.020	-0.021	14.9%	-0.021
CE430-CE300	-0.028	-0.025	-0.026	-0.026		-0.020	-0.028	-0.020	-0.025	33.0%	-0.024
CE440-CE300	-0.018	-0.015	-0.015	-0.016		-0.010	-0.018	-0.010	-0.015	51.9%	-0.015
CE500-CE300	-0.045	-0.010	-0.011	-0.024	-0.034	-0.030	-0.045	-0.010	-0.026	135.4%	-0.033
CE510-CE500	0.409	0.416	0.416	0.408	0.397	0.410	0.397	0.416	0.409	4.6%	0.409
CE525-CE520	0.582	0.574	0.572	0.504	0.606	0.490	0.490	0.606	0.555	21.0%	0.577
CE530-CE500	-0.242	-0.258	-0.257	-0.214	-0.276	-0.220	-0.276	-0.214	-0.245	25.5%	-0.286
CE545-CE540	0.560	0.559	0.560	0.334	0.546	0.510	0.334	0.560	0.511	44.3%	0.448

IDB (°C)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	Trane
CE310-CE300	0.13	0.06	0.00	0.00	0.01	0.02	0.00	0.13	0.04	364.3%	0.01
CE320-CE300	0.28	0.33	0.33	0.16	0.25	0.54	0.16	0.54	0.32	119.3%	0.17
CE330-CE300	0.26	0.22	0.22	0.18	0.21	0.19	0.18	0.26	0.21	34.0%	0.22
CE330-CE320	-0.02	-0.11	-0.11	0.02	-0.03	-0.35	-0.35	0.02	-0.10	365.4%	0.04
CE340-CE300	0.25	0.22	0.22	0.21	0.23	0.22	0.21	0.25	0.23	19.5%	0.23
CE330-CE340	0.00	0.00	0.00	-0.02	-0.01	-0.03	-0.03	0.00	-0.01	319.0%	-0.01
CE350-CE300	2.04	2.11	2.11	2.15	2.19	2.16	2.04	2.19	2.13	7.1%	2.13
CE360-CE300	1.74	1.56	1.50	1.23	1.40	1.38	1.23	1.74	1.47	34.6%	1.34
CE400-CE300	0.50	0.00	0.00	0.00		0.00	0.00	0.50	0.10	498.8%	0.00
CE410-CE300	0.50	0.00	0.00			0.00	0.00	0.50	0.12	400.0%	0.00
CE420-CE300	0.30	0.00	0.00	0.00		0.00	0.00	0.30	0.06	500.3%	0.00
CE430-CE300	0.37	0.00	0.00	0.00		0.00	0.00	0.37	0.07	500.3%	0.00
CE440-CE300	0.29	0.00	0.00	0.00		0.00	0.00	0.29	0.06	500.2%	0.00
CE500-CE300	-3.39	-3.39	-3.50	-3.71	-2.98	-1.13	-3.71	-1.13	-3.02	85.5%	-3.50
CE510-CE500	1.24	0.11	0.11	-0.02	0.00	0.00	-0.02	1.24	0.24	526.6%	0.00
CE525-CE520	13.33	13.61	13.56	13.53	13.63	15.80	13.33	15.80	13.91	17.8%	13.69
CE530-CE500	-0.21	-0.06	0.00	0.21	0.00	0.00	-0.21	0.21	-0.01	4302.5%	0.00
CE545-CE540	13.32	13.56	13.56	13.52	13.58	15.71	13.32	15.71	13.87	17.3%	13.69

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-21. Delta Various Annual Means (Zone Humidity, Relative Humidity)

Humidity Ratio (kg/kg)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	0.0020	0.0021	0.0021	0.0020	0.0020	0.0019	0.0019	0.0021	0.0020	9.9%	0.0020
CE320-CE300	0.0009	0.0009	0.0009	0.0008	0.0009	0.0007	0.0007	0.0009	0.0009	25.7%	0.0009
CE330-CE300	0.0007	0.0007	0.0007	0.0007	0.0006	0.0007	0.0006	0.0007	0.0007	9.3%	0.0007
CE330-CE320	-0.0002	-0.0002	-0.0002	-0.0001	-0.0002	0.0000	-0.0002	0.0000	-0.0002	143.9%	-0.0002
CE340-CE300	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	4.1%	0.0007
CE330-CE340	-0.0001	0.0000	0.0000	0.0000	-0.0001	0.0000	-0.0001	0.0000	0.0000	277.9%	0.0000
CE350-CE300	0.0006	0.0008	0.0008	0.0006	0.0006	0.0006	0.0006	0.0008	0.0007	34.2%	0.0006
CE360-CE300	-0.0006	-0.0005	-0.0005	-0.0005	-0.0006	-0.0006	-0.0006	-0.0005	-0.0006	22.0%	-0.0006
CE400-CE300	0.0007	0.0008	0.0008	0.0008		0.0008	0.0007	0.0008	0.0008	8.7%	0.0007
CE410-CE300	0.0007	0.0003	0.0003			0.0003	0.0003	0.0007	0.0004	94.5%	0.0007
CE420-CE300	0.0002	0.0002	0.0002	0.0002		0.0001	0.0001	0.0002	0.0002	58.3%	0.0002
CE430-CE300	0.0002	0.0002	0.0002	0.0002		0.0002	0.0002	0.0002	0.0002	19.7%	0.0002
CE440-CE300	0.0001	0.0001	0.0001	0.0000		0.0000	0.0000	0.0001	0.0001	148.5%	0.0001
CE500-CE300	0.0007			0.0001	0.0010	0.0015	0.0001	0.0015	0.0008	169.4%	0.0000
CE510-CE500	0.0004			0.0000	0.0000	0.0000	0.0000	0.0004	0.0001	394.2%	0.0000
CE525-CE520	0.0070			0.0078	0.0070	0.0075	0.0070	0.0078	0.0073	10.9%	0.0074
CE530-CE500	-0.0035			-0.0027	-0.0044	-0.0040	-0.0044	-0.0027	-0.0037	48.0%	-0.0063
CE545-CE540	0.0018			0.0024	0.0029	0.0026	0.0018	0.0029	0.0024	46.8%	0.0000

Relative Humidity (%)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	9.72	10.25	10.25	9.96	10.01	9.87	9.72	10.25	10.01	5.3%	9.96
CE320-CE300	3.39	2.95	2.97	3.25	3.28	2.01	2.01	3.39	2.97	46.4%	3.49
CE330-CE300	2.23	2.32	2.37	2.59	2.26	2.77	2.23	2.77	2.42	22.3%	2.64
CE330-CE320	-1.16	-0.63	-0.60	-0.66	-1.02	0.76	-1.16	0.76	-0.55	347.8%	-0.84
CE340-CE300	2.47	2.43	2.45	2.56	2.47	2.85	2.43	2.85	2.54	16.5%	2.71
CE330-CE340	-0.24	-0.11	-0.08	0.03	-0.21	-0.08	-0.24	0.03	-0.12	232.7%	-0.07
CE350-CE300	-3.13	-2.81	-2.73	-3.42	-3.51	-3.37	-3.51	-2.73	-3.16	24.7%	-3.25
CE360-CE300	-7.58	-6.77	-6.79	-6.22	-6.96	-6.72	-7.58	-6.22	-6.84	19.9%	-6.57
CE400-CE300	2.16	3.95	3.97	3.96		4.08	2.16	4.08	3.62	53.1%	3.31
CE410-CE300	1.88	1.39	1.35			1.82	1.35	1.88	1.61	33.0%	3.31
CE420-CE300	0.16	0.88	0.69	0.81		0.83	0.16	0.88	0.67	106.1%	0.91
CE430-CE300	0.21	0.91	1.02	1.01		1.24	0.21	1.24	0.88	117.8%	1.09
CE440-CE300	-0.29	0.20	0.29	0.24		0.30	-0.29	0.30	0.15	394.1%	0.33
CE500-CE300	17.91			10.61	18.12	15.80	10.61	18.12	15.61	48.1%	9.70
CE510-CE500	-2.35			0.11	-0.01	0.11	-2.35	0.11	-0.53	461.4%	0.10
CE525-CE520	-8.41			-6.41	-10.09	-14.80	-14.80	-6.41	-9.93	84.5%	-7.39
CE530-CE500	-19.80			-10.22	-24.49	-24.13	-24.49	-10.22	-19.66	72.6%	-36.17
CE545-CE540	-11.90			-7.68	-3.18	-14.62	-14.62	-3.18	-9.34	122.5%	-13.31

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-22. Delta Hourly Integrated Maximum Total Consumptions

Total Consumption (Wh,e)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	Trane
CE310-CE300	968	1019	993	641	721	614	614	1019	826	49.0%	564
CE320-CE300	1402	1352	1379	1055	1172	1327	1055	1402	1281	27.1%	975
CE330-CE300	1721	1648	1805	1414	1535	1787	1414	1805	1652	23.7%	1358
CE330-CE320	319	296	426	360	363	460	296	460	371	44.3%	384
CE340-CE300	1555	1594	1588	1234	1345	1553	1234	1594	1478	24.3%	1169
CE330-CE340	166	54	217	180	190	234	54	234	173	103.8%	190
CE350-CE300	1	90	0	0	0	-2	-2	90	15	621.2%	0
CE360-CE300	1143	1172	1124	844	931	1214	844	1214	1071	34.5%	778
CE400-CE300	2	0	75	0		-29	-29	75	10	1087.2%	0
CE410-CE300	2	0	0			1	0	2	1	258.7%	0
CE420-CE300	0	0	0	0		0	0	0	0	----	0
CE430-CE300	0	0	0	0		0	0	0	0	500.0%	0
CE440-CE300	0	0	0	0		-87	-87	0	-17	500.0%	0
CE500-CE300	-1460	-1133	-1177	-1501	-1755	-1274	-1755	-1133	-1383	45.0%	-1566
CE510-CE500	1038	1159	1162	1011	1009	1070	1009	1162	1075	14.2%	1015
CE525-CE520	-1669	-1451	-1483	-1531	-1625	-1099	-1669	-1099	-1476	38.6%	-1680
CE530-CE500	-2138	-2372	-2370	-2228	-2185	-2185	-2372	-2138	-2246	10.4%	-2000
CE545-CE540	-1494	-1593	-1593	-915	-1495	-1514	-1593	-915	-1434	47.3%	-1219

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-23. Delta Hourly Integrated Maximum Coil Loads (Total, Sensible)

Sensible + Latent Coil Load (Wh,th)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	5154	5349	5578	4393	4759	4919	4393	5578	5025	23.6%	4298
CE320-CE300	8144	22412	22368	7032	7402	7848	7032	22412	12534	122.7%	6936
CE330-CE300	11318	12227	33117	10712	11476	10343	10343	33117	14865	153.2%	10529
CE330-CE320	3174	-10185	10749	3680	4074	2495	-10185	10749	2331	898.0%	3593
CE340-CE300	9478	19418	28094	8595	8864	9060	8595	28094	13918	140.1%	8555
CE330-CE340	1840	-7191	5023	2117	2612	1283	-7191	5023	947	1289.3%	1974
CE350-CE300	-82	0	-1	0	0	5	-82	5	-13	669.0%	1
CE360-CE300	6683	9212	9564	5726	5820	6379	5726	9564	7231	53.1%	5595
CE400-CE300	9005	9142	18383	7995	8702	8702	7995	18383	10645	97.6%	4780
CE410-CE300	-82	0	0	0	0	1	-82	1	-20	409.8%	4780
CE420-CE300	0	0	0	0	0	0	0	0	0	----	0
CE430-CE300	0	0	0	0	0	0	0	0	0	500.0%	0
CE440-CE300	0	0	0	0	0	-295	-295	0	-59	500.0%	0
CE500-CE300	-4689	-3694	-3749	-5087	-5935	-4517	-5935	-3694	-4612	48.6%	-5417
CE510-CE500	3108	3481	3482	3531	3381	3542	3108	3542	3421	12.7%	3566
CE525-CE520	410	-412	-412	-76	8	-881	-881	410	-227	568.4%	-166
CE530-CE500	-7651	-8131	-8131	-8008	-7791	-7929	-8131	-7651	-7940	6.0%	-7919
CE545-CE540	500	-291	-292	-187	-30	-302	-302	500	-100	800.3%	-202

Sensible Coil Load (Wh,th)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	-183	-123	-86	-254	-379	-259	-379	-86	-214	136.9%	-312
CE320-CE300	8038	7916	7867	8441	7677	8059	7677	8441	8000	9.6%	7872
CE330-CE300	9949	10207	11285	11234	10540	10513	9949	11285	10621	12.6%	11168
CE330-CE320	1911	2291	3418	2793	2863	2454	1911	3418	2622	57.5%	3296
CE340-CE300	9552	8883	8881	9357	9483	9272	8881	9552	9238	7.3%	9118
CE330-CE340	397	1324	2404	1877	1057	1241	397	2404	1383	145.1%	2050
CE350-CE300	0	0	0	0	0	-32	-32	0	-5	603.8%	1
CE360-CE300	8783	8908	8860	9090	8524	9271	8524	9271	8906	8.4%	8886
CE400-CE300	0	0	0	0	0	-31	-31	0	-6	503.2%	0
CE410-CE300	-12	0	0	0	0	-15	-15	0	-7	224.7%	0
CE420-CE300	0	0	0	0	0	-15	-15	0	-3	500.0%	0
CE430-CE300	0	0	0	0	0	-15	-15	0	-3	500.0%	0
CE440-CE300	0	0	0	0	0	-33	-33	0	-7	500.0%	0
CE500-CE300	-3728	-3194	-3197	-3682	-4681	-3090	-4681	-3090	-3595	44.3%	-3688
CE510-CE500	2180	2504	2505	2441	2345	2451	2180	2505	2404	13.5%	2448
CE525-CE520	287	-309	-304	-336	-210	-717	-717	287	-265	379.1%	-400
CE530-CE500	285	-433	-433	-211	0	-192	-433	285	-164	437.9%	-108
CE545-CE540	500	-291	-292	-187	-35	-302	-302	500	-101	793.7%	-202

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-24. Delta Hourly Integrated Maximum Coil Loads (Latent)

Latent Coil Load (Wh,th)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	Trane
CE310-CE300	6271	5835	5876	6040	5737	5685	5685	6271	5907	9.9%	6015
CE320-CE300	13512	22193	22109	11961	11322	11537	11322	22193	15439	70.4%	12123
CE330-CE300	18190	17637	31415	16899	17809	17096	16899	31415	19841	73.2%	17059
CE330-CE320	4678	-4556	9306	4939	6487	5559	-4556	9306	4402	314.9%	4936
CE340-CE300	15213	21147	26617	13676	13850	13402	13402	26617	17318	76.3%	13894
CE330-CE340	2977	-3510	4798	3223	3959	3694	-3510	4798	2523	329.2%	3165
CE350-CE300	116	-1	-1	1	380	1211	-1	1211	284	426.5%	1
CE360-CE300	-361	722	942	-1715	-1516	-1458	-1715	942	-564	470.9%	-1722
CE400-CE300	17440	16274	23002	16082		16253	16082	23002	17810	38.9%	12320
CE410-CE300	1503	0	-3			-15	-15	1503	371	408.9%	12320
CE420-CE300	115	0	0	0		2	0	115	23	491.5%	0
CE430-CE300	0	1801	1707	839		2	0	1801	870	207.1%	841
CE440-CE300	0	0	-3	0		-253	-253	0	-51	494.1%	0
CE500-CE300	-1670	-1571	-1661	-2396	-2570	-2630	-2630	-1571	-2083	50.8%	-2687
CE510-CE500	927	990	990	1116	1045	1112	927	1116	1030	18.3%	1374
CE525-CE520	123	-122	-122	249	212	-144	-144	249	33	1201.2%	197
CE530-CE500	-7965	-7733	-7733	-7838	-7626	-7726	-7965	-7626	-7770	4.4%	-7849
CE545-CE540	-627	0	0	-1655	-841	-1181	-1655	0	-717	230.7%	0

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-25. Delta Hourly Integrated Maximum and Minimum COP2

Maximum COP2							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	-0.025	0.272	0.271	0.248	0.257	0.240	-0.025	0.272	0.210	141.1%	0.361
CE320-CE300	0.000	1.274	1.110	0.014	0.073	0.500	0.000	1.274	0.495	257.3%	0.066
CE330-CE300	0.000	0.240	1.738	0.146	0.251	0.170	0.000	1.738	0.424	409.6%	0.000
CE330-CE320	0.000	-1.034	0.628	0.132	0.179	-0.330	-1.034	0.628	-0.071	2344.2%	-0.066
CE340-CE300	0.000	0.752	1.482	0.061	0.147	0.070	0.000	1.482	0.419	354.0%	0.000
CE330-CE340	0.000	-0.512	0.256	0.085	0.105	0.100	-0.512	0.256	0.006	13685.7%	0.000
CE350-CE300	0.000	0.020	0.006	0.630	0.061	0.000	0.000	0.630	0.120	526.8%	-0.113
CE360-CE300	0.233	0.559	0.570	0.530	0.561	0.560	0.233	0.570	0.502	67.2%	0.734
CE400-CE300	-0.091	0.219	0.919	0.146		0.170	-0.091	0.919	0.273	370.7%	-0.011
CE410-CE300	-0.280	0.034	-0.002			-0.040	-0.280	0.034	-0.072	436.1%	-0.011
CE420-CE300	-0.387	-0.062	-0.098	-0.104		0.060	-0.387	0.060	-0.118	378.3%	-0.092
CE430-CE300	-0.387	-0.064	-0.098	-0.133		0.050	-0.387	0.050	-0.126	346.0%	-0.092
CE440-CE300	-0.285	-0.095	-0.098	-0.123		-0.070	-0.285	-0.070	-0.134	160.0%	-0.092
CE500-CE300	0.107	3.498	1.444	0.273	0.314	0.260	0.107	3.498	0.983	345.1%	0.319
CE510-CE500	0.417	0.000	0.000	0.487	0.505	0.390	0.000	0.505	0.300	168.4%	0.569
CE525-CE520	0.904	1.429	1.379	0.766	0.836	0.560	0.560	1.429	0.979	88.8%	0.874
CE530-CE500	-0.269	-3.386	-1.451	-0.273	-0.345	-0.260	-3.386	-0.260	-0.997	313.5%	-0.429
CE545-CE540	0.794	0.819	0.973	0.470	0.490	0.480	0.470	0.973	0.671	74.9%	0.648

