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Vertiv Response to 15-Day Express Terms for Computer Rooms

Additional submitted attachment is included below.

July 28, 2021
California Energy Commission
1516 Ninth Street, MS 34
Sacramento, CA 95814

RE: Docket No. 21-BSTD-01:2022 Energy Code Update Rulemaking; *Nonresidential Computer Room Efficiency Code Change Recommendations*

Vertiv Group Corporation ("Vertiv") submits these comments in response to Comment #238848 in this docket, submitted on July 14, 2021, which contains the proposed language in the "15-Day Express Terms 2022 Energy Code – Residential and Nonresidential," (the "15-Day Express Terms"). Vertiv opposes the adoption of the Net Sensible Coefficient of Performance ("NSenCOP") prescriptive metrics that were added to Tables 140.9-A "Minimum Pumped Refrigerant Economizer CRAC Net Sensible COP by Climate Zone" and 141.1-A "Net Sensible COP By Climate Zone for Alterations" for refrigerant economizers serving computer rooms. As further discussed in these comments, the metrics in these tables are unsubstantiated, excessively restrictive, and impossible to comply with as written. The metrics have not been vetted through meaningful industry involvement, contain significant errors, and are being hastily added to the 15-Day Express Terms with an unreasonably abbreviated timeline for review.

By contrast, Vertiv supports the NSenCOP mandatory metrics added in Table 110.2-L "Floor-Mounted Air Conditioners and Condensing Units Serving Computer Rooms – Minimum Efficiency Requirements" of the 15-Day Express Terms. Unlike the prescriptive metrics added to Tables 140.9-A and 141.1-A, the mandatory metrics are adopted from those published in ANSI/ASHRAE/IES Standard 90.1-2019 "Energy Standard for Buildings Except Low-Rise Residential Buildings," which have been vetted by industry-trusted groups, including the ASHRAE 90.1 committee, AHRI 1360 committee, and the Department of Energy ("DOE"). This table reflects the appliance energy conservation standards that DOE has indicated it will adopt within the next 18 months, and which will apply to the products at issue here. *See* "Preliminary Analysis Regarding Energy Efficiency Improvements in ANSI/ASHRAE/IES Standard 90.1-2019."

For the following reasons, Vertiv strongly urges the California Energy Commission ("CEC" or "Commission") to reject adoption of the NSenCOP metrics added in Tables 140.9-A and 141.1-A of the 15-Day Express Terms:

- The proposed metrics in Tables 140.9-A and 141.1-A improperly reference and misapply the definitions and calculation methods within AHRI Standard 1360. In an attempt to develop "equivalency" metrics for refrigerant economizer technology, the proposed NSenCOP prescriptive metrics distort AHRI 1360's intended purpose. Despite referencing AHRI 1360, which contains specific testing conditions and metrics, Section 100.1 "Definitions and Rules of Construction" of the proposed 2022 Energy Code defines the NSenCOP metric differently from the definition of NSenCOP contained in Section 3.11 of AHRI 1360. The definition in Section 100.1 purports to adopt the "Standard Rating Conditions table(s) of AHRI 1360," which represents a single testing condition under static inputs. However, a portion of the data used in CASE's analysis explaining how it developed the NSenCOP prescriptive metrics ("Analysis Report") represents *annualized* performance data including full load, partial economizer, and full economizer hours. Static inputs under a single testing condition cannot be properly compared to annualized performance data to develop equivalency metrics. Contrary to what is required under AHRI 1360, CASE did not calculate Vertiv's energy model at standard operating conditions (i.e., model included higher External Static Pressure,

varying cooling load, and year-round ambient temperature conditions). For example, the Appendix included in CASE's comment #238233 listed Operating Return Air Temperature equal to 80 and/or 90-degree Dry Bulb, whereas AHRI Standard 1360 Standard Rating Condition lists Operating Return Air Temperature equal to 85-degree Dry Bulb. As such, the proposed metrics purport to apply the standardized metric in AHRI 1360, but instead impose arbitrary operating conditions, which has the effect of distorting the standard. We also note that the inappropriate application of AHRI 1360 was also identified to CEC staff by AHRI's administrator of this standard during a virtual roundtable organized by CEC Staff with Vertiv and certain members of the CASE team on July 26, 2021.

