ENERGY STAR®
Distribution Transformers Launch Webinar

January 14, 2014

Verena Radulovic
U.S. Environmental Protection Agency

Webinar Details

- Webinar slides and related materials will be available on the Transformers Web page:
  - www.energystar.gov/newspecs
  - *Follow link to "Version 1.0 is in Development" under "Transformers"*

- Audio provided via teleconference:

  Call in: +1 (877) 423-6338 (U.S.)
  +1 (571) 281-2578 (International)
  Code: 773366#

  - Phone lines will remain open during discussion
  - Please mute line unless speaking
  - Press *6 to mute and *6 to un-mute your line

Introductions

Verena Radulovic
U.S. Environmental Protection Agency

Matt Malinowski
ICF International

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ICF International

Doug Frazee
ICF International

Mahesh Sampat
EMS Consulting

Webinar Agenda

Time	Topic
1:00–1:30	Introduction
1:30–1:45	Transformers Energy Savings Opportunity
1:45–2:00	Definitions, Scope, General Requirements
2:00–2:30	Qualification Criteria
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Established in 1992

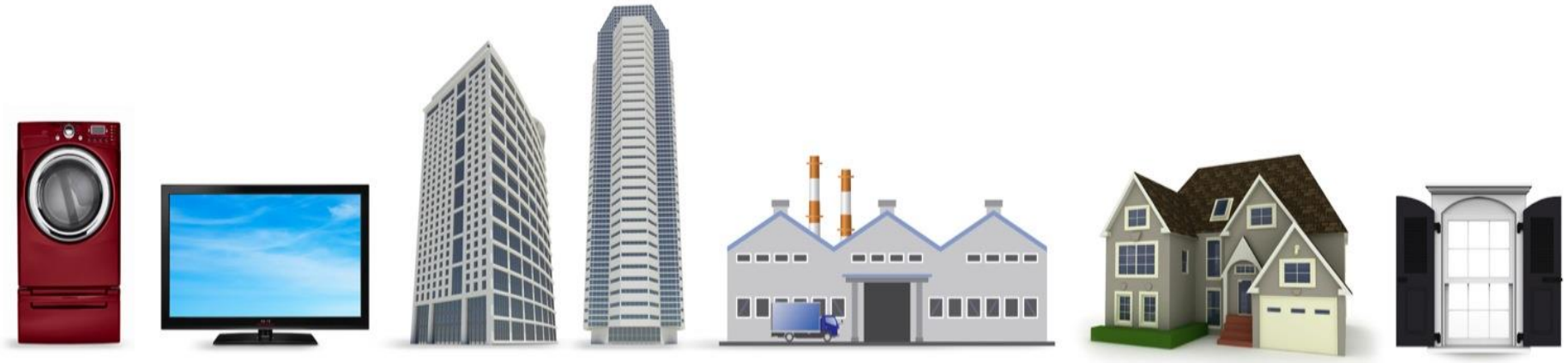
Voluntary climate protection partnership with the U.S. Environmental Protection Agency (EPA)

Strategic approach to energy management, promoting energy efficient products and practices

Tools and resources to help save money and protect the environment

For more than **20 years**, EPA's ENERGY STAR program has identified the most energy-efficient products, buildings, plants, and new homes – all based on the latest government-backed standards.

Today, every ENERGY STAR label is verified by a rigorous third-party certification process.



To date,
the **ENERGY STAR**
program has:

- Prevented 2 billion metric tons of greenhouse gas emissions
- Saved $300 billion on utility bills

ENERGY STAR = Energy Efficiency

ENERGY STAR has become synonymous with energy efficiency.

ENERGY STAR is also the most comprehensive resource available for proven
energy efficiency guidance.

At **energystar.gov**:

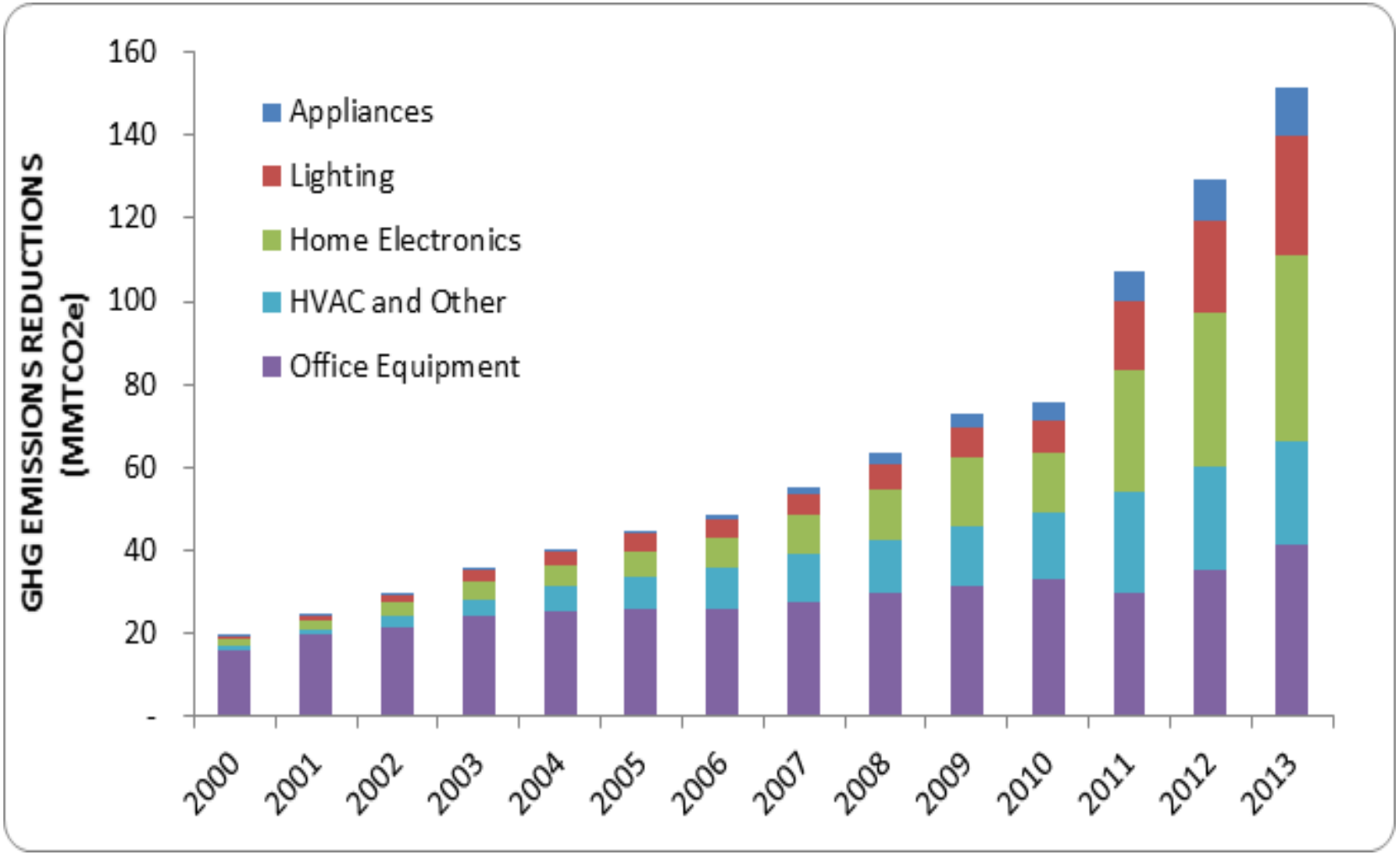
Reducing the complexity of energy efficiency to a **simple choice**.


ENERGY STAR. The simple choice for energy efficiency.
ENERGY STAR
Today,
this little blue label
does all the hard work
of certifying outstanding
energy efficiency in:
70
Product
Categories