Minimum COP2							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	0.072	0.052	0.050	0.111	0.087	0.060	0.050	0.111	0.072	84.8%	0.040
CE320-CE300	0.032	0.003	0.004	0.060	0.029	0.020	0.003	0.060	0.025	231.0%	0.006
CE330-CE300	0.032	0.000	0.000	0.063	0.038	0.030	0.000	0.063	0.027	231.1%	0.006
CE330-CE320	0.000	-0.003	-0.004	0.003	0.009	0.010	-0.004	0.010	0.002	584.2%	0.000
CE340-CE300	0.032	0.000	0.000	0.063	0.038	0.030	0.000	0.063	0.027	231.1%	0.006
CE330-CE340	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	----	0.000
CE350-CE300	-0.003	0.000	0.000	0.000	0.000	0.000	-0.003	0.000	0.000	742.2%	0.000
CE360-CE300	0.032	0.001	0.000	0.063	0.038	0.030	0.000	0.063	0.027	229.7%	0.006
CE400-CE300	-0.011	-0.064	-0.066	0.000		0.000	-0.066	0.000	-0.028	233.8%	0.000
CE410-CE300	-0.007	0.000	0.000			0.000	-0.007	0.000	-0.002	400.0%	0.000
CE420-CE300	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	----	0.000
CE430-CE300	-0.022	-0.064	-0.066	0.000		0.000	-0.066	0.000	-0.030	217.2%	0.000
CE440-CE300	-0.011	-0.064	-0.066	0.000		0.000	-0.066	0.000	-0.028	234.7%	0.000
CE500-CE300	-0.108	-0.105	-0.149	-0.076	-0.119	-0.100	-0.149	-0.076	-0.110	66.6%	-0.081
CE510-CE500	0.203	0.124	0.000	0.160	0.215	0.190	0.000	0.215	0.149	144.8%	0.000
CE525-CE520	0.469	0.476	0.420	0.408	0.561	0.430	0.408	0.561	0.461	33.2%	0.527
CE530-CE500	-0.184	-0.198	-0.154	-0.173	-0.193	-0.190	-0.198	-0.154	-0.182	24.2%	-0.230
CE545-CE540	0.479	0.459	0.460	0.277	0.549	0.440	0.277	0.549	0.444	61.2%	0.362

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-26. Delta Hourly Integrated Maximum and Minimum IDB

Maximum IDB (°C)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	0.88	1.78	1.61	1.47	1.57	1.00	0.88	1.78	1.39	65.1%	1.54
CE320-CE300	6.16	6.50	6.39	6.71	7.27	5.46	5.46	7.27	6.41	28.2%	6.80
CE330-CE300	6.03	6.61	6.89	6.07	6.85	5.11	5.11	6.89	6.26	28.4%	6.55
CE330-CE320	-0.13	0.11	0.50	-0.64	-0.42	-0.35	-0.64	0.50	-0.15	736.8%	-0.24
CE340-CE300	6.11	6.50	6.45	6.50	7.10	5.39	5.39	7.10	6.34	27.0%	6.73
CE330-CE340	-0.07	0.11	0.44	-0.43	-0.25	-0.28	-0.43	0.44	-0.08	1078.3%	-0.18
CE350-CE300	8.38	9.83	9.83	10.00	9.95	8.81	8.38	10.00	9.47	17.1%	9.99
CE360-CE300	7.56	7.67	7.45	7.51	7.95	6.94	6.94	7.95	7.51	13.4%	7.80
CE400-CE300	0.91	2.45	3.72	1.91		-0.15	-0.15	3.72	1.77	218.8%	0.06
CE410-CE300	0.63	0.00	0.00			0.00	0.00	0.63	0.16	400.0%	0.06
CE420-CE300	0.00	0.00	0.00	0.00		0.04	0.00	0.04	0.01	500.0%	0.00
CE430-CE300	1.00	0.00	0.00	0.00		0.26	0.00	1.00	0.25	396.6%	0.00
CE440-CE300	0.85	0.00	0.00	0.00		0.07	0.00	0.85	0.18	461.5%	0.00
CE500-CE300	-0.39	0.00	0.00	0.00	-0.03	-1.19	-1.19	0.00	-0.27	441.5%	0.00
CE510-CE500	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.05	600.0%	0.01
CE525-CE520	19.96	18.95	19.12	20.00	19.02	16.38	16.38	20.00	18.90	19.1%	19.72
CE530-CE500	0.31	-0.05	-0.05	0.00	0.00	0.00	-0.05	0.31	0.04	1025.2%	0.00
CE545-CE540	19.53	19.89	19.89	20.00	19.95	20.00	19.53	20.00	19.88	2.4%	19.99

Minimum IDB (°C)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE320-CE300	0.00	1.94	1.95	-0.96	0.00	0.00	-0.96	1.95	0.49	597.5%	-0.97
CE330-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE330-CE320	0.00	-1.94	-1.95	0.96	0.00	0.00	-1.95	0.96	-0.49	596.8%	0.97
CE340-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE330-CE340	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----	0.00
CE350-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----	0.00
CE360-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE400-CE300	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	500.0%	0.00
CE410-CE300	0.00	0.00	0.00			0.00	0.00	0.00	0.00	----	0.00
CE420-CE300	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	500.0%	0.00
CE430-CE300	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	500.0%	0.00
CE440-CE300	0.00	0.00	0.00	0.00		0.01	0.00	0.01	0.00	500.0%	0.00
CE500-CE300	0.50	-0.72	-0.89	0.22	0.54	17.05	-0.89	17.05	2.78	644.6%	0.31
CE510-CE500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE525-CE520	0.14	0.06	0.05	0.18	0.03	19.44	0.03	19.44	3.32	585.3%	0.24
CE530-CE500	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	533.6%	0.00
CE545-CE540	0.22	0.06	0.05	0.18	0.03	18.06	0.03	18.06	3.10	581.6%	0.24

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.5.2-27. Delta Hourly Integrated Maximum and Minimum Zone Humidity Ratio

Maximum Humidity Ratio (kg/kg)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	0.0025	0.0050	0.0052	0.0020	0.0020	0.0023	0.0020	0.0052	0.0032	102.1%	0.0020
CE320-CE300	0.0047	0.0039	0.0039	0.0042	0.0041	0.0043	0.0039	0.0047	0.0042	19.9%	0.0042
CE330-CE300	0.0044	0.0040	0.0040	0.0043	0.0036	0.0043	0.0036	0.0044	0.0041	19.0%	0.0043
CE330-CE320	-0.0004	0.0001	0.0001	0.0001	-0.0005	0.0000	-0.0005	0.0001	-0.0001	696.5%	0.0001
CE340-CE300	0.0046	0.0039	0.0037	0.0042	0.0038	0.0043	0.0037	0.0046	0.0041	21.8%	0.0042
CE330-CE340	-0.0002	0.0001	0.0003	0.0001	-0.0002	0.0000	-0.0002	0.0003	0.0000	3174.2%	0.0001
CE350-CE300	0.0035	0.0061	0.0062	0.0036	0.0030	0.0032	0.0030	0.0062	0.0043	74.6%	0.0034
CE360-CE300	0.0001	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0002	0.0001	366.5%	0.0000
CE400-CE300	0.0037	0.0032	0.0033	0.0033		0.0039	0.0032	0.0039	0.0035	20.2%	0.0034
CE410-CE300	0.0036	0.0031	0.0032			0.0039	0.0031	0.0039	0.0034	23.3%	0.0034
CE420-CE300	0.0010	0.0009	0.0004	0.0010		0.0013	0.0004	0.0013	0.0009	98.3%	0.0011
CE430-CE300	0.0029	0.0018	0.0019	0.0025		0.0024	0.0018	0.0029	0.0023	49.6%	0.0027
CE440-CE300	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	500.0%	0.0000
CE500-CE300	-0.0016	-0.0019	-0.0019	-0.0019	-0.0017	-0.0019	-0.0019	-0.0016	-0.0018	20.6%	-0.0021
CE510-CE500	0.0002	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	352.6%	0.0000
CE525-CE520	0.0104	0.0103	0.0102	0.0115	0.0101	0.0067	0.0067	0.0115	0.0099	48.3%	0.0107
CE530-CE500	-0.0047	-0.0038	-0.0037	-0.0049	-0.0062	-0.0047	-0.0062	-0.0037	-0.0047	53.9%	-0.0085
CE545-CE540	0.0009	0.0072	0.0059	0.0000	0.0034	0.0013	0.0000	0.0072	0.0031	230.7%	0.0000

Minimum Humidity Ratio (kg/kg)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000	646.4%	0.0000
CE320-CE300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	600.0%	0.0000
CE330-CE300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	600.0%	0.0000
CE330-CE320	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	600.0%	0.0000
CE340-CE300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	600.0%	0.0000
CE330-CE340	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	----	0.0000
CE350-CE300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	----	0.0000
CE360-CE300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	600.0%	0.0000
CE400-CE300	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	500.0%	0.0000
CE410-CE300	0.0000	0.0000	0.0000			0.0000	0.0000	0.0000	0.0000	----	0.0000
CE420-CE300	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	500.0%	0.0000
CE430-CE300	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	500.0%	0.0000
CE440-CE300	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	500.0%	0.0000
CE500-CE300	0.0050			0.0051	0.0049	0.0083	0.0049	0.0083	0.0058	58.2%	0.0052
CE510-CE500	0.0000			0.0000	0.0000	0.0002	0.0000	0.0002	0.0001	400.0%	0.0000
CE525-CE520	0.0007			0.0005	0.0004	0.0088	0.0004	0.0088	0.0026	322.8%	0.0006
CE530-CE500	-0.0006			-0.0003	-0.0015	-0.0037	-0.0037	-0.0003	-0.0015	226.1%	-0.0042
CE545-CE540	0.0021			0.0030	0.0034	0.0028	0.0021	0.0034	0.0028	47.3%	0.0000

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

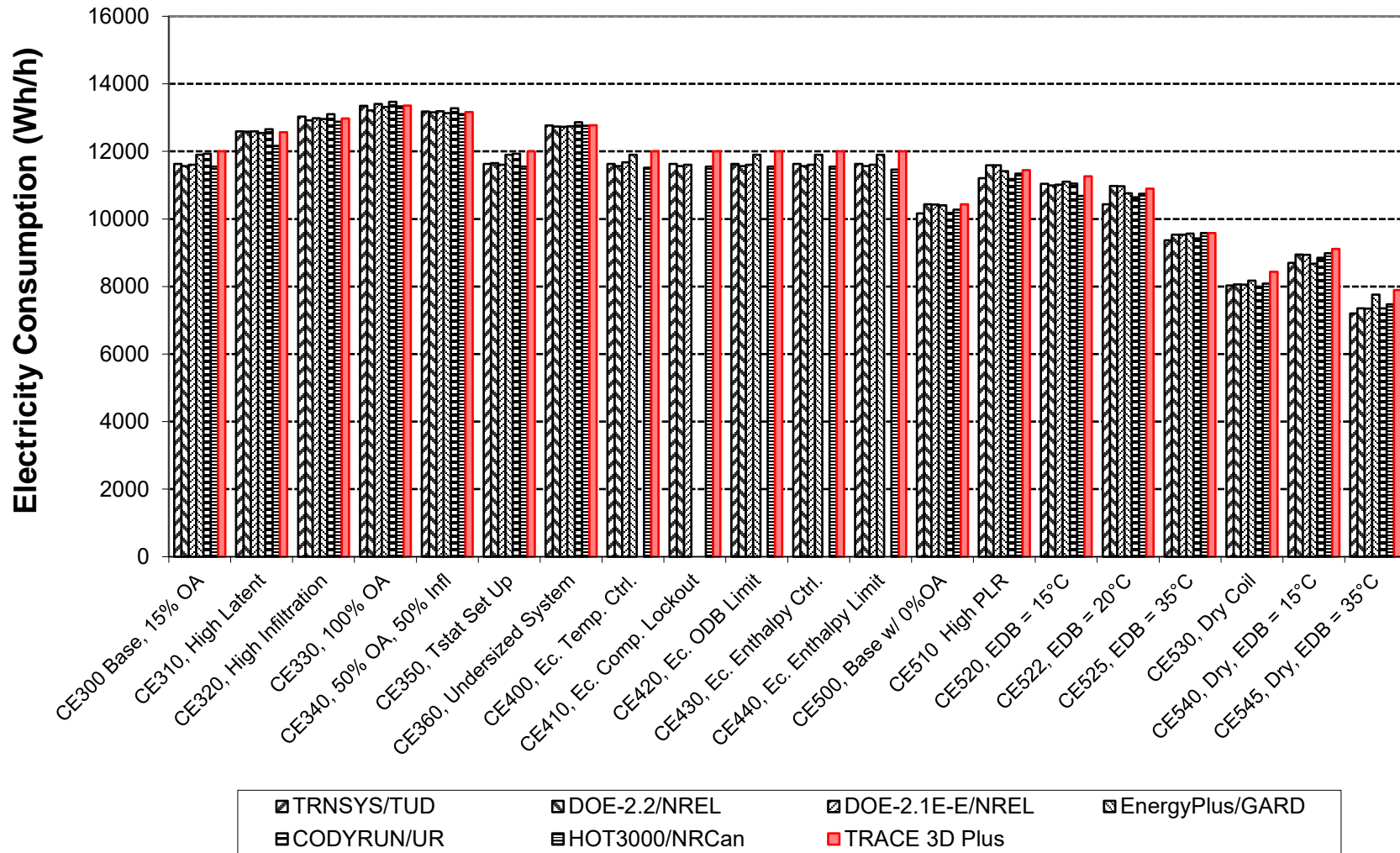
Table B16.5.2-28. Delta Hourly Integrated Maximum and Minimum Zone Relative Humidity

Maximum Relative Humidity (%)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	8.91	30.83	31.85	10.28	9.00	10.75	8.91	31.85	16.94	135.4%	10.02
CE320-CE300	13.05	14.06	14.82	14.60	15.00	14.44	13.05	15.00	14.33	13.6%	14.97
CE330-CE300	7.87	9.11	9.09	8.51	8.00	11.26	7.87	11.26	8.97	37.8%	8.87
CE330-CE320	-5.18	-4.95	-5.73	-6.09	-7.00	-3.18	-7	-3	-5.35	71.3%	-6.09
CE340-CE300	11.14	12.02	12.41	12.43	12.00	12.81	11	13	12.13	13.8%	12.75
CE330-CE340	-3.27	-2.91	-3.32	-3.92	-4.00	-1.55	-4	-2	-3.16	77.5%	-3.88
CE350-CE300	0.00	11.77	12.27	0.00	2.00	5.21	0.00	12.27	5.21	235.6%	0.00
CE360-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE400-CE300	14.96	16.22	16.72	16.27		18.87	14.96	18.87	16.61	23.5%	16.92
CE410-CE300	14.44	15.44	15.94			18.74	14.44	18.74	16.14	26.7%	16.92
CE420-CE300	2.05	5.16	2.68	4.92		6.41	2.05	6.41	4.24	102.7%	5.63
CE430-CE300	11.92	9.08	9.58	12.38		11.50	9.08	12.38	10.89	30.3%	13.07
CE440-CE300	-0.06	0.00	0.00	0.00		0.07	-0.06	0.07	0.00	13500.0%	0.00
CE500-CE300	31.21			31.63	32.00	-7.36	-7.36	32.00	21.87	180.0%	32.35
CE510-CE500	0.00			0.00	0.00	-2.57	-2.57	0.00	-0.64	400.0%	0.00
CE525-CE520	9.77			6.19	5.00	-20.65	-20.65	9.77	0.08	39706.5%	7.18
CE530-CE500	-8.96			-3.84	-21.00	-24.07	-24.07	-3.84	-14.47	139.8%	-59.20
CE545-CE540	29.60			41.06	50.00	-15.82	-15.82	50.00	26.21	251.1%	-0.67

Minimum Relative Humidity (%)							Statistics, All Results				TRACE 3D Plus
Case	TRNSYS TUD	DOE-2.2 NREL	DOE21E-E NREL	EnergyPlus GARD	CODYRUN UR	HOT3000 NRCan	Min	Max	Mean	(Max-Min) /Mean*	
CE310-CE300	0.06	0.00	0.00	1.10	1.00	0.99	0.00	1.10	0.52	209.6%	0.04
CE320-CE300	0.00	0.00	0.00	0.24	0.00	-2.02	-2.02	0.24	-0.30	761.2%	0.22
CE330-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE330-CE320	0.00	0.00	0.00	-0.24	0.00	2.02	-0.24	2.02	0.30	761.1%	-0.22
CE340-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE330-CE340	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----	0.00
CE350-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----	0.00
CE360-CE300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	600.0%	0.00
CE400-CE300	-0.12	0.00	0.00	-0.48		-0.37	-0.48	0.00	-0.19	246.0%	-0.34
CE410-CE300	-0.12	0.00	0.00	-0.48		-0.36	-0.36	0.00	-0.12	298.7%	-0.34
CE420-CE300	-0.12	0.00	0.00	-0.48		-0.35	-0.48	0.00	-0.19	251.4%	-0.34
CE430-CE300	-0.12	0.00	0.00	-0.48		-0.36	-0.48	0.00	-0.19	248.3%	-0.34
CE440-CE300	-0.12	0.00	0.00	-0.48		-0.40	-0.48	0.00	-0.20	238.1%	-0.34
CE500-CE300	40.07			40.76	39.00	37.89	37.89	40.76	39.43	7.3%	38.28
CE510-CE500	-1.32			0.12	0.00	0.32	-1.32	0.32	-0.22	747.8%	0.05
CE525-CE520	-15.74			-13.87	-17.00	-17.50	-17.50	-13.87	-16.03	22.6%	-16.06
CE530-CE500	-23.81			-21.14	-26.00	-19.15	-26.00	-19.15	-22.53	30.4%	-38.13
CE545-CE540	-19.35			-16.77	-12.00	-19.60	-19.60	-12.00	-16.93	44.9%	-18.82

