

ENERGY STAR Distribution Transformers Framework Document Stakeholder Comment Summary and Response

Topic	Subtopic	Stakeholder Comment	Recommended EPA Response
General		<p>Several stakeholders supported the effort to launch a voluntary program for medium-voltage, liquid-immersed distribution transformers. One of these stakeholders noted that current technology and materials are commercially available that meet the EPA proposed efficiency criteria levels. Another stakeholder stated that the proposed levels seem suitable; however, it may be beneficial to incorporate a total cost of ownership approach into the specification as well, treating the proposed levels as a soft target.</p> <p>Several stakeholders commented that an ENERGY STAR effort is not worthwhile given the current market environment and limited interest. One stakeholder suggested that EPA assess the significant capital required to establish or expand processing amorphous metal and balance this cost with the market demand. The stakeholder did not believe that there will be sufficient demand: rather than the 50% market penetration suggested in the Framework Document, 10% would be more accurate.</p>	<p>EPA appreciates the support for developing a voluntary program for medium-voltage, liquid-immersed distribution transformers.</p> <p>EPA is proposing a new approach based on optimizing transformer efficiency for a given capacity factor (i.e., for a specific application) to address the concerns of utilities and other stakeholders. To this end, EPA proposes to set ENERGY STAR efficiency levels at each capacity factor from 10% to 70% (in 5% increments) that reflect the highest efficiency performance while maintaining a good selection of products across a variety of manufacturers at each capacity factor. A transformer design could earn the ENERGY STAR at one or more capacity factors. It is not EPA's intention to establish requirements such that only amorphous core technology qualifies. EPA is proposing to allow for ENERGY STAR certification at particular capacity factors, so that purchasers can easily identify highly efficient alternatives that meet their individual needs.</p>
DOE Rulemaking, General		<p>One stakeholder stated that EPA should defer to DOE's conclusion in the rulemaking process that a more efficient standard would not be beneficial. This stakeholder noted that in 2007 EPA sunset the former ENERGY STAR distribution transformers program due to DOE activity superseding the program as well as levels of interest not justifying the cost of maintaining the program.</p> <p>Other stakeholders noted, however, that DOE adopted TSL 1 standards because of other reasons such as sole-source providers, risk remanufacturing of inefficient old transformers, or capital and engineering costs, rather than energy savings potential. One of the stakeholders estimated the potential of going beyond TSL 1 as on the order of \$7 billion and 2 Quads of energy.</p>	<p>EPA found that there are potential savings beyond the standard levels established during the recent DOE rulemaking, and that these savings may best be realized through a voluntary program such as ENERGY STAR.</p> <p>In Draft 1, EPA proposes a new approach which will promote higher efficiencies optimized for different capacity factors. Doing so will allow various technologies to meet the efficiency criteria. EPA also proposes developing a supplemental tool that will help purchasers identify products that will best meet their needs.</p>
DOE Rulemaking	Analysis/Dataset Concerns	<p>Several stakeholders commented that the DOE analysis and dataset are inaccurate and could cause misleading results, specifically:</p> <ul style="list-style-type: none"> • Outdated or misapplied utility rates (wholesale versus retail rates); • 30 year life expectancy contrary to accepted industry practices (20.5 year average); • Outdated commodity costs; and • Disagreement between 35% average modeled capacity factor and 50% tested capacity factor. <p>In addition, one stakeholder commented that the modeling was based on non-public information.</p>	<p>The dataset and assumptions that DOE used went through an open standards process and are publicly available on their website and in the Technical Supporting Document. This analysis reflects the most accurate information currently publicly available. EPA welcomes any additional data from stakeholders that can be used to inform the specification development process.</p>
Scope		<p>A stakeholder recommended that the scope include 10 kVA through 500 kVA products for single-phase and 15 kVA through 2500 kVA for three-phase products for liquid-immersed distribution transformers that operate between 1 and 36 kV. This commenter suggested units with secondary voltages exceeding 600 V should be excluded. They also suggested that impedance and tap ranges should remain as specified in the DOE final rule and the maximum insulation level should be 150 kV BIL.</p> <p>Finally, another stakeholder suggested also including low and medium-voltage dry-type distribution transformers to capture additional savings. This stakeholder mentioned that low-voltage dry-type purchases are generally based on lowest first cost, lowest efficiency because the decision does not include the involvement of the end-user so an ENERGY STAR program could greatly influence the market.