EPA U.S. DEPARTMENT OF ENERGY

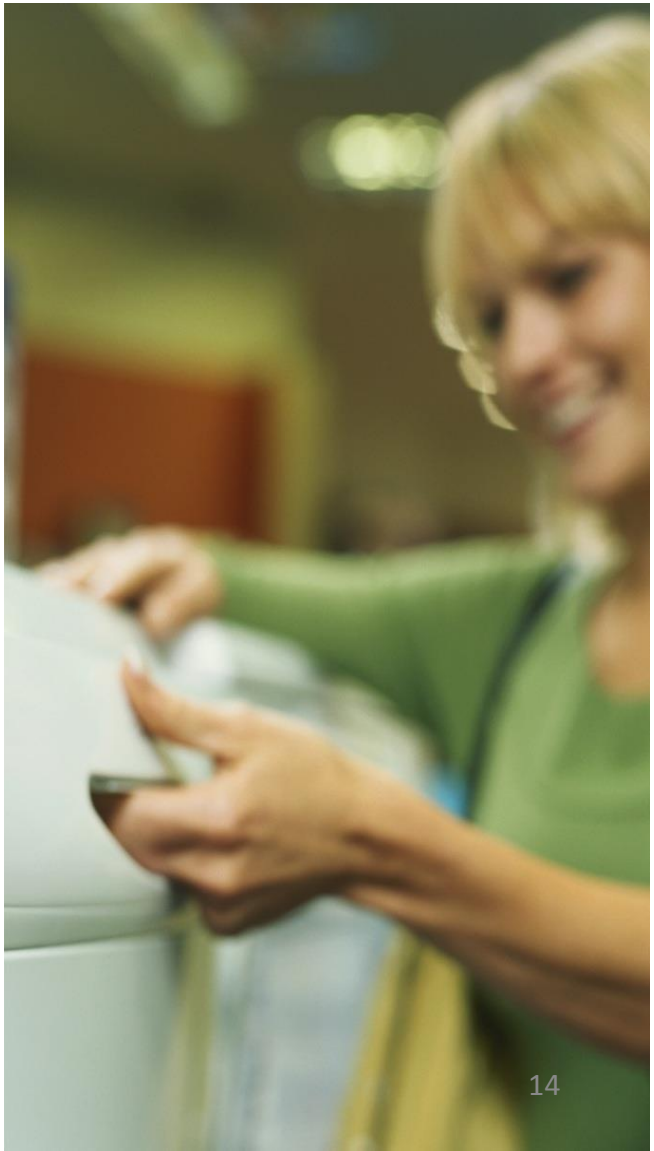
* = Covered by EU agreement

Greenhouse savings by product category



Benefits of an ENERGY STAR certified product

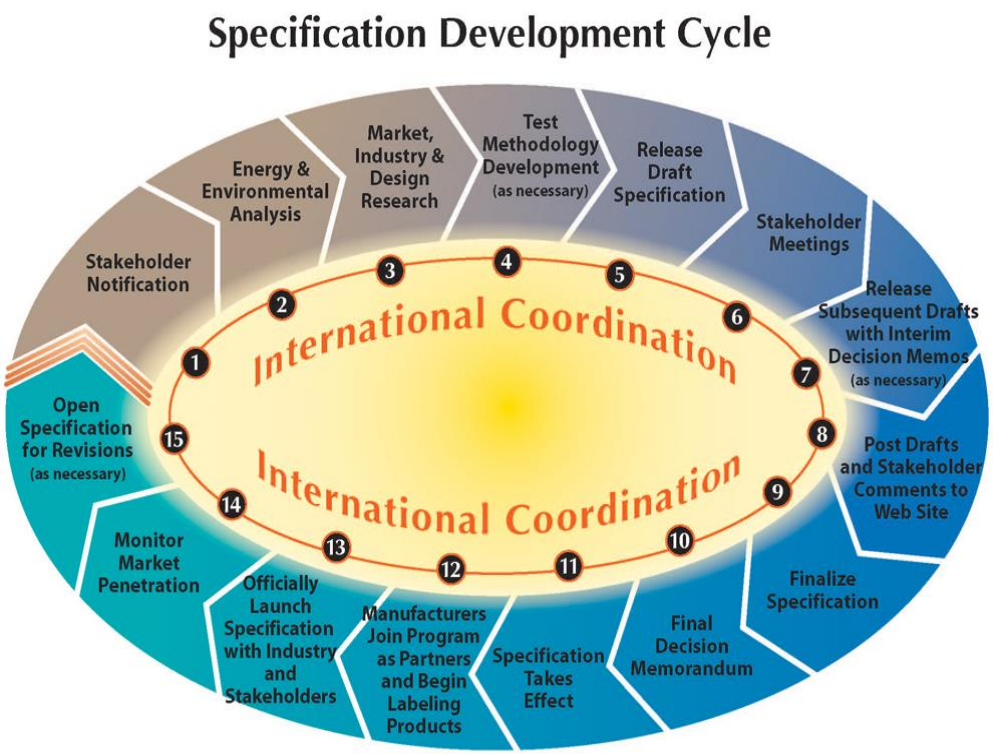
- Consume less energy
  - Reduced kWh – reduced CO2 emissions
- Equivalent or better quality
- Annual and life cycle cost savings
- Publicly demonstrate commitment to environment
- Third-party certification procedures bolster the integrity of the program and ensure energy-efficient performance



Maintaining Relevancy

Specifications are updated in response to market changes:

- High market share
- Change in Federal minimum efficiency standards
- Availability, performance, or quality concerns
- Advancements in technology
- Changes in test procedures

