

# CAREC High Technology Roadmap

-EE&C, BAT & BP

13-14 March 2018 Ashgabat, Turkmenistan

ADB and ECCJ



27th CAREC ESCC MEETING

13-14 March 2018, Yyldyz Hotel Ashgabat, Turkmenistan

# What we discuss today?

## 1. Why EE&C?

- (1) Main portion of CO2 reduction is EE&C
- (2) Areas to be targeted in terms of EE&C
- (3) Best Practices-Japan's past 40 year experience

## 2. 6 viewpoints to see the EE&C related issues

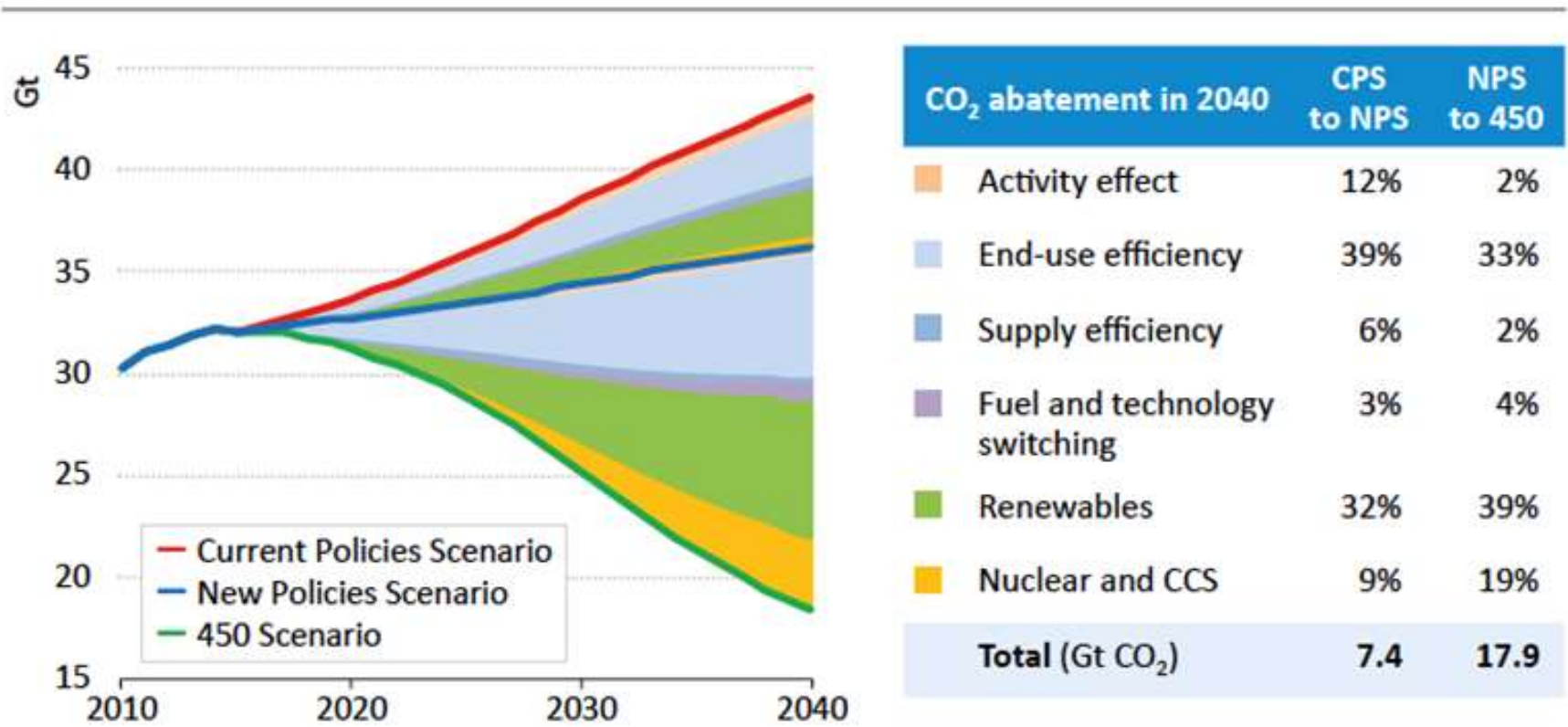
- (1) Reduction of energy requirements
- (2) High-efficiency equipment
- (3) Energy management by using measurement and control systems
- (4) Coordinated use of electricity and heat and the use of energy in stages
- (5) Recovery of wasted energy
- (6) Unutilized energy and stored energy

## 3. Best Available Technologies

## 4. Best Practices including BATS

# CO2 reduction depends mainly on EE&C

**Figure 7.8** ▶ World energy-related CO<sub>2</sub> emissions abatement by scenario

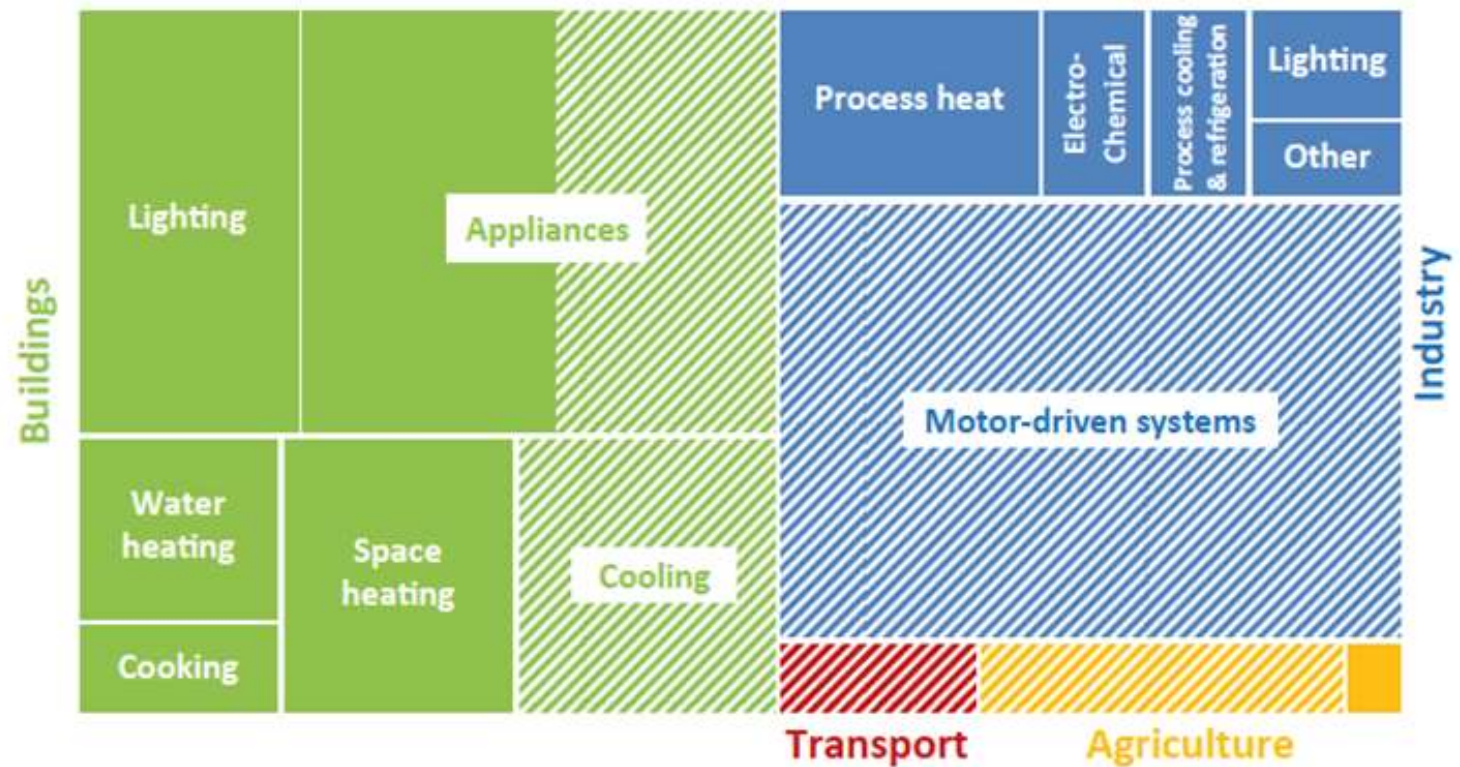


*Energy efficiency is a key abatement measure in the New Policies and the 450 Scenario*

Notes: CPS = Current Policies Scenario; NPS = New Policies Scenario; CCS = carbon capture and storage.