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

**Figure B16.5.2-3. HVAC BESTEST: CE300 - CE545
 Peak Hour Total Electricity Consumption**



**Figure B16.5.2-10. HVAC BESTEST: CE300 - CE545
 Annual Outdoor (Condenser) Fan Electricity Consumption
 Sensitivities**

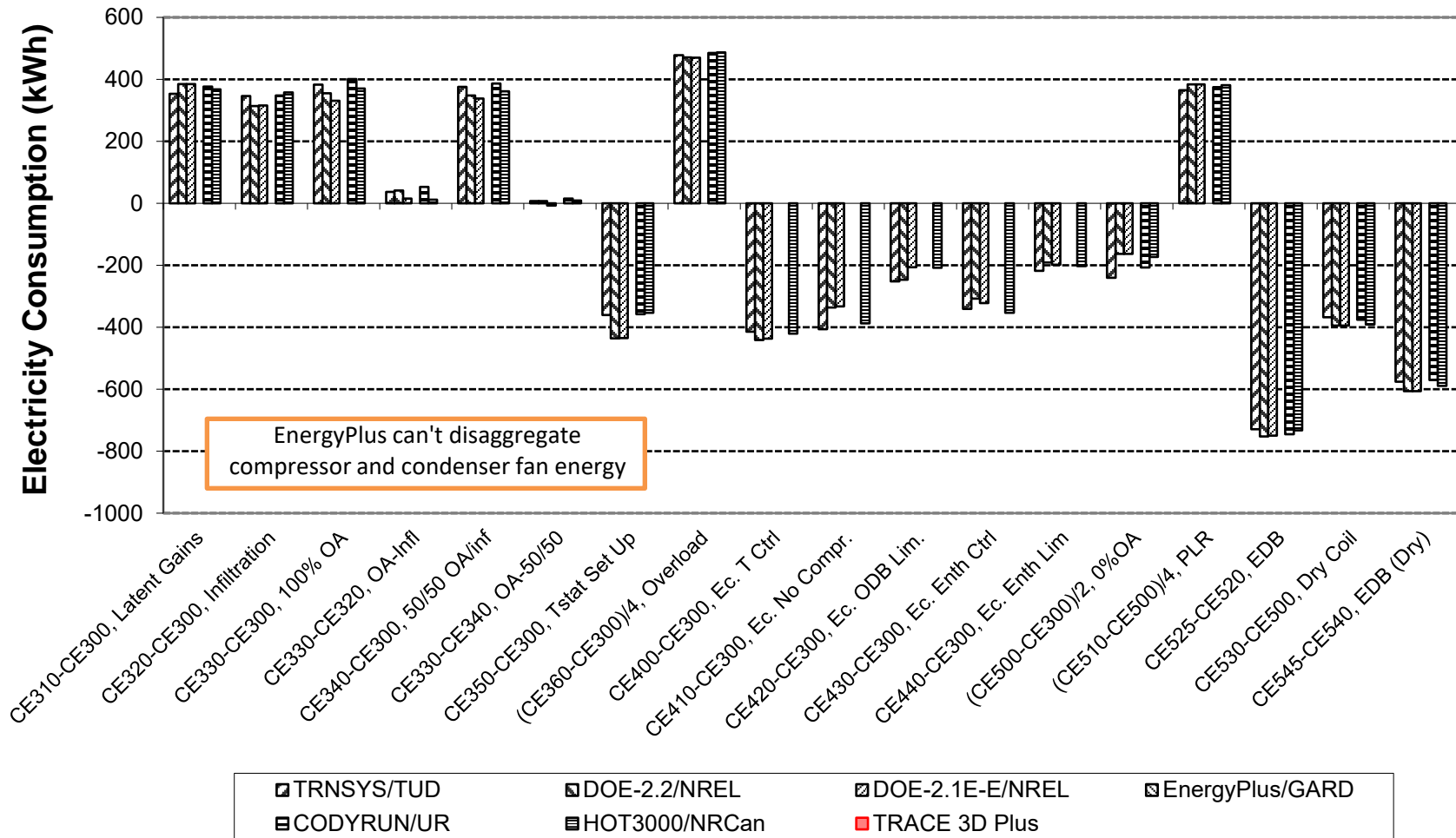
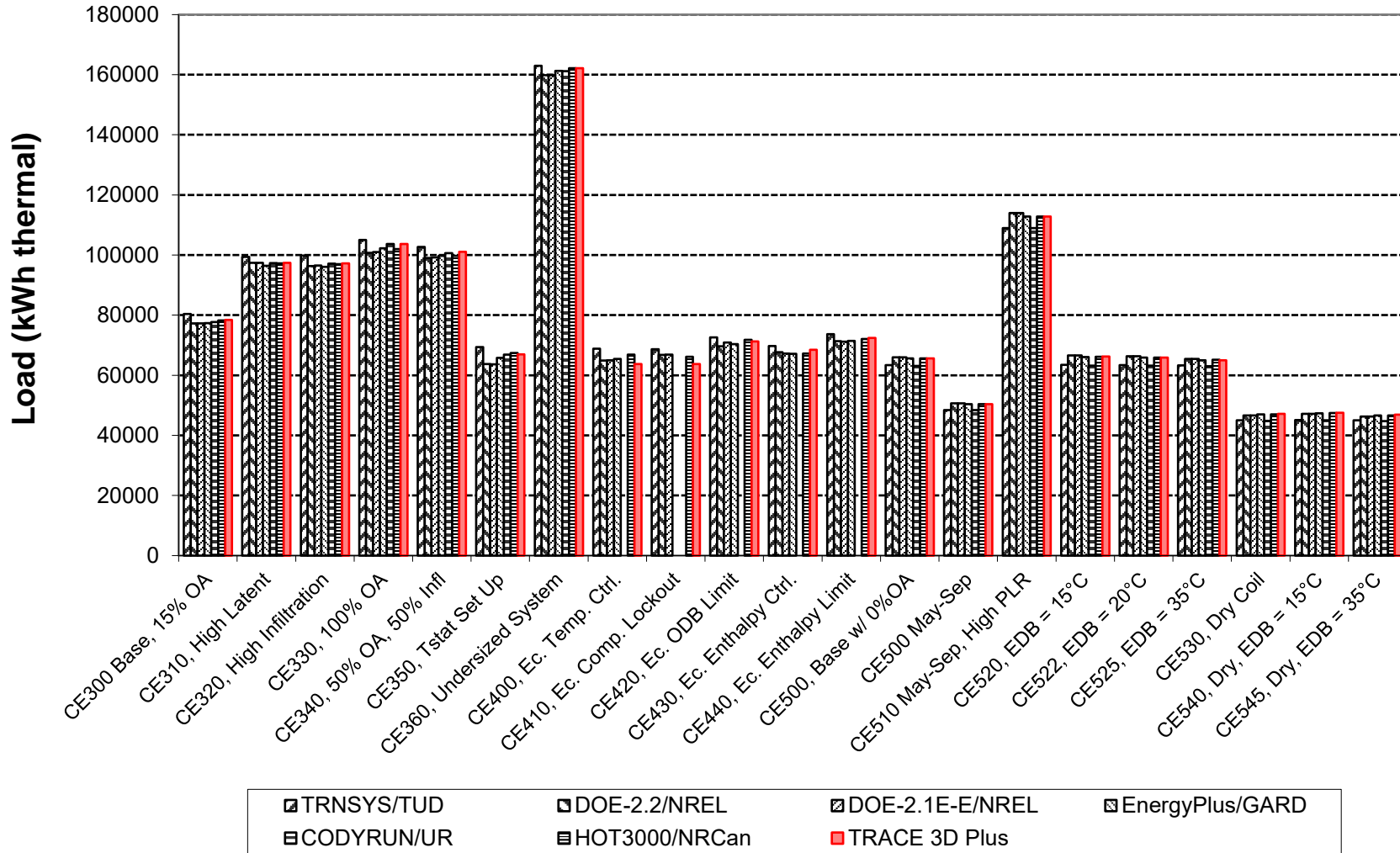
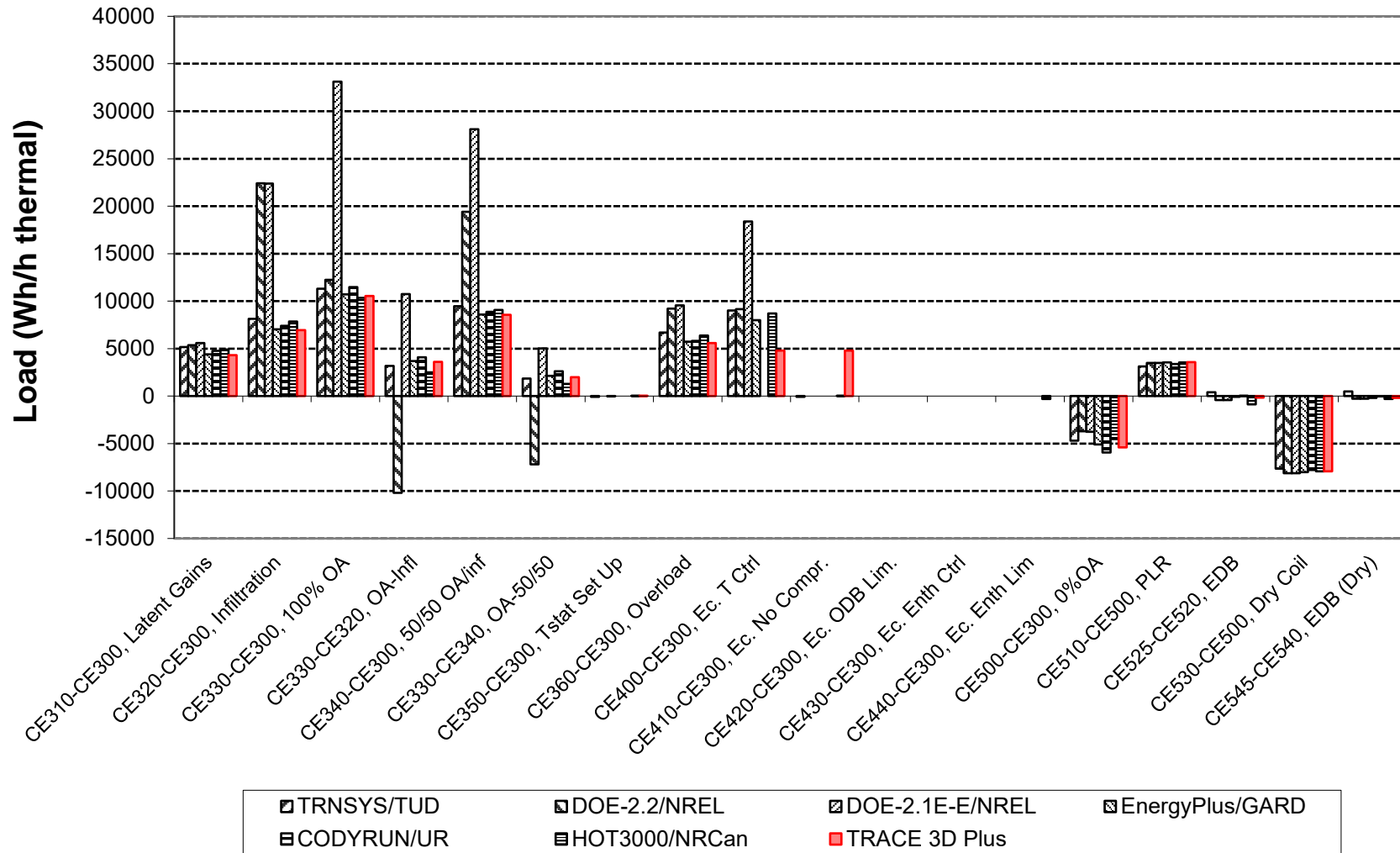


Figure B16.5.2-11. HVAC BESTEST: CE300 - CE545
Annual Total Coil Load



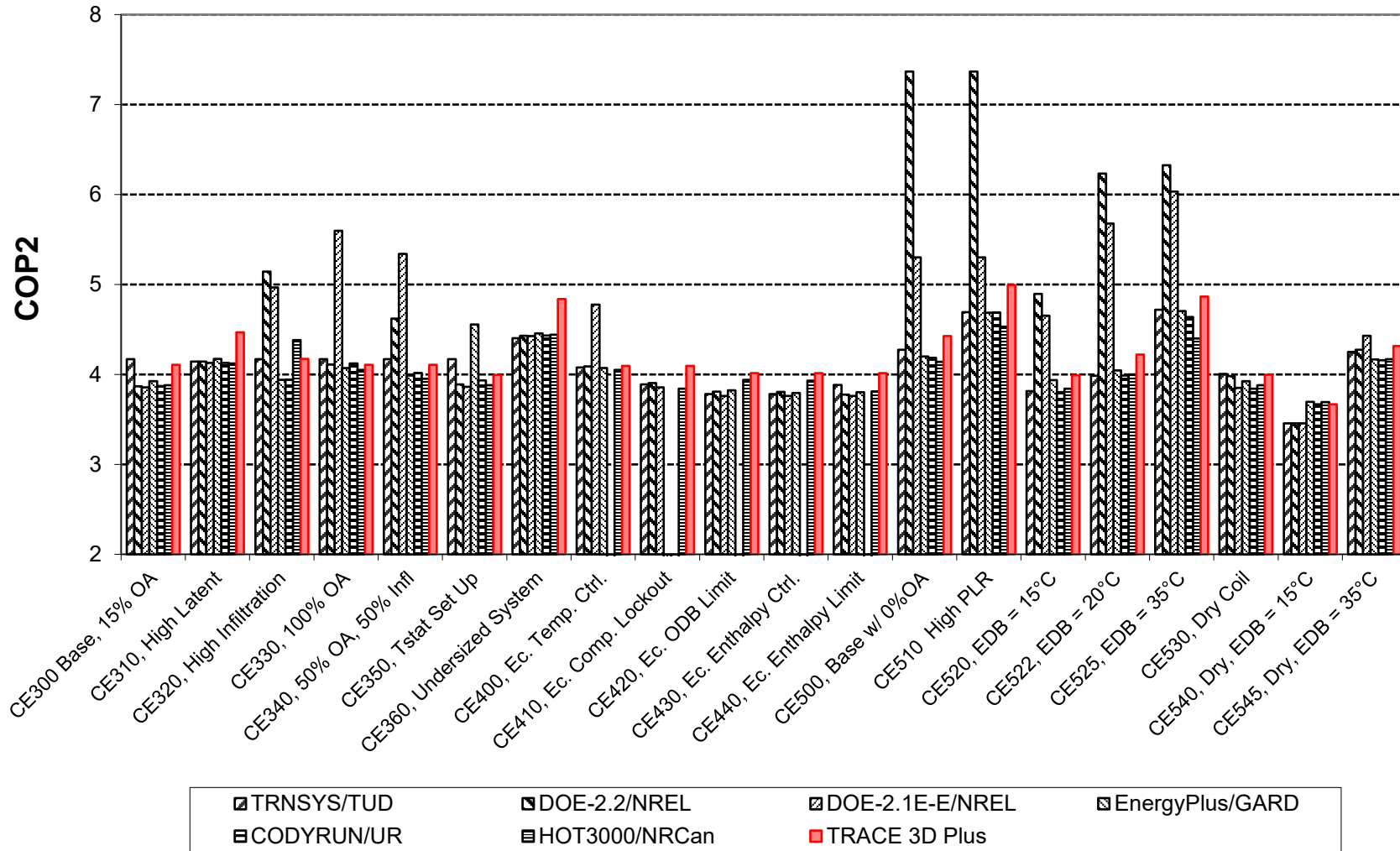
ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
 Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

**Figure B16.5.2-13. HVAC BESTEST: CE300 - CE545
 Hourly Maximum Total Coil Load Sensitivities**



ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
 Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Figure B16.5.2-23. HVAC BESTEST: CE300 - CE545
Hourly Maximum COP2