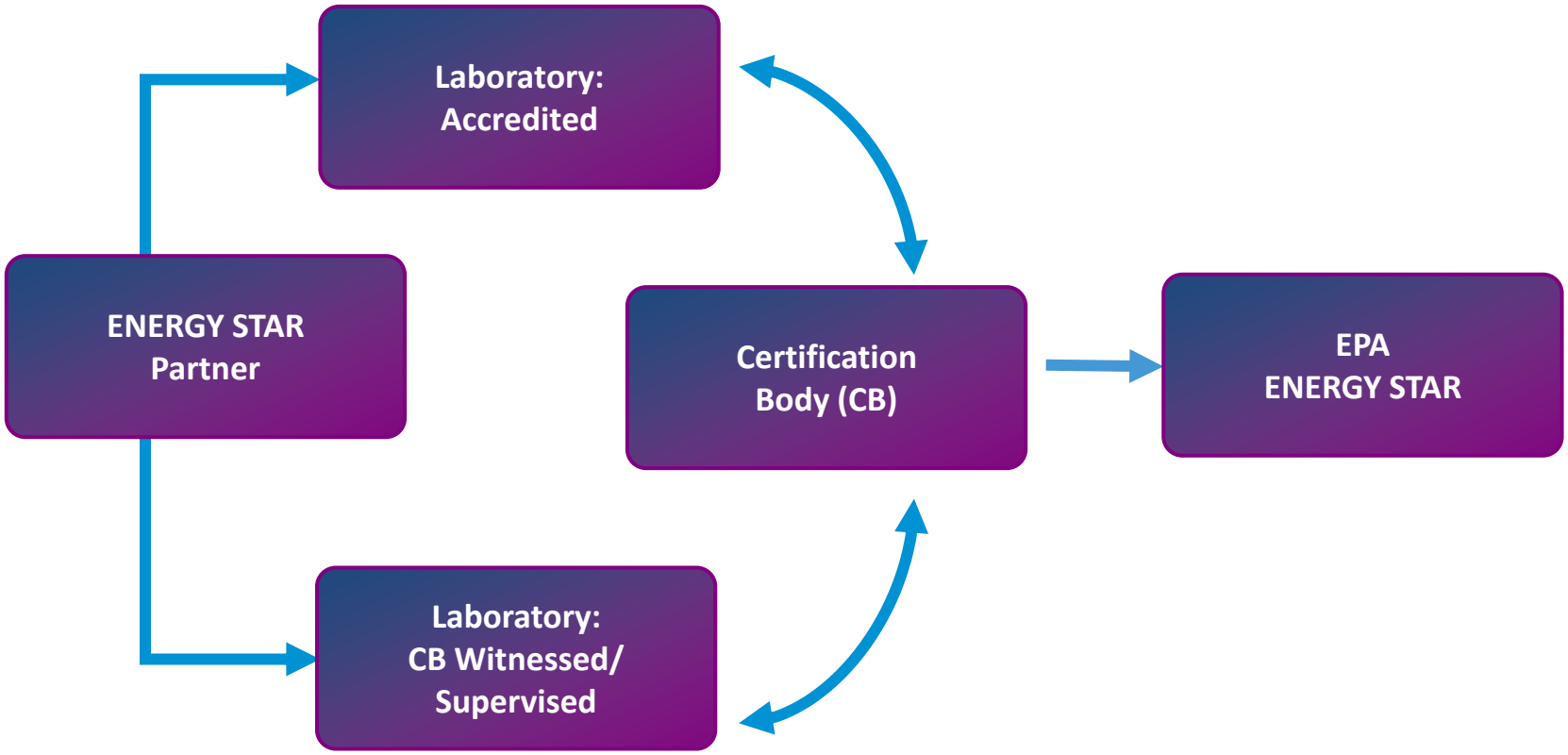


Assessing New Products for ENERGY STAR

EPA considers a set of well-tested program principles to:

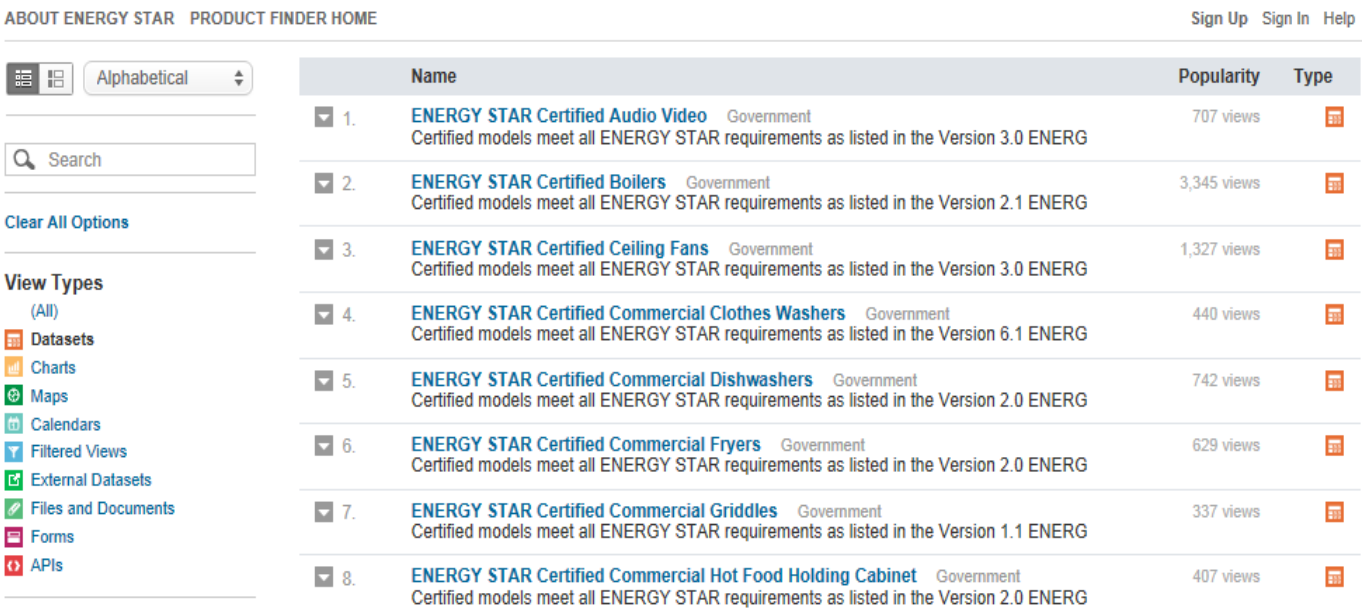
- Ensure that product categories proposed for inclusion in the ENERGY STAR portfolio will yield significant energy savings on a national basis.
- Pursue products where product energy consumption and performance can be measured and verified with testing.
- Propose eligibility criteria that maintain product performance such that performance is not traded for efficiency.
- Enable purchasers to recover their investments in greater efficiency within a reasonable period of time and such that more than one manufacturer can meet them.

Product Qualification to Data Submittal



Certified Product Lists

- Updated daily
- Custom filters and embed options for retailers, partners, media
- Export options including Excel, .csv, APIs
- One portal where stakeholders access certified products*
  data.energystar.gov *Excludes Windows and Non-AHRI CAC/ASHPs



ENERGY STAR Commercial Products

Specifications:

- Commercial Food Service products
- Data Centers

Outreach/Marketing:

- Low Carbon IT campaign

Testing and Verification:

- Appropriate for commercial products, varies from consumer-facing programmatic approach.

