

**American Council for an Energy-Efficient Economy  
Natural Resources Defense Council  
Appliance Standards Awareness Project**

September 23, 2016

Ms. Ashley Armstrong  
Appliance and Equipment Standards Program  
Building Technologies Office  
US Department of Energy  
1000 Independence Ave. SW

*Via email to:* CACHeatPump2016TP0029@ee.doe.gov

Re: Docket No. EERE-2016-BT-TP-0029; RIN 1904-AD71

Dear Ms. Armstrong:

This letter comprises the comments of the American Council for an Energy-Efficient Economy (ACEEE), the Natural Resources Defense Council (NRDC), and the Appliance Standards Awareness Project (ASAP) with respect to the Supplemental Notice of Proposed Rulemaking (SNOPR) for Test Procedures for [Residential] Central Air Conditioners and Heat Pumps. The Docket Number and RIN are given above.

This Rulemaking proposes revisions to the current test methods, including additions and revisions to the June 2016 final rule. In this letter, <SNOPR --page, column> refers to the Federal Register Vol. 81, #164, starting at p. 58164, published August 24, 2016. For conciseness and convenience, we omit the first two (most significant) digits of the SNOPR Federal Register page number.

We thank the Department for the opportunity to comment on the SNOPR. Among other important topics, this rulemaking addresses changes negotiated as part of the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) working group on Central Air Conditioners and Heat Pumps (the “RegNeg”). Our groups participated in that working group and look forward to full implementation of all of the terms contained in the agreed-upon Term Sheet.<sup>1</sup> These include new minimum efficiency standards and test procedure provisions.

We strongly support the SNOPR and offer several recommendations. The proposed rule advances critical elements of the term sheet agreed upon by the RegNeg, implements needed clarifications and revisions to the existing test methods and certification requirements, and addresses a newly-exploited loophole for products designed to use R-407C as a refrigerant. In these comments, we begin with high level recommendations which address (1) the test methods

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<sup>1</sup> The term sheet can be found in the standards docket (EERE-2014-BT-STD-0048-0076) at <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0048-0076>

which will take effect with the 2023 standards (Appendix M1); (2) the need for a “clean sheet” rewrite of the heat pump test method, and; (3) proposed treatment for R-407C units. The next section of the comments (item 4) addresses in sequence many of the questions posed by DOE in the SNOPR.

**1. We support DOE’s proposals for the test procedure intended to take effect with the 2023 standard (Appendix M1).**

We are pleased by the Department’s commitment to implementation of the RegNeg’s Term Sheet, as shown throughout this SNOPR. The term sheet includes revisions to the test method which will affect measured energy use. These changes are slated to take effect when the next standard, negotiated by the RegNeg, is implemented in 2023. Elements of the term sheet implemented in this SNOPR include the minimum external static pressure requirements, default fan power for coil only units and an optional low ambient test for variable speed heat pumps. The Term Sheet left final decisions on the heating load line to DOE. Although DOE has chosen a heating load line with a shallower slope than we originally recommended, DOE’s approach, including the use of different slopes for variable speed equipment, appears reasonable and supported by the record. We understand that comments filed by the California Investor Owned Utilities will include additional data supporting the heating load lines selected by DOE in the SNOPR, with some potential slight modifications. We further address the heating load line and other appendix M1 issues on item 4 below.

**2. We recommend that DOE initiate a “clean sheet” review of the heat pump test method.**

Historically, heat pumps have been treated as secondary to air conditioning. In the past, heat pump performance limited the appeal of this technology in many regions of the country. More recently, improved understanding of field conditions and advanced technologies have made heat pumps a much more attractive option for more and more consumers. From the national policy perspective, heat pumps are potentially important in reaching long-term climate goals.

Factors which indicate the potential for heat pumps to see significant market growth and emphasis on their heating function in the years ahead include the following:

- As far south as Birmingham AL, there are more full-load heating than cooling hours.
- Nationally, twice as many dwellings are gas-heated as electric (RECS 2009, Table HC6.1).
- 24.8 million homes are heated with built-in resistance heating systems, either electric warm-air furnaces, baseboard electric, or similar systems. In contrast, only 9.8 million houses have heat pumps RECS 2009, Table HC6.1). Thus, there is enormous potential for saving energy by supplanting these systems with modern heat pumps, whether ducted, mini-split, or other.