**Figure B16.5.2-24. HVAC BESTEST: CE300 - CE545
 Hourly Maximum COP2 Sensitivities**

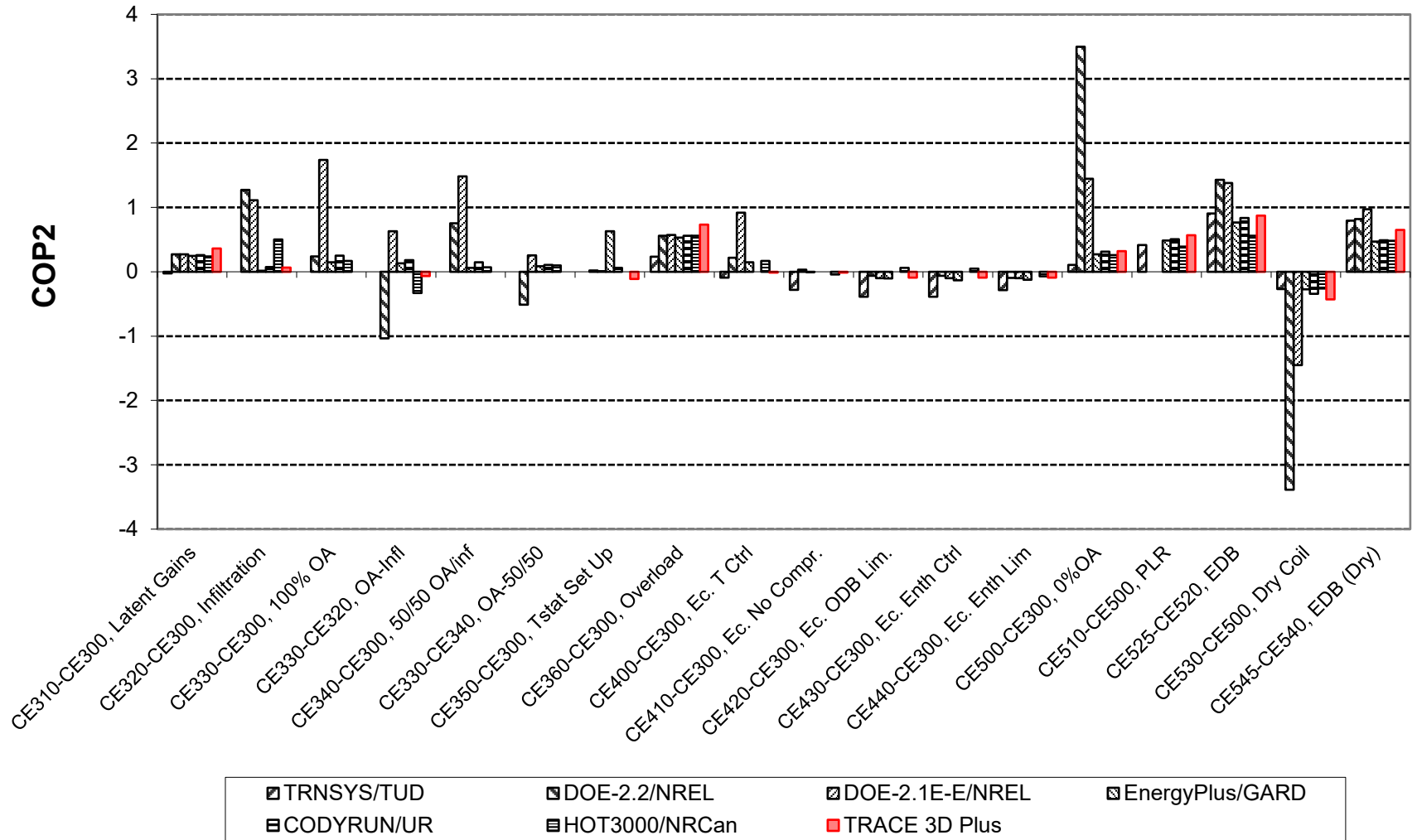
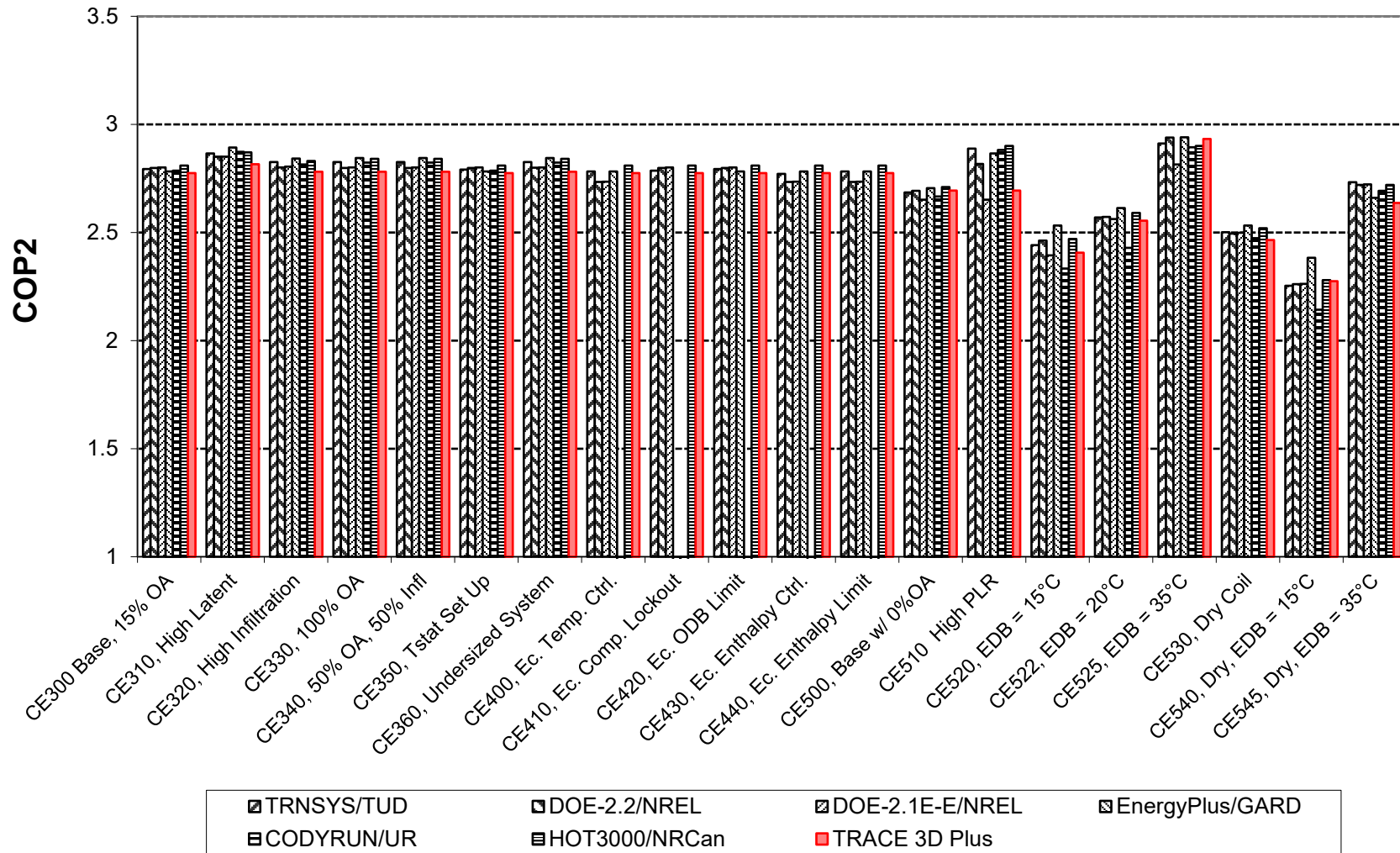


Figure B16.5.2-25. HVAC BESTEST: CE300 - CE545
Hourly Minimum COP2



**Figure B16.5.2-26. HVAC BESTEST: CE300 - CE545
 Hourly Minimum COP2 Sensitivities**

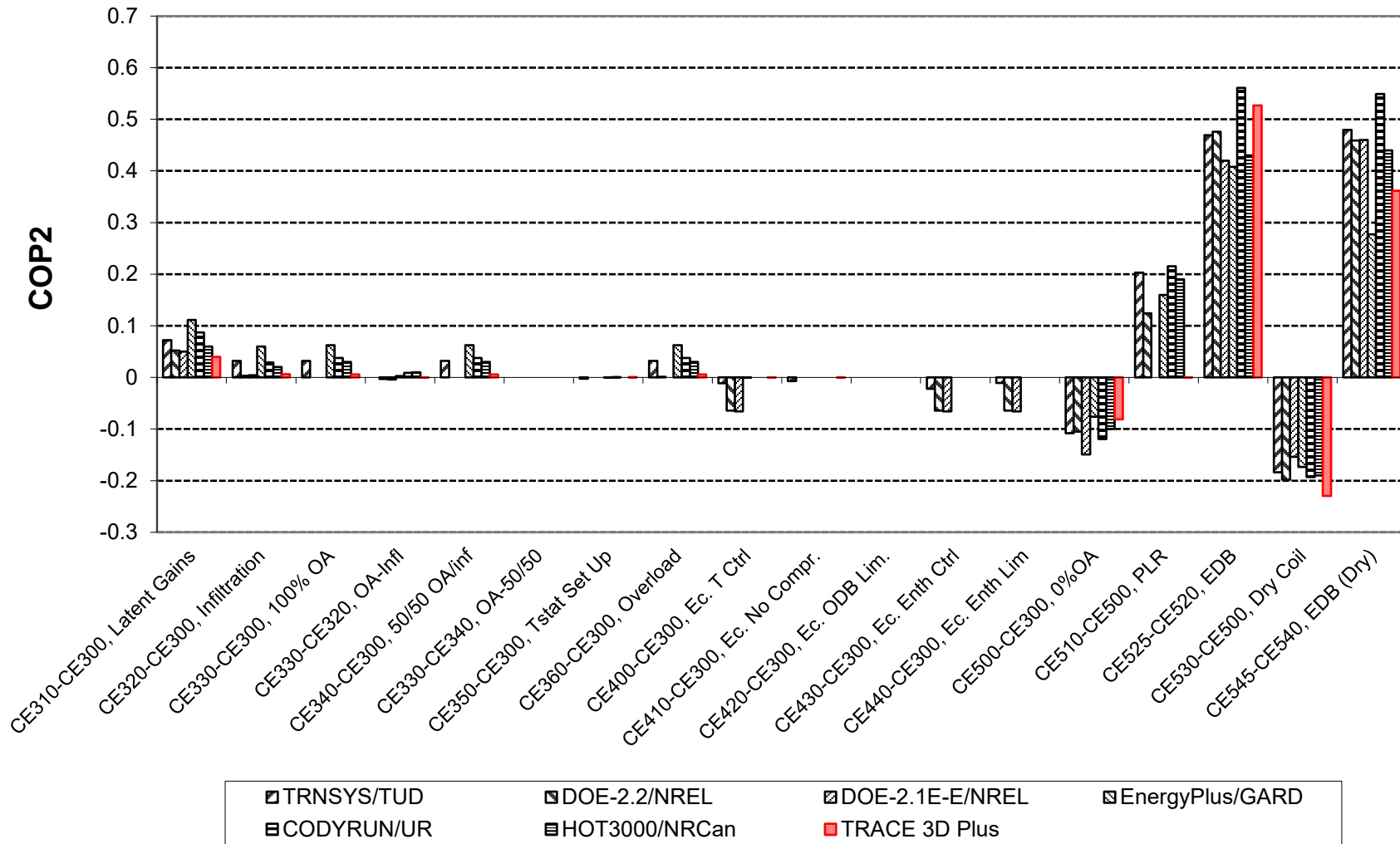


Figure B16.5.2-29. HVAC BESTEST: CE300 - CE545
Hourly Maximum Indoor Dry-Bulb Temperature

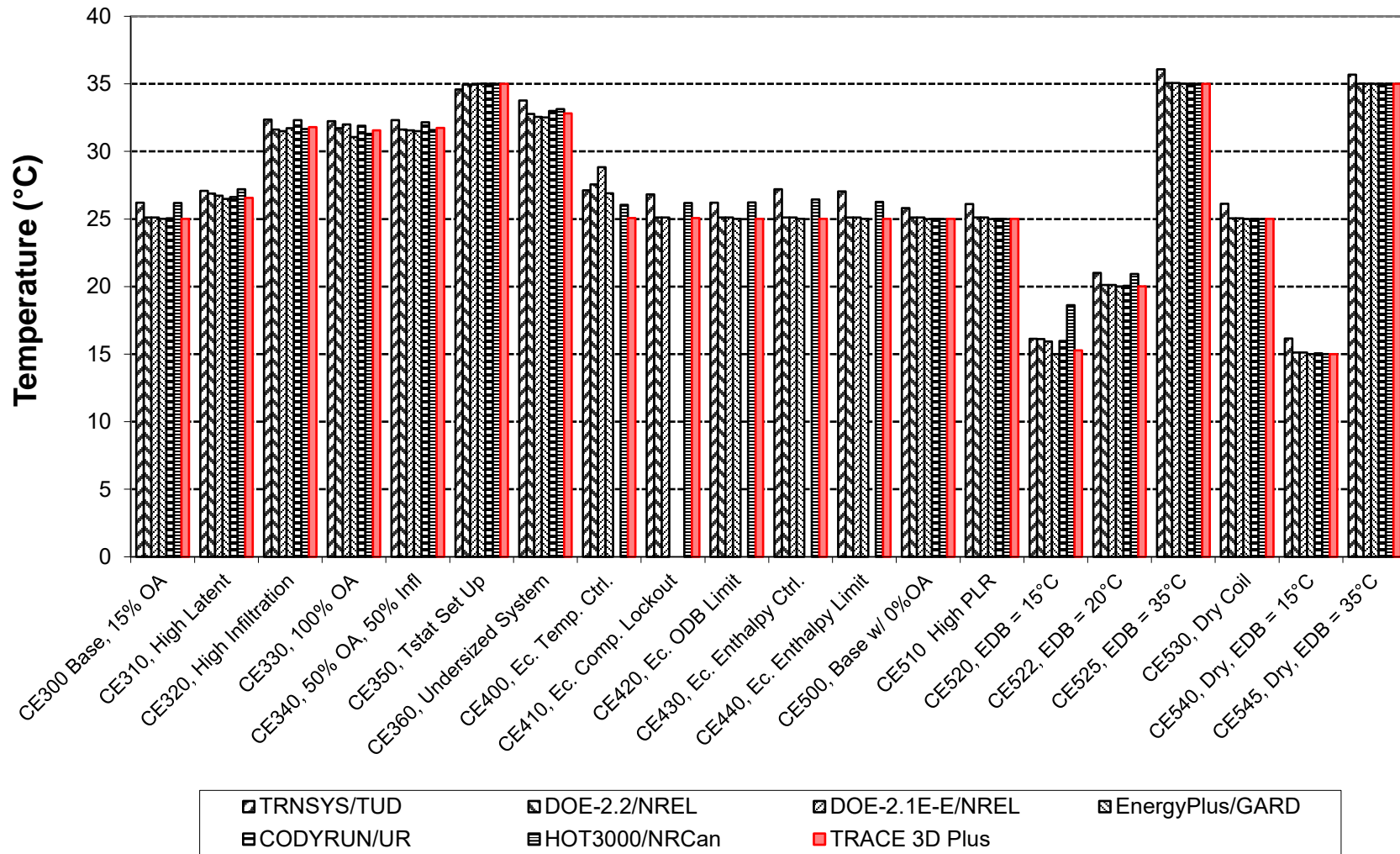
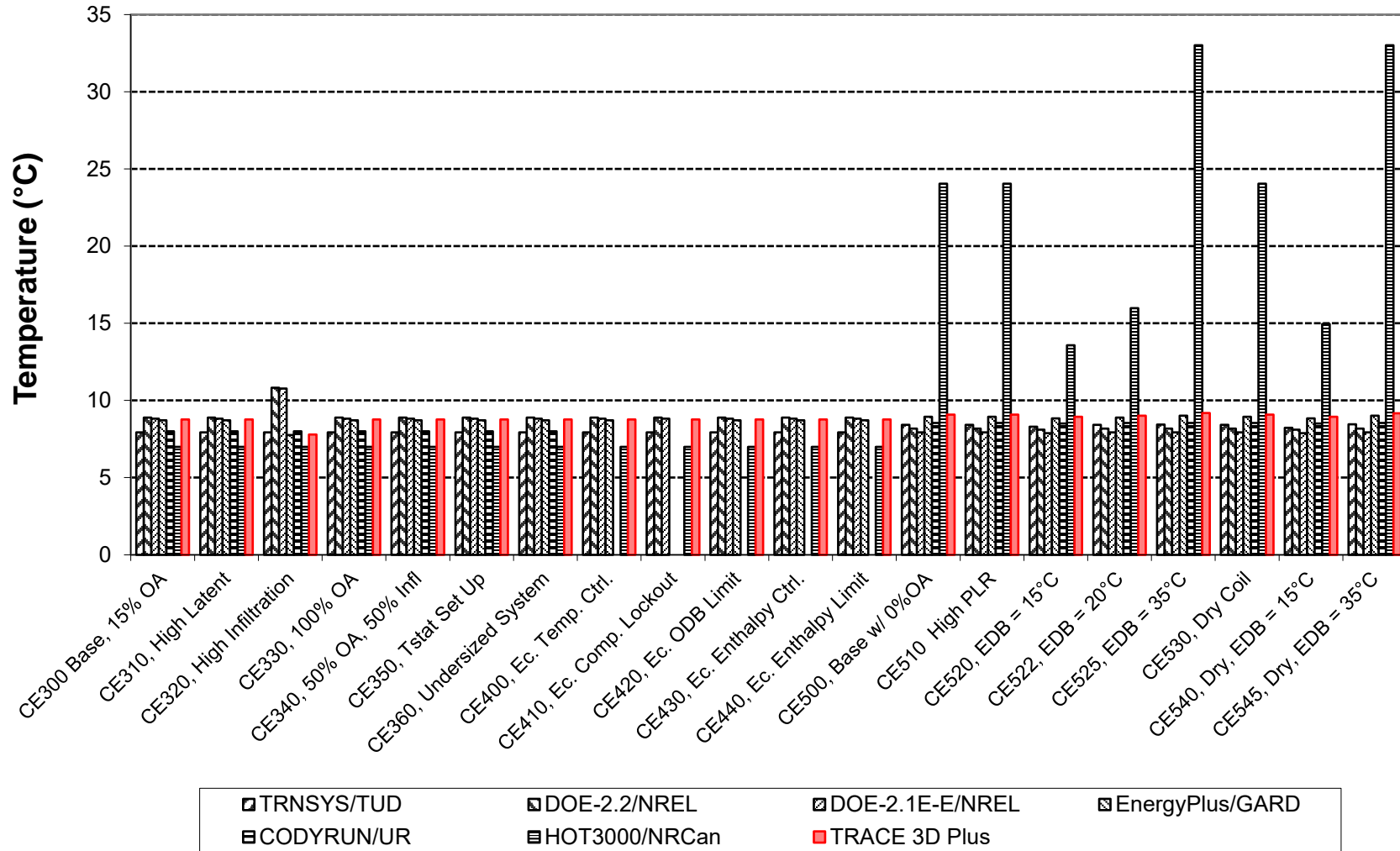
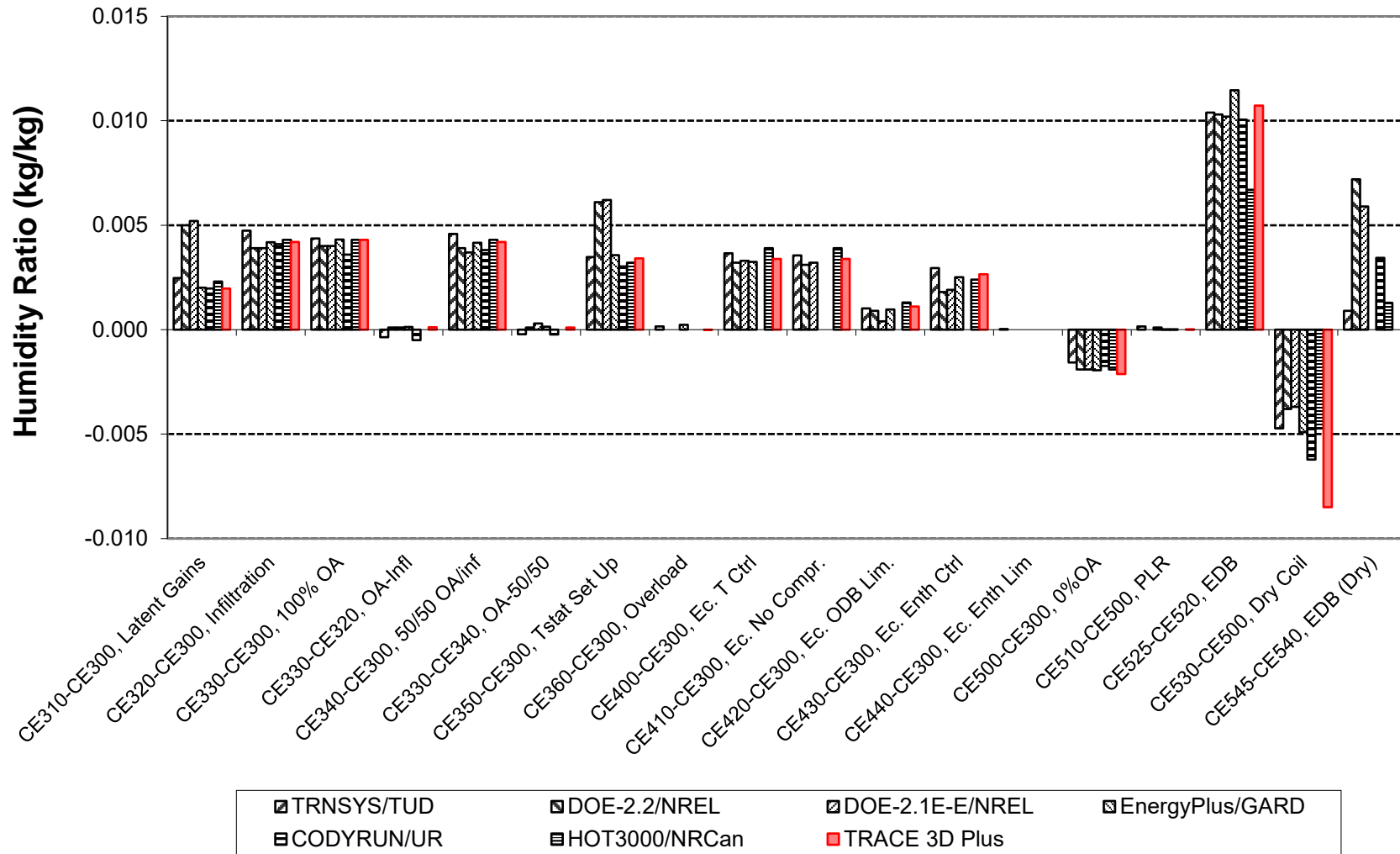