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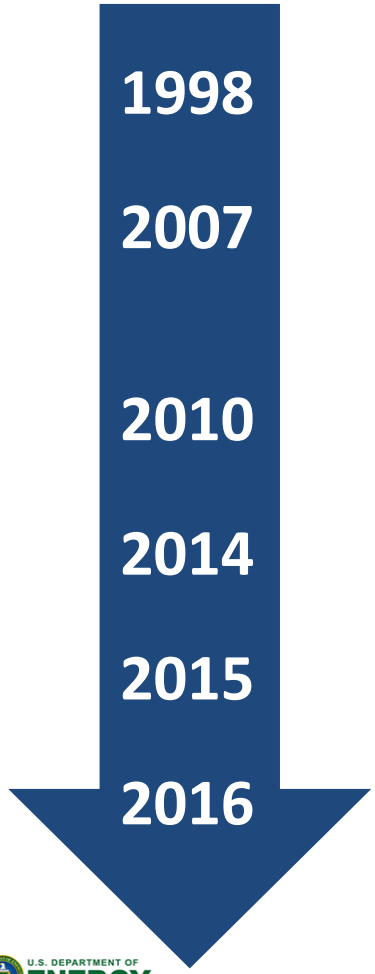
Distribution Transformers



ENERGY STAR Transformers program in effect

DOE Federal Standard for low voltage dry-type transformers in effect/ENERGY STAR program was sunset

DOE Federal Standard for medium voltage dry-type and liquid-immersed transformers in effect

ENERGY STAR scopes Distribution Transformers and launches framework for liquid immersed distribution transformers. Anticipates developing and finalizing Version 1.0 Specification in 2015.

DOE Revised Standard for low/medium voltage dry-type and liquid-immersed transformers in effect

1998-2007 ENERGY STAR Transformers Program

- Partners performed an economic analysis of total cost of ownership and bought transformers that met the ENERGY STAR key product criteria.

Key Product Criteria for ENERGY STAR Labeled Commercial and Industrial Transformers (Single Phase)

Single Phase-kVa	Efficiency Level (%)
15	97.7
25	98.0
37.5	98.2
50	98.3
75	98.5
100	98.6
167	98.7
250	98.8
333	98.9

Criteria for ENERGY STAR Labeled Commercial and Industrial Transformers (Three Phase)

Three Phase-kVa	Efficiency Level (%)
15	97.0
30	97.5
45	97.7
75	98.0
112.5	98.2
150	98.3
225	98.5
300	98.6
500	98.7
750	98.8
1000	98.9

DOE Federal Standards

- The U.S. Department of Energy (DOE) issued Federal Standards for low voltage dry-type transformers in 2007.
- DOE set standards for medium voltage dry-type and liquid-immersed transformers in 2010.
- DOE revised the standards for all three transformer types and these standards will go into effect in 2016.

ENERGY STAR Scoping Effort

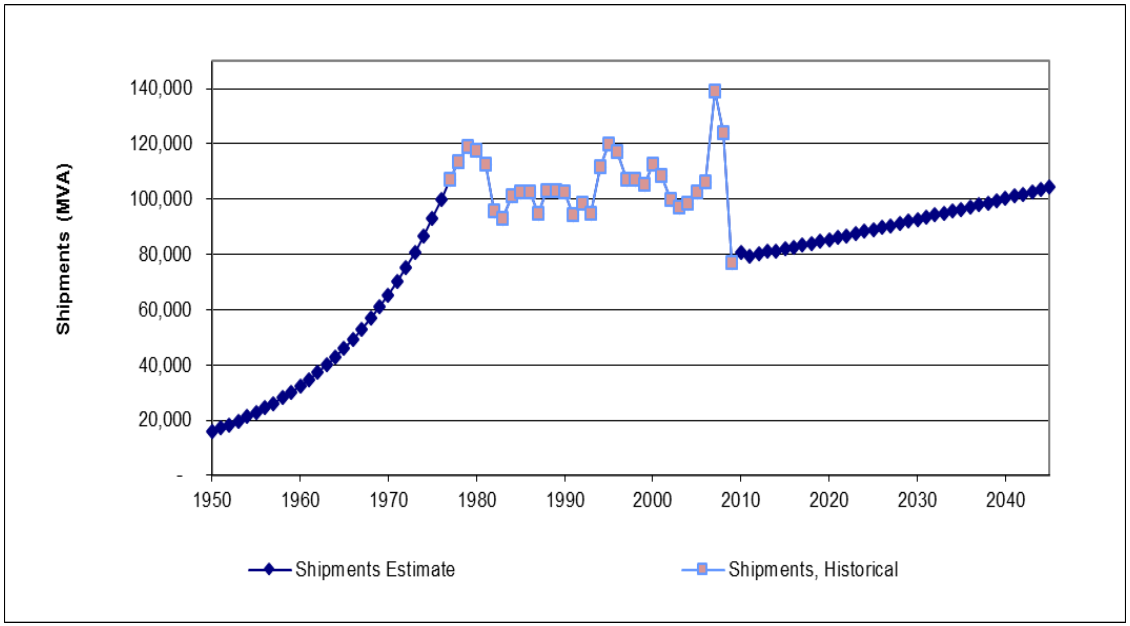
- In late 2013/early 2014, EPA conducted a Scoping Report for Distribution Transformers to determine the energy and monetary savings potential
  - Savings was determined to be significant

Opportunity for Additional Energy Savings

- Significant energy savings can be realized on a national basis beyond the 2016 DOE Standards, based on small increases in efficiency.
- For distribution transformers, core and winding efficiency can be improved or the geometric configuration of the transformer altered
  - The resulting national savings could grow to approximately 4 to 5 TWh per year if 50% of the stock is replaced
- DOE conducted extensive analysis and devised different trial standard levels (TSLs) for various equipment classes (ECs).
  - Energy savings is highly dependent on equipment class

Energy Savings and Sales Forecasts

- DOE-estimated 2009 shipments were based on insights including a general reduction in commercial and industrial market activity.
- The market was forecasted to grow at a steady pace after 2009.



