

Latest Standard for Transformer Efficiency in Japan

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**Agency of Natural Resources and Energy
Ministry of Economy, Trade and Industry, JAPAN**

A silhouette of a traditional Japanese pagoda is visible on the right side of the slide, partially overlapping the text. The pagoda has multiple tiers and a spire at the top.

Background for improvement the Transformer Efficiency

In Japan, to save the energy consumption (CO2 exhaust) , several equipment had been set the criteria for loss consumption.

Several equipment are refrigerators, air conditioner, Television, Automobile and so on.

Now, we have set the new criteria for the distribution transformers efficiency.

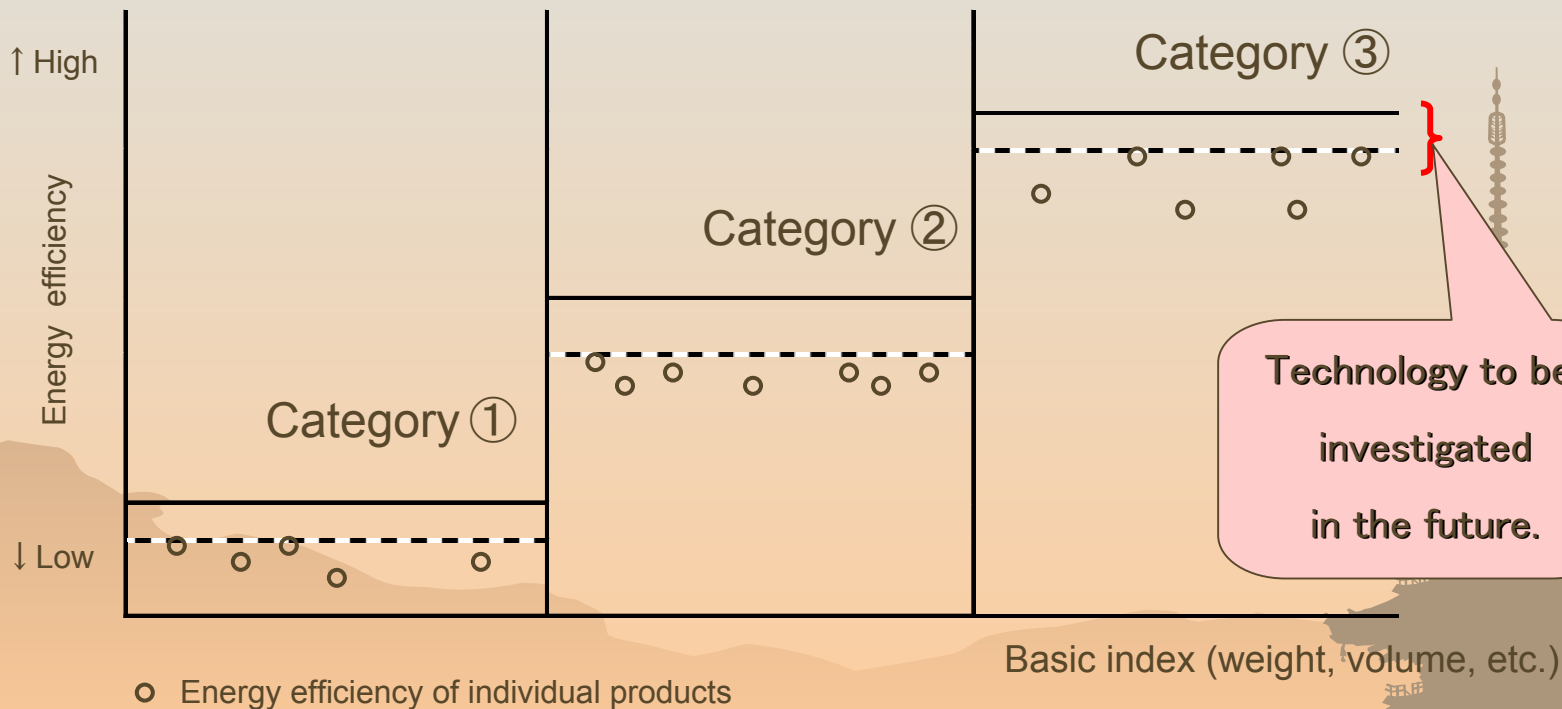


The Concept of the Top Runner Standard

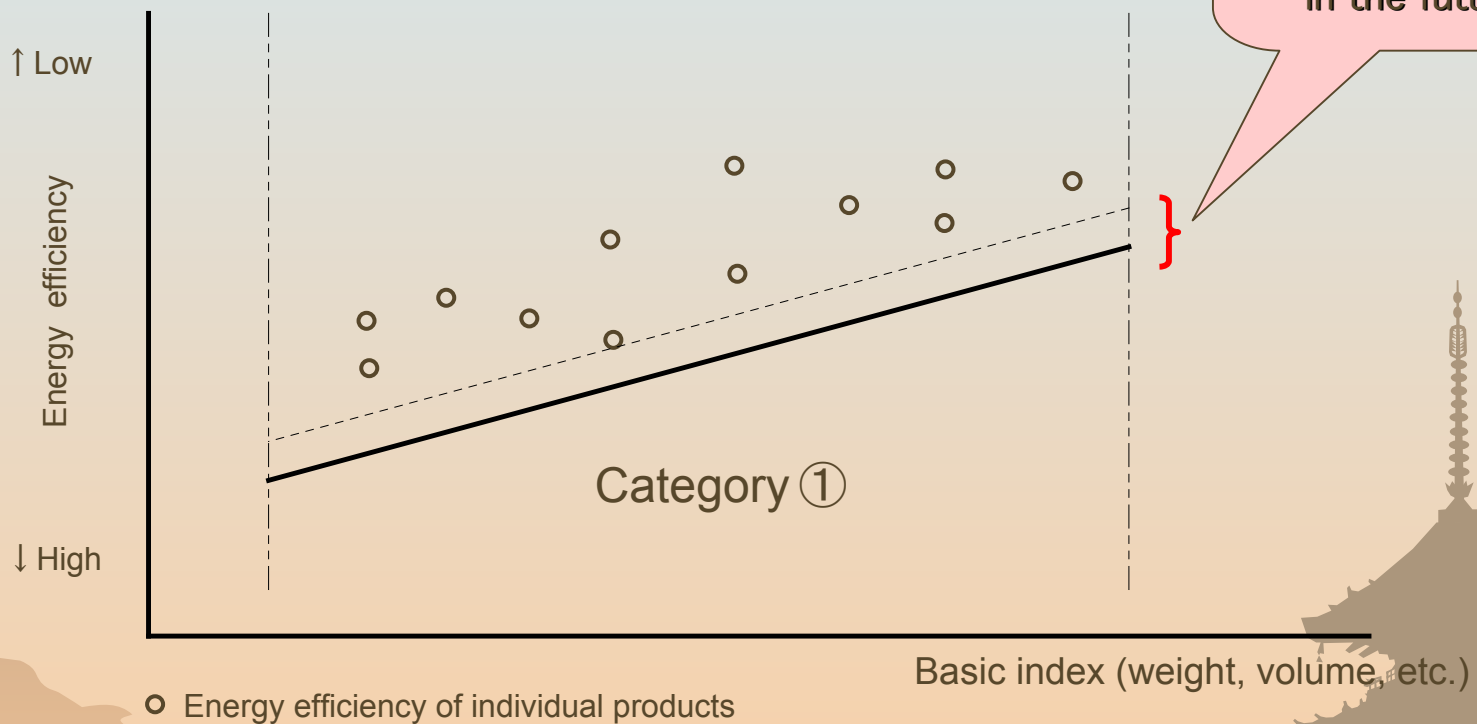
○ Top Runner Standard:

The energy efficiency standard for equipment are set higher level than the performance of the best-efficiency equipment among currently commercialized products for each category.

