EnergyFront

Validation and Testing Report

ASHRAE Standard 140 envelope cases, HVAC BESTEST, Furnace BESTEST, EnergyPlus 9.4 example files, software test suites, scope limitations and tests still to be done

Item	Value
Software	EnergyFront V3.5, development build step 71 (interface that writes EnergyPlus input files)
Simulation engine	EnergyPlus 9.4.0 (U.S. Department of Energy), unmodified
Test period	October 2026
Report date	23 October 2026, revised 24 October 2026 (ASHRAE 140 cases 640 and 940, Section 3)
Test platform	Development version of EnergyFront on a test computer; the Windows program is covered by the release tests (Section 10)
Status	Technical record of the tests performed. Not a certification, accreditation or approval by ASHRAE, the U.S. DOE, NREL or any rating authority.

How to read this report. EnergyFront does not compute building physics itself: it writes an EnergyPlus input file (IDF) from its interface inputs, runs EnergyPlus and reads back the results. The tests therefore answer three questions: (1) does EnergyFront write the same model as a reference IDF, so that EnergyPlus gives the same results; (2) when an existing IDF is opened in EnergyFront, what is kept, what is approximated and what is lost, and is every loss reported to the user; (3) do the inputs of the interface reach the IDF as intended. The accuracy of the physics itself is that of EnergyPlus 9.4 and is documented by its developers.

1. Purpose and scope

This report records the validation and verification tests run on EnergyFront in October 2026, the results, the known limitations of the tool, and the tests that remain to be done. Its aim is that users and customers know exactly what has been tested, under which conditions, and where the tool should not be relied on without further checks. The tests do not cover every use of EnergyFront: a feature or use that is not listed among the limitations (Section 8) is not thereby validated, and any use outside the tested scope is at the user's responsibility.

What this report is not:

- It is not an ASHRAE Standard 140 certification. Standard 140 is a method of test; it does not certify software. The example results of the Standard (Annex B8) are ranges of other programs, not pass/fail criteria.
- It is not a validation of EnergyPlus. EnergyFront uses EnergyPlus 9.4 unmodified; the results of the reference IDFs (the EnergyPlus column of the tables) are those of EnergyPlus.
- It is not an empirical validation against measured data. No measured building has been compared yet (Section 9).
- It is not an approval for any compliance path (for example ASHRAE 90.1 Appendix G, Estidama, Dubai Green Building Regulations). Acceptance of software is decided by each authority.

2. Test environment and method

Item	Description
Engine	EnergyPlus 9.4.0, run with ExpandObjects (-x) for HVACTemplate objects
Weather	ASHRAE 140 envelope: 725650TYCST.epw (Denver, supplied with the Standard). HVAC BESTEST: CE100ATM2, CE200ATM2, HE100WWY2, HE210WWY2 (NREL BESTEST-GSR). Example files: USA_IL_Chicago-OHare TMY3. Software tests: ARE_ABU_DHABI_IWEC. Weather files are not redistributed in the package (third-party terms).
Method A: generation fidelity	The case is entered in the EnergyFront interface (project file *.json). EnergyFront writes its IDF. Both the reference IDF and the EnergyFront IDF are run in EnergyPlus with the same weather, and the results are compared.
Method B: round trip of an IDF	The IDF is run as it is. It is then opened with File > Open IDF 9.4, written again by EnergyFront and run with the same weather. Compared: floor, wall, window and roof area, lighting and equipment energy, zone sensible heating and cooling, site energy and mean zone air temperature.
Method C: software tests	Automated tests of the program (Section 6): inputs and rules, units, interface, tagging for PareVia/EPCalibration, traceability of every input to the IDF objects it changes.

3. ASHRAE Standard 140-2020 envelope cases (Method A)

Cases 600 and 900 (low and high mass, south windows), their variants 610 to 650 and 910 to 950 (overhang, east and west windows, shading fins, thermostat setback, night ventilation) and the free-floating cases 600FF, 650FF, 900FF and 950FF. The reference IDFs of 600, 900 and their FF variants were supplied by the developer; the references of 610 to 650 and 910 to 950 were derived from them by adding the geometry and controls of each case as specified in the Standard, except the recovery from the setback of 640 and 940 (see the note below the table). The EnergyFront projects were created by opening each reference IDF in EnergyFront (File > Open IDF 9.4). A project holds only the inputs of the EnergyFront interface, so the IDF that EnergyFront writes is built from those inputs, not copied from the reference.