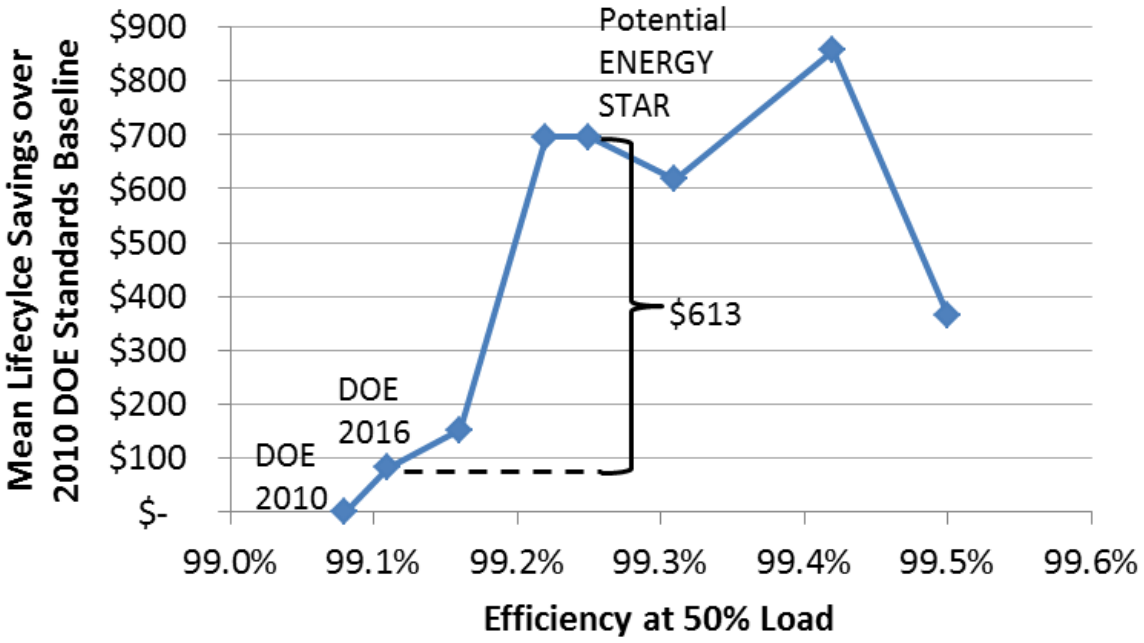
Source: U.S. Department Of Energy (DOE), Technical Support Document

Projected Sales: Largest opportunity lies in liquid-immersed, medium voltage distribution transformers

Distribution Transformer Equipment Type	Units Shipped	MVA Capacity Shipped
Liquid-immersed, medium-voltage, single-phase	683,726	21,994
Liquid-immersed, medium-voltage, three-phase	49,739	32,266
Dry-type, medium-voltage, single-phase, 20-45 kV BIL	709	23
Dry-type, medium-voltage, three-phase, 20-45 kV BIL	522	257
Dry-type, medium-voltage, single-phase, 46-95 kV BIL	546	23
Dry-type, medium-voltage, three-phase, 46-95 kV BIL	2,074	3,655
Dry-type, medium-voltage, single-phase, ≥ 96 kV BIL	202	9
Dry-type, medium-voltage, three-phase, ≥ 96 kV BIL	1,286	2,206
Total	**738,804**	**60,433**

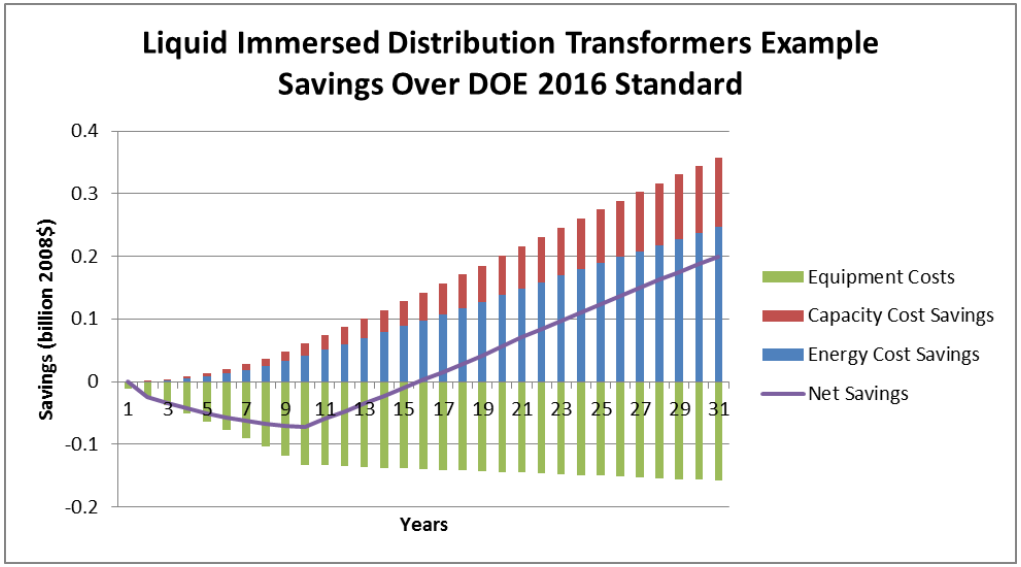
Source: U.S. Department Of Energy (DOE), Technical Support Document