# Areas to be targeted in terms of EE&C

**Figure 7.9** ▶ Global total final electricity consumption by end-uses, 2014



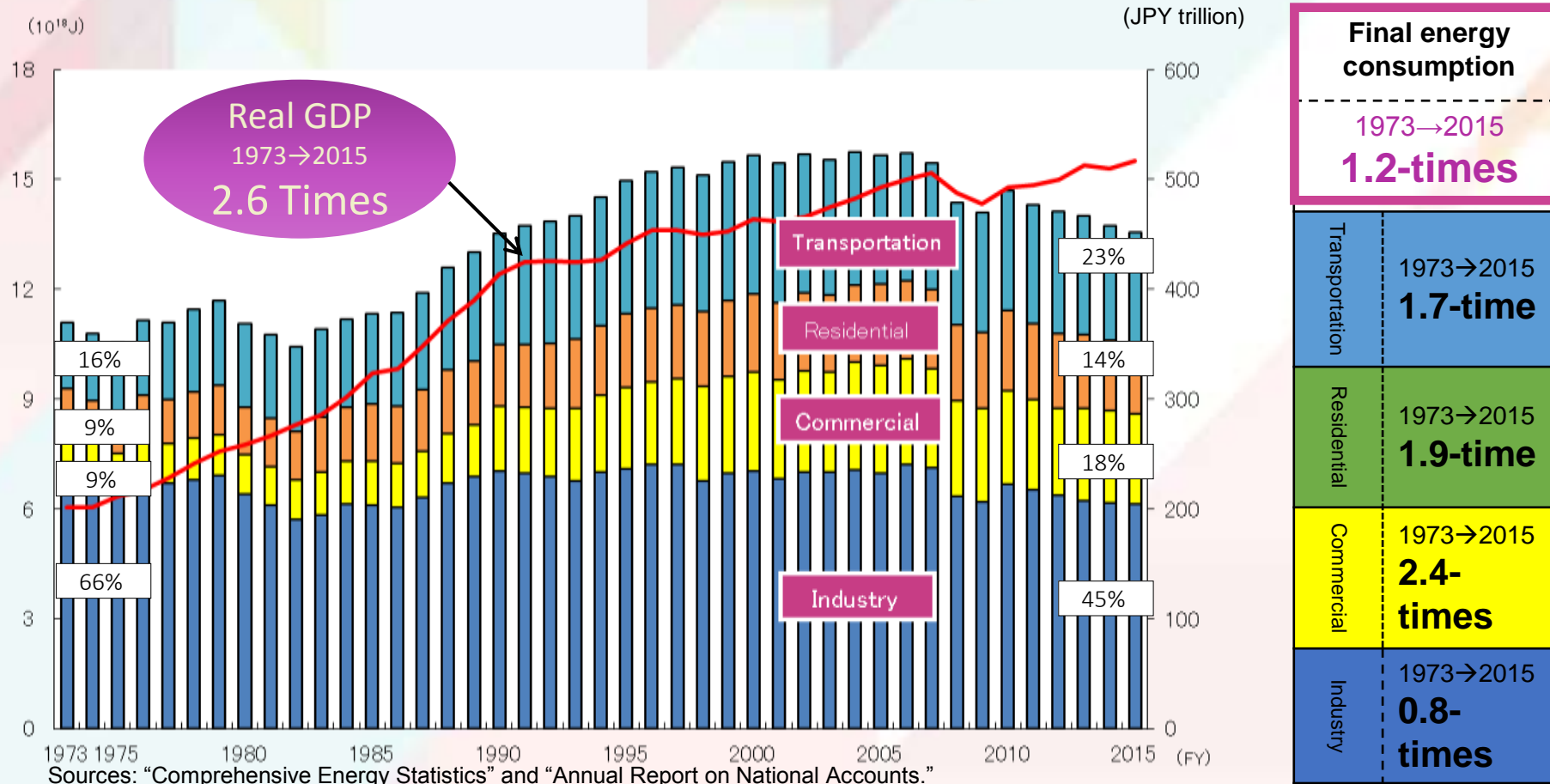
▨ Share of motors: 53%

*Motors account for more than half of today's electricity consumption*

Source: IEA analysis.

# Trends in Final Energy Consumption in Japan

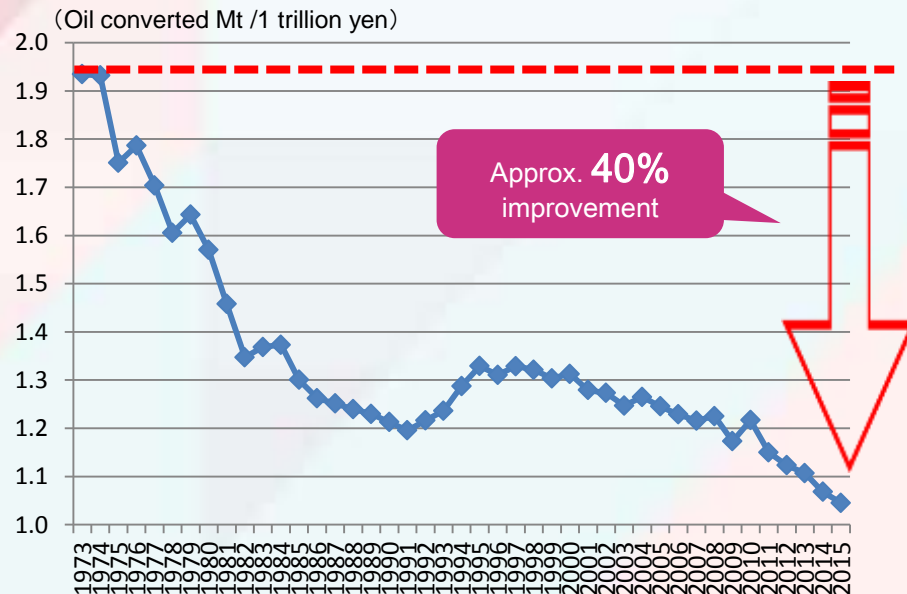
After oil shock, real GDP became 2.6 times, while final energy consumption 1.2 times