Case	Quantity	EnergyPlus, reference IDF	EnergyFront	Difference	Example results of the Standard (range)
600	Annual heating (MWh)	4.243	4.243	+0.01 %	3.99 to 4.50
600	Annual sensible cooling (MWh)	6.283 *	6.283 *	+0.00 %	5.43 to 6.16
600	Peak heating (kW)	3.150	3.150	+0.01 %	3.02 to 3.36
600	Peak sensible cooling (kW)	6.614 *	6.614 *	+0.00 %	5.42 to 6.48
610	Annual heating (MWh)	4.293	4.293	+0.01 %	4.07 to 4.59
610	Annual sensible cooling (MWh)	4.522 *	4.522 *	+0.00 %	4.12 to 4.38
610	Peak heating (kW)	3.137	3.138	+0.01 %	3.02 to 3.36
610	Peak sensible cooling (kW)	6.343	6.344	+0.00 %	5.33 to 6.43
620	Annual heating (MWh)	4.386	4.386	+0.01 %	4.09 to 4.72
620	Annual sensible cooling (MWh)	4.183	4.183	+0.00 %	3.84 to 4.40
620	Peak heating (kW)	3.177	3.177	+0.01 %	3.04 to 3.38
620	Peak sensible cooling (kW)	4.844 *	4.844 *	+0.00 %	3.96 to 4.80
630	Annual heating (MWh)	4.681	4.682	+0.01 %	4.36 to 5.14
630	Annual sensible cooling (MWh)	2.895	2.896	+0.00 %	2.57 to 3.07
630	Peak heating (kW)	3.155	3.155	+0.01 %	3.04 to 3.39
630	Peak sensible cooling (kW)	4.235 *	4.235 *	+0.01 %	3.53 to 4.21
640	Annual heating (MWh)	2.716 *	2.715 *	-0.01 %	2.40 to 2.68
640	Annual sensible cooling (MWh)	6.077 *	6.077 *	+0.00 %	5.24 to 5.89
640	Peak heating (kW)	5.495 *	5.495 *	+0.01 %	4.04 to 4.66
640	Peak sensible cooling (kW)	6.577 *	6.578 *	+0.00 %	5.37 to 6.43
650	Annual sensible cooling (MWh)	5.055 *	5.056 *	+0.00 %	4.19 to 4.95
650	Peak sensible cooling (kW)	6.337 *	6.337 *	+0.00 %	5.04 to 6.29
900	Annual heating (MWh)	1.535	1.535	+0.02 %	1.38 to 1.81
900	Annual sensible cooling (MWh)	2.614	2.613	-0.00 %	2.27 to 2.71
900	Peak heating (kW)	2.628	2.628	+0.02 %	2.44 to 2.78
900	Peak sensible cooling (kW)	3.131	3.131	+0.00 %	2.56 to 3.38
910	Annual heating (MWh)	1.818	1.818	+0.02 %	1.65 to 2.16
910	Annual sensible cooling (MWh)	1.443	1.443	-0.01 %	1.19 to 1.49
910	Peak heating (kW)	2.641	2.641	+0.02 %	2.47 to 2.80
910	Peak sensible cooling (kW)	2.350	2.350	+0.00 %	2.08 to 2.72
920	Annual heating (MWh)	3.197	3.197	+0.02 %	2.96 to 3.61
920	Annual sensible cooling (MWh)	2.793	2.793	-0.00 %	2.55 to 3.13
920	Peak heating (kW)	2.717	2.718	+0.02 %	2.51 to 2.90
920	Peak sensible cooling (kW)	3.293	3.293	+0.00 %	2.71 to 3.48
930	Annual heating (MWh)	3.866	3.867	+0.01 %	3.52 to 4.38
930	Annual sensible cooling (MWh)	1.945	1.945	-0.00 %	1.65 to 2.16
930	Peak heating (kW)	2.734	2.735	+0.01 %	2.54 to 2.97
930	Peak sensible cooling (kW)	2.793	2.793	+0.01 %	2.33 to 3.05
940	Annual heating (MWh)	1.052	1.052	+0.02 %	0.86 to 1.39
940	Annual sensible cooling (MWh)	2.553	2.553	-0.00 %	2.20 to 2.61
940	Peak heating (kW)	4.300 *	4.300 *	+0.00 %	3.05 to 3.88
940	Peak sensible cooling (kW)	3.131	3.131	+0.00 %	2.56 to 3.38