- Manufacturers of refrigerant economizers cannot comply with the proposed metrics in Tables 140.9-A and 141.1-A as they are written because the metrics do not provide necessary testing inputs. In order to comply with the proposed NSenCOP metrics, a manufacturer must have specific inputs such as return air temperature, heat rejection and cooling fluid conditions, and external static pressure. Contrary to the proposed metrics, AHRI Standard 1360 Section 6. "Rating Requirements" includes the following tables detailing specific inputs used to calculate NSenCOP:
    1. "Table 2. Indoor Return Air Temperature Standard Rating Conditions" lists the Return Dry-bulb/ Dew-point in degrees F.
    2. "Table 3. Heat Rejection/ Cooling Fluid Standard Rating Conditions" lists the specific Test Condition, which is dependent on System Type.
    3. "Table 4. Minimum External Static Pressure Standard Rating Conditions" lists the External Static Pressure, which is dependent on the ASHRAE Standard Model (airflow configuration) and Net Sensible Cooling Capacity ("NSCC") of the equipment.

  Without these specific inputs, refrigerant economizer manufacturers cannot calculate compliance to the proposed prescriptive metrics.

- The proposed metrics in Tables 140.9-A and 141.1-A improperly ignore refrigerant economizers' various efficiency capabilities and instead impose one single efficiency value per Climate Zone. By imposing one prescriptive NSenCOP for each Climate Zone, the prescriptive metrics discount the numerous operating conditions that have a significant effect on efficiency performance—including airflow configuration, return air temperature, and the cooling capacity of the technology. By contrast, Table 110.2-L in the proposed language includes metrics that match the methodology in ASHRAE 90.1-2019 Table 6.8.1-10 "Floor-Mounted Air Conditioners and Condensing Units Serving Computer Rooms – Minimum Efficiency Requirements," where the mandatory NSenCOP metrics vary based on the Standard Model (or airflow configuration) and the NSCC. Rather than imposing a single efficiency value, these mandatory values range from 1.89 up to 2.70 and are calculated from varying Return Air Dry Bulb Temperatures and External Static Pressures.

- Vertiv's data was improperly manipulated without knowledge of Vertiv's products in order to derive the metrics added in Tables 140.9-A and 141.1-A. When Vertiv originally submitted its data in relation to its proposal to add PRE technology as a prescriptive requirement in Title 24, Vertiv never anticipated that its data would be used to calculate prescriptive efficiency metrics in the NSenCOP table. Indeed, its data is not suitable for such purpose. The data

Vertiv submitted was specific to only one of its numerous models of PRE technology. As CASE explained during the roundtable on July 26, it had to make a number of assumptions with Vertiv's data to derive the efficiency metrics—assumptions that CASE admitted could be incorrect. In manipulating and misapplying Vertiv's energy model, the Commission is creating a precedent that will discourage industry and other stakeholders from sharing information with the Commission in future proceedings.

- Six of the proposed metrics added in Tables 140.9-A and 141.1-A are erroneous in that they inexplicably fall below the mandatory requirements of Table 110.2-L. The CASE comment fails to explain why the NSenCOP for a number of prescriptive requirements are lower than the mandatory requirements for the same Climate Zone. Under CEC regulations, the mandatory requirements are intended to impose a floor for energy efficiency, and prescriptive requirements impose more stringent requirements. Promulgating prescriptive efficiency metrics that are lower than the mandatory requirements is not only confusing for regulated stakeholders, but also shows that the methodology used to develop the prescriptive metrics is flawed. This is in addition to the fact that regulated stakeholders are not provided with any inputs to facilitate compliance to the proposed metrics. We note that CEC staff signaled that these values were in fact erroneous and would be revised; however, even in that case, no revised values have been made publicly available for review as part of the 15-day comment period, meaning that no stakeholders have reviewed them.

- In an effort to create "equivalency" metrics for refrigerant economizers, reflected in the proposed metrics in Tables 140.9-A and 141.1-A, CASE adjusted supply-fan performance, thereby creating an arbitrary data set for a completely fictitious refrigerant economizer. By devaluing the supply-fan performance in Vertiv's energy models, CASE's data analysis no longer reflects the actual performance of the modelled refrigerant economizer. Adjusting the efficiency performance of the supply-fan—a component inherent to refrigerant economizers—discredits the actual efficiency of the economizer system and distorts the data in the economizer energy model. Even more concerning, this adjusted data used by the CASE team does not correspond to any actual refrigerant economizer in existence—it is totally fictitious. Adoption of metrics that will regulate actual refrigerant economizers based on data derived from modeling fictitious devices would be outrageous. In addition to Vertiv's concerns about this in the current matter, Vertiv is also concerned that promulgating regulations based on data derived from fictitious devices would set a troubling precedent.