DOE’s shipments analysis for the RegNeg confirms that heat pump sales are expected to increase dramatically in the years ahead.

As discussed at length during the RegNeg, the current heat pump rating method fails to adequately address heat pumps as heating appliances. The current method is a patchwork of add-

ons which attempt to capture the performance of advanced systems. The major issue seems to be that the method still centers on cooling performance, and assumes sizing based on cooling loads. Although we support the content of the SNO PR with respect to heat pumps, we also strongly urge the Department and other stakeholders to commence a “clean sheet” effort to develop a new rating and test method that is grounded in understanding of all present and anticipated systems. Stakeholders include manufacturers (AHRI 210/240-2008), technical professionals (ASHRAE 37-2009), ACCA (Manuals J, S, and others), HARDI, energy efficiency advocates, and utilities. We need a road map with real deliverables so DOE, within a reasonable period of time, can move to a heat pump test which better reflects heating performance.

### **3. We support DOE’s proposed approach for units which can use multiple refrigerants and for addressing “golden” indoor units.**

DOE proposes to address two critical issues which have become apparent over the past few months and which we believe are being exploited to manufacture and sell products which do not meet existing energy efficiency standards.

In 2010 the US Environmental Protection Agency (EPA) banned the sale of complete R-22 air conditioning systems to comply with the Montreal Protocol’s phaseout of ozone-depleting substances. EPA, however, left manufacturers the option to sell replacement outdoor R-22 units so long as they are not charged with R-22 in the factory. Under DOE regulations at the time, manufacturers were required to seek an alternate test method to certify these so-called ‘outdoor units with no match,’ but none had done so by the end of 2015 despite selling unmatched R-22 units for many years.<sup>2</sup>

In June 2016, DOE issued a final rule that closed the unmatched unit certification loophole by requiring that units sold as a replacement for existing outdoor units using R-22 as a refrigerant be characterized and rated as an “outdoor unit with no match.” Units with “no match” are assigned an indoor unit for testing and rating purposes which is representative of typical units in homes today with which they will be installed, thereby enabling DOE to assure that existing standards are met.

The practical effect of this amendment was to end the sale of R-22 outdoor units.<sup>3</sup> However, in response to the change affecting R-22 units, one manufacturer<sup>4</sup> began marketing products with a rarely-used alternate refrigerant, R-407C. This refrigerant, unlike the now-ubiquitous R-22 replacement R-410A, can be installed and operated either with R-407C or R-22.<sup>5</sup>

These R-407C units have been and continue to be marketed for use with R-22. Since R-22 is commonly used in the marketplace and R-407C is not, we expect units designed for R-407C are

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<sup>2</sup> Enforcement Policy Statement: Split-System Central Air Conditioners without HSVC. DOE. December 15, 2015.

<sup>3</sup> A manufacturer could in theory improve their R-22 outdoor units to achieve compliance, but we are not aware of any manufacturer who has done so.

<sup>4</sup> The manufacturer, Johnson Controls, Inc. (JCI), markets under multiple brand names including York, Guardian and Coleman. Full list of JCI brands is at <http://www.johnsoncontrols.com/buildings/our-brands>.

<sup>5</sup> The timing of market introduction of the R-407C units which coincided with the elimination of R-22 outdoor replacement units makes it clear that they are intended as a substitute.

in fact installed and used with R-22. Thus, this manufacturer has found a way to continue marketing replacement outdoor units that do not meet existing standards, effectively circumventing the June final rule.

Second, some products, including the R-407C units brought to market this year, can only meet existing minimum efficiency standards by having the smaller outdoor unit paired with an oversized, more-efficient indoor unit (a “golden” indoor unit). In the case of the R-407C products, these products are primarily being marketed as a replacement outdoor unit to be matched with an existing, already-installed indoor unit. They simply are not sold with the “golden” unit that enables them to get the rating which makes them legal for sale. Similarly, other products based on mismatched outdoor and indoor units are unlikely to be sold in quantity. This mismatching appears to be a tactic for certifying and selling low cost, low-efficiency outdoor units used for replacement purposes.