Case	Quantity	EnergyPlus, reference IDF	EnergyFront	Difference	Example results of the Standard (range)
950	Annual sensible cooling (MWh)	0.708	0.708	-0.00 %	0.59 to 0.71
950	Peak sensible cooling (kW)	2.428 *	2.428 *	+0.01 %	2.05 to 2.39
600FF	Max / min / mean temperature (C)	65.02 / -12.01 / 25.34	65.02 / -12.01 / 25.34	0.00 K	62.37 to 68.36 / -13.84 to -9.90 / 24.26 to 26.10
900FF	Max / min / mean temperature (C)	44.64 / 1.89 / 25.56	44.64 / 1.89 / 25.56	0.00 K	43.25 to 46.00 / 0.60 to 2.16 / 24.46 to 25.69
650FF	Max / min / mean temperature (C)	63.67 / -16.99 / 18.66	63.67 / -16.99 / 18.66	0.00 K	61.13 to 66.85 / -17.76 to -16.70 / 17.60 to 18.93
950FF	Max / min / mean temperature (C)	36.91 / -12.71 / 14.91	36.91 / -12.71 / 14.91	0.00 K	36.13 to 37.10 / -13.36 to -12.50 / 14.35 to 15.00

* outside the range of the example results of the Standard (shaded). In every such row the reference IDF run in EnergyPlus 9.4 gives the same value, so the departure belongs to the reference model with EnergyPlus 9.4 and not to the translation by EnergyFront. The heating of cases 640 and 940 is explained below; the other departures have not been investigated further (Section 9).

Cases 640 and 940, heating. In the reference IDF of these two cases the heating setback ends as a step: 10 °C until 07:00 and 20 °C from 07:00. ASHRAE Standard 140-2020 specifies a linear recovery from 10 °C at 07:00 to 20 °C at 08:00. With an ideal heating system of unlimited capacity, the step puts the whole recovery into the first time step after 07:00, which raises the hourly peak and the annual heating. The reference IDF was run again with the recovery of the Standard (steps of 1.67 K every 10 minutes from 07:00 to 08:00), all other inputs unchanged:

Case	Quantity	Setback as a step (reference IDF and EnergyFront)	Recovery of the Standard, 07:00 to 08:00 (reference IDF)	Example results of the Standard (range)
640	Annual heating (MWh)	2.716 *	2.582	2.40 to 2.68
640	Peak heating (kW)	5.495 *	4.502	4.04 to 4.66
940	Annual heating (MWh)	1.052	0.974	0.86 to 1.39
940	Peak heating (kW)	4.300 *	3.084	3.05 to 3.88

With the recovery of the Standard both cases lie within the example ranges, so the departure comes from the setback input, not from EnergyPlus 9.4 or from EnergyFront. The time step (4, 6 or 20 per hour) and the zone air heat balance algorithm change the peak of the step by about 5 % at most and do not explain it. The schedules of EnergyFront have hourly values, so a recovery within the hour cannot be entered: EnergyFront models these two cases with the step, as the reference IDF in the table of results (Section 8).

Result. In all 48 comparisons the EnergyFront model gives the same annual and peak loads as the reference IDF within 0.02 %, and the same maximum, minimum and mean temperatures of the free-floating cases (0.00 K). This shows that the interface inputs of EnergyFront can express these cases completely and that EnergyFront writes them as the reference does. It does not by itself show that EnergyPlus is within the ranges of the Standard.

4. HVAC BESTEST and Furnace BESTEST (Method B)

ASHRAE 140 Section 5.3 (CE100, CE200: unitary split cooling) and Section 5.4 (HE100, HE230: furnace), EnergyPlus 9.4 input files supplied by the developer, opened in EnergyFront and run again. Run period January to March as in the files.

Case	Quantity	EnergyPlus (reference IDF)	EnergyFront	Difference	Cause
CE100	Zone sensible cooling (kWh)	11743	11745	+0.02 %	Loads, envelope and setpoint kept
CE100	Mean zone temperature (C)	22.20	22.20	0.00 K	
CE100	Cooling electricity (kWh)	4428	4080	-7.8 %	EnergyFront writes its own PTAC, not the DX performance curves of the test (reported)
CE100	Fan electricity (kWh)	462	107	-77 %	EnergyFront fan, not the 271 Pa / 0.5 efficiency fan of the test (reported)
CE200	Zone sensible cooling (kWh)	13243	13245	+0.02 %	Latent gain 1817 W kept
CE200	Mean zone temperature (C)	26.66	26.66	0.00 K	
CE200	Cooling electricity (kWh)	4219	4204	-0.4 %	