</p>	<p>EPA intends to keep the scope consistent with the DOE standard. However, EPA appreciates the feedback on capping the single-phase scope at 500 kVA and the BIL at 150 kV, and will consider these adjustment if more information or data can be provided confirming this would be necessary to ensure ENERGY STAR product availability.</p> <p>Despite seeing value in expanding the scope to include low and medium-voltage dry-type transformers, EPA determined that liquid-immersed transformers are sold in much larger quantities and thus would yield the greatest national energy and monetary savings for utilities. In the future, EPA will reconsider expanding the scope to include these other product types should new data become available and will engage the relevant stakeholders.</p>

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Transparency	Contracting	Two stakeholders requested more transparency regarding EPA's selection and hiring of subcontractors to ensure that there is no conflict of interest.	EPA has contracted with ICF Consulting, which maintains an approved process for ensuring that subcontractors do not present a conflict of interest. ICF vetted and sub-contracted EMS International Consulting, Inc. to analyze independent objective data and provide feedback that is non-discretionary and based solely on EMS's expertise in the industry.
Loading Variation		<p>Stakeholders commented on the variable nature of loading profiles depending on the specific application of a distribution transformer. They noted that different sizes and voltage ratings tend to serve varying types of load based on local factors and usually a reduction in one type of loss (load versus no-load) results in an increase in the other. Another commenter noted the difference between capacity factor (average load relative to nameplate rating) and load factor (average load relative to peak load). Also, they mentioned that utilities are generally aware of the types of loads that are most commonly served by a particular transformer in their environment.</p> <p>Another stakeholder stated that for higher-loaded transformers, amorphous core technology will decrease efficiency and result in increased losses.</p>	<p>EPA understands that loading profiles for differing applications will vary and that efficiency at one loading point will be different at another. Therefore, EPA has proposed a new approach that will allow manufacturers to certify models that provide savings over the minimum-standards-compliant model for the specific capacity factor and application where the transformer will be deployed. The proposed efficiency levels will include different types of technologies and materials.</p> <p>EPA is also proposing to give utilities the opportunity to use a tool that will find and compare the most energy efficient and cost-effective transformers for their specific application.</p>
Efficiency Criteria		<p>A stakeholder suggested moving forward with TSL 4 for liquid-immersed distribution transformers and TSL 3 for low- and medium-voltage dry-type transformers. Two other stakeholders agreed that TSL 4 seems suitable because it would provide large savings and would facilitate market transformation of materials and was found to be cost-effective in the DOE Technical Support Document. However, they recommended considering an approach that does not specify an efficiency level but encourages the total cost of ownership analysis to determine whether higher efficiency is economically justified. One commenter noted three reasons for considering this approach:</p> <ul style="list-style-type: none"> • TSL 4 could be uneconomical for some equipment classes in some applications (e.g., DOE found that about 18% of Design Line 2 transformers would not be cost-effective at TSL 4) • In some applications, a higher efficiency than TSL 4 could be economical and a total cost of ownership approach could capture these opportunities • Utilities have the technical expertise and data to perform this calculation and ENERGY STAR could recognize and promote a best-practice culture of performing these analyses - NEMA TP-1 lays out an accepted method for this analysis. <p>Stakeholders also noted the following in regard to efficiency criteria:</p> <ul style="list-style-type: none"> • DOE did not identify TSL 4 efficiency values for all included transformer kVA ratings and EPA would have to develop these. • TSL 4 efficiency levels may allow a few silicon steel design options for single-phase, amorphous designs would be the likely option for three-phase. • EPA should not raise efficiency levels from TSL 1 for sizes larger than 500 kVA because of the increased size and weight of these pole-mounted units. 	<p>In response to the initial framework document released as part of this specification development process, EPA heard from stakeholders about the importance of optimizing transformers for their intended capacity factor, or load. A review of the Department of Energy's (DOE's) transformer data set (which includes over 6000 transformer designs) indicates that different transformers perform more efficiently at different capacity factors, i.e. some transformers perform more efficiently at lower capacity factors, whereas others perform more efficiently at higher ones. Given these circumstances, EPA is proposing to allow for ENERGY STAR certification at particular capacity factors, so that purchasers can easily identify highly efficient alternatives that meet their individual needs.