- Partial economizer hours are improperly factored into the analysis used to develop the metrics in Tables 140.9-A and 141.1-A. As a threshold matter, the revised code does not provide any parameters—such as temperature thresholds—to clarify the term "partial economizer." Without specific inputs, partial economization can mean the unit is consuming power anywhere between 1% load addressed with compressor(s) and 99% load from economizing to 99% load addressed with compressor(s) and 1% load from economizing, including all possible percentage splits in between. Thus, power consumption under partial economization can vary significantly from full economization. Despite this, the Analysis Report treats values derived from partial and full economization as equal by adding them together to create total economization hours over the course of a year. This is an erroneous method that produces inherently flawed data. The flawed economization hours are then used as the basis for the NSenCOP prescriptive metrics, which are accordingly also erroneous.

- The Analysis Report improperly treats Time Dependent Valuation ("TDV") power consumption as an annualized metric. TDV power consumption includes full economization, partial economization, and full cooling hours, which all have drastically different power consumption during different times of the year. The Analysis Report creates a metric that assumes energy consumption is the same at any point of the year. In addition, the Analysis Report calculates a linear relation of performance across the year by reverse-engineering this TDV factor and multiplying it by a % factor based off of gained economization hours with increased economizer temperature thresholds from the 2019 Energy Code to the proposed 2022 Energy Code. In other words, the Analysis Report wrongly assumes that power consumption is the most efficient at full economizer temperature threshold and decreases linearly as it reaches the undefined partial economizer temperature threshold. In reality, energy consumption does not fit in a linear model.

- Introducing Substantial Last-Minute Changes Deprive Stakeholders of the Ability to Adequately Review and Respond to the Proposed Language. The Commission's addition of an unsubstantiated NSenCOP table in the 15-day comment period raises significant procedural fairness concerns. This new table imposes significant metrics for compliance with Title 24, and its addition during the 15-day comment period rather than the longer 45-day comment period or still earlier in the process would on its own be concerning. In this case, however, the timeline for review was actually much shorter, as a practical matter. Commission Staff did not provide the underlying methodology for this new table to Vertiv until July 21, 2021—a mere 5 business days before the close of the comment period—and only then after Vertiv directly requested it. To understand the compliance impacts of an addition like this, Vertiv and other stakeholders need to conduct detailed analysis of the NSenCOP values and the underlying methodology and data used to develop it, and because this addition was completely new in the 15-Day Express Terms, stakeholders could not prepare in advance. Such an effort would be challenging within 15 days, but expecting stakeholders like Vertiv to complete fulsome analysis in only two days is unreasonable. Additionally, concerns raised by this NSenCOP table fall only on refrigerant economizer manufacturers; no similar changes were made for other economizer technologies. This is inherently unfair to stakeholders like Vertiv. Making the situation still more challenging, Commission Staff could not promptly answer Vertiv's questions with respect to how the NSenCOP metrics were developed, and instead scheduled virtual a roundtable for Vertiv and the CASE Team to discuss these issues on July 26, 2021—only two days before the close of the 15-day comment period. (Attached as Appendix A are slides from Vertiv's presentation during the July 26 roundtable.) During the roundtable, Commission Staff and CASE were unable to fully explain what conditions must be imposed for pumped refrigerant economizer ("PRE") technology to comply with the NSenCOP metrics, and the discussion included acknowledgement of (i) errors with certain NSenCOP values in the proposed table and (ii) the possibility that certain underlying data used to determine the NSenCOP values may not have been properly derived. To summarize, Vertiv was left with less than two days remaining in the 15-day comment period to complete its analysis of additions to the 15-Day Express Terms that will have significant compliance impacts, but where (i) Vertiv has outstanding, unaddressed questions, (ii) there are known mistakes in the 15-Day Express Terms but no corrected values, and (iii) there are also issues in the underlying methodology and data used

to derive the new NSenCOP values. Not only has this late change to the proposed language disproportionately affected Vertiv's ability to adequately comment on the proposed language, but the specific circumstances here have created an unreasonable situation for Vertiv, which as described above will face significant barriers to making its PRE technology available to California consumers if the 15-Day Express Terms are adopted with the added NSenCOP values. Despite its best efforts to navigate these challenging circumstances, Vertiv is left in a wholly unfair position and one that is not faced by other economizer manufacturers.