Case	Quantity	EnergyPlus (reference IDF)	EnergyFront	Difference	Cause
HE100	Zone heating (kWh)	21600	8438	-61 %	Test fixes convection coefficients at 20 W/m2K (not an EnergyFront input; reported). Without them EnergyPlus gives 8368 kWh: EnergyFront +0.8 %
HE230	Zone heating (kWh)	9951	5456	-45 %	Convection coefficients and NoSun/NoWind surfaces (both reported). With both removed EnergyPlus gives 5069 kWh: EnergyFront +7.6 % (electric baseboard in place of a cycling furnace)

Result. The thermal loads of the zone are reproduced within 0.02 %. The HVAC equipment energy is not the same, because EnergyFront writes its own HVAC systems (with sizing, fans and controls of its own) and does not keep the component curves of an IDF. The HVAC equipment models of EnergyFront have **not** been validated against the HVAC BESTEST performance cases (Section 9).

5. EnergyPlus 9.4 example files (Method B)

47 example files of EnergyPlus 9.4 were opened in EnergyFront, written again and run (annual, Chicago TMY3): one-zone tests, shading, windows, HVACTemplate systems, airflow network, daylighting, ground slab, complex glazing, and the 16 DOE commercial reference buildings. The purpose is to check the importer: a difference is acceptable only when the import report names its cause.

Class	Meaning	Files
A match	Areas, lighting and equipment within 3 %, zone loads within 5 %, mean temperature within 0.5 K	3
B explained	Every difference is named in the import report (approximated or not converted)	41
B test artifact	Artificial test geometry (an open zone) that EnergyFront closes; not reported	1
C not imported	Not imported, with a clear message (simple surface objects)	2

Differences in % (EnergyFront minus EnergyPlus); dT is the difference of the annual mean zone air temperature in K. Large differences in zone heating and site energy follow from the HVAC that EnergyFront writes and from the objects that are not converted (exterior lights, refrigeration, gas equipment), listed under the table.

File	Class	Floor area	Walls	Windows	Lights	Equip.	Zone cool.	Zone heat.	Site energy	dT K
1ZoneUncontrolled	A match	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	-100.0	+0.00
1ZoneUncontrolled_win_1	B explained	+0.0	+0.0	-7.5	+0.0	+0.0	+0.0	+0.0	+0.0	-0.36
1ZoneUncontrolled_win_2	B explained	+0.0	+0.0	-7.5	+0.0	+0.0	+0.0	+0.0	+0.0	-2.55
1ZoneUncontrolledResLayers	A match	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	-100.0	-0.31
1ZoneUncontrolled_FCfactor_Slab_UGWall	B explained	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	+4.40
1ZoneUncontrolled3SurfaceZone	B artifact	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	+0.0	-100.0	-1.06
4ZoneWithShading_Simple_1	C not imported									
4ZoneWithShading_Simple_2	C not imported									
SolarShadingTest	B explained	-14.3	-16.6	-17.2	+0.0	+0.0	+14.3	-43.9	-62.5	+0.10
5ZoneAirCooled	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+31.7	-51.1	-1.5	-0.19
5ZoneAutoDXVAV	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+6.8	-70.2	-1.7	-0.62
5ZoneNightVent1	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+32.7	-78.8	-6.3	-0.24
5ZoneNightVent2	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+33.8	-79.2	-6.5	-0.17
HVACTemplate-5ZonePTAC	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	-2.5	+5.4	+27.7	+0.50
HVACTemplate-5ZonePTHP	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	-2.5	+8.0	+9.3	+0.50
HVACTemplate-5ZoneVAVWaterCooled	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+22.2	-59.9	+4.3	-0.00
HVACTemplate-5ZoneVAVFanPowered	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+43.2	-70.0	+0.9	-0.47
HVACTemplate-5ZonePackagedVAV	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+34.9	-60.8	+29.0	-0.25
HVACTemplate-5ZoneFanCoil	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+10.5	+18.7	+9.9	+0.11
HVACTemplate-5ZoneVRF	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+7.9	+18.0	+1.8	+0.13
HVACTemplate-5ZoneUnitarySystem	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+10.9	+15.1	+13.6	+0.10
HVACTemplate-5ZonePurchAir	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	-17.8	-1.3	-12.7	+0.67
HVACTemplate-5ZoneBaseboardHeat	B explained	-50.0	-20.0	+0.0	+0.0	-0.0	+0.0	+59.2	+1.4	+0.05
AirflowNetwork_Simple_House	B explained	-50.0	-14.9	+0.0	-0.0	+0.0	-69.9	+93.8	+40.3	-0.34
AirflowNetwork_Simple_SmallOffice	B explained	-50.0	-23.1	+0.0	+7.1	-0.0	-10.2	-15.4	-47.6	+1.47
VentilationSimpleTest	B explained	-66.7	-66.7	-66.7	-66.7	-66.7	+0.0	+0.0	-43.1	+0.36
PurchAirWithDaylighting	B explained	+0.0	+0.0	+0.0	+8.5	-0.0	+4.9	+1.1	+0.3	+0.10
PurchAirWindowBlind	A match	+0.0	+0.0	+0.0	-0.0	-0.0	-2.6	+1.6	-3.6	+0.16
WindowTestsSimple	B explained	-43.6	-62.2	-88.9	+0.0	+0.0	+0.0	+0.0	+0.0	-8.36
ZoneCoupledGroundHTSlabInGrade	B explained	+0.0	+0.0	+0.0	+0.0	+0.0	-1.2	-16.1	-13.7	+0.00
CmplxGlz_SmOff_IntExtShading	B explained	+0.0	+9.9	+0.0	+0.0	+0.0	-9.1	+38.6	+11.2	+0.35
RefBldgSmallOffice	B explained	+0.0	+0.0	+0.0	+2.6	+1.3	+17.2	-5.5	-9.5	+1.51
RefBldgMediumOffice	B explained	+0.0	-0.1	+0.0	+2.7	+1.6	+30.9	-6.2	+7.0	-0.51
RefBldgPrimarySchool	B explained	+0.0	+0.0	+0.0	+1.9	+0.9	+47.6	+152.5	+17.8	-1.52
RefBldgMidriseApartment	B explained	+0.0	+0.0	+0.0	+0.1	+0.1	+8.2	+3.7	+39.3	-0.28
RefBldgStand-aloneRetail	B explained	+0.0	+0.0	+0.0	+1.5	+1.0	+4.2	+224.2	+41.6	-0.74