Figure B16.5.2-31. HVAC BESTEST: CE300 - CE545
Hourly Minimum Indoor Dry-Bulb Temperature



**Figure B16.5.2-35. HVAC BESTEST: CE300 - CE545
 Hourly Maximum Humidity Ratio Sensitivities**



ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
 Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Figure B16.5.2-37. HVAC BESTEST: CE300 - CE545
Annual Mean Relative Humidity

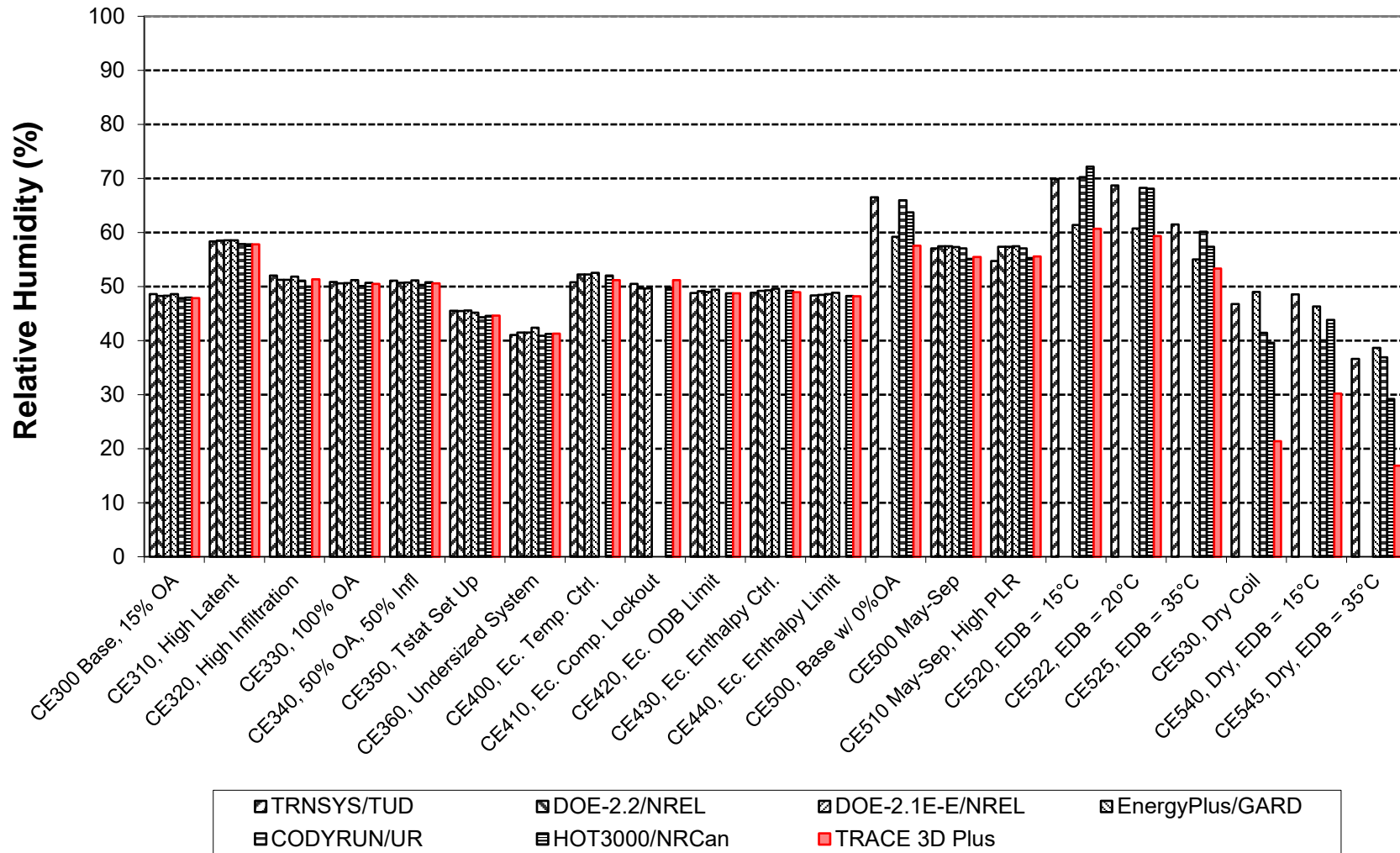
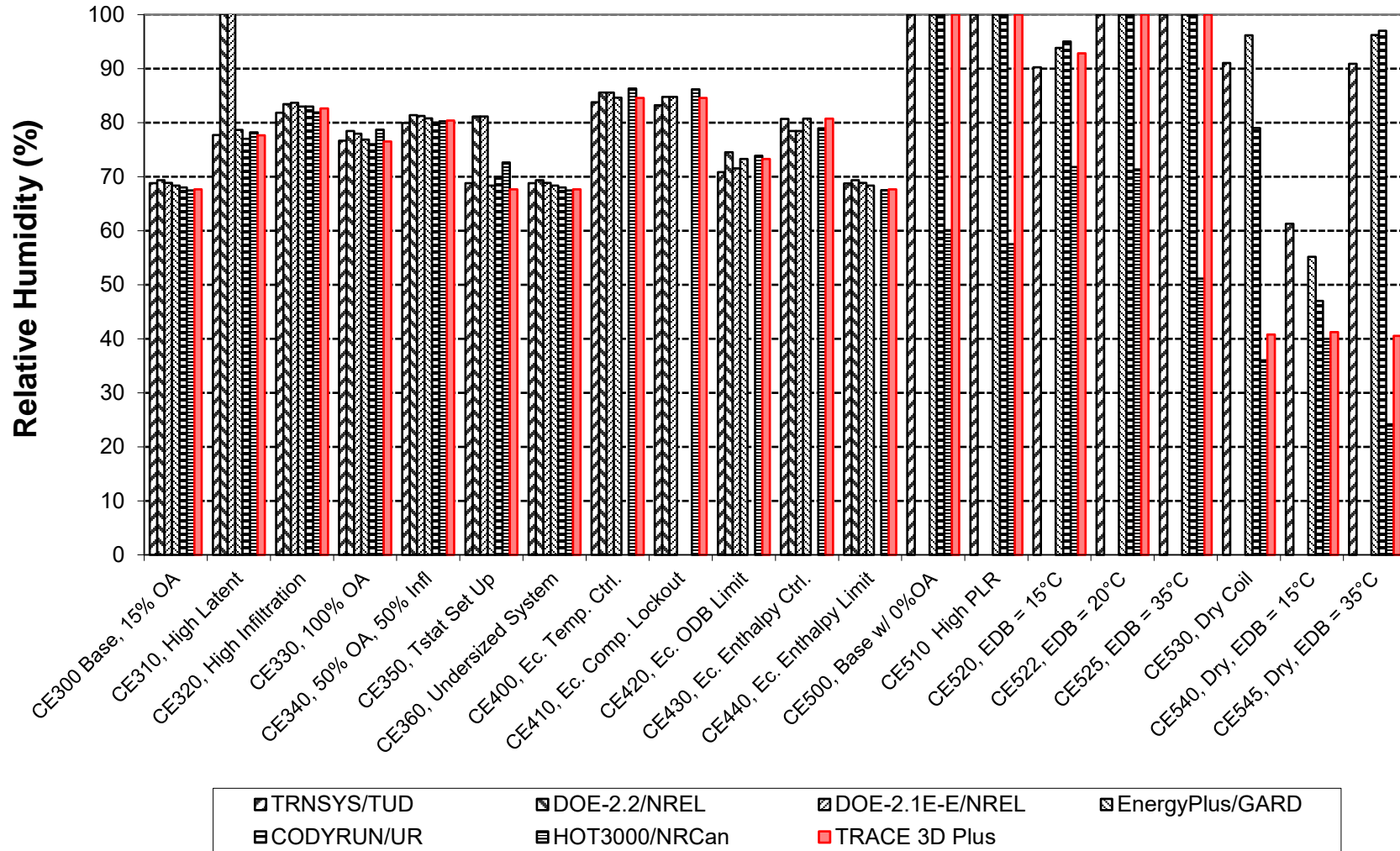


Figure B16.5.2-39. HVAC BESTEST: CE300 - CE545
Hourly Maximum Zone Relative Humidity



**Figure B16.5.2-40. HVAC BESTEST: CE300 - CE545
 Hourly Maximum Relative Humidity Sensitivities**

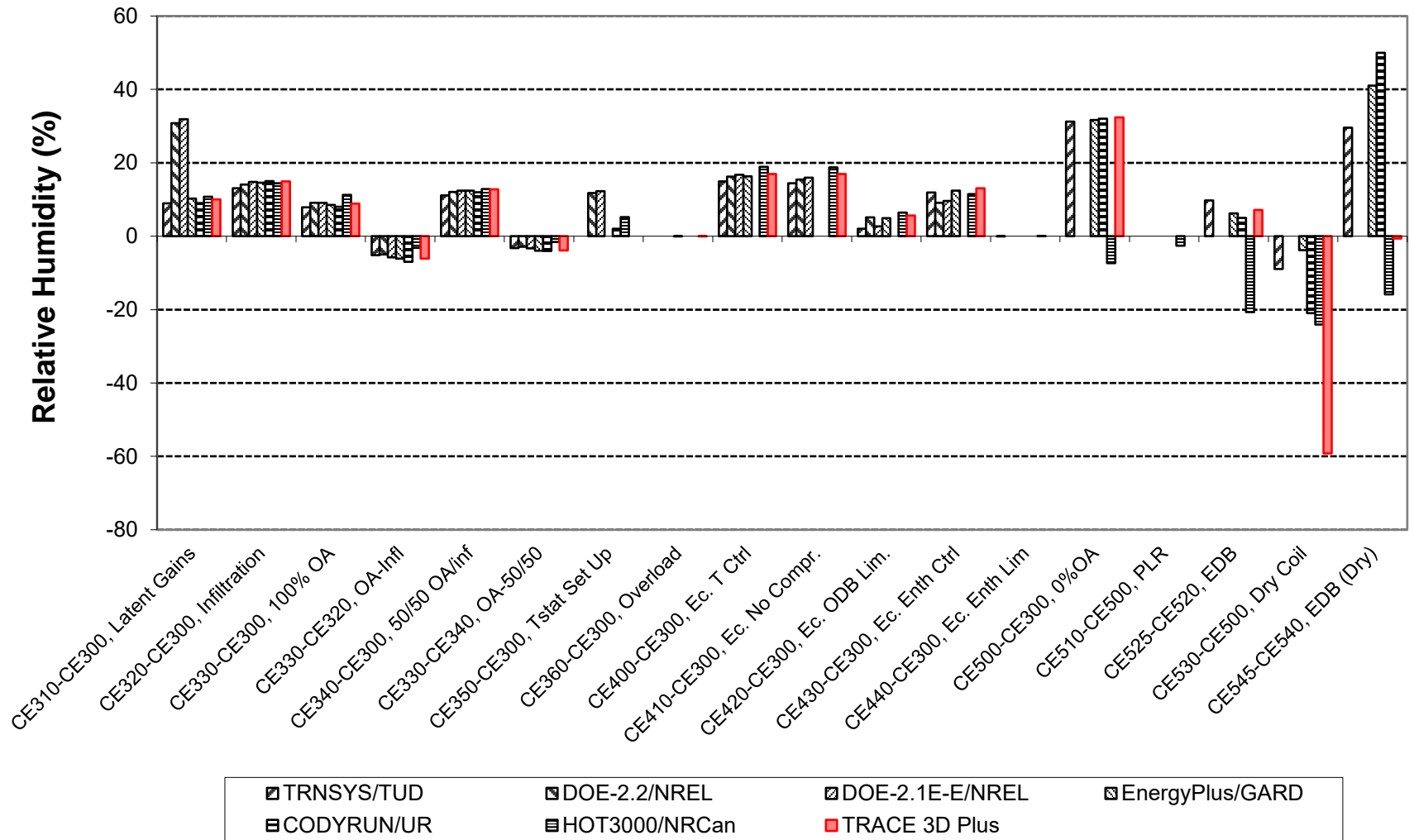
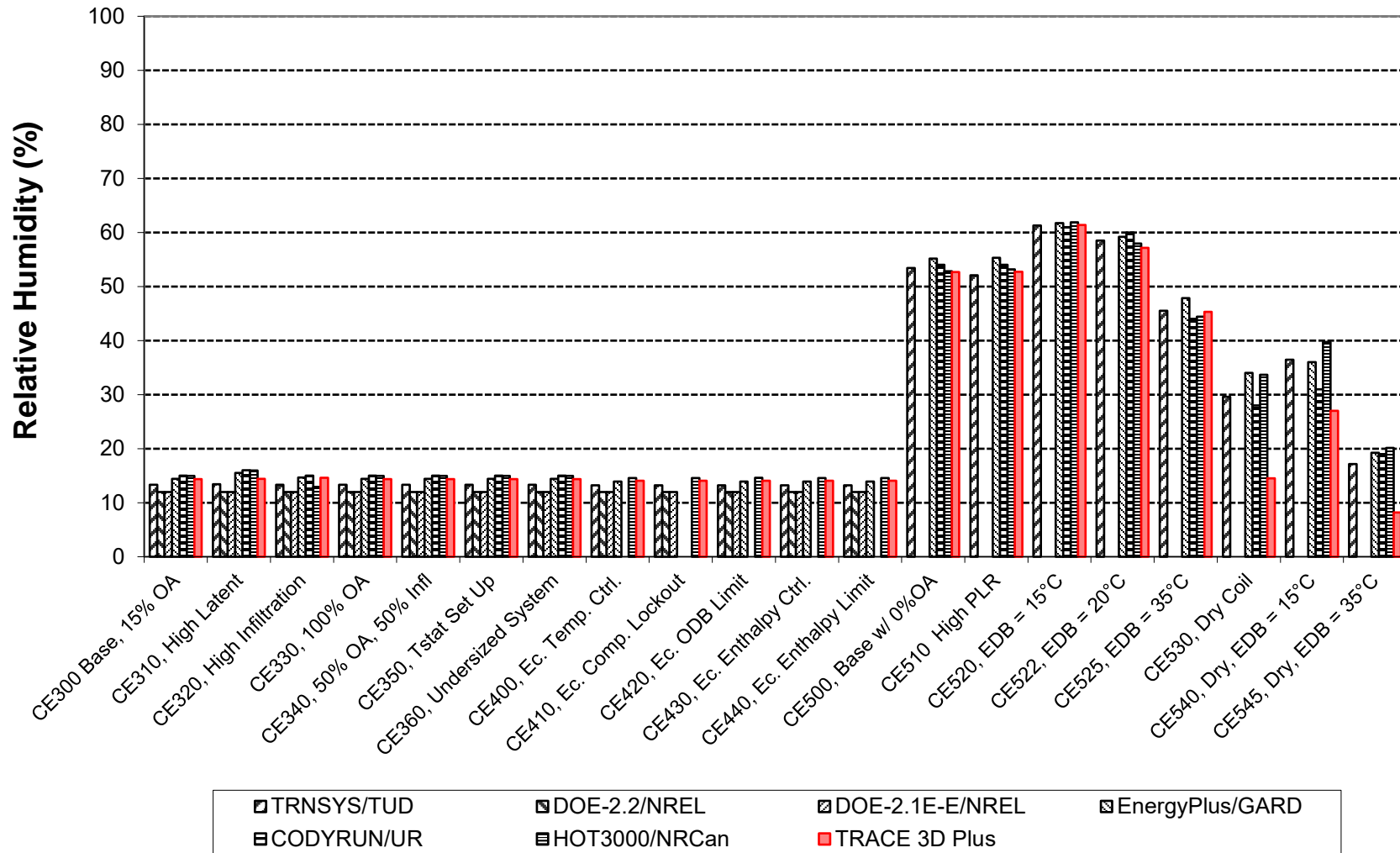
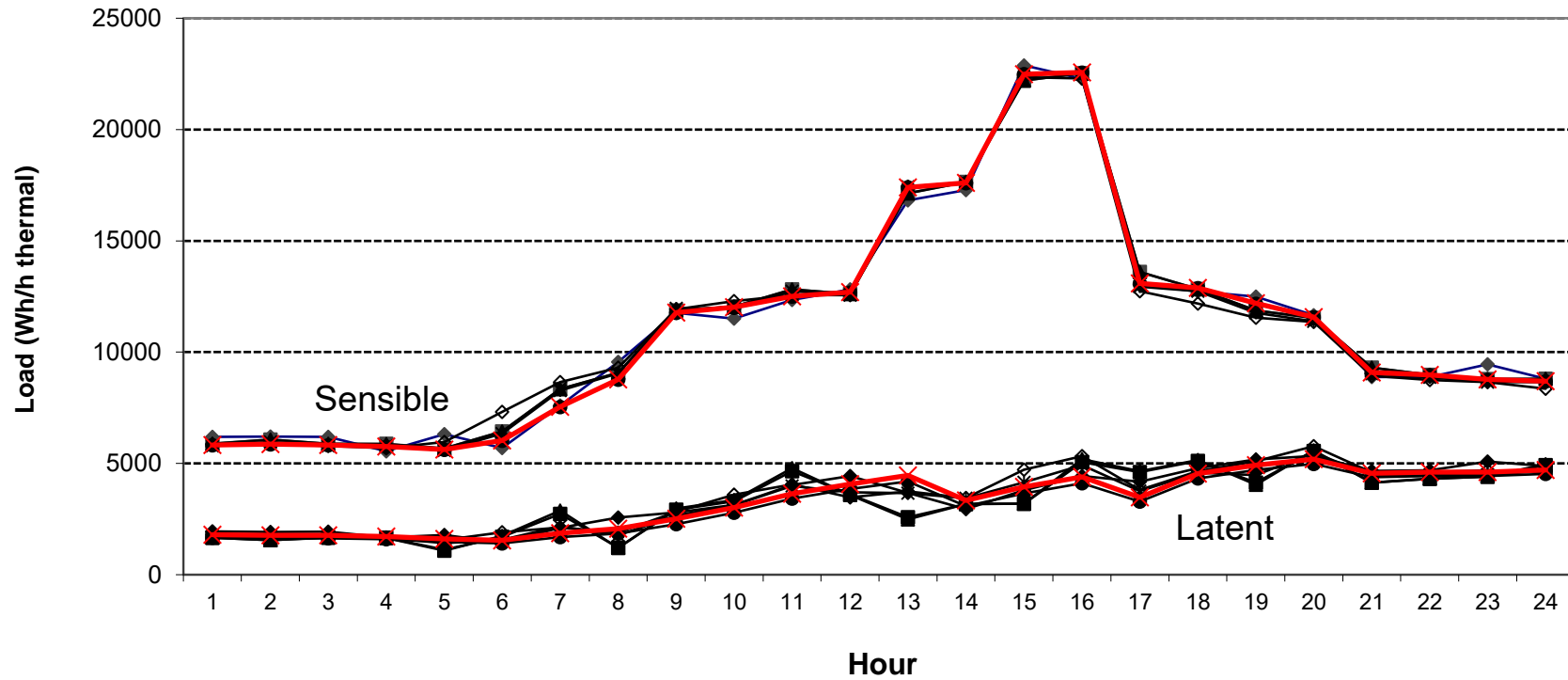