</p> <p>To this end, EPA proposes to set ENERGY STAR efficiency levels at each capacity factor from 10% to 70% (in 5% increments) that reflect the highest efficiency performance while maintaining a good selection of products across a variety of manufacturers at each capacity factor. In order for products to earn the ENERGY STAR, they must deliver energy savings beyond the savings resulting from conventional products—those that just meet the DOE minimum efficiency standards. A transformer design could earn the ENERGY STAR at one or more capacity factors.</p> <p>EPA will evaluate and propose energy efficiency requirements at all capacity factors based on data indicating which products perform most efficiently when optimized for each capacity factor. Overall, EPA's proposed approach will allow various technologies to qualify for ENERGY STAR, as different technologies deliver greater energy efficiencies at different capacity factors.</p>
Non-Efficiency Criteria		<p>Stakeholders commented on the following non-efficiency criteria:</p> <ul style="list-style-type: none"> • All transformers should meet the Institute of Electrical and Electronics Engineers (IEEE) National Standard; and • Only one kVA size rating should be listed as nameplate. 	EPA expects all products that are ENERGY STAR certified to already meet industry standards and common practices, but welcomes additional feedback on requirements that will ensure high quality products. In Draft 2, EPA can include language requiring that all transformers meet or exceed safety and quality standards.

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Transparency	Sources	Another stakeholder requested that EPA provide the data and methodology used to determine the savings and what factors and assumptions were taken into account. They pointed out that efficiency based on an arbitrary load level cannot be accurate so the savings presented can be misleading if assumptions are not specifically stated.	To calculate savings, EPA used only public information developed during the DOE rulemaking. Cost of materials and efficiency of representative units as well as lifetime and other assumptions were also taken from the DOE Technical Support Document. However, EPA understands that forecasted savings values based on modeling and assumptions will not be completely accurate but instead provide an estimate based on information available. Under the new approach proposed in Draft 1, EPA will update the savings calculations. Again, EPA welcomes any new data from stakeholders that can inform the specification and savings potential.
Amorphous Core	Sole Source	Several stakeholders expressed concern over only one company currently having the technological capability of producing amorphous metals and the barriers that prevent other producers from manufacturing amorphous metal cores. One stakeholder pointed out that a supply chain issue and pricing and competition issues would result from selecting a specific technology that only certain manufacturers can provide. Also, they mentioned that this could limit utilities' ability to choose the most efficient and cost-effective product because they would be forced to make investments in additional supporting infrastructure that are not captured in DOE's cost-benefit analysis. Another commenter stated that no change in material availability has taken place since DOE found that the available amorphous steel is well below the amount required to meet the U.S. liquid-immersed distribution transformer market demand and questioned data provided to EPA regarding the wider availability of amorphous material. Another stakeholder stated that data provided to DOE in the rulemaking process proves that existing technologies and material grades could be competitively utilized at efficiency levels higher than those chosen. The stakeholder also noted that one US supplier can commit to supplying 45,000 tons of amorphous metal domestically and an additional 60,000 tons from abroad, with additional amounts available from other suppliers.	Through a voluntary program, ENERGY STAR strives to encourage manufacturers to provide the most efficient, yet cost-effective transformers using materials that would provide the highest energy and cost savings. EPA understands the concerns regarding only one company having the capability of producing amorphous metals. The new approach proposed in Draft 1 should alleviate those concerns while also encouraging manufacturers to use materials that offer improvements in efficiency and develop new capabilities. It also does not appear that amorphous steel is the only option for increased efficiency: DOE analyses indicated that grain oriented steel transformers can meet higher efficiency levels. EPA welcomes and encourages further input and data from stakeholders on the cost-effectiveness of more efficient grain-oriented steels. EPA will consider grain oriented and amorphous core materials when developing efficiency levels for different capacity factors.