File	Class	Floor area	Walls	Windows	Lights	Equip.	Zone cool.	Zone heat.	Site energy	dT K
RefBldgSmallHotel	B explained	+0.0	-5.0	+0.0	-0.1	-0.0	-2.0	+44.1	-5.6	-0.37
RefBldgOutPatient	B explained	+0.0	-7.6	-7.3	+2.8	+1.8	-20.1	+247.6	-45.3	-0.56
RefBldgWarehouse	B explained	-4.9	+0.0	+0.0	-4.5	+2.2	-16.5	-20.1	-10.1	-0.14
RefBldgQuickServiceRestaurant	B explained	+0.0	+0.0	+0.0	+0.0	-0.0	+14.7	+24.6	-33.7	+2.82
RefBldgFullServiceRestaurant	B explained	+0.0	+0.0	+0.0	+0.0	-0.0	+48.9	+21.9	-24.3	+3.88
RefBldgStripMall	B explained	+0.0	+0.0	-0.0	+1.5	+1.0	+40.3	-19.6	-5.7	-0.09
RefBldgSecondarySchool	B explained	+0.0	+1.5	-15.3	+1.9	+1.0	+39.2	+13.0	+5.6	-1.58
RefBldgLargeOffice	B explained	+0.0	+2.9	+0.0	+2.7	+1.4	+9.6	+34.7	+1.6	-0.38
RefBldgLargeHotel	B explained	-48.6	+36.3	-66.9	-50.7	-37.1	-56.1	+187.6	-66.1	-1.50
RefBldgHospital	B explained	-11.4	+24.4	-53.0	-14.5	-20.8	-28.3	+59.5	-59.7	+0.58
RefBldgSuperMarket	B explained	+0.0	+0.0	+0.0	+1.3	+0.7	+138.1	-79.4	-54.7	+0.20