We believe DOE has effectively and appropriately and effectively addressed these two related issues in the SNO PR. Any product compatible with R-22 systems would have to comply with the same rule – tested as outdoor units with no match – whether they use R-22 or R-407C or any other refrigerant suitable as an R-22 replacement, creating equal treatment and a level playing field for all refrigerants. Combined with the series of other measures described in the SNO PR, these approaches will ensure that products manufactured attain the energy efficiency performance levels required by existing minimum efficiency standards.

We comment on additional features and details of DOE’s approach to units with “no match” and to the “golden” indoor unit circumvention in our responses to questions #1 and #9, respectively, in section 4 of these comments. In an appendix to these comments, we address a number of objections to the SNO PR raised during the public meeting by the current maker of R-407C units.

We are not aware of any other manufacturer who has exploited this loophole to circumvent the June test procedure rule. We also are not aware of any barriers to other manufacturers developing R-407C units. Thus, if DOE permits the loophole to remain open, it is likely that other manufacturers will develop their own R-407C units, further undercutting existing standards.

#### **4. Responses to the SNO PR’s enumerated questions.**

In this section, we respond to many of the questions listed at the end of the DOE document (-165, 1). At the end of this section, we address additional issues for which DOE did not enumerate questions.

##### *Issue 1: Proposed certification requirements for outdoor units with no match.*

Assuming that it can be applied to the coil technologies used before and in 2010, we support the limit on normalized gross indoor fin surface to  $\leq 1.0 \text{ in}^2/\text{Btu-hr}$ . We support the requirement to assign separate model number (each with its own certification requirements) to systems designed for more than one refrigerant (-170, 2). We support DOE’s additional requirements, which include: (1) if an outdoor unit is distributed without a designated refrigerant, the OUM must determine the represented value as an outdoor unit with no match, and; (2) additional non-public information requirements for certification (-172, col. 1).

With respect to the requirement that units needing more than one pound of refrigerant charge be rated as a “no match” unit, we are aware that the one manufacturer offering R-407C units has recently begun to provide a small amount of refrigerant charge with shipped outdoor units. This charge is almost certainly vented to the atmosphere if, as is almost universally the case, the unit is installed with an R-22 system. Standard practice for matched pairs is to ship with much more refrigerant, so if the manufacturer expects the unit to be installed with 407C, they would be shipping with a full charge, just as they do with other legal refrigerants. It appears that including this small amount of R407C is an attempt to avoid being designated as a unit with “no match.” This practice is a particularly egregious effort to circumvent standards since the vented refrigerant has a GWP of 1,774, meaning each pound is equal to 1,774 pounds of CO<sub>2</sub>, as much as is emitted by driving an average car about 2,000 miles. DOE’s proposal will end this circumvention.

However, we urge DOE to consider manufacturer input with respect to whether the limitation on units requiring more than a one pound of charge on installation might conflict with current practice or inhibit the transition to refrigerants designed to replace R-410A. For example, longer-than-average refrigerant lines, high efficiency microchannel heat exchangers, and use of atypical coil diameters may all require more than one pound of charge to be added upon installation. Units using next-generation refrigerants may also need to be shipped with smaller quantities of refrigerant due to flammability concerns and therefore may require more charge at the time of installation. DOE should balance the imminent need to address loophole abuse and the long term need to allow new approaches.

In summary, we commend DOE for building a relatively robust wall of defense against efforts to essentially duplicate the earlier “dry-ship” subterfuge that flooded the market with products intended to continue the use of R-22 but performing below the minimum required energy efficiency standards.

*Issue 2: Allowable ICM ratings and compliance with regional standards*

We support DOE’s decision to replace the prior requirement with improved language, stating: “An ICM cannot certify an individual combination with a rating that is compliant with a regional standard if the individual combination includes a model of outdoor unit that the OUM has certified with a rating that is not compliant with a regional standard. Conversely, an ICM cannot certify an individual combination with a rating that is not compliant with a regional standard if the individual combination includes a model of outdoor unit that an OUM has certified with a rating that is compliant with a regional standard.” (-172, 2).

*Issue 3: One-sided tolerance tests*

We support the use of one-sided tolerance tests where possible. We believe that there may be legitimate business reasons to label and sell units that are more efficient than their certified values (for example, to allow a single basic model to cover more products). In addition, consumers can only be pleased if a product does better than claimed.