- The 15-day Express Terms contains multiple unexplained discrepancies and errors. For example, the language references "pumped refrigerant economizers" in certain sections (*see* Section 140.9(a)(1)(C)) while omitting "pumped" from the discussion of refrigerant economizers in other sections (*see* Section 141.1(b)(1)(C)). Particularity in describing the regulated technology is important, especially in distinguishing between categories and subcategories of that technology. For example, Vertiv's refrigerant economizer products are unique in that they use a pump, whereas other refrigerant economizer technologies do not. It is crucial that the proposed language make clear which technology is subject to these particular regulations.

- The proposed prescriptive NSenCOP metrics are not only premature, but they also have the unintended consequence of stifling innovation that could otherwise advance the Commission's efforts in energy efficiency and energy conservation. The 15-day language, as it is written, penalizes Vertiv for developing an innovative, energy-efficient technology that does not face the same drawbacks as other economizer technology, which are dependent on water consumption or clean air. Notably, the prescriptive metrics do not currently account for refrigerant economizers' water savings when compared to waterside economizers.

Vertiv acknowledges the Commission's recent and ongoing efforts to address the concerns identified in these comments, including for example the July 26 informal roundtable session with Vertiv and members of the CASE team. As previously discussed with Commission Staff, Vertiv is submitting the above comments to meet the 15-day comment period deadline, but Vertiv also intends to continue participating in the efforts to finalize the proposed language, which Vertiv understands will continue past the close of the 15-day comment period. As such, Vertiv may submit additional and/or updated comments in light of those efforts as they proceed or at their conclusion. Given the ongoing nature of these efforts, Vertiv respectfully requests that the Commission consider any such additional and/or updated comments from Vertiv when they are submitted.

Appendix A:

Vertiv's Roundtable Presentation
July 26, 2021

California Energy Commission:
2022 Energy Code Update Rulemaking

Lisa Saponaro and Ben Dolcich

26-July-2021

General Issues with Tables 140.9-A and 141.1-A

- **Proposed metrics use data provided from only one refrigerant manufacturer, which has not been thoroughly vetted by crucial stakeholders.**
  - Compared to Mandatory requirements in Table 110.2-L that have been vetted by ASHRAE 90.1 committee and through AHRI 1360 committee with the Federal DOE

- **Proposed metrics assume one single value with no differentiation of metrics based on ASHRAE Standard Model or Net Sensible Cooling Capacity (NSCC) (See Table 110.2-L for reference).**

- **Six proposed metrics in Prescriptive Tables 140.9-A and 141.1-A fall below the Mandatory requirements of Table 110.2-L**
  - What is justification to allow lower Prescriptive values versus Mandatory requirements?

Mandatory Requirements

TABLE 110.2-L Floor-Mounted Air Conditioners and Condensing Units Serving Computer Rooms – Minimum Efficiency Requirements

Equipment Type	Standard Model	Net Sensible Cooling Capacity	Minimum Net Sensible COP	Rating Conditions Return air (dry bulb/dew point)	Test Procedure[a]
Air Cooled	Downflow	< 80,000 Btu/h	2.70	85°F / 52°F (Class 2)	AHRI 1360
Air Cooled	Downflow	≥ 80,000 Btu/h and < 295,000 Btu/h	2.58	85°F / 52°F (Class 2)	AHRI 1360
Air Cooled	Downflow	≥ 295,000 Btu/h	2.36	85°F / 52°F (Class 2)	AHRI 1360
Air Cooled	Upflow - ducted	< 80,000 Btu/h	2.67	85°F / 52°F (Class 2)	AHRI 1360
Air Cooled	Upflow - ducted	≥ 80,000 Btu/h and < 295,000 Btu/h	2.55	85°F / 52°F (Class 2)	AHRI 1360
Air Cooled	Upflow - ducted	≥ 295,000 Btu/h	2.33	85°F / 52°F (Class 2)	AHRI 1360
Air Cooled	Upflow - nonducted	< 65,000 Btu/h	2.16	75°F / 52°F (Class 1)	AHRI 1360
Air Cooled	Upflow - nonducted	≥ 65,000 Btu/h and < 240,000 Btu/h	2.04	75°F / 52°F (Class 1)	AHRI 1360
Air Cooled	Upflow - nonducted	≥ 240,000 Btu/h	1.89	75°F / 52°F (Class 1)	AHRI 1360
Air Cooled	Horizontal	< 65,000 Btu/h	2.65	95°F / 52°F (Class 3)	AHRI 1360
Air Cooled	Horizontal	≥ 65,000 Btu/h and < 240,000 Btu/h	2.55	95°F / 52°F (Class 3)	AHRI 1360
Air Cooled	Horizontal	≥ 240,000 Btu/h	2.47	95°F / 52°F (Class 3)	AHRI 1360