Figure B16.5.2-41. HVAC BESTEST: CE300 - CE545
Hourly Minimum Zone Relative Humidity



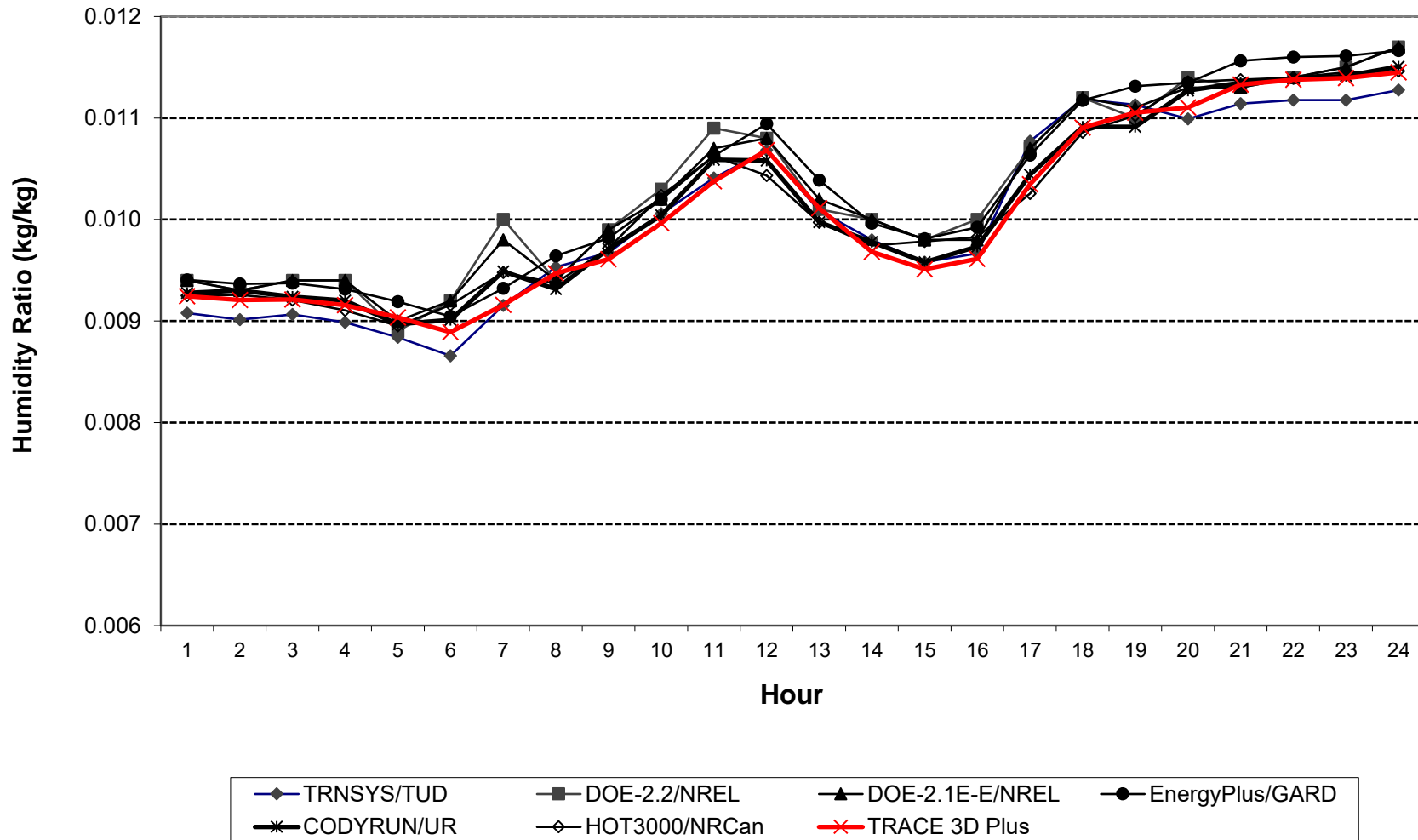
**Figure B16.5.2-47. HVAC BESTEST: CE300
 June 28 Hourly Coil Loads**



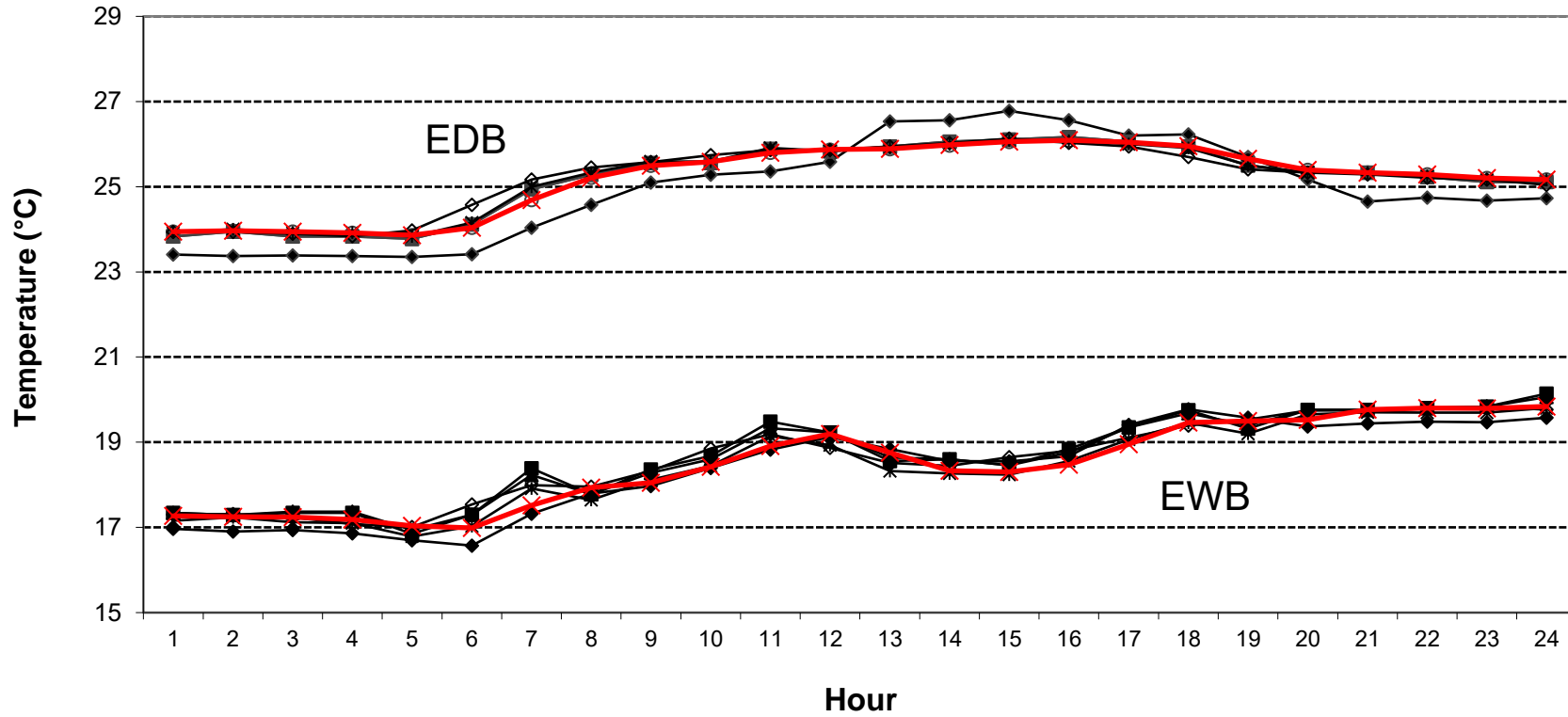
◆ TRNSYS/TUD	■ DOE-2.2/NREL	▲ DOE-2.1E-E/NREL	● EnergyPlus/GARD
* CODYRUN/UR	◇ HOT3000/NRCan	✕ TRACE 3D Plus	◆ TRNSYS/TUD
■ DOE-2.2/NREL	▲ DOE-2.1E-E/NREL	● EnergyPlus/GARD	* CODYRUN/UR
◇ HOT3000/NRCan	✕ TRACE 3D Plus		

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

**Figure B16.5.2-49. HVAC BESTEST: CE300
June 28 Hourly Zone Humidity Ratio**



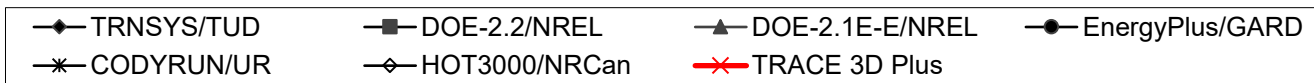
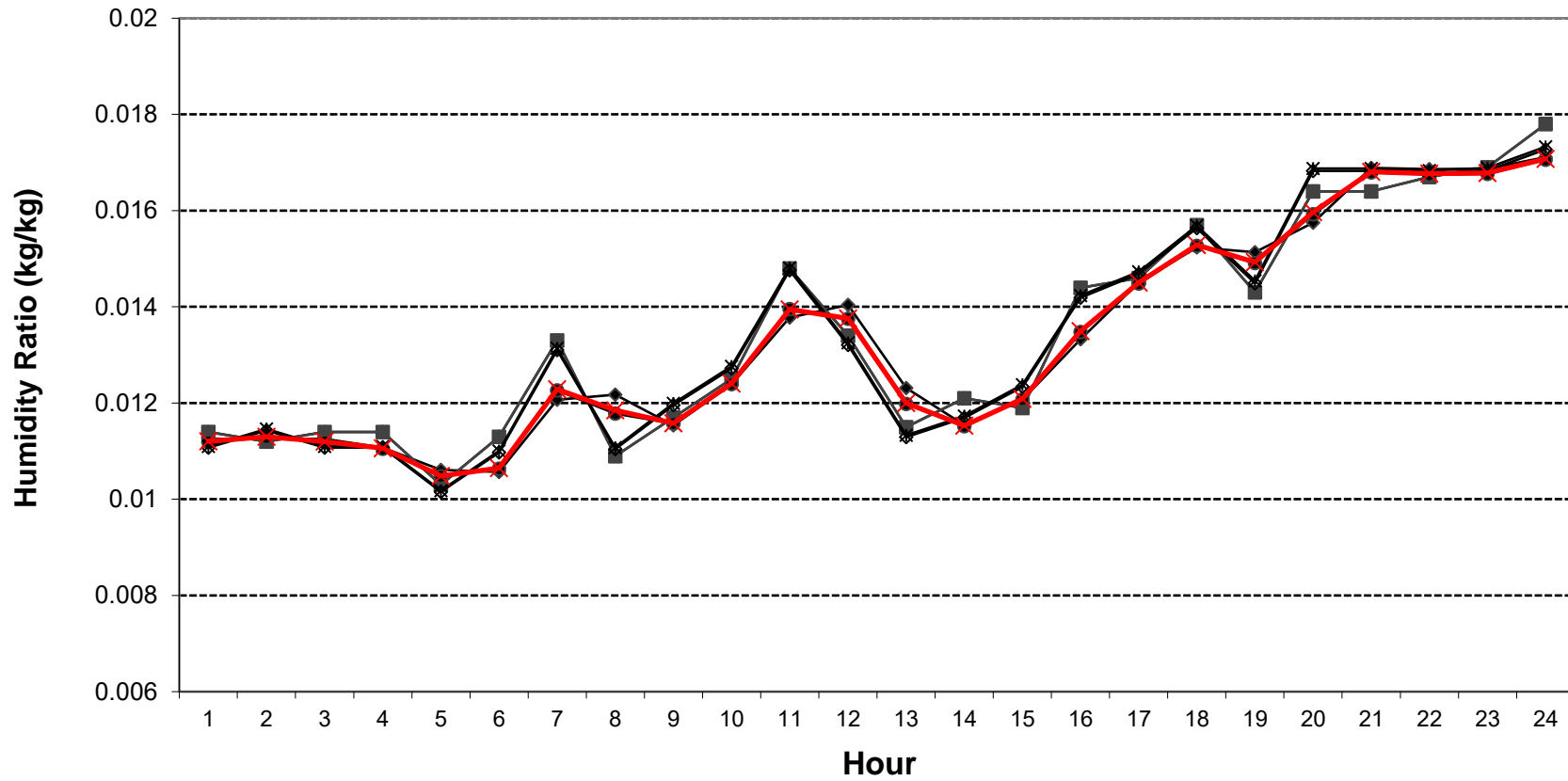
**Figure B16.5.2-50. HVAC BESTEST: CE300
 June 28 Hourly EDB & EWB**



◆ TRNSYS/TUD	■ DOE-2.2/NREL	▲ DOE-2.1E-E/NREL	○ EnergyPlus/GARD	* CODYRUN/UR
◇ HOT3000/NRCan	✖ TRACE 3D Plus	◆ TRNSYS/TUD	■ DOE-2.2/NREL	▲ DOE-2.1E-E/NREL
○ EnergyPlus/GARD	* CODYRUN/UR	◇ HOT3000/NRCan	✖ TRACE 3D Plus	

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.5.2
Example Results for Section 5.3 - HVAC Equipment Performance Tests CE300 through CE545

Figure B16.5.2-52. HVAC BESTEST: CE300
June 28 Hourly OHR



ASHRAE Standard 140-2020
Informative Annex B16, Section B16.6

Example Results
for

Section 5.4 - HVAC Equipment Performance Tests HE100 through HE230

ASHRAE Standard 140-2020
Participating Organizations and Computer Programs for
Quasi-Analytical Solutions and Example Simulation Results
Section 5.4 - HVAC Equipment Performance Tests HE100 through HE230

The quasi-analytical solutions and programs used to generate the example simulation results are described below. The first column ("Model"), indicates the proper program name and version number, or indicates a quasi-analytical solution.