Causes of the differences, per file

File	Cause (as named in the import report of EnergyFront)
1ZoneUncontrolled	Match. Site energy: Exterior:Lights not converted (reported).
1ZoneUncontrolled_win_1	Window5 data-file glazing (with its frame) not read (reported): EnergyFront glazing, glass area only.
1ZoneUncontrolled_win_2	As win_1 (reported); a window with a multiplier becomes that many windows (reported).
1ZoneUncontrolledResLayers	Match. Ground floor U 5.67 W/m2K above the range, 5 used (reported). Exterior lights (reported).
1ZoneUncontrolled_FCfactor_Slab_UGWall	C-factor / F-factor ground constructions not converted (reported).
1ZoneUncontrolled3SurfaceZone	Test of an open zone: one 61 m south wall (the length of the perimeter), a floor and a roof. EnergyFront builds the four walls of the floor outline: same area, four orientations (not reported; artificial test).
4ZoneWithShading_Simple_1	Not imported: simple surface objects (Wall:Exterior, Window ...); clear error message.
4ZoneWithShading_Simple_2	Not imported: simple surface objects; clear error message.
SolarShadingTest	A zone not joined to its floor is not converted (reported); site shading rectangles not on a wall (reported).
5ZoneAirCooled	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
5ZoneAutoDXVAV	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
5ZoneNightVent1	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
5ZoneNightVent2	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZonePTAC	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZonePTHP	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZoneVAVWaterCooled	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZoneVAVFanPowered	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZonePackagedVAV	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZoneFanCoil	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZoneVRF	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZoneUnitarySystem	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZonePurchAir	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
HVACTemplate-5ZoneBaseboardHeat	Return plenum is not a zone (reported: floor area counted by EnergyPlus, plenum walls); HVAC written by EnergyFront (reported).
AirflowNetwork_Simple_House	Attic not a zone (reported); airflow network distribution not converted (reported); own HVAC.
AirflowNetwork_Simple_SmallOffice	Attic (reported); daylighting reference points placed by EnergyFront (reported); AFN ducts (reported).

File	Cause (as named in the import report of EnergyFront)
VentilationSimpleTest	Two zones not joined to the floor are not converted (reported).
PurchAirWithDaylighting	Daylighting reference points placed by EnergyFront (reported): lighting +8.5 %.
PurchAirWindowBlind	Close match (loads within 3 %).
WindowTestsSimple	Separate test cells overlapping in plan (reported): one plan per floor in EnergyFront.
ZoneCoupledGroundHTSlabInGrade	Site:GroundDomain:Slab (2-D ground model) not converted (reported).
CmplxGlz_SmOff_IntExtShading	Complex fenestration (BSDF) not converted (reported); basement modelled above ground (reported).
RefBldgSmallOffice	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).
RefBldgMediumOffice	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).
RefBldgPrimarySchool	Skylights (reported); gas kitchen equipment (reported): all equipment -15 %, electric +0.9 %.
RefBldgMidriseApartment	Unit heaters of corridors and stairs not recognised (reported); otherwise geometry, lights, equipment within 0.1 %.
RefBldgStand-aloneRetail	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).
RefBldgSmallHotel	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).
RefBldgOutPatient	Stairs and elevator shafts 9.1 m high get one storey (now reported): walls -7.6 %, windows -7.3 %; gas equipment (reported).
RefBldgWarehouse	Unit heaters not recognised: those zones without HVAC (reported); zones overlapping, sloped floor (reported).
RefBldgQuickServiceRestaurant	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).
RefBldgFullServiceRestaurant	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).
RefBldgStripMall	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).
RefBldgSecondarySchool	Skylights not converted (reported): windows -15 %; gas equipment (reported).
RefBldgLargeOffice	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).
RefBldgLargeHotel	Zones with different multipliers on one floor (guest rooms x76): the floor is modelled once (reported); gas equipment (reported).
RefBldgHospital	Zones with different multipliers on one floor (reported); a zone not joined (reported); gas equipment (reported).
RefBldgSuperMarket	Holidays not kept (lighting +1.5 to 2.8 %, reported); gas equipment, refrigeration, exterior lights not converted (reported); HVAC written by EnergyFront (reported).

Result. After the fixes of step 70, no difference remains that the import report does not name, except the artificial open-zone test. Before the fixes, the round trip had found silent differences in infiltration, thermostats, window air conditioners, adiabatic floors, outdoor air, loads on several schedules, floor heights with zone multipliers, equipment heat lost and latent gains; all were corrected or are now reported.

6. Automated software tests (Method C)

Suite	What it checks	Result
Inputs and rules	Inputs, limits, rules of the interface, validation messages	170 checks passed
Units and generator	Units, conversions, generator parts, IDF read-back of imported models	514 checks passed
Interface	Interface: pages, forms, switching, the Outputs tab, run buttons	488 checks passed
Variables for PareVia and EPCalibration	Tagged IDF and CSV for PareVia and EPCalibration	47 checks passed
Traceability of the inputs	Every input is changed in at least one of 30 buildings; each change must change the IDF objects listed in the traceability matrix, and inputs hidden by the interface must not change it	307 inputs, 30 buildings, 5 checks passed
Verification report	Verification report after a run: entered values against what EnergyPlus reports	1 known open item (ground temperature of an imported layered construction); present in earlier versions as well
Extended generator and HVAC tests	Larger sets of buildings and HVAC systems	Not run in this round

Every run of EnergyFront also writes a verification report (Results > Verification): the inputs next to what EnergyPlus reports back (areas, U-values, loads, schedules, setpoints, outdoor air). It is a check of each model, not of the tool in general.