[a] Applicable test procedure and reference year are provided under the definitions.

Prescriptive Requirements

Equipment Type	Standard Model	Net Sensible Cooling Capacity	Minimum Net Sensible COP	Rating Conditions Return air (dry bulb/dew point)	Test Procedure[a]
Air Cooled	Downflow	≥ 295,000 Btu/h	2.36	85°F / 52°F (Class 2)	AHRI 1360

Table 140.9-A: Minimum Pumped Refrigerant Economizer CRAC Net Sensible COP by Climate Zone

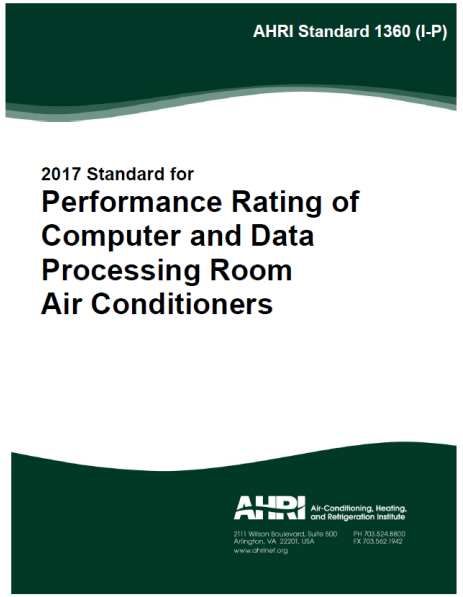
Climate Zone	Net Sensible COP
Climate Zone 1	5.5
Climate Zone 2	4.5
Climate Zone 3	4.2
Climate Zone 4	3.8
Climate Zone 5	4.3
Climate Zone 6	2.7
Climate Zone 7	2.3
Climate Zone 8	2.8
Climate Zone 9	3.3
Climate Zone 10	3.4
Climate Zone 11	3.9
Climate Zone 12	4.0
Climate Zone 13	3.7
Climate Zone 14	3.7
Climate Zone 15	3.6
Climate Zone 16	3.0

Table 141.1-A: Net Sensible COP By Climate Zone For Alterations

Climate Zone	Net Sensible COP
Climate Zone 1	2.9
Climate Zone 2	2.8
Climate Zone 3	2.5
Climate Zone 4	2.6
Climate Zone 5	2.6
Climate Zone 6	2.1
Climate Zone 7	1.7
Climate Zone 8	2.1
Climate Zone 9	2.3
Climate Zone 10	2.5
Climate Zone 11	2.8
Climate Zone 12	2.7
Climate Zone 13	2.7
Climate Zone 14	2.7
Climate Zone 15	2.7
Climate Zone 16	2.3

Tables 140.9-A and 141.1-A: Misapplication of AHRI 1360

- **Refrigerant economizer manufacturers cannot calculate compliance to these proposed metrics.**
  - NSenCOP is calculated, per AHRI Standard 1360, using “any set of given Rating Conditions,” of which none of the following values are defined within sections 140.9 or 141.1:
    - Return Air Dry Bulb Temperature
    - Return Air Dewpoint Temperature
    - For Air-Cooled units, Outdoor Ambient Temperature
    - External Static Pressure
  - Proposed T24 Standard references an allowable Supply Air temperature ***range*** from 65°F to 80°F DB. It is impossible to calculate what the resultant Supply Air temperature is for compliance to the proposed metrics.



- **Proposed metrics manipulate data to combine a peak load performance point with assumed annualized performance data to generate an otherwise pre-defined metric.**
  - NSenCOP, per AHRI Standard 1360, is not an annualized metric of performance. It is calculated with Standard Rating Conditions of typical summer performance – no economizer conditions are included.