*Issue 4: Time delays for approach to equilibrium of units with self-regulating crankcase heaters*  
DOE’s approach to this issues seems reasonable and responsive to the needs to treat units with

sound blankets separately from those without. We can imagine classes of compressors with self-regulating heaters but more or less thermal mass and higher power or lower power heating elements for which the proposed limits are sub-optimal, and trust that the Department will allow alternative routes to show that the time delays proposed by OEMs, even for specific models, will approach equilibrium.

*Issue 5: Limiting internal volume of pressure measurement systems for heat pumps*

We appreciate DOE's interest in accurate measurement, given that some pipe regions will carry either liquid or vapor when changing operating modes during cyclic testing. We cannot judge whether the proposed volumetric limits are the "right" ones. We appreciate that the proposed method allows larger volumes for larger systems (-174, 2).

*Issue 6: Bin-by-bin method to calculate EER and COP for intermediate speed operation for variable speed heat pumps*

We support the bin approach as likely to be more representative of field performance than the earlier approaches.

*Issue 8: Time-delay reporting in certification reports for coil-only units*

We support the DOE's proposal, unless others demonstrate significant problems associated with it. This proposal attempts to resolve the problem that fan time delays for coil-only units are "owned" by the furnace regulations, so all DOE can do in AC/HP certification is to require that coil-only ratings specify whether a time delay is included, and if so, the duration of the delay used.

*Issue 9: NGIFS for single-split, coil-only combinations*

In general, we find the Department's logic to be sound, and strongly support the proposal to limit NGIFS to  $\leq 2.0$  in<sup>2</sup>/Btu-hr. Increasing the indoor coil size to improve system energy efficiency does not make sense beyond a certain point because excessively large indoor coils are expensive and are likely to require new, expensive, sheet metal fabrication to fit and to adapt to current ductwork.<sup>6</sup> Relying on outsized test coils to achieve compliance with energy standards that are rarely if ever actually installed would result in many actual systems installed with efficiency below minimum efficiency standards.

We do not believe that the proposed NGIFS limit will inhibit future indoor coil technologies or practices for real world installations. That said, DOE should consider the input of manufacturers who may have a few models designed for hot-dry climates where the apparent evaporator surface oversizing can improve rated performance. Any final NGIFS limit or other approach to solving the "golden" indoor unit problem needs to balance DOE's obligation to ensure compliance with existing standards and allow for future innovation. Finally, if necessary, if manufacturers find a true market need for products with over-sized indoor units they can always avail themselves of DOE's test method waiver provisions. Close monitoring through the waiver process would allow DOE to ascertain that specific offerings are being marketed and sold in matched pairs, rather than as circumvention of existing standards.

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<sup>6</sup> Please note that retaining the old plenum is often done as a cost-saving measure, but is generally far from optimum.

*Issue 10: Compressor speeds and slope factors at 17 °F, 35 °F, and 47 °F*

We support the Department's proposed changes, that the full-speed test at 17 °F and 35 °F would use the maximum speed in which the system controls would operate the compressor normally at a 17 °F ambient temperature, while an extrapolation is used to calculate the 47 °F test. We feel this method is reasonable and will adequately address OEM concerns, voiced during the RegNeg, that some variable speed heat pumps may be unable to pass the appendix M test procedure. Additionally, we feel that the extent of the Department's evaluation of the available AHRI data was sufficient to develop the capacity slope factors (CSFs) and power slope factor (PSF), which are appropriately used to calculate the 47 °F extrapolation.

*Issue 11: Full speed 47 °F test speed no lower than the 95 °F full-speed cooling test*

We agree that it is appropriate to allow the full-speed 47 °F test to be at the manufacturer's discretion.

*Issue 12: Break-in period*

We are comfortable with the certification reporting requirements and clarifications issued by DOE. However, despite the Department's explanation (-179, 2), we are not convinced that DOE needs to establish any upper limit for break-in period. Conceptually, break-in (like heat-soaking a tank water heater) does not have to be conducted in the test cell. In an era of ever better precision and accuracy in metal-working, the need for a longer break-in period is not obvious, but neither is the need to preclude it.