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

The third column ("Implemented By") indicates the national research facility, university, or industry organization with expertise in building science that performed the simulations or did the quasi-analytical solutions.

The entries in the fourth column are the abbreviations for the simulations and quasi-analytical solutions generally used in the tables and charts which follow.

See Standard 140, Annex B17 for further details.

Participating Organizations and Computer Programs

Model	Authoring Organization	Implemented By	Abbreviation
ESP-r/HOT3000 Tier 1 tests - version 1.1 Tier 2 tests - version 1.7	CETC/ESRU, ^{a,b} Canada/United Kingdom	CETC, ^a Canada	ESP-r/HOT3000/CETC
EnergyPlus 1.0.2.008	LBNL/UIUC/CERL/OSU/GARD Analytics/FSEC/DOE-OBT, ^{c,d,e,f,g,h}	GARD Analytics, USA	EnergyPlus/GARD
DOE-2.1E version c133	LANL/LBNL/JJH, ^{i,j} USA	CETC, ^a Canada	DOE-2.1E/CETC
Analytical/Quasi-Analytical	CETC ^a	CETC ^a	Analytical/Quasi-Analytical

^aCETC CANMET Energy Technology Centre, Natural Resources Canada, Canada

^bESRU: Energy Systems Research Unit, University of Strathclyde, Scotland, United Kingdom

^cLBNL: Lawrence Berkeley National Laboratory, United States

^dUIUC: University of Illinois Urbana/Champaign, United States

^eCERL: U.S. Army Corps of Engineers, Construction Engineering Research Laboratories, United States

^fOSU: Oklahoma State University, United States

^gFSEC: University of Central Florida, Florida Solar Energy Center, United States

^hDOE-OBT: U.S. Department of Energy, Office of Building Technology, State and Community Programs, Energy Efficiency and Renewable Energy, United States

ⁱLANL: Los Alamos National Laboratory, United States

^jJJH: James J. Hirsch & Associates, United States

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.6
Example Results for Section 5.4 - HVAC Equipment Performance Tests HE100 through HE230

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B16.6-2	Total Furnace Input (GJ)	Tables	A26 – L43
B16.6-3	Fuel Consumption (m ³ /s)	Tables	A45 – L62
B16.6-4	Fan Energy, both fans (kWh)	Tables	A64 – K76
B16.6-5	Mean Zone Temperature (°C)	Tables	A78 – J85
B16.6-6	Maximum Zone Temperature (°C)	Tables	A87 – J94
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List of Figures

<i>Figure</i>	<i>Description</i>	<i>Sheet Tab</i>
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B16.6-2	Total Furnace Input (GJ)	B16.1-2 INPUT
B16.6-3	Fuel Consumption (m ³ /s)	B16.1-3 FUEL
B16.6-4	Fan Energy, both fans (kWh)	B16.1-4 FANS
B16.6-5	Mean Zone Temperature (°C)	B16.1-5 MEAN T
B16.6-6	Maximum Zone Temperature (°C)	B16.1-6 MAX T
B16.6-7	Minimum Zone Temperature (°C)	B16.1-7 MIN T

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.6
Example Results for Section 5.4 - HVAC Equipment Performance Tests HE100 through HE230

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.6-1. Total Furnace Load (GJ)

Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Statistics, All Results				Analytical/ Quasi-Analytical	TRACE 3D Plus Trane
				Min	Max	(Max-Min) /Analytical*	Mean /Mean**		
HE100: 100% eff.	77.94	77.75	77.76	77.75	77.94	0.2%	77.74	77.76	
HE110: 80% eff.	77.94	77.75	77.76	77.75	77.94	0.2%	77.74	77.76	
HE120: 80% eff., PLR=0.4	31.25	31.10	31.13	31.10	31.25	0.5%	31.10	31.22	
HE130: No Load	0.00	0.00	0.16	0.00	0.16	----	0.00	0.04	
HE140: Periodic PLR	31.26	31.10	31.12	31.10	31.26	0.5%	31.10	31.22	
HE150: Continuous Circ. Fan	29.88	29.59	29.57	29.57	29.88	1.1%	29.65	31.23	
HE160: Cycling Circ. Fan	31.26	30.46	30.49	30.46	31.26	2.6%	31.10	31.22	
HE170: Draft Fan	29.88	29.59	29.57	29.57	29.88	1.1%	29.65	31.23	
Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Min	Max	Mean /Mean**	(Max-Min) /Analytical*	Analytical/ Quasi-Analytical	TRACE 3D Plus Trane
HE210: Realistic Weather	41.36	42.04	42.06	41.36	42.06	41.82	1.7%	-	43.03
HE220: Setback Thermostat	39.41	39.87	39.76	39.41	39.87	39.68	1.2%	-	40.73
HE230: Undersized Furnace	34.32	34.59	34.37	34.32	34.59	34.43	0.8%	-	35.79

* Abs[(Max-Min) / (Analytic Solution)]

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

Table B16.6-2. Total Furnace Input (GJ)

Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Statistics, All Results				Analytical/ Quasi-Analytical	TRACE 3D Plus Trane
				Min	Max	(Max-Min) /Analytical*	Mean /Mean**		
HE100: 100% eff.	77.74	77.71	78.42	77.71	78.42	0.9%	77.71	77.76	
HE110: 80% eff.	96.92	97.22	98.02	96.92	98.02	1.1%	97.22	97.20	
HE120: 80% eff., PLR=0.4	38.41	38.27	38.56	38.27	38.56	0.8%	38.27	38.42	
HE130: No Load	0.00	0.00	0.14	0.00	0.14	----	0.00	0.05	
HE140: Periodic PLR	39.00	39.00	38.76	38.76	39.00	0.6%	39.00	39.06	
HE150: Continuous Circ. Fan	37.23	36.94	36.82	36.82	37.23	1.1%	37.02	37.37	
HE160: Cycling Circ. Fan	38.12	38.12	37.96	37.96	38.12	0.4%	38.09	38.35	
HE170: Draft Fan	37.23	36.94	36.82	36.82	37.23	1.1%	37.02	37.37	
Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Min	Max	Mean /Mean**	(Max-Min) /Analytical*	Analytical/ Quasi-Analytical	TRACE 3D Plus Trane
HE210: Realistic Weather	50.53	52.01	52.37	50.53	52.37	51.64	3.6%	-	52.77
HE220: Setback Thermostat	47.87	49.35	49.47	47.87	49.47	48.89	3.3%	-	50.04
HE230: Undersized Furnace	41.37	42.55	43.22	41.37	43.22	42.38	4.4%	-	43.41

* Abs[(Max-Min) / (Analytic Solution)]

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.6
Example Results for Section 5.4 - HVAC Equipment Performance Tests HE100 through HE230

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.6-3. Fuel Consumption (m³/s)

Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Statistics, All Results				Analytical/ Quasi-Analytical	TRACE 3D Plus Trane
				Min	Max	(Max-Min) /Analytical*	Mean		
HE100: 100% eff.	0.000263	0.000263	0.000265	0.000263	0.000265		0.9%	0.000263	0.000263
HE110: 80% eff.	0.000328	0.000329	0.000332	0.000328	0.000332		1.1%	0.000329	0.000329
HE120: 80% eff., PLR=0.4	0.000130	0.000130	0.000131	0.000130	0.000131		0.8%	0.000130	0.000130
HE130: No Load	0.000000	0.000000	0.000000	0.000000	0.000000		----	0.000000	0.000000
HE140: Periodic PLR	0.000132	0.000132	0.000131	0.000131	0.000132		0.6%	0.000132	0.000132
HE150: Continuous Circ. Fan	0.000126	0.000125	0.000125	0.000125	0.000126		1.1%	0.000125	0.000126
HE160: Cycling Circ. Fan	0.000129	0.000129	0.000129	0.000129	0.000129		0.4%	0.000129	0.000130
HE170: Draft Fan	0.000126	0.000125	0.000125	0.000125	0.000126		1.1%	0.000125	0.000126
Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Min	Max	Mean	(Max-Min) /Mean**	Analytical/ Quasi-Analytical	TRACE 3D Plus Trane
HE210: Realistic Weather	0.000171	0.000176	0.000177	0.000171	0.000177	0.000175	3.5%	-	0.000179
HE220: Setback Thermostat	0.000162	0.000167	0.000167	0.000162	0.000167	0.000165	3.3%	-	0.000169
HE230: Undersized Furnace	0.000140	0.000144	0.000146	0.000140	0.000146	0.000143	4.3%	-	0.000147

* Abs[(Max-Min) / (Analytic Solution)]

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

Table B16.6-4. Fan Energy, both fans (kWh)

Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Statistics, All Results				Analytical/ Quasi-Analytical	TRACE 3D Plus Trane
				Min	Max	(Max-Min) /Analytical*	Mean		
HE150: Continuous Circ. Fan	432.0	433.3	432.1	432.0	433.3		0.3%	432.0	419.4
HE160: Cycling Circ. Fan	170.2	172.2	172.4	170.2	172.4		1.3%	172.8	172.2
HE170: Draft Fan	473.4	473.1	473.1	473.1	473.4		0.1%	473.2	461.1
Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Min	Max	Mean	(Max-Min) /Mean**	Analytical/ Quasi-Analytical	TRACE 3D Plus Trane
HE210: Realistic Weather	281.6	291.4	298.9	281.6	298.9	290.6	6.0%	-	294.4
HE220: Setback Thermostat	268.3	276.1	281.2	268.3	281.2	275.2	4.7%	-	280.6
HE230: Undersized Furnace	458.3	431.4	478.4	431.4	478.4	456.0	10.3%	-	483.3

* Abs[(Max-Min) / (Analytic Solution)]

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

ASHRAE Standard 140-2020, Informative Annex B16, Section B16.6
Example Results for Section 5.4 - HVAC Equipment Performance Tests HE100 through HE230

Note: The statistics in the tables below are based on the Standard 140 informative example results.
 These statistics do not have any substantial importance and are not to be interpreted as acceptance criteria.

Table B16.6-5. Mean Zone Temperature (°C)

Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Statistics, All Results				TRACE 3D Plus Trane
				Min	Max	Mean	(Max-Min) /Mean**	
HE210: Realistic Weather	20.01	20.00	19.98	19.98	20.01	20.00	0.2%	20.00
HE220: Setback Thermostat	18.75	18.53	18.53	18.53	18.75	18.60	1.2%	18.52
HE230: Undersized Furnace	15.48	15.17	15.64	15.17	15.64	15.43	3.0%	15.35

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

Table B16.6-6. Maximum Zone Temperature (°C)

Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Statistics, All Results				TRACE 3D Plus Trane
				Min	Max	Mean	(Max-Min) /Mean*	
HE210: Realistic Weather	21.45	20.00	20.06	20.00	21.45	20.50	7.1%	20.00
HE220: Setback Thermostat	22.70	20.00	20.11	20.00	22.70	20.94	12.9%	20.00
HE230: Undersized Furnace	20.14	20.00	20.06	20.00	20.14	20.07	0.7%	20.00

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

Table B16.6-7. Minimum Zone Temperature (°C)

Cases	ESP-r/HOT3000 CETC	EnergyPlus GARD	DOE-2.1E CETC	Statistics, All Results				TRACE 3D Plus Trane
				Min	Max	Mean	(Max-Min) /Mean*	
HE210: Realistic Weather	20.00	20.00	19.89	19.89	20.00	19.96	0.6%	20.00
HE220: Setback Thermostat	15.00	15.00	14.94	14.94	15.00	14.98	0.4%	15.00
HE230: Undersized Furnace	1.45	4.48	3.22	1.45	4.48	3.05	99.3%	1.85

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

Figure B16.6-1. Comparison of the Energy Delivered for the Fuel-Fired Furnace Test Cases

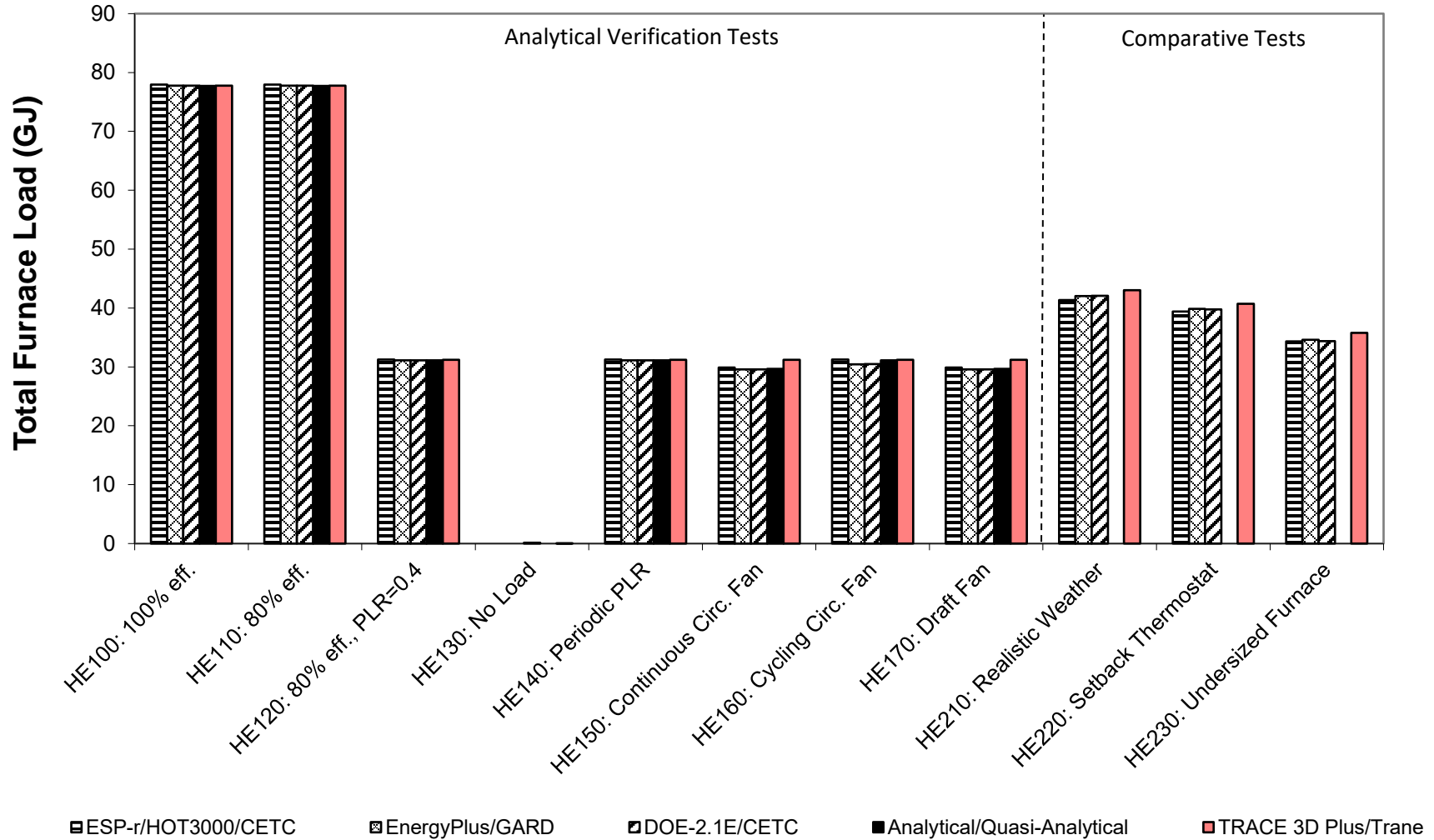


Figure B16.6-2. Comparison of the Energy Consumed for the Fuel-Fired Furnace Test Cases

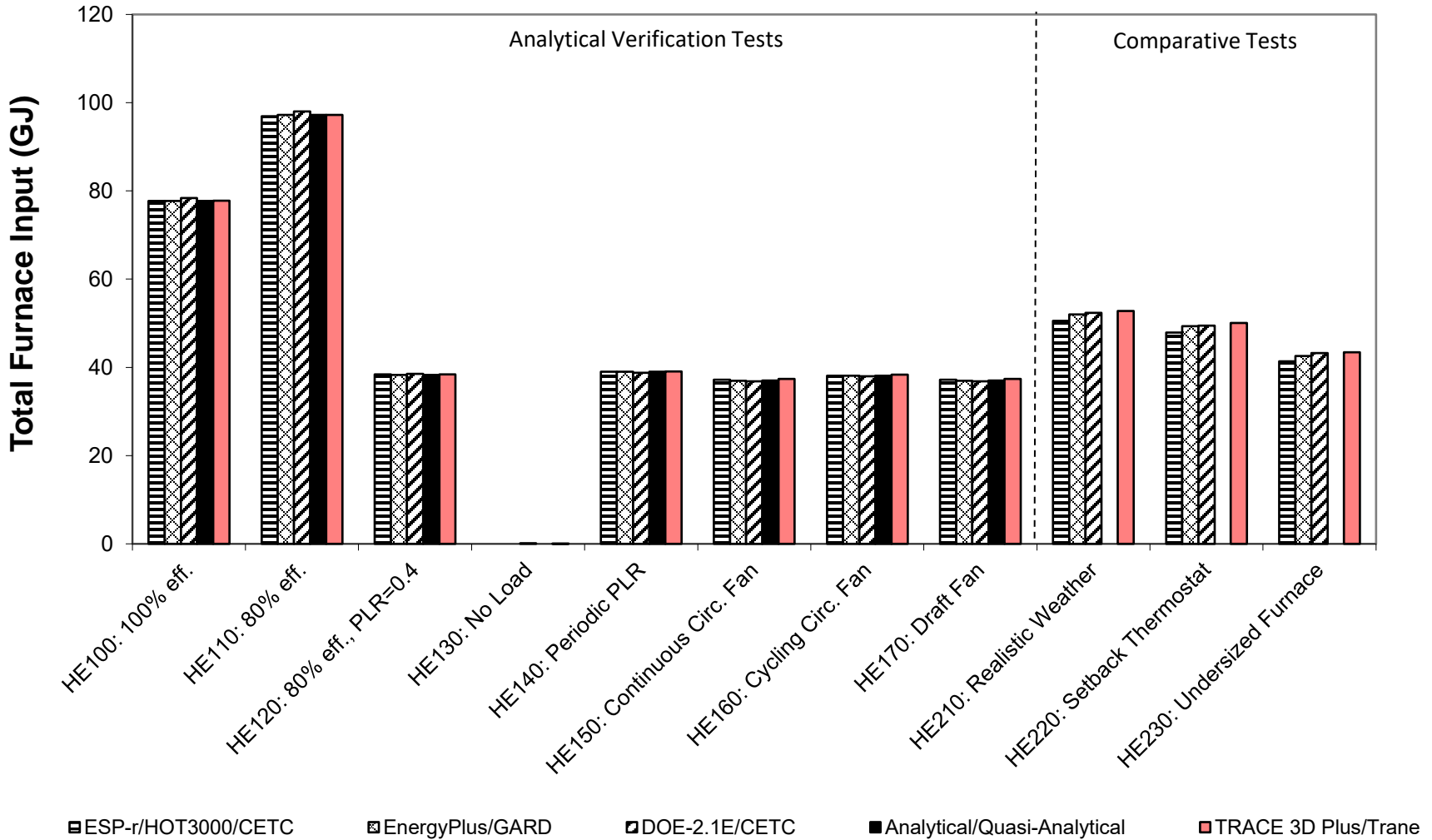


Figure B16.6-3. Comparison of the Fuel Consumed for the Fuel-Fired Furnace Test Cases