# Japan's Energy Efficiency Efforts after the Oil Crises

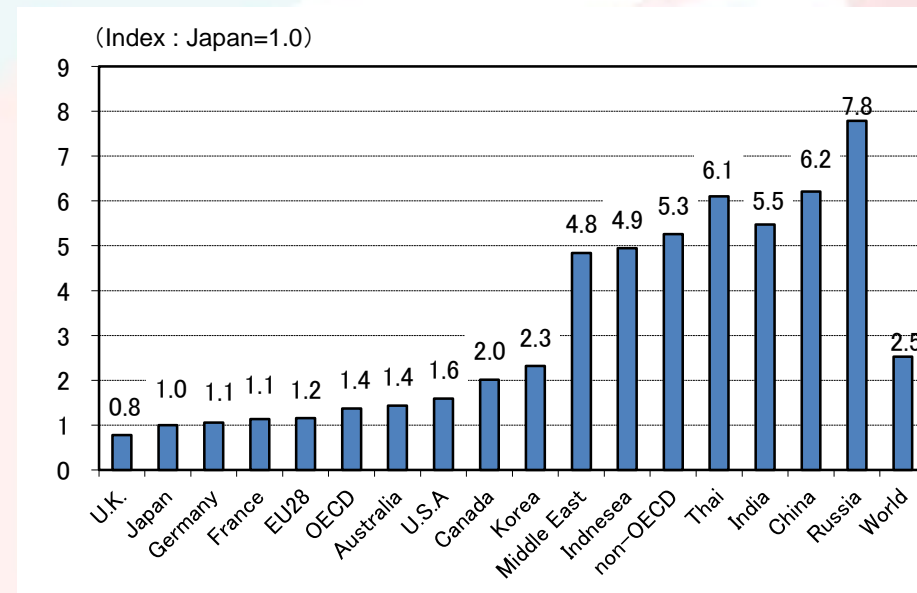
- Japan has improved energy efficiency by approx. **40% after the oil crises in the 1970s** as a result of positive actions by both public and private industrial sectors.
- Japan intensively introduced **"Energy Management System based on the Act on the Rational Use of Energy"**, then achieved the lowest level of energy consumption per GDP in the world.

Primary energy use per real GDP of Japan



Source ) Total Energy Statistics by ANRE/METI

Primary energy supply per GDP unit of each country (2013)

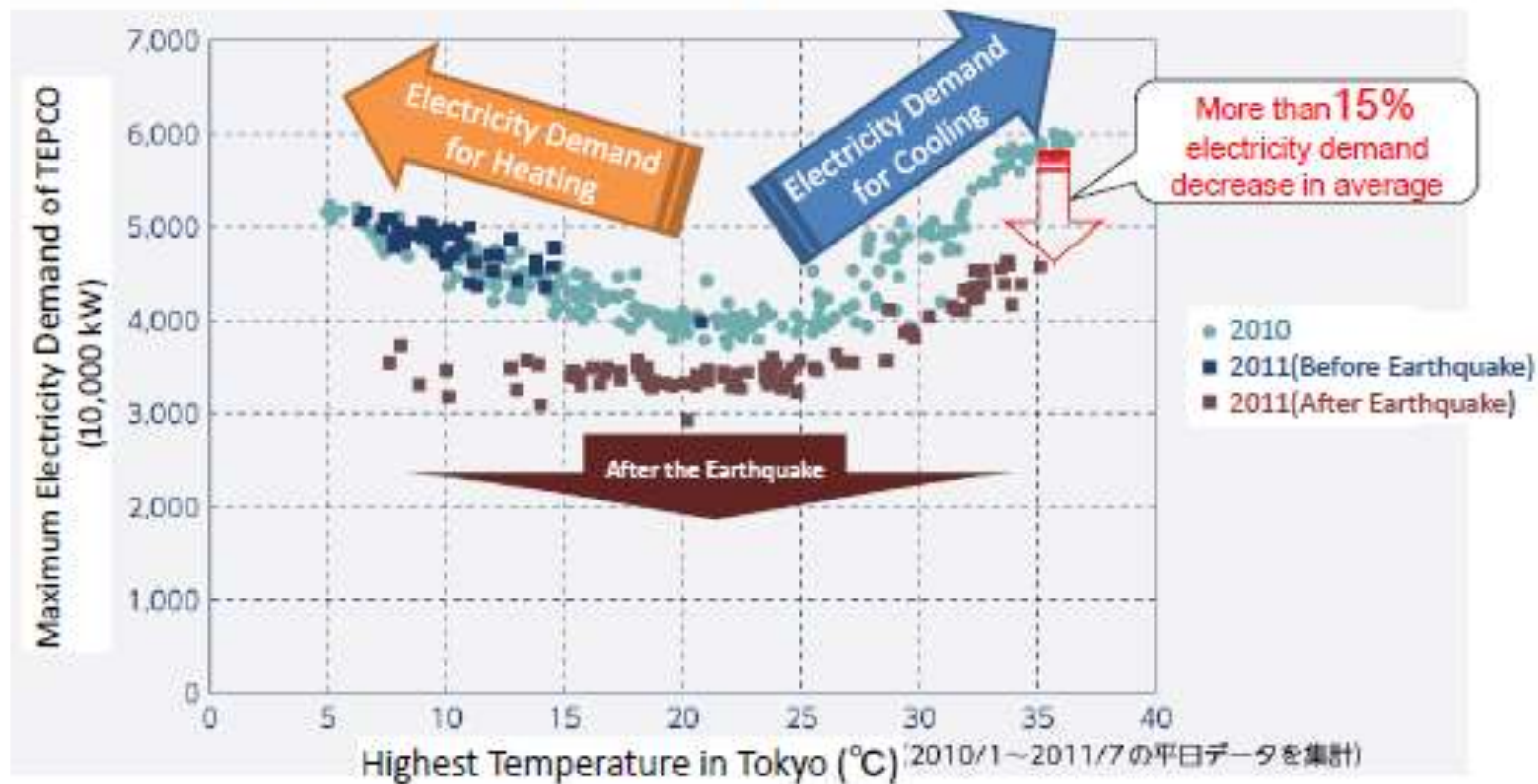


Calculated according to IEA statistics

# Energy Saving after the Great East Japan Earthquake

## Energy Saving after the Great East Japan Earthquake

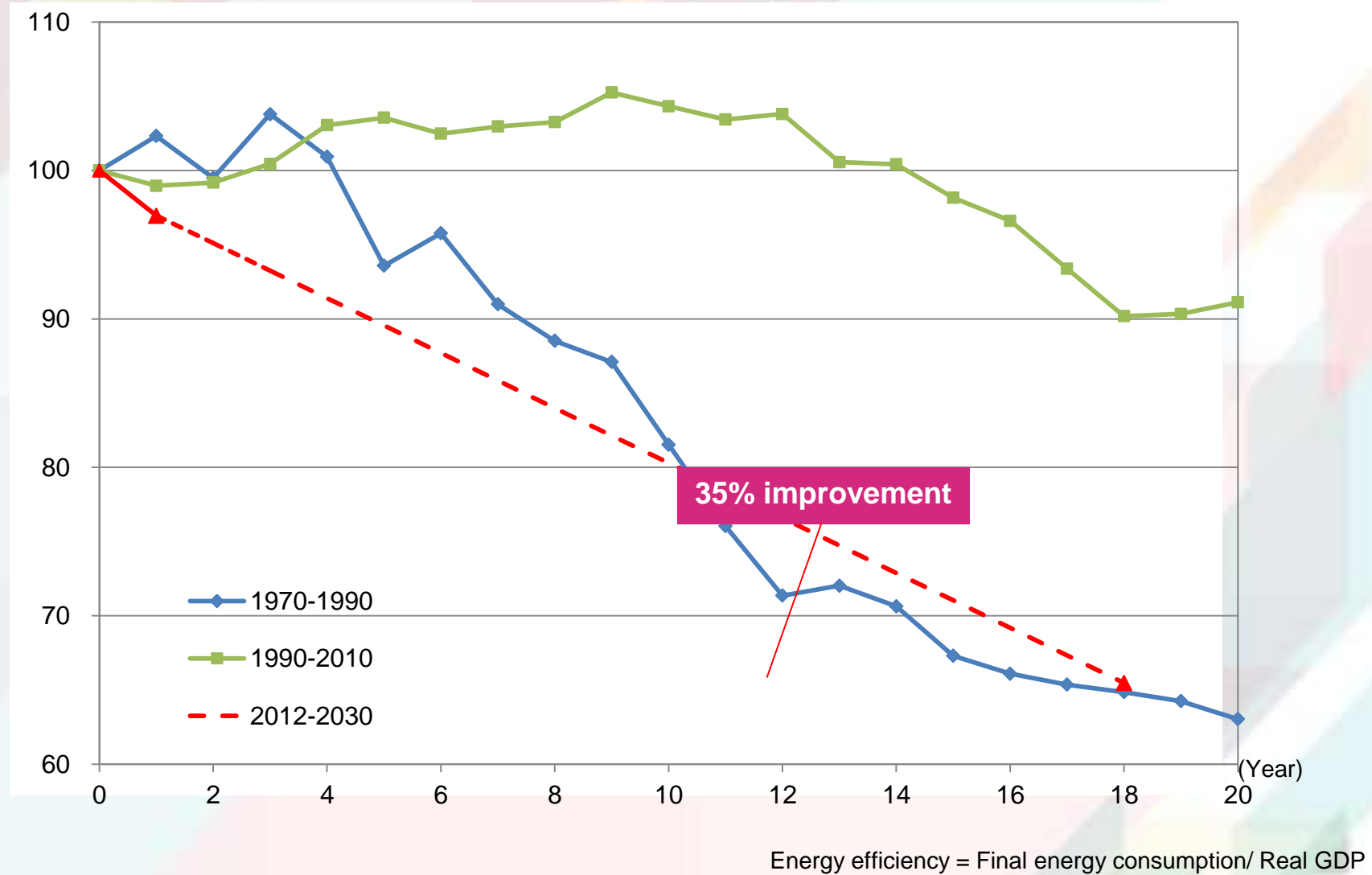
- Achieved **more than 15 % of Electricity Demand decrease** in 2011 after the great east Japan Earthquake on March 11, 2011.



Source : CRIEPI

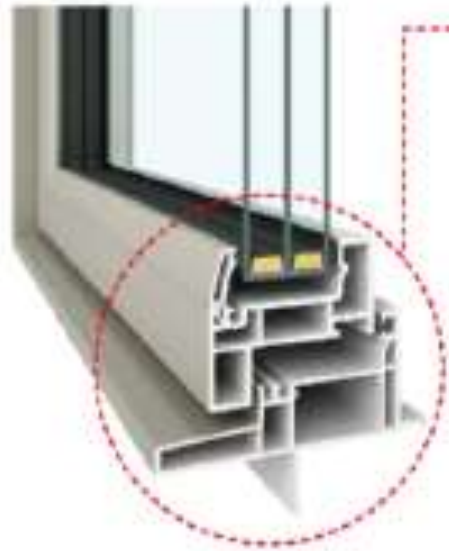
# Japan's EE&C target in 2030

## Improvement of energy efficiency 1970-2010 vs 2012-2030





## High-performance triple-glazed vinyl windows APW430



### [Multi-chamber Structure]

High-performance triple-glazed vinyl window

### APW 430



Lower frame: 4 chambers, Sliding window: 3 chambers

### Standard vinyl window



Lower frame: 3 chambers, Sliding window: 2 chambers

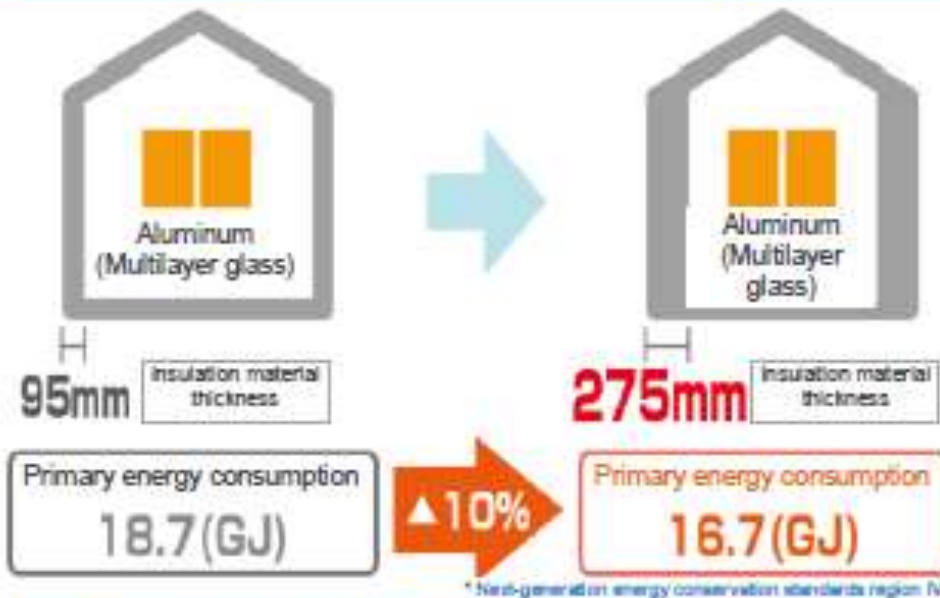
[Frame heat-transfer coefficient]  $1.33 \text{ W/m}^2\text{K}$

13% reduction

$1.52 \text{ (W/m}^2\text{k)}$

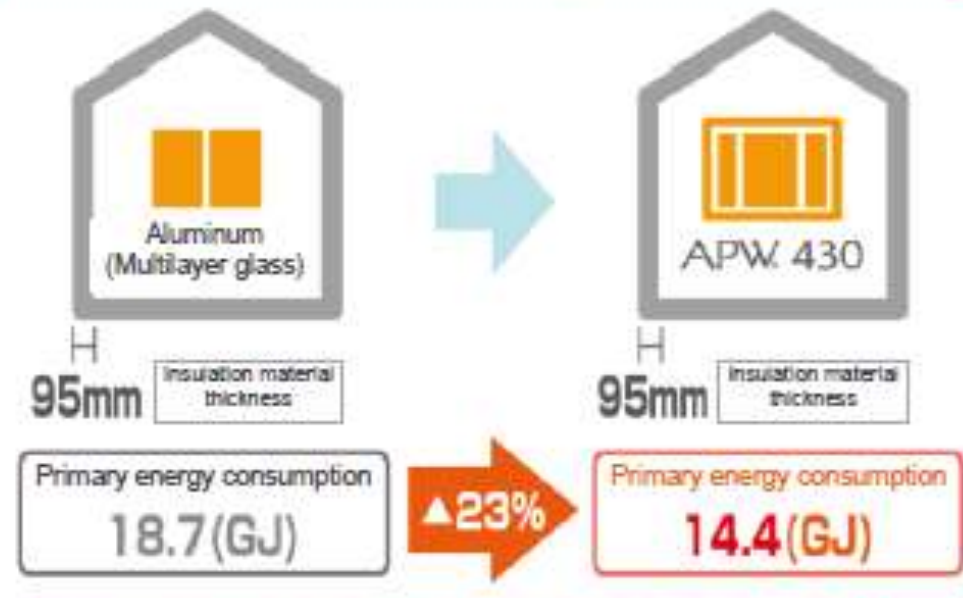
## High-performance triple-glazed vinyl windows APW430-(2)

Case where the cooling and heating energy has been reduced by 10% due to changing the walls (thermal insulation material)



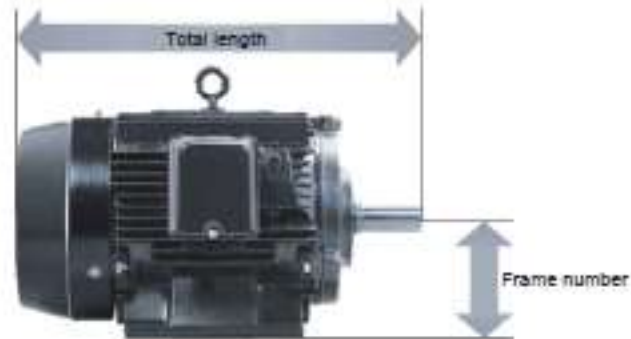
- The increase in cost will be 1,000,000 yen or more due to the materials cost and construction costs corresponding to the additional insulating material thickness of 180mm.
- Temperatures in the rooms will not be uniform

Case where the cooling and heating energy has been reduced due to changing the windows (to APW430)

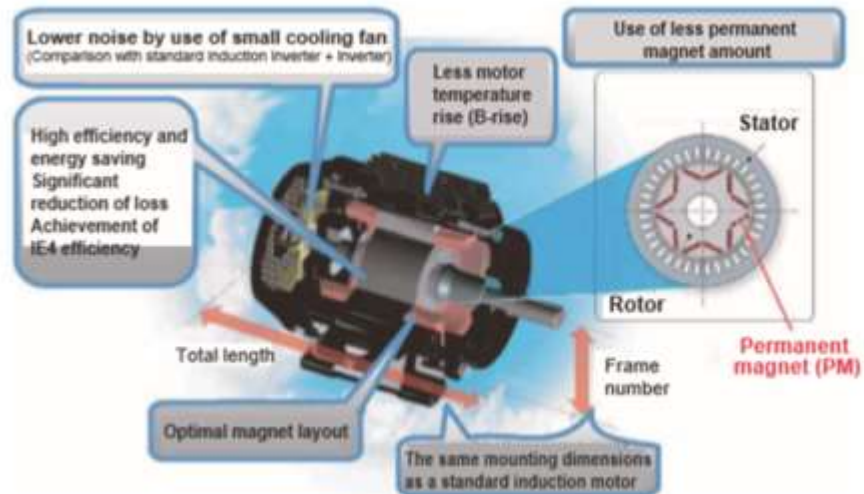


- Simply by changing the windows, there will be a 23% reduction in the cooling and heating energy
- The increase in cost will be around 500,000 yen.
- Temperatures in the rooms will be uniform

## High Efficiency Motor

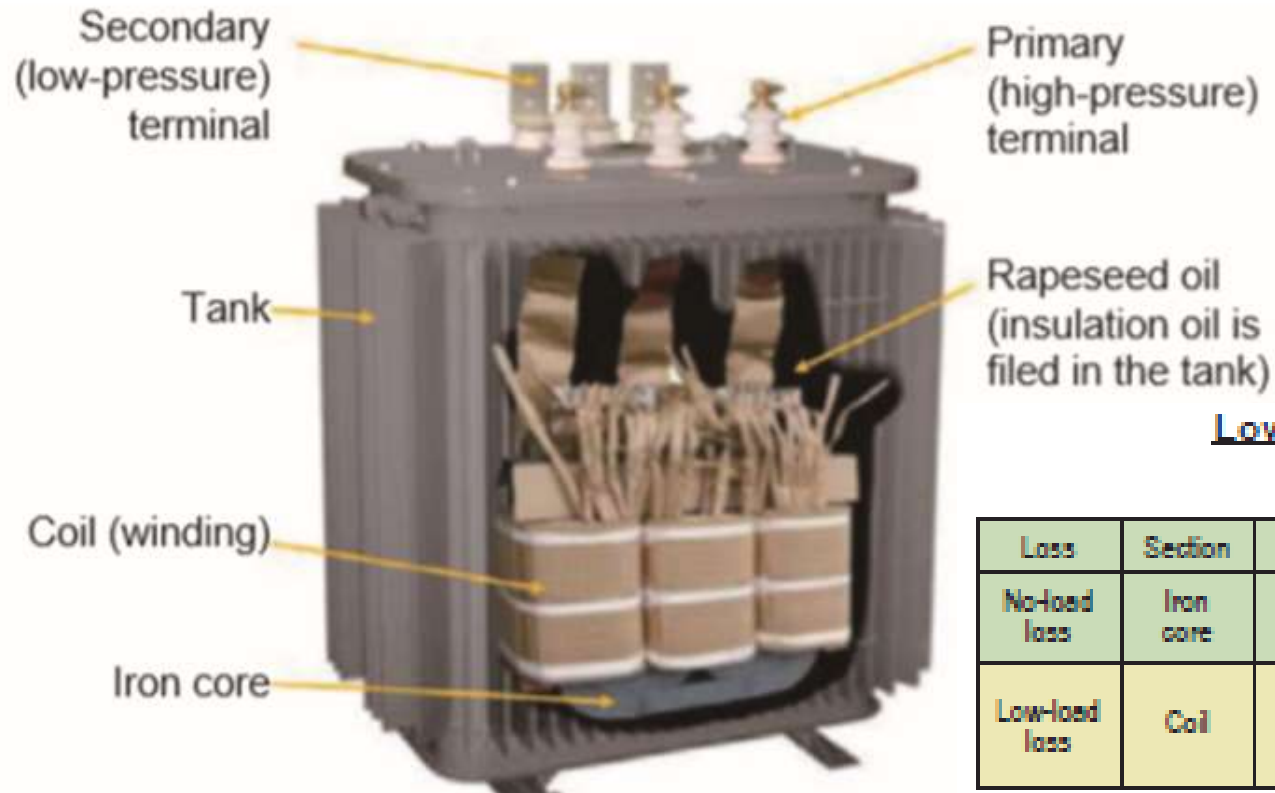


The same mounting dimensions as a conventional induction motor



## High Efficiency Transformer

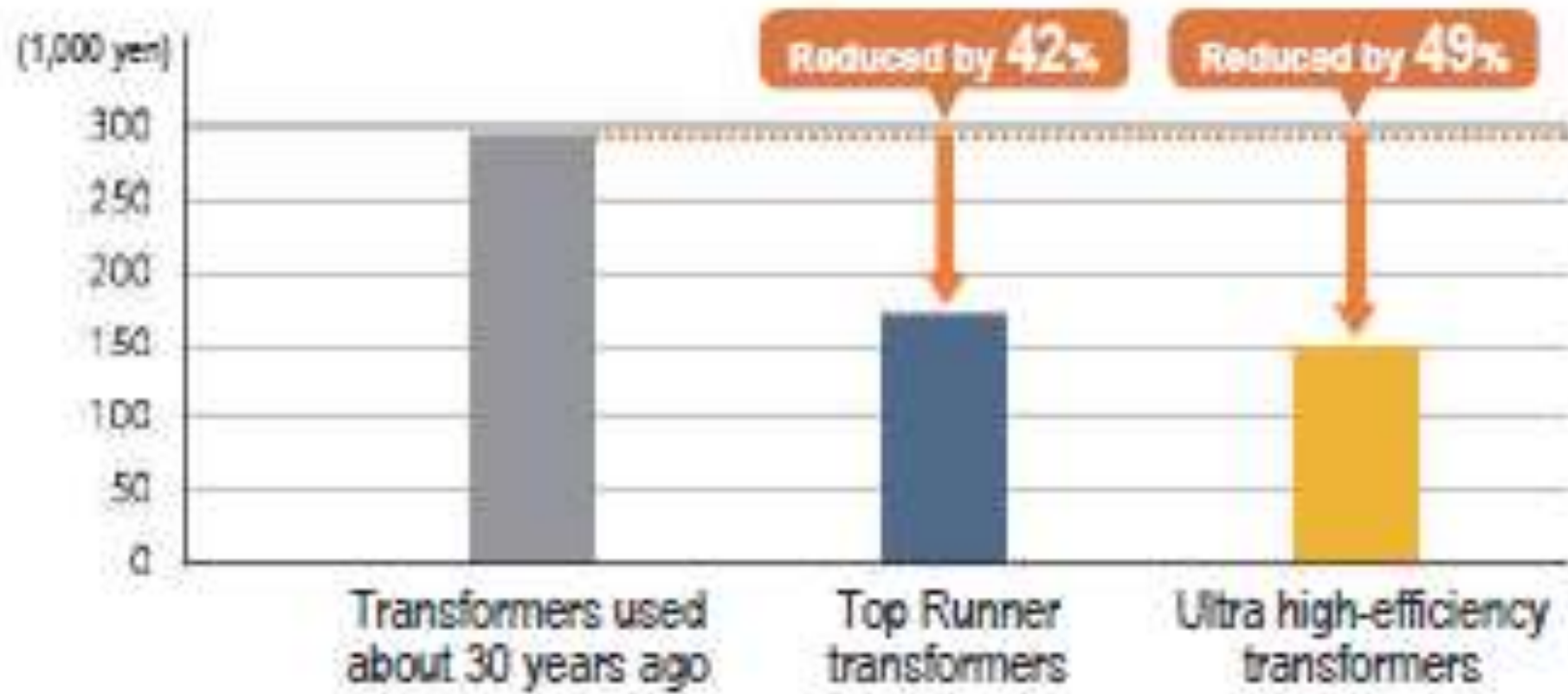
### Structural drawing of a oil-immersed transformer



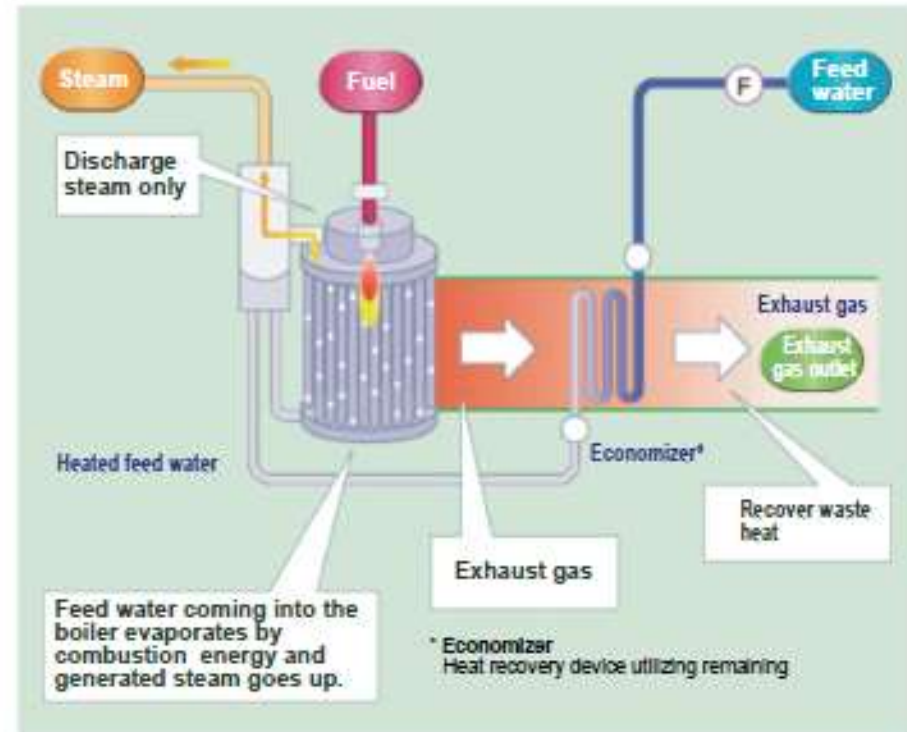
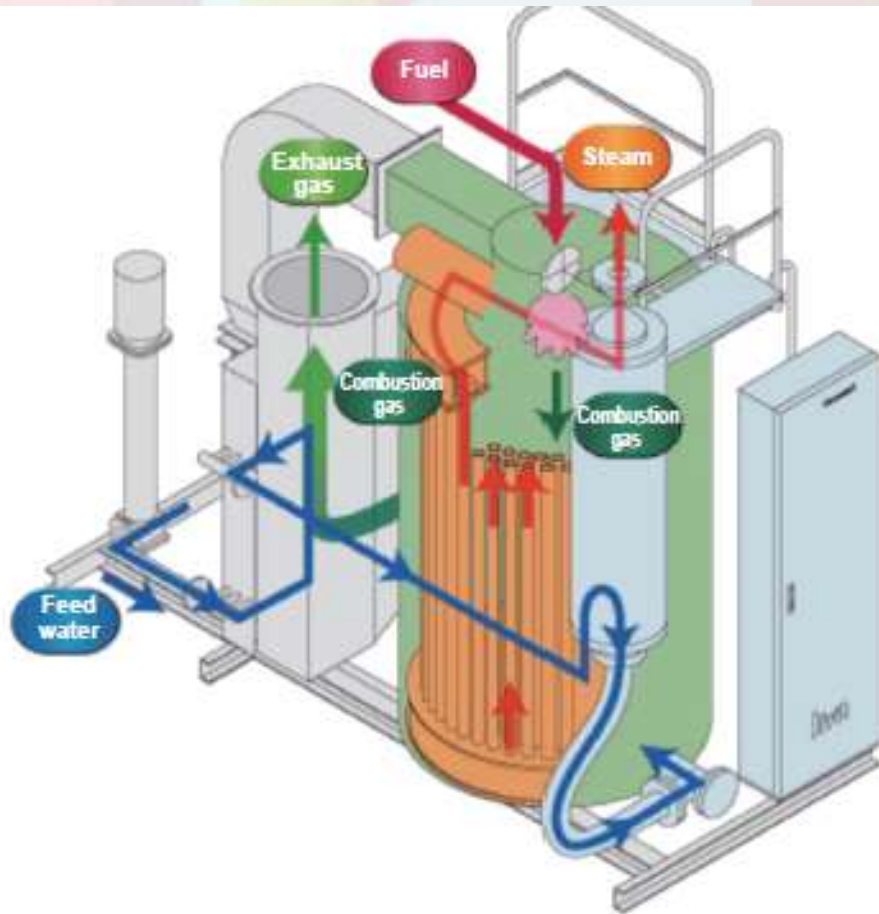
### Low-loss technology

Loss	Section	Major reason	Low-loss technology
No-load loss	Iron core	Magnetic resistance	Improving materials & structure Thinning iron core
Low-load loss	Coil	Electric resistance	Replacing aluminum with copper Shortening winding length Thinning insulators

## High Efficiency Transformer-(2)



## High efficiency Boiler



## High efficiency Boiler-(2)

Feature

**1**

**High efficiency**

**98%**

**High efficiency at partial loads**

**Combustion and feed water PI controls  
(proportional and integral controls)**






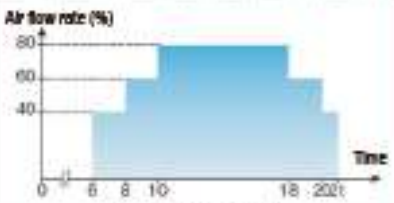


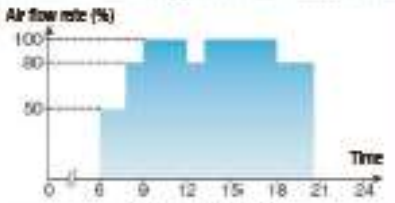


**Forced draft fan / feed water pump  
Inverter as standard**

**Steam dryness of  
99.5% or dryer**

**Broad turn down 10:1  
(optional)**

**Combustion control in response to  
O<sub>2</sub> rate in exhaust gas (optional)**

## High Efficiency Inverter

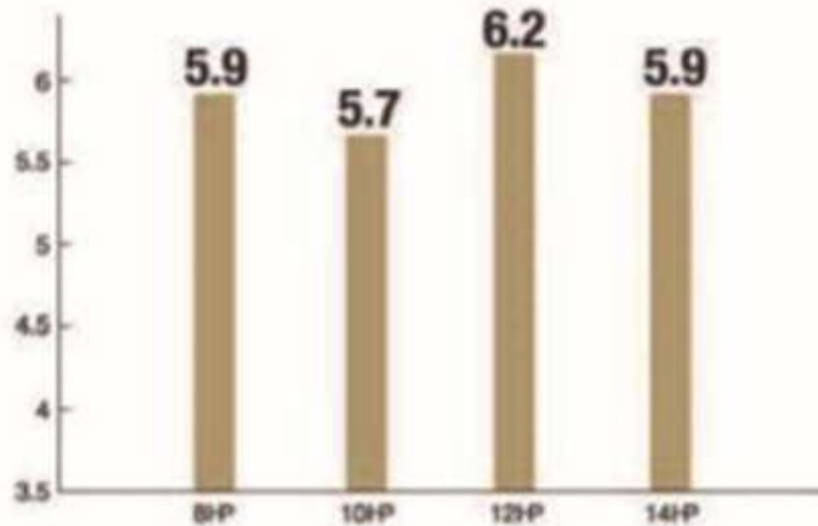
	Coolant pumps for showcases Commercial (valve) + General-purpose motor (SF-PR) Inverter + General-purpose motor (SF-PR)	Energy-saving effects in the Design Building of Mitsubishi Electric Inverter + General-purpose motor (SF-JR) Inverter + General-purpose motor (SF-PR)	Air-conditioning systems for building Inverter + General-purpose motor (SF-PR) Inverter + IPM motor (MM-EFS)
Conditions	<p>[Number of pumps in use] ●Coolant pumps 2.2 kW x 2 units</p> 	<p>[Number of pumps in use] ●Outdoor units (ventilators) 0.75 kW x 3 units 1.5 kW x 1 unit 2.2 kW x 3 units ●Air conditioners 15 kW x 1 unit 18.5 kW x 1 unit 30 kW x 2 units</p> 	<p>[Number of pumps in use] ●Fans for air conditioners 5.5 kW x 10 units 7.5 kW x 10 units 3.7 kW x 100 units</p> 
Operation scheme	<p>Water flow rate</p>  <p>8,760 hours in a year</p> <p>●In the case of operation with commercial power supply Approx. 40,000 kWh Approx. 560,000 yen</p> <p>●In the case of Inverter-controlled operation Approx. 20,000 kWh Approx. 290,000 yen</p> 	<p>Air flow rate (%)</p>  <p>6,476 hours in a year</p> <p>●In the case of operation with SF-JR Approx. 250,000 kWh Approx. 3,440,000 yen</p> <p>●In the case of operation with SF-PR Approx. 230,000 kWh Approx. 3,200,000 yen</p>  	<p>Air flow rate (%)</p>  <p>6,110 hours in a year</p> <p>●In the case of operation with SF-PR Approx. 2,230,000 kWh Approx. 31,270,000 yen</p> <p>●In the case of operation with IPM motor Approx. 2,100,000 kWh Approx. 29,430,000 yen</p>  
	<p><b>Energy-saving effect of the use of Inverter control and replacement with IPM motors (per year)</b></p> <p>●Energy-saving effect in a year (in cost difference) Approx. 20,000 kWh or <b>270,000 yen</b></p> <p>●Effect on CO<sub>2</sub> reduction in a year Approx. 20,000 kWh or <b>10.7 tons</b></p>	<p>●Energy-saving effect in a year (in cost difference) Approx. 17,000 kWh or <b>240,000 yen</b></p> <p>●Effect on CO<sub>2</sub> reduction in a year Approx. 17,000 kWh or <b>9.5 tons</b></p>	<p>●Energy-saving effect in a year (in cost difference) Approx. 131,000 kWh or <b>1,840,000 yen</b></p> <p>●Effect on CO<sub>2</sub> reduction in a year Approx. 131,000 kWh or <b>72.3 tons</b></p>



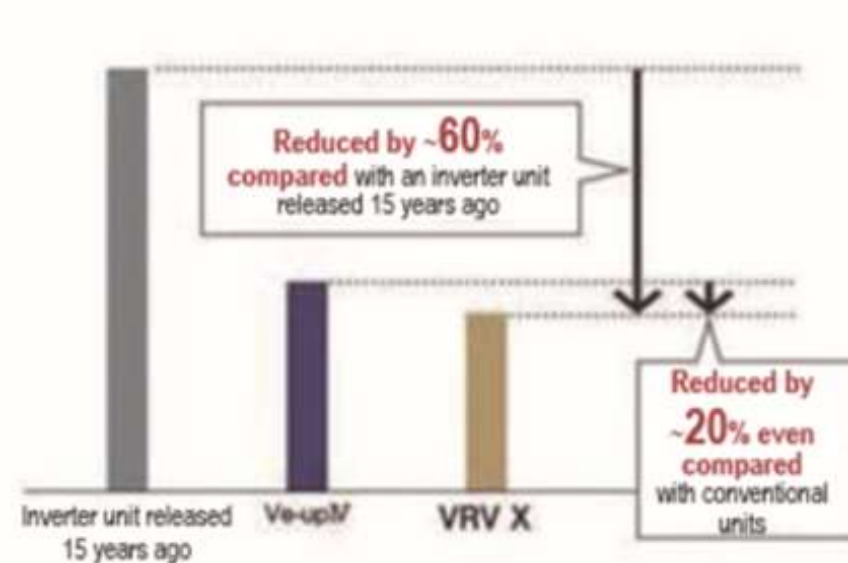
## High Efficiency Air Conditioner

- Efficiency of multisystem air conditioner for highly-efficient buildings
- APF of latest multisystem air conditioner for highly-efficient buildings

APF value by capacity of VRV X \*1

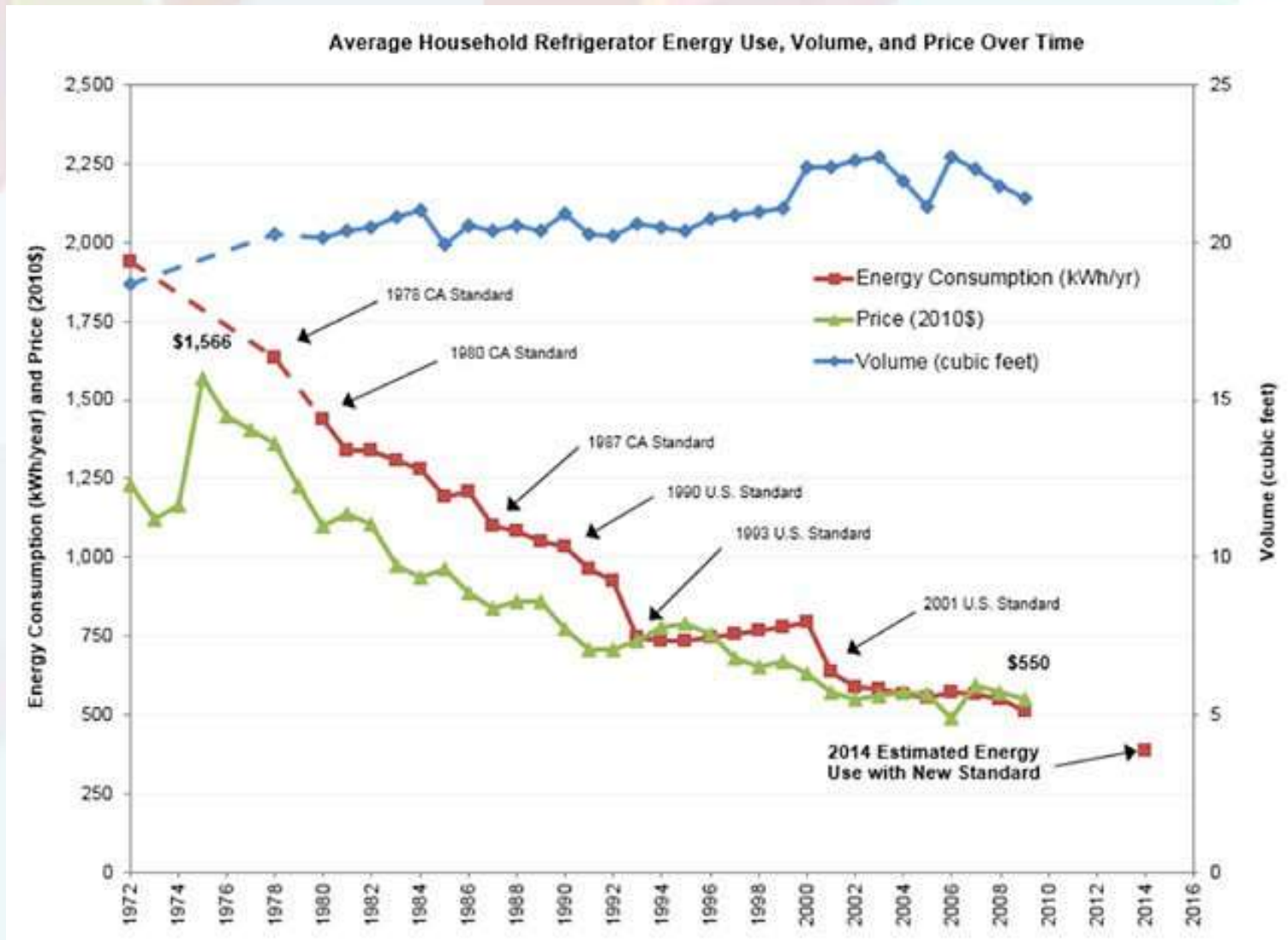


Power consumption comparison \*2

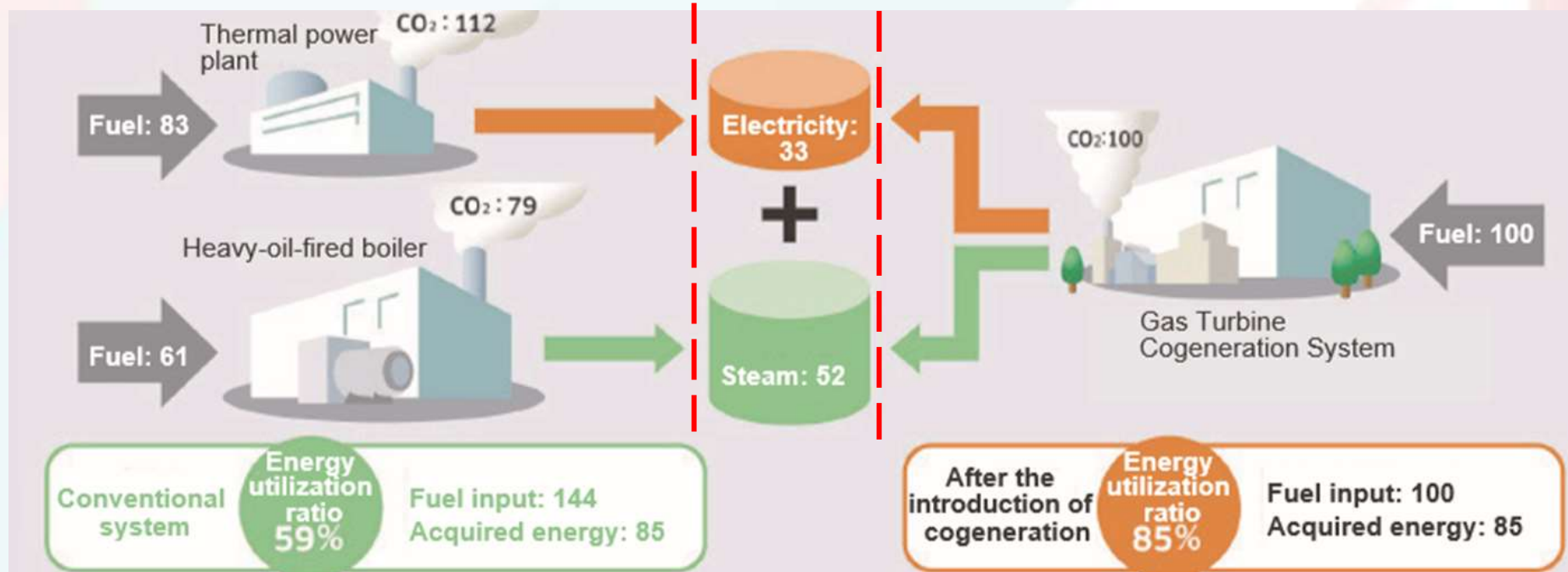
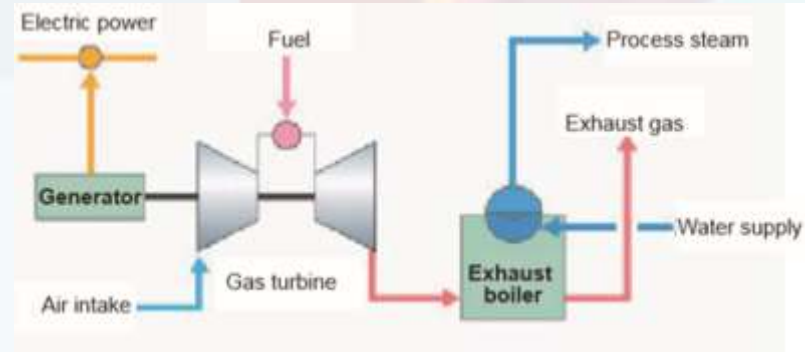


# BAT- 7

## Household Refrigerator



## Cogeneration System



## Green Concept Elevator

- Green concept elevator reduces energy consumption 50% max. compared with a conventional one.

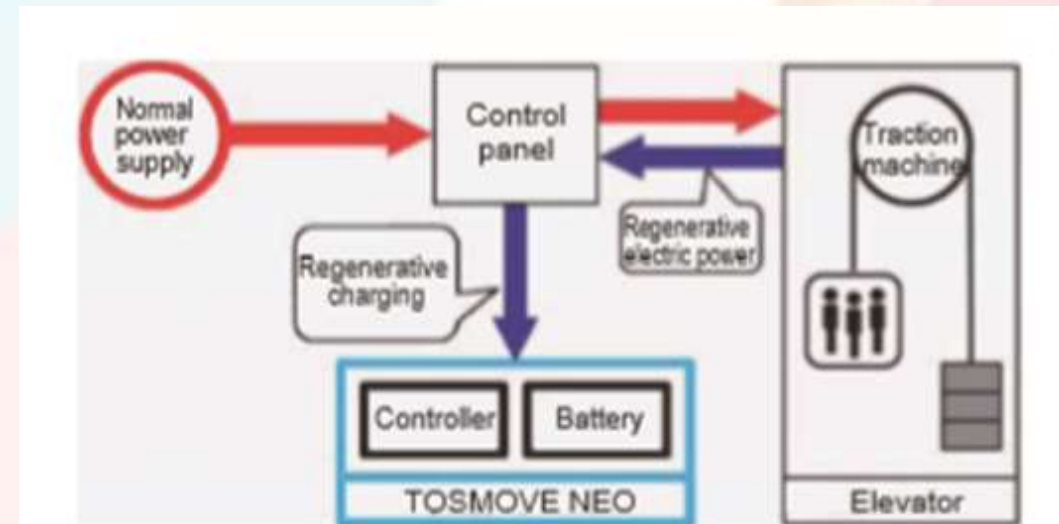