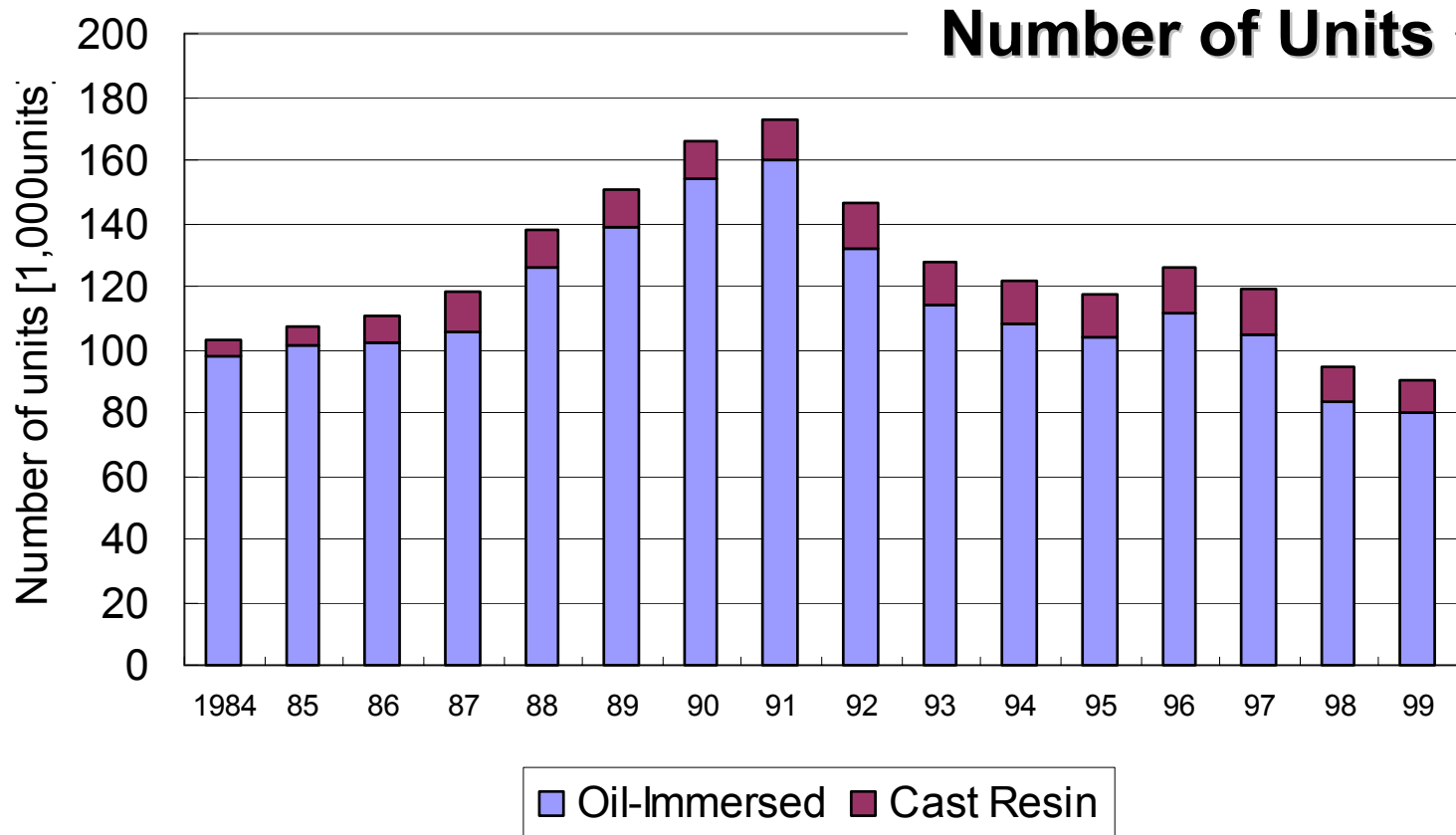
Case 1



Case 2

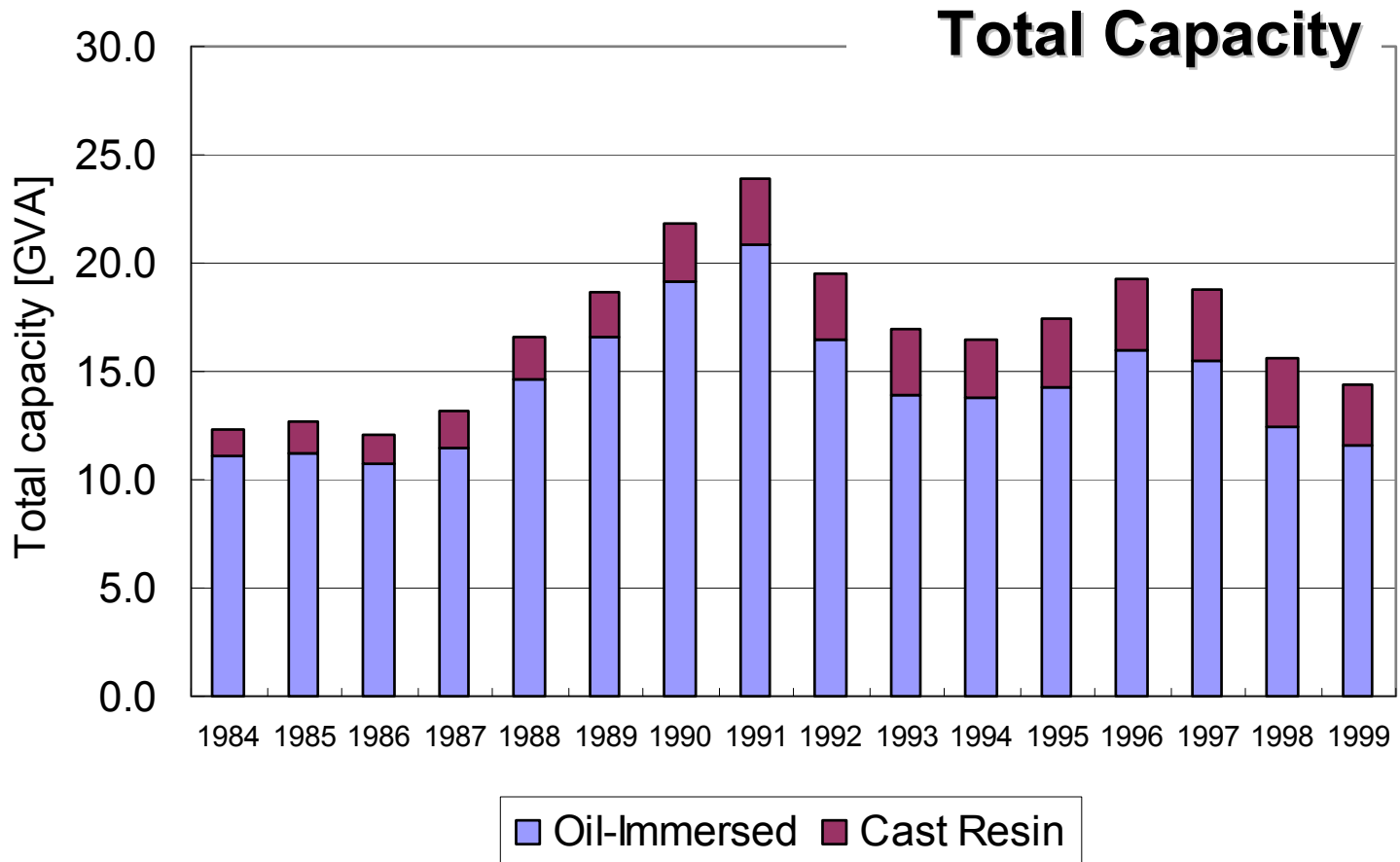


Distribution Transformers Market



Under operating : 1.6 million units in Japan

Distribution Transformers Market



Transformer total capacity under operating : 343 GVA

average capacity : 157 kVA/unit

Transformer Efficiency Standard in Japan

Scope

Applicable for oil immersed and cast resin distribution transformers

excluding :

The transformers for generation and transmission. The transformers that have extremely low demand or are used for special applications. For example, pole mounted transformers, gas insulating transformers, transformers with capacity over 2000kVA, etc.