*Issue 13: Removing the 5% tolerance for part load operation when comparing the sum of nominal capacities of the indoor units and the intended system part load capacity*

We appreciate that the Department has recognized the unintended consequence of the prior language and proposes to remove the indicated wording from section 2.2.3.a of Appendix M.

*Issue 15: Minimum ESP requirements*

We support the proposed minimum ESP requirements in Table III.5, which generally comport with the term sheet published by the ASRAC WG. We appreciate the Department's proposal to restrict reduced ESP requirements for "space-constrained" systems to the indoor coil, as opposed to including the outdoor unit.

*Issue 17: Reduced minimum ESP requirement for condensing furnaces*

We fully support DOE's decision to abandon the proposed ESP reduction for these units, as provided for in the Term Sheet.

*Issue 18: 8% change in required coil-only air movement efficiency for mobile home furnaces*

The Department's explanation for this change makes sense and we support the proposed change.

*Issue 19. Mobile home coil-only units*

We support DOE on 406 cfm/ton, and the definition and label requirements for mobile home coil-only systems.

*Issue 20: Calculating HSPF and SEER*

We support DOE's proposed adjustments to the heating load line equation, used to calculate heat

pump HSPF efficiency rating. Based on research previously provided by Oak Ridge National Laboratory, and subsequent adjustments to the equation made after discussion during the RegNeg, the new HSPF metric more accurately reflects U.S. heat pump operation. We strongly support the Department's decision to vary the zero-load temperature and slope factor(s) within the equation by region, rather than use a single equation. For the sake of this rulemaking, we support DOE's adjustments to both HSPF and SEER; however, in the long-term, we strongly recommend DOE work closely with AHRI, ASHRAE, and other stakeholders using a "clean sheet" approach in developing a new heat pump rating method.

*Issue 21: Minimum HSPF values*

Absent better information, we feel the linear interpolation was an appropriate way to derive the minimum HSPF values, and support the values assigned.

*Issue 22: Alternative HSPF rating approach*

We support DOE's proposed alternative rating approach, which should increase test accuracy. Extrapolation based on the performance at 47 °F and 62 °F minimum-speed tests tends to overestimate efficiency. We also agree with the concept of documenting whether this alternative approach was used to determine variable speed heat pump ratings, for the sake of transparency.

*Issue 23: Heat pump capacity and power input evaluation with and without 5 °F test*

We support DOE's proposed interpolation calculation for temperatures between 5 °F and 17 °F when the 5 °F full-speed test is used, and are comfortable continuing to use the extrapolation calculation when the 5 °F full-speed test is not conducted.

*Issue 24: Target wet bulb temperature for 5 °F test*

We support DOE's proposed wet bulb temperature of 3.5 °F for the optional 5 °F test.

*Issue 25: General comments on 5 °F test*

We generally support DOE's variable-speed compressor heat pump proposals; however, feel that in any case when the 5 °F full-speed test is conducted, the full-speed performance should be calculated through interpolation, rather than extrapolation from the 47° - 17° trend.

*Additional issues*

We support replacing the "Highest Sales Volume" (HSV) unit with the requirements recommended by the CAC/HP ECS Working Group, that is, to require at least one coil-only rating that is representative of the least efficient coil distributed in commerce with a particular condensing unit. Since manufacturers self-designate their HSVs, sometimes before models even enter commerce, the HSV combination is subject to gaming and is difficult to impossible to monitor if it is being properly determined. We are glad the RegNeg Term Sheet included a term to move away from the HSV approach and that DOE has adopted that recommendation.

## **5. Summary and Conclusions**

The Department has accomplished much with this SNOPR, and we appreciate the significant effort that has gone into its development. It should resolve important standards circumvention



issues, including those associated with R-407C units. It implements the consensus agreements of the negotiated rulemaking, and clarifies the test procedure where needed.

We hope these comments will be helpful as the Department finalizes the rule.

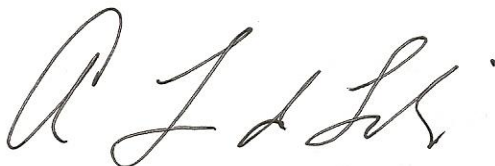
Sincerely,



Harvey Sachs  
Senior Fellow  
American Council for an Energy-Efficient Economy



Alexander Hillbrand  
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Appendix.