7. Output selection and calibration output

- **Outputs tab.** A 3-floor office with VAV, chiller and gas boiler, outputs chosen for floors 2 and 3 (hourly): EnergyPlus completed without severe errors; verification 116 comparisons, all agree; the custom meter 'Selected End Uses' equals the sum of its four meters exactly (200.15 MWh); eplusout.sql holds only the meters and variables chosen.
- **Facility electricity including the HVAC of Ideal loads** (EMS output variable, Electricity:Facility + DistrictCooling/COP + DistrictHeating/efficiency): equal to the hand calculation within 0.002 % per month in Abu Dhabi (COP 3.5) and Chicago (COP 3.5, heat pump 2.5). Must be called at the zone time step; a call at the system time step over-counts by 18 to 31 %. Not yet part of the EnergyFront interface (manual IDF objects).

8. Known limitations

The following limitations apply to the current build. Users should be informed of them; results in these areas need independent checking.

Engine and version

- EnergyPlus 9.4.0 only. Other versions are not supported or tested.
- The physics, numerical methods and their accuracy are those of EnergyPlus 9.4. Known issues of that version apply.
- Some ASHRAE 140 results of EnergyPlus 9.4 with the reference inputs lie outside the example ranges of the Standard: the cooling of the low-mass cases 600 to 650 and the peak cooling of 950 (Section 3). The heating of 640 and 940 lies outside with the setback entered as an hourly step, and within the ranges with the 1-hour recovery of the Standard (Section 3).

Geometry

- Footprints: rectangle, L, U, courtyard, custom polygon and drawn plan; perimeter-core or single zone per floor. Roofs are flat; sloped roofs and ceilings of an imported IDF are made flat.
- Plenums and attics are not zones; their height is kept in the floor-to-floor height.
- A floor that mixes zones with different multipliers is modelled once (large hotel, hospital: -37 % and -21 % equipment energy in the round trip).
- Zones taller than one storey (stairs, shafts) are given one storey.
- Imported IDFs must use detailed surfaces (BuildingSurface:Detailed, FenestrationSurface:Detailed); simple surface objects are refused with a message.
- Zones not joined to the floor plan, overlapping zones and floors in separate parts are simplified (reported).

Constructions, glazing and ground

- Window5 data-file glazing, complex fenestration (BSDF) and C-factor / F-factor ground constructions are not converted.
- Fixed convection coefficients (SurfaceProperty:ConvectionCoefficients) and NoSun/NoWind exposure are not inputs of EnergyFront (reported on import).
- Two-dimensional ground models (Site:GroundDomain) are not converted; the ground options of EnergyFront apply.
- Skylights are not converted on import.

Internal loads and schedules

- Holidays of an imported IDF are not kept (lighting +1.5 to 2.8 % in the DOE buildings).
- Gas equipment, refrigeration and exterior lighting are not converted.
- Loads on several schedules in one zone are put on one schedule with the annual energy kept; the hourly profile of the others is not kept (reported).
- Schedules have hourly values. A setpoint that changes within the hour, such as the 1-hour recovery from the setback in ASHRAE 140 cases 640 and 940, cannot be entered: the change is made at the full hour (Section 3).

HVAC

- EnergyFront writes its own systems (Ideal loads, PTAC, PTHP, split/unitary DX, VRF, fan coil + chiller, VAV + chiller, packaged VAV, free running). Components, curves, loops and controls of an imported IDF are not kept; equipment energy can differ substantially from the original (Sections 4 and 5).
- Unit heaters and some other zone equipment are not recognised on import (reported).
- A heating-only zone is heated by electric baseboards, not a gas furnace.
- The HVAC equipment models have not been validated against HVAC BESTEST performance cases (CE300 and above).
- Ideal loads report district cooling and heating (thermal energy). EnergyFront converts them to electricity or gas with a constant COP/efficiency on the Results page only; Electricity:Facility of EnergyPlus does not include them.

Results, outputs and calibration

- With 'Only the outputs chosen', the Zones, Heat map and Overheating pages stay empty.
- Zone variables are those of one zone and are not multiplied by zone or floor multipliers; a floor modelled by the multiplier gives the results of the floor that represents it.

- Electricity of a floor contains lighting and equipment only; the energy of a central HVAC system cannot be split by floor.
- Daylighting reference points are placed by EnergyFront (lighting +8.5 % in one example file).