Target year

The newly manufactured Transformer shall be changed to comply the new criteria before the year listed above.

- *Oil-Immersed Transformers: FY 2006*
- *Cast Resin Transformers: FY 2007*



Method of Measuring Energy Efficiency

The energy efficiency of the transformer is represented by total loss (W), which is calculated from the following formula using no-load loss (W) and load loss (W) .

$$\text{Total loss (W)} = \text{No-load loss (W)} + (m/100)^2 \times \text{Load loss (W)}$$

m: load factor

Transformers with capacity of 500kVA or less: 40 (%)

Transformers with capacity over 500kVA: 50 (%)

Special technologies to reduce the loss

Current technology

- *Amorphous metal and so on.*

Future technology development

- *Refining the control of magnetic domain in Grain Oriented Silicone Steel*

- reflected in the target standard values



Classification for Efficiency

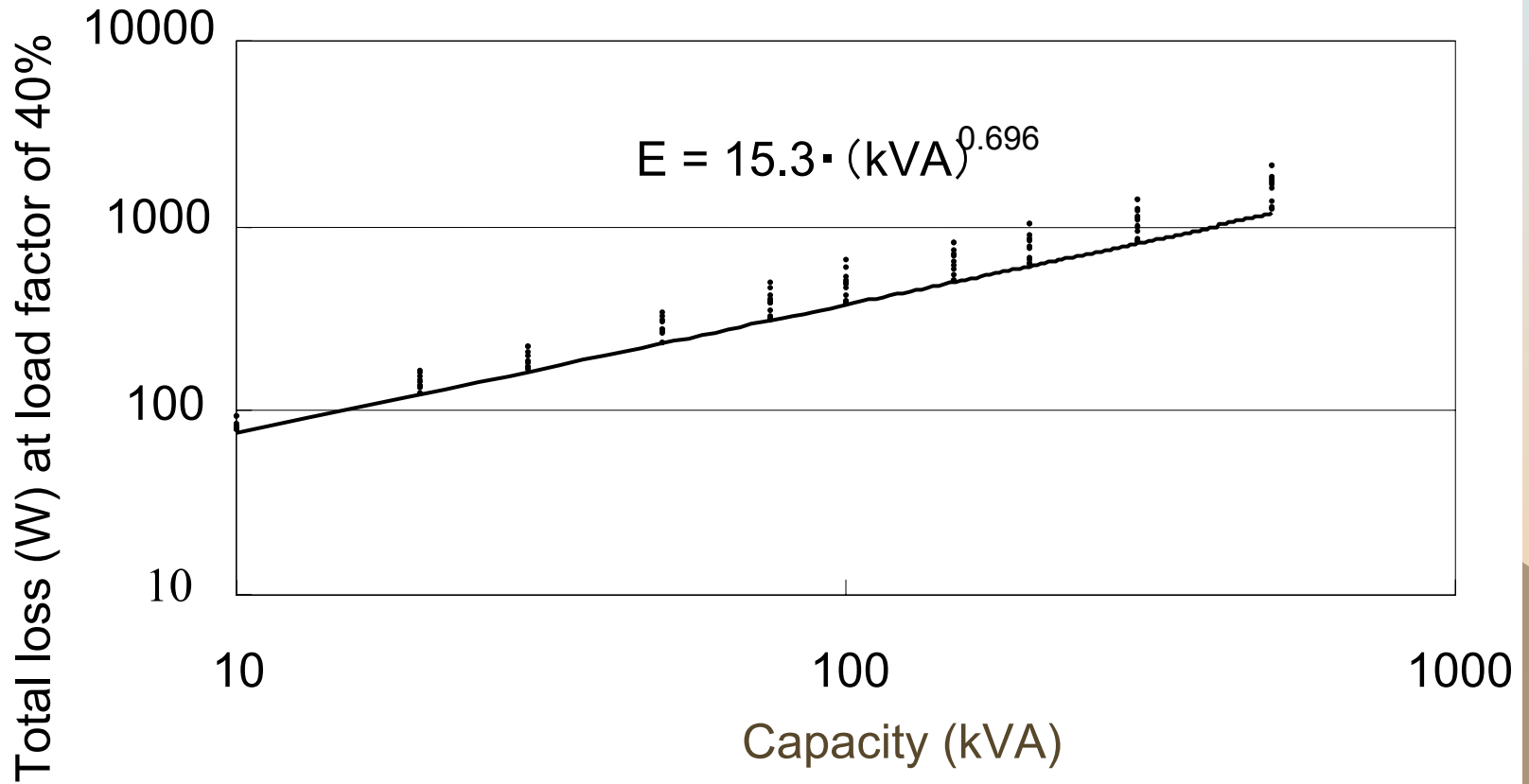
<u>Category</u>	<u>Contents</u>
<i>a. Type</i>	<i>: Oil-Immersed, Cast Resin</i>
<i>b. No. of phases</i>	<i>: Single, Three</i>
<i>c. Capacity</i>	<i>: 500kVA or less , over 500kVA</i>
<i>d. Frequency</i>	<i>: 50Hz, 60Hz</i>