Amorphous Core	Operational Concerns	A stakeholder stated that amorphous core transformers can sacrifice functionality in regards to ferroresonance (which they noted cannot be easily corrected by adding an arrester or changing operating practices). This would prevent utilities from easily adopting ENERGY STAR transformers and cause them to push back against state ENERGY STAR purchasing policies.	EPA understands that ferroresonance is not an issue for Design Lines 1, 2, and 3 (single-phase), but is occasionally seen with DL 4 and 5 (three-phase) transformers. Based on available information and past studies, including the IEEE report <i>Performance of Metal-oxide Arrester Exposed to Ferroresonance in Pad-mount Transformers</i> , the majority of operational concerns have mitigation strategies that are industry-accepted. Furthermore, transformers using other steel materials should be able to certify for ENERGY STAR as well per the approach proposed in Draft 1.
Amorphous Core	Weight and Size	Several stakeholders stated that an increase in the size and weight of transformers would be necessary to meet higher efficiency criteria and that this was supported by DOE data. This could result in limited availability of products that would meet the efficiency levels, consumer confusion, cost increases, and dissatisfaction. A stakeholder also mentioned that the DOE analysis does not address space limitations. One stakeholder mentioned that new technologies may be available to provide reduced size and weight, increased reliability, and other advantages over amorphous transformers.	EPA recognizes that increased weight and size is a valid concern when increasing the efficiency of a transformer. The approach proposed in Draft 1 should allow transformers to qualify for a given application and thus should be able to provide options on the technology and material that a purchaser can buy. As a result, EPA's proposed approach should allow products of different weights and sizes to earn the ENERGY STAR. EPA welcomes additional information about future technologies that can enhance energy efficiency in transformers.

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Small Company Investment		<p>A stakeholder stated that both the ENERGY STAR effort and the DOE rulemaking process focused on the big manufacturers in the industry and do not support smaller companies by recognizing the effort and investment that would be required to meet more stringent efficiency levels. This commenter suggested another program to encourage efficiency that would not force small companies to leave the market or risk investing a large capital sum on the program (e.g., a program to replace old transformers). Another commenter agreed, noting that requiring amorphous core can put small manufacturers at a disadvantage due to the capital investment necessary.</p>	<p>EPA notes that ENERGY STAR is a voluntary program, and manufacturers can choose to participate in this effort. In addition, it is EPA's understanding that a significant investment would not be needed to purchase more efficient transformer materials, such as a pre-assembled amorphous cores, and then assemble them with other components. However, as noted above, the approach proposed in Draft 1 should allow transformers to qualify for a given application and thus should be able to provide options for various available efficient technologies and material. EPA welcomes further input from stakeholders to better understand opportunities to mitigate any barriers to market uptake of more energy efficient products.</p>
Total Cost of Ownership		<p>Several stakeholders agreed that a total cost of ownership approach was the best step moving forward and would help achieve greater marketplace acceptance. They noted that this would allow customers flexibility to optimize their purchase based on their balanced interests. A stakeholder noted that having one level for all transformers and applications would not be appropriate for a voluntary program because transformer performance varies under different load conditions and this could lead to installations that are less cost-effective and less energy efficient. This situation could occur for local governments that have purchasing policies requiring ENERGY STAR products as well.