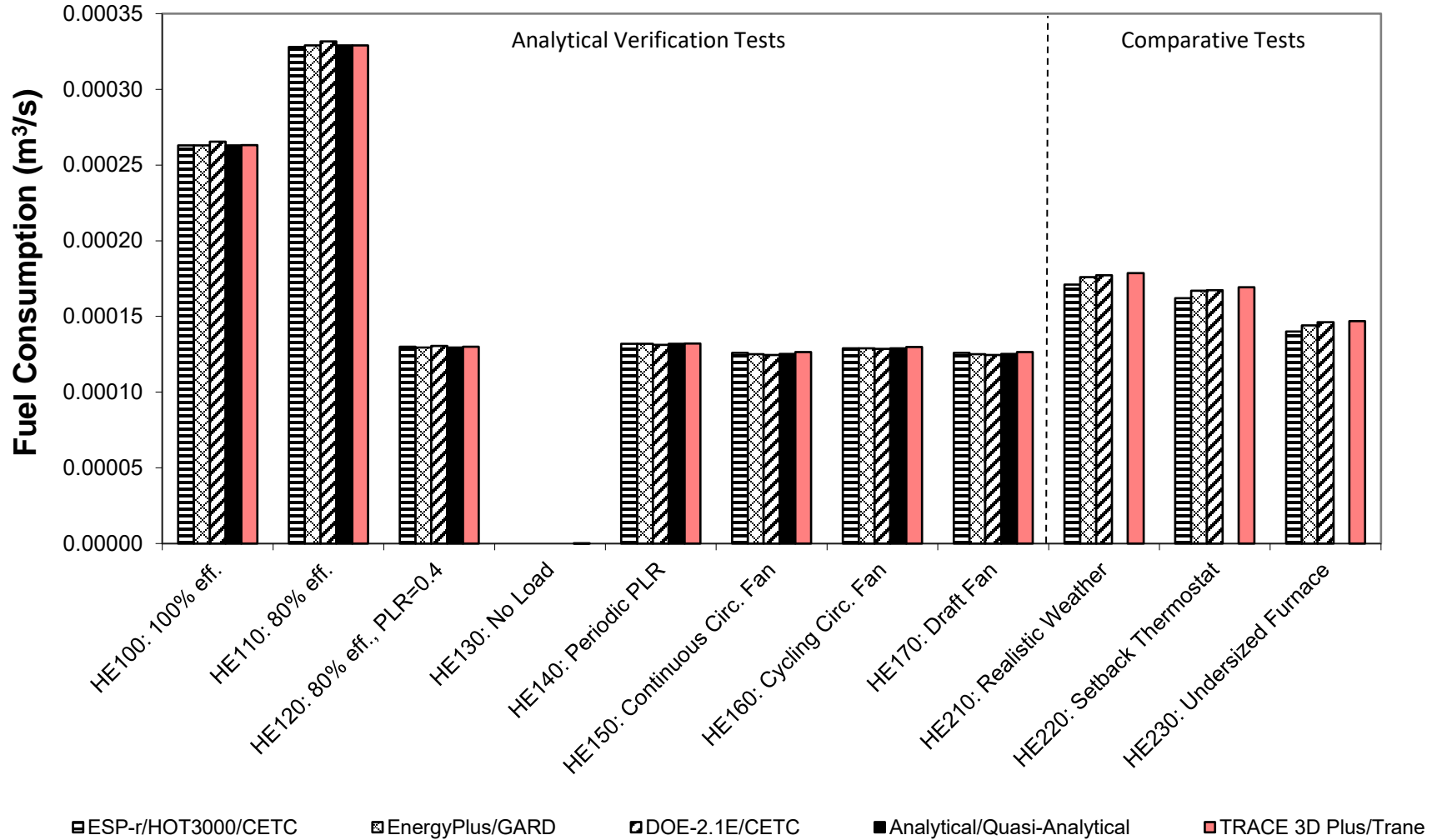


Figure B16.6-4. Comparison of the Fan Energy for the Fuel-Fired Furnace Test Cases

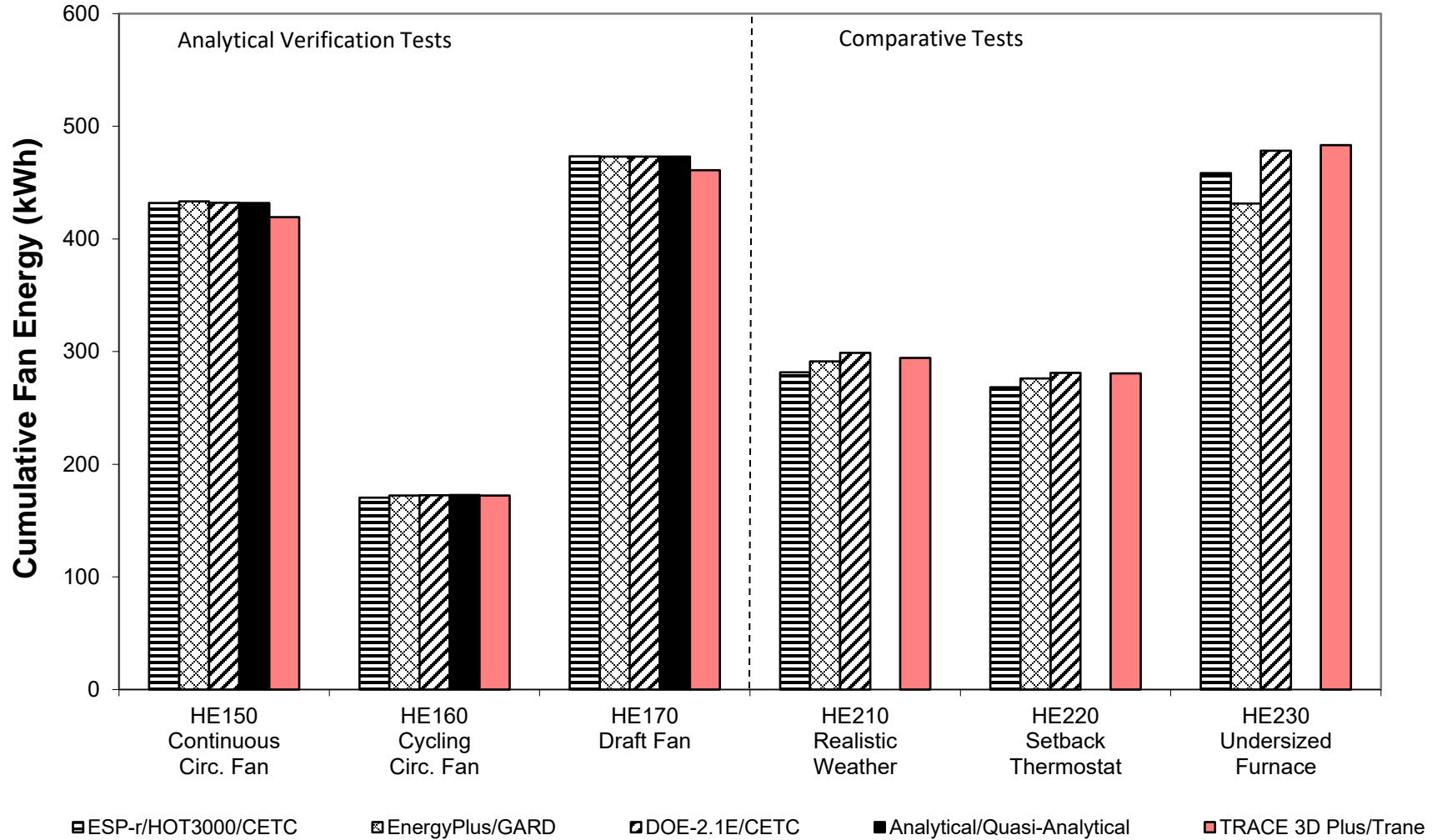


Figure B16.6-5. Comparison of the Mean Zone Temperature for the Fuel-Fired Furnace Comparative Test Cases

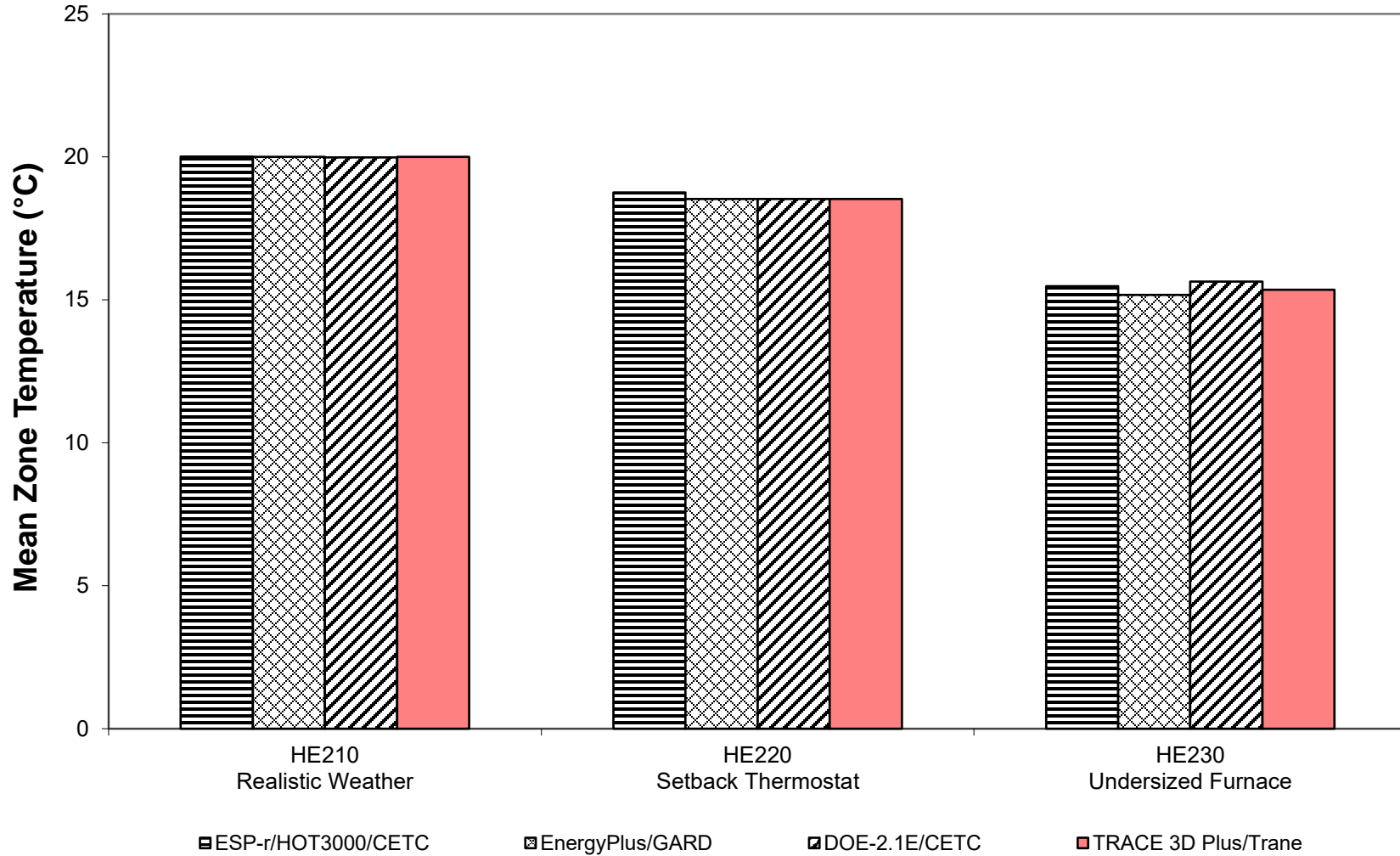
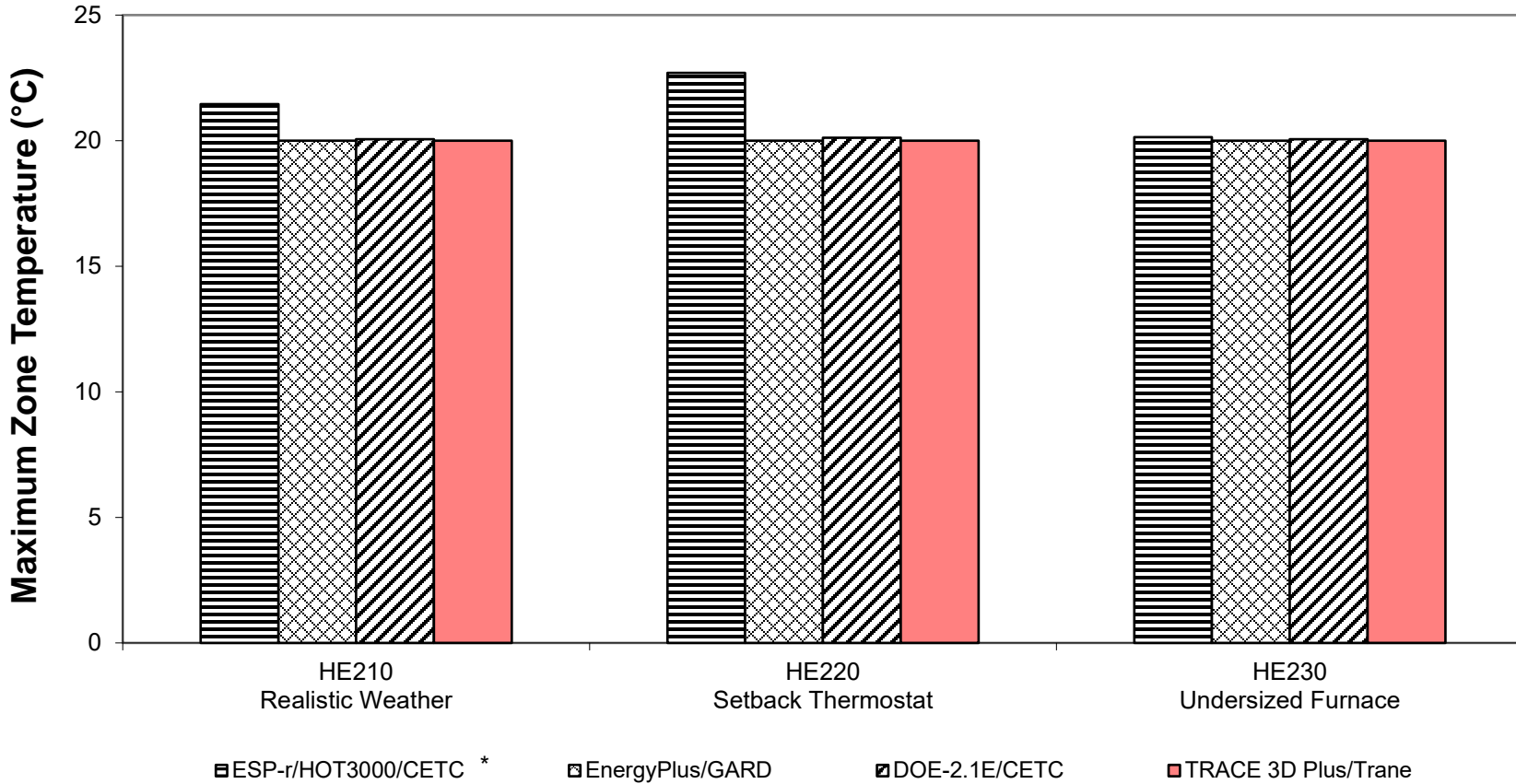


Figure B16.6-6. Comparison of the Maximum Zone Temperature for the Fuel-Fired Furnace Comparative Test Cases



* ESP-r's finite-difference discretization scheme with respect to time can be fully explicit, fully implicit, or any weighting in between. The program's default 50/50 weighting was employed for the simulations reported here and was found to produce some temperature solution oscillations for particular cases. However, subsequent analysis revealed that these oscillations had no effect upon the predicted fuel and electricity consumptions, the metrics of primary interest in these test cases.

Figure B16.6-7. Comparison of the Minimum Zone Temperature for the Fuel-Fired Furnace Comparative Test Cases