Example *Unit* Cost Savings: 50 kVA Liquid-immersed Medium Voltage



Total National Energy Savings Example

Equip. Class	Typical Unit	National Energy Savings at 50% Stock Replacement (TWh/yr)
EC 1	50 kVA, 1 Phase	0.86
	25 kVA, 1 Phase	1.52
EC 2	1500 kVA, 3 Phase	1.64
	3x500 kVA, 1 Phase	0.086
	Grand Total	**4.1**



Further discussion of how EPA arrived at national and individual savings potential during discussion of potential criteria

ENERGY STAR Framework & Launch of Version 1.0 Specification Development

- On Dec 9, 2014, EPA launched a Framework Document to invite stakeholders to participate in the development of a Version 1.0 Distribution Transformers specification and outline what a specification would look like.

ENERGY STAR Distribution Transformers
Draft Specification Framework
December 9 2014

Please send comments to DistributionTransformers@energystar.gov no later than January 28, 2015

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Definitions

- EPA prefers to use industry accepted definitions and aligns with the definitions adopted by DOE in the Code of Federal Regulations, 10 CFR 431.192.

Should EPA consider any additional definitions?

Proposed Scope

- EPA proposes to include liquid-immersed, medium voltage distribution transformers, that operate between 1 and 36 kV input voltage
- Most sales shipments are for liquid-immersed, medium voltage distribution transformers.

Distribution Transformer Equipment Type	Units Shipped	MVA Capacity Shipped
Liquid-immersed, medium-voltage, single-phase	683,726	21,994
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Total	**738,804**	**60,433**

Source: U.S. Department Of Energy (DOE), Technical Support Document

Proposed Scope

- Liquid-immersed transformers:
  - Represent a larger portion of the distribution market
  - Efficiency can be increased beyond the 2016 federal standards

Should EPA consider including other sizes and types of distribution transformers, based on their energy savings potential?

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Equipment Classes, Design Lines, Trial Standard Levels and Efficiency Levels

- DOE developed a categorization of distribution transformers based on basic properties and these are called ***Equipment Classes*** (ECs).
- DOE then further focused on one or two ***Design Lines*** (DLs) at a typical power and voltage as the range in each EC was too large to analyze.
  - 5 DLs exist for liquid immersed transformers to better reflect manufacturer selling prices (further categorized from 2 ECs)
- DOE then selected ***Efficiency Levels*** (ELs) for each DL
- Finally, DOE grouped the LCC analysis results into ***Trial Standard Levels*** (TSLs)

Source: U.S. Department Of Energy (DOE), Technical Support Document

Proposed Criteria

- TSL 4 (in green below) represents the maximum net present value at a 7% discount rate based on DOE's life-cycle cost assessment
  - TSL 4 would achieve cumulative national savings of 4.1 TWh over the 2016 DOE Standard (in yellow)
  - Unit savings from TSL 4 would be dependent on equipment class but on average, 3MWh per year

Design Line	Baseline	TSL						
		1	2	3	4	5	6	7
	Percent							
1	99.08	99.11	99.16	99.16	99.22	99.25	99.31	99.50
2	98.91	98.95	99.00	99.00	99.07	99.11	99.18	99.41
3	99.42	99.49	99.48	99.51	99.57	99.54	99.61	99.73
4	99.08	99.16	99.16	99.16	99.22	99.25	99.31	99.60
5	99.42	99.48	99.48	99.51	99.57	99.54	99.61	99.69

Source: U.S. Department Of Energy (DOE), "Energy Conservation Program: Energy Conservation Standards for Distribution Transformers Final Rule," 78 FR 23397

Example Annual *Unit* Energy and Capacity Cost Savings at TSL 4

Equip. Class	Typical Unit	Cost Increase (2008$)	Unit Energy Savings (kWh/yr)	First-year Energy Cost Savings (2008$)	First-year Capacity Cost Savings (2008$)	Payback Based on First-year Energy and Capacity Cost Savings (yr)
EC 1	50 kVA, 1 Phase	$435	470	$32	$12	9.8
	25 kVA, 1 Phase	$234	220	$15	$7	10.8
EC 2	1500 kVA, 3 Phase	$4,311	4,936	$367	$167	8.1
	3x500 kVA, 1 Phase	$3,410	4,908	$348	$134	7.1
	Weighted Average	**$2,636**	**3,037**	**225**	**101**	**8.1**

$$Total\ Cost\ Payback = \frac{Cost\ Increase\ of\ Installed\ Equipment}{Energy\ Savings + Capacity\ Savings}$$

Product Payback Potential

- As electric utilities are the main purchasers of medium voltage transformers, payback calculation includes:
  - Energy cost, and
  - Avoided cost of extra capacity during peak periods

- Payback estimated at approximately 9-10 years for liquid-immersed distribution transformers, in average product lifespan of 32 years.
  - Comparable to payback for other products: 1/3 of useful life

** Understood barriers for utility purchasers:

- Cost savings depends on utility structure and state regulatory environment.
- Budgetary structures often not aligned with TCO approach.