</p> <p>A stakeholder stated that the purchase cost of a transformer would be 17% greater at TSL 4 which could lead to an increase in electric rates in excess of \$0.40/kWh because of the proposed approach in EPA's framework document that sets one efficiency level for transformers designed for different applications. Conversely, the A/B factor evaluation would allow for the transformer to be customized for an application, thus balancing increased efficiency and cost-effectiveness. This stakeholder further commented that the proposed ENERGY STAR proposed approach could lead to a 4% increase in energy use over a total cost of ownership approach.</p>	<p>EPA understands that a total cost of ownership approach would allow utilities to find a transformer that would be best suited for the intended application. EPA's new approach presented in Draft 1 will allow manufacturers to certify transformers for their intended application. A supplemental purchasing tool will allow utilities to compare both efficiency and cost-effectiveness from a list of certified ENERGY STAR transformers. As mentioned previously, EPA understands the concerns regarding a one-size-fits-all approach and considers that Draft 1 addresses these concerns.</p>
Program Longevity		<p>Several stakeholders mentioned the possibility of an ENERGY STAR specification leading to an increase in the federal standard efficiency levels. They noted that EPA should assure industry that there will be longevity to the proposed program to ensure that the efforts of those that decide to invest are worthwhile.</p>	<p>EPA expects that the approach proposed in Draft 1 will allow the program to have a long lifetime because it will designate for stakeholders efficient transformer models tailored to suit their specific applications, rather than only designating efficiency at a single capacity factor. As with other ENERGY STAR product categories that are covered by DOE, should DOE issue a revised Federal Standard in the future, EPA expects to also revise the ENERGY STAR requirements provided that additional savings above the Federal Standard exist at a variety of capacity factors. EPA's proposed purchasing tool will also assist in prioritizing efficient products.</p>

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Test Procedures		<p>A stakeholder agreed with the DOE single load point test and did not support the creation of variable load curves and varying certifications based on estimated loads because it is too complex. They appreciated EPA's effort to consider additional test requirements in addition to the existing DOE procedure and mentioned that they use ANSI/IEEE methodologies, which have been the standard in the industry.</p> <p>Another stakeholder stated that the DOE test procedure and Alternative Efficiency Determination Method (AEDM) for modelling efficiency should be used for qualification and noted that given the large variety of models, they would not support the use of third party testing and witnessing to qualify.</p> <p>Finally, one stakeholder commented that efficiency should be determined at 50% load at 55°C and no load at 20°C as stated in the DOE rule.</p>	<p>EPA intends to harmonize with the DOE test method, though also proposes to have manufacturers report efficiency at multiple loading points based on the original DOE test. Doing so should not increase testing burden since efficiencies testing is performed at 0% and 100%, and then performance at a specified capacity factor is calculated from these two measurements. EPA proposes that manufacturers use the AEDM (Alternative Efficiency Determination Method) to certify products to ENERGY STAR to align with the process in place for self-certification to the DOE Final Rule, thus reducing testing burden.</p> <p>EPA now requires all ENERGY STAR labeled products to be third-party certified, where products are tested in an EPA-recognized laboratory and reviewed by an EPA-recognized certification body (CB). Laboratories that are accredited to ISO/IEC 17025 by an EPA-recognized accreditation body (AB) may apply for EPA recognition and unaccredited laboratories can gain EPA recognition by participating in a CB's witnessed or supervised manufacturers' testing laboratory (W/SMTL) program. For those distribution transformer manufacturers that operate their own laboratories for testing and are not accredited, EPA recommends that manufacturers participate in a CB's W/SMTL. More information on EPA's third party certification and verification program is available at www.energystar.gov/3rdpartycert.</p>