Detailed Issues with Generation of Tables 140.9-A and 141.1-A

- **Data analysis has been hastily presented for public review – received EOB 21 July 2021.**

- **Data analysis has not been fully vetted for thorough understanding.**

- **Partial economizer hours are improperly factored into the analysis.**
  - No parameters exist within the proposed T24 standard defining operating thresholds of partial economization operation – unvetted assumptions are made.

  - To Vertiv, partial economization means the unit is operating in some combination of economizer and compressorized cooling mode with the distribution being anywhere between 1% economizer + 99% compressorized and vice versa. This is not accounted for in the analysis for either the baseline water economizer or proposed refrigerant economizer.

- **It appears the analysis evenly distributes the TDV power consumption over the course of the year that includes full economization, partial economization, and full cooling hours, which all have drastically different power consumptions**
  - Given this, it goes on to apply an economization only-based % change across an entire year.

  - This seems to assume power consumption is the same throughout the year, which is a mishandling and inappropriate reverse-engineering of the TDV factor.

Detailed Issues with Generation of Tables 140.9-A and 141.1-A

- **The analysis haphazardly combines different metrics.**

  - The evaporator fan power consumption has been equalized between the baseline water economizer and the proposed refrigerant economizer to reflect a minimally-compliant fan. This creates refrigerant economizer data for ***a fictitious piece of equipment*** that does not exist in the marketplace.

  - The analysis takes the peak load performance point, using AHRI Standard Rating Conditions for the refrigerant economizer and ***somehow adds an annualized metric*** to the fictitious refrigerant economizer data generated in the first point, after it has been adjusted for an incorrectly assumed amount of Full Economization hours.

Proposed Language

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

(a) **Prescriptive Requirements for Computer Rooms.** ~~Space conditioning systems serving a c~~Computer room~~s~~ with a power density greater than 20 W/ft² shall comply with this section ~~by being designed with and having constructed and installed a cooling system that meets the requirements of Subsections 1 through 6~~.

1. **Economizers.** Each individual cooling system primarily serving computer rooms shall include either:

   A. An integrated air economizer capable of providing partial cooling even when additional mechanical cooling is required and capable of providing 100 percent of the expected system cooling load ~~as calculated in accordance with a method approved by the Commission,~~ at 65°F to 80.6°F supply air temperature at outside air temperatures of ~~55~~65°F dry-bulb and below or ~~/~~50°F wet-bulb and below, and be equipped with a fault detection and diagnostic system as specified by Section 120.2(i); or

   B. An integrated water economizer capable of providing partial cooling even when additional mechanical cooling is required and capable of providing 100 percent of the expected system cooling load ~~as calculated in accordance with a method approved by the Commission,~~ at 65°F to 80.6°F supply air temperature at outside air temperatures of ~~40~~50°F dry-bulb and below or ~~/34~~45°F wet-bulb and below.

   C. An integrated pumped refrigerant economizer with a net sensible COP meeting or exceeding the values in Table 140.9-A, capable of providing partial cooling even when additional mechanical cooling is required, and capable of providing 100 percent of the expected system cooling load at 65°F to 80.6°F supply air temperature at outside air temperatures of 50°F dry-bulb and below.

Table 112: Annual Water Savings

Climate Zone	Waterside Economizer Estimated Water Usage (Gallons/ Year)
1	3,085,319
2	3,731,281
3	3,783,238
4	3,949,805
5	3,815,402
6	3,948,464
7	3,985,559
8	4,160,250
9	4,210,500
10	4,229,898
11	4,245,299
12	4,021,818
13	4,256,418
14	4,221,673
15	4,791,583
16	3,657,596
Average	4,005,881

Unlike air economizers, outside air conditions do not interfere with refrigerant economizers.

Unlike water economizers, refrigerant economizers use no water.

Problems with Proposed Prescriptive NSenCOP Metrics

- The proposal incorporates substantial late-stage changes, which does not give impacted stakeholders enough time to thoroughly vet the analysis
- The proposal lists Prescriptive requirements that fall below Mandatory efficiency requirements
- The proposal considers only one manufacturer's performance data without input from that manufacturer
- The proposal makes improper reference to AHRI Standard 1360 and does not correctly apply the definitions and calculation methods
- The analysis makes multiple unsubstantiated assumptions based on nonstandard methodology, which has not been vetted by industry
- The analysis intentionally discredits the efficiency of and arbitrarily assigns additional performance metrics to only refrigerant economizer technology


VERTIV.