### **Responses to objections to DOE’s treatment for R407C units.**

The manufacturer supplying R-407C units strenuously objected to DOE’s proposed approach to these products at the public hearing. We believe the Department has provided a sound technical basis for the approach taken in the SNOPR. We also believe that this approach will ensure that products meet the existing minimum efficiency standards in a predictable and fair way, resulting in energy savings and economic savings for equipment buyers, as intended by the rule which created the existing standards. The currently existing standards were negotiated in 2009 by manufacturers and other interested parties, including the manufacturer of R-407C units and the signatories to this letter. DOE adopted the negotiated levels in a final rule published in 2011 (76 Federal Register 37408 codified at [CFR 430.32\(c\)\(3\)](#)) and those standards took effect in 2015. As supporters of that rule, we hold a strong interest in seeing it properly implemented without circumvention.

#### **Currently-marketed R-407C units are costly, inefficient, high-GWP options to replace part or all of older R-22 air conditioners.**

The manufacturer of R-407C units claimed they offer consumers a “low-cost, high-efficiency, non-ozone-depleting, low-GWP option” when parts of their R-22 air conditioners fail.<sup>7</sup> They are certified as barely meeting current standards, and they achieve that certified value by rating with a matched indoor unit, even though they are rarely if ever installed with that matched unit. Instead, they are paired with indoor units already installed, and therefore achieve much lower efficiency than certified. Moreover, even the matched certification rating is achieved with an oversized indoor coil which inflates the performance of the outdoor half of its ‘system’; the claims that R-407C outdoor units are “high-efficiency” are simply not true. As typically installed, they do not even achieve the efficiency required by today’s minimum standards.

R-407C is indeed non-ozone-depleting, but is far from low-GWP.<sup>8</sup> At a GWP of 1,774, it has 98% the GWP of R-22 and 85% the GWP of R-410A. To their credit, the air conditioner industry, including the manufacturer of R-407C units, has generally favored phasing down hydrofluorocarbon (HFC) refrigerants under the Montreal Protocol, a treaty that relies on GWP as a metric for understanding national targets of HFC reductions. Manufacturers know which compounds are considered low-GWP, and R-407C is most certainly *not* one of them.

Lastly, inefficient R-407C outdoor units are a bad deal for consumers. Sub-standard efficiency means higher energy use and higher electricity bills. Every customer who purchases an R-407C unit will get substantially lower efficiency than claimed by the product rating and will be saddled with higher energy bills than a truly compliant product.

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<sup>7</sup> Transcript of Proceedings, Test Procedures for Central Air Conditioners. August 26, 2016. Pg 13.

<sup>8</sup> GWP = Global Warming Potential, a measure of how much a compound contributes to greenhouse gas accumulation. CO<sub>2</sub> has a GWP of 1.

**The manufacturer of R-407C units claims DOE is seeking to replace EPA as ‘regulator of HVAC refrigerants,’ yet nothing could be further from the truth.<sup>9</sup>**

DOE regulates energy efficiency and has a legal obligation to ensure that manufacturers comply with its standards. The SNOPR does precisely that by ensuring that units intended as replacement units have to meet the same rules *regardless of the refrigerant they are designed to use*. In the SNOPR, DOE clearly sets out to close a loophole in its own regulations that, if left unaddressed, will result in the sale of units that do not meet existing standards, resulting in higher energy consumption. That is the purpose of DOE’s “no-match” requirements for certifying these units.

Furthermore, DOE is not banning the sale of R-407C units. Selling outdoor unit replacements using R-407C is and will continue to be perfectly legal – in fact, manufacturers may produce and sell outdoor units with no match using any refrigerant they want, including R-22 and R-407C. But these units will need to meet the efficiency of DOE’s existing minimum standards, rather than skate by with a certified value not achieved in the real world. DOE’s SNOPR effectively addresses the efficiency performance of products on the market today.

EPA has managed refrigerants under Clean Air Act authority since it began the Significant New Alternatives Policy (SNAP) Program in 1994. Nothing in DOE’s SNOPR suggests even the slightest intent to commandeer that role.

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<sup>9</sup> Transcript of Proceedings, Test Procedures for Central Air Conditioners. August 26, 2016. Pg 10.