Efficiency of transformer are specified in accordance with each category (a,b,c and d) and contents in each category.

Formulas for Target Standards

Product category	No. of phases	Rated frequency Rated capacity	Formula for target standards (Note)	Class
Oil-Immersed	Single phase	50 Hz - 500 kVA or less	$E=15.3 \cdot (\text{kVA})^{0.696}$	I
		60 Hz - 500 kVA or less	$E=14.4 \cdot (\text{kVA})^{0.698}$	II
	Three phase	50 Hz - 500 kVA or less	$E=23.8 \cdot (\text{kVA})^{0.653}$	III-1
		50 Hz - over 500 kVA	$E=9.84 \cdot (\text{kVA})^{0.842}$	III-2
		60 Hz - 500 kVA or less	$E=22.6 \cdot (\text{kVA})^{0.651}$	IV-1
		60 Hz - over 500 kVA	$E=18.6 \cdot (\text{kVA})^{0.745}$	IV-2
Cast Resin	Single phase	50 Hz - 500 kVA or less	$E=22.9 \cdot (\text{kVA})^{0.647}$	V
		60 Hz - 500 kVA or less	$E=23.4 \cdot (\text{kVA})^{0.643}$	VI
	Three phase	50 Hz - 500 kVA or less	$E=33.6 \cdot (\text{kVA})^{0.626}$	VII-1
		50 Hz - over 500 kVA	$E=24.0 \cdot (\text{kVA})^{0.727}$	VII-2
		60 Hz - 500 kVA or less	$E=32.0 \cdot (\text{kVA})^{0.641}$	VIII-1
		60 Hz - over 500 kVA	$E=26.1 \cdot (\text{kVA})^{0.716}$	VIII-2

- Class I (Oil-immersed, single-phase, 50Hz, 500kVA or less)



Judgement criteria for manufacturers / importers

Regarding the transformers shipped to the Japanese market after the target years, a weighted average of energy efficiency by each manufacturers / importers must not exceed the target standard value in each category.



Improvements of energy efficiency

- Distribution transformers

30.3%

*Total loss value per unit in FY 1999 (average) : 818W

Total loss value per unit in the target year (average) : 570W



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