Platform and process

- The automated tests ran on the development version of EnergyFront; the Windows program is checked by the release tests (Section 10).
- Results depend on the weather file and the inputs chosen by the user; the tool does not check that they represent the real building.
- The report has been prepared by the developer and has not yet been reviewed independently.

9. Tests still to be done

Priority	Test	Why
High	Empirical validation against a measured building (monthly bills and, if possible, logged indoor temperatures), with ASHRAE Guideline 14 metrics	No comparison with measured data yet
High	HVAC BESTEST performance cases (CE300 to CE545) and Furnace BESTEST with the HVAC systems that EnergyFront writes	HVAC equipment energy of EnergyFront not validated
High	End-to-end calibration with EPCalibration on a real dataset; EMS output 'electricity including HVAC' built into the interface and tested	Calibration is a main use of the tool
High	Windows EXE tests of EnergyFront, PareVia and EPCalibration on clean machines (regional settings with decimal comma, long paths, non-ASCII names, licence)	Automated tests run on the development version
Medium	Investigate the remaining ASHRAE 140 departures of EnergyPlus 9.4 (cooling of the low-mass cases 600 to 650, peak cooling of 950); add a recovery within the hour to the schedules, so that cases 640 and 940 can be entered as specified	Explain or document the departure; the heating of 640 and 940 is explained (Section 3)
Medium	Remaining ASHRAE 140 cases: 195 to 440 (in-depth), 960 (sunspace), ground coupling; update to the current edition of the Standard	Wider coverage of envelope physics
Medium	Comparative test of the same building in another EnergyPlus interface (e.g. OpenStudio, DesignBuilder)	Independent check of inputs and defaults
Medium	Natural ventilation, airflow network, mixed mode, adaptive setpoint control scripts, daylighting	Covered by software tests only
Medium	Resolve the open item of the verification-report test; run the extended generator and HVAC tests	Regression coverage
Low	Round trip of the remaining EnergyPlus example files and DataSets	Importer coverage
Low	Large buildings (more than 20 floors, many zones): run time, shadow calculation	Performance
Low	Independent review of this report by a person not involved in the development	Avoid self-assessment

10. Tests to repeat with every release (Windows executables)

- **EnergyFront:** new project; Generate IDF and Run simulation from the Simulation page; Outputs tab in both modes; Results > Verification all agree; File > Open IDF 9.4 of an example file; Export input report; tagged IDF and CSV export.
- **PareVia:** load the tagged IDF and the Excel of variables; run 2 to 3 cases; results read correctly.
- **EPCalibration:** load the tagged IDF with monthly bills; run; CV(RMSE) and NMBE computed on the facility electricity.

11. Suggested disclosure to users

The following text can be adapted for the documentation, the About window or the licence agreement:

> *EnergyFront is an interface that prepares input files for EnergyPlus 9.4 and presents its results. The accuracy of the simulation depends on EnergyPlus, on the weather data and on the inputs entered by the user. EnergyFront has been tested as described in its Validation and Testing Report (October 2026), including the limitations listed there; it has not been certified or approved by ASHRAE, the U.S. Department of Energy or any rating authority. Results are estimates and must be checked by a qualified professional before they are used for design, compliance, financial or contractual decisions. The tests listed do not cover every use of the software. A feature or use that is not listed among the limitations is not thereby validated; any use outside the tested scope is at the user's responsibility.*

Note: this report is a technical record, not legal advice. The licence agreement (limitation of liability, warranty, governing law in the UAE) should be reviewed by a qualified lawyer.

12. Third-party materials

- EnergyPlus 9.4.0: U.S. Department of Energy, distributed under the EnergyPlus licence (BSD-style). The example files are those distributed with EnergyPlus 9.4; the ASHRAE 140 and HVAC/Furnace BESTEST input files are EnergyPlus 9.4 versions supplied by the developer; they are not included in the public package.
- ASHRAE Standard 140-2020: only the example result ranges of Annex B8 are quoted, with reference to the Standard. The Standard itself and its weather file are not reproduced.
- Weather files (TMY3, IWEC, BESTEST-GSR) are not included in the package; they are available from their publishers under their own terms.

Appendix: content of the public package

Folder	Content
01_Report	This report (PDF and Word)
02_ASHRAE140_cases	Results table (CSV) and the EnergyFront projects of the cases (*.json), to repeat the cases in EnergyFront with the weather file of the Standard
03_HVAC_BESTEST_and_example_files	Results tables (CSV) of HVAC BESTEST, Furnace BESTEST and the EnergyPlus example files
04_Licences	EnergyPlus licence notice