Total National Energy Savings at TSL 4

Equip. Class	Typical Unit	National Energy Savings at 50% Stock Replacement (TWh/yr)
EC 1	50 kVA, 1 Phase	0.86
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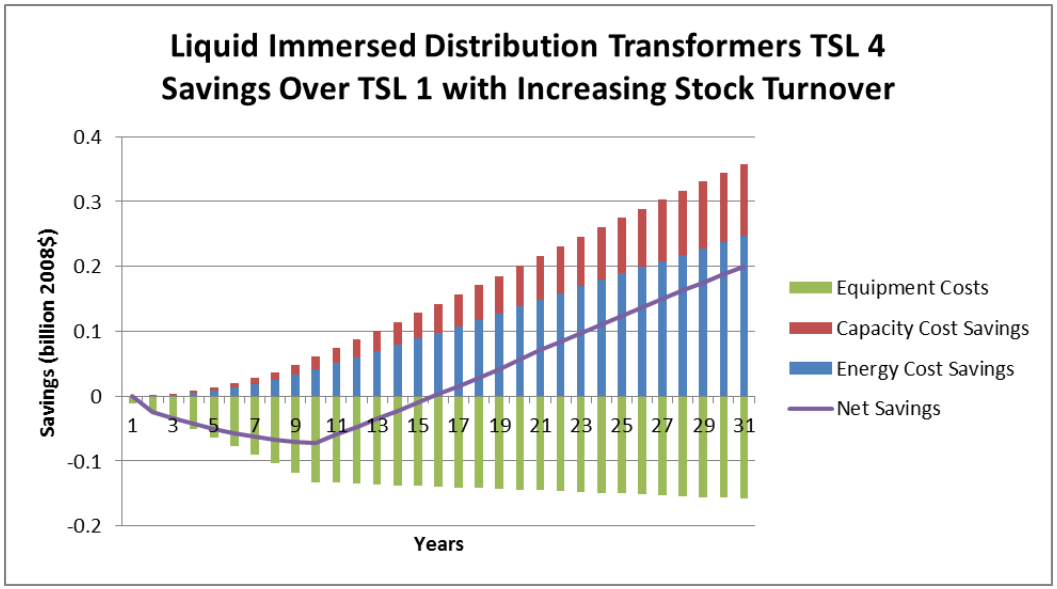
	Grand Total	**4.1**



Proposed Criteria Feedback Request

- General feedback on the proposed TSL 4 efficiency level.
- Should EPA consider including other product characteristics that provide energy savings opportunities for inclusion in the specification, such as:
  - 'Smart' functionality or ability to communicate and respond to fluctuations in supply and demand

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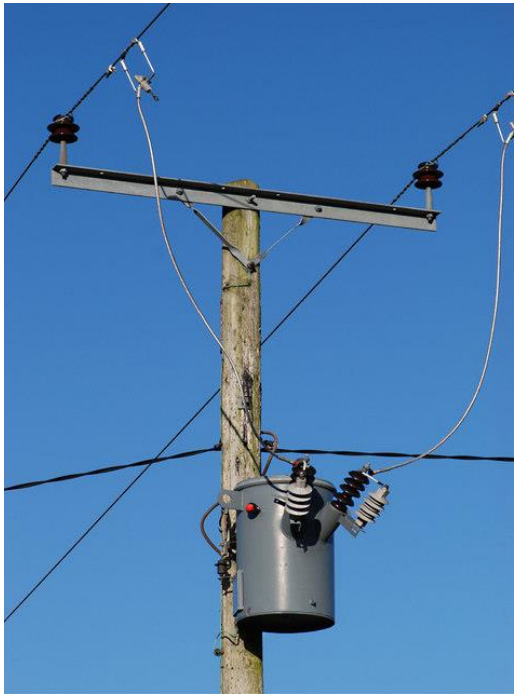
Test Method

- EPA will use the DOE test procedure outlined in 10 CFR 431.193

- In addition to the load percentages outlined in the DOE test procedure, should distribution transformers also be tested at other load percentages to optimize energy efficiency for specific applications? (Efficiency at other loading points would be determined via the DOE test procedure)



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Open Discussion

- DOE and EPA would now like to open up the line for any general comments from stakeholders.

Written Comments

- In addition to making verbal comments during today's call, stakeholders are encouraged to submit written comments to

distributiontransformers@energystar.gov

Comment Deadline
Wednesday, January 28, 2015

Specification Development Timeline

- EPA is proposing the following specification development timeline:

Event	Date
Launch Webinar	January 14, 2014
Deadline for Written Comments on Framework Document	January 28, 2015
Draft 1 Specification Issued	February/March 2015
Draft 1 Stakeholder In-Person Meeting	March/April 2015
Additional Draft Specifications Issued and Associated Stakeholder Webinars	Spring/Summer 2015
Final Specification Issued	Fall 2015
Specification Effective	Fall 2015

Contact Information

Please send any additional comments to distributiontransformers@energystar.gov or contact:

For questions regarding the specification, you may contact Verena Radulovic at Radulovic.Verena@epa.gov or (202) 343-9845.

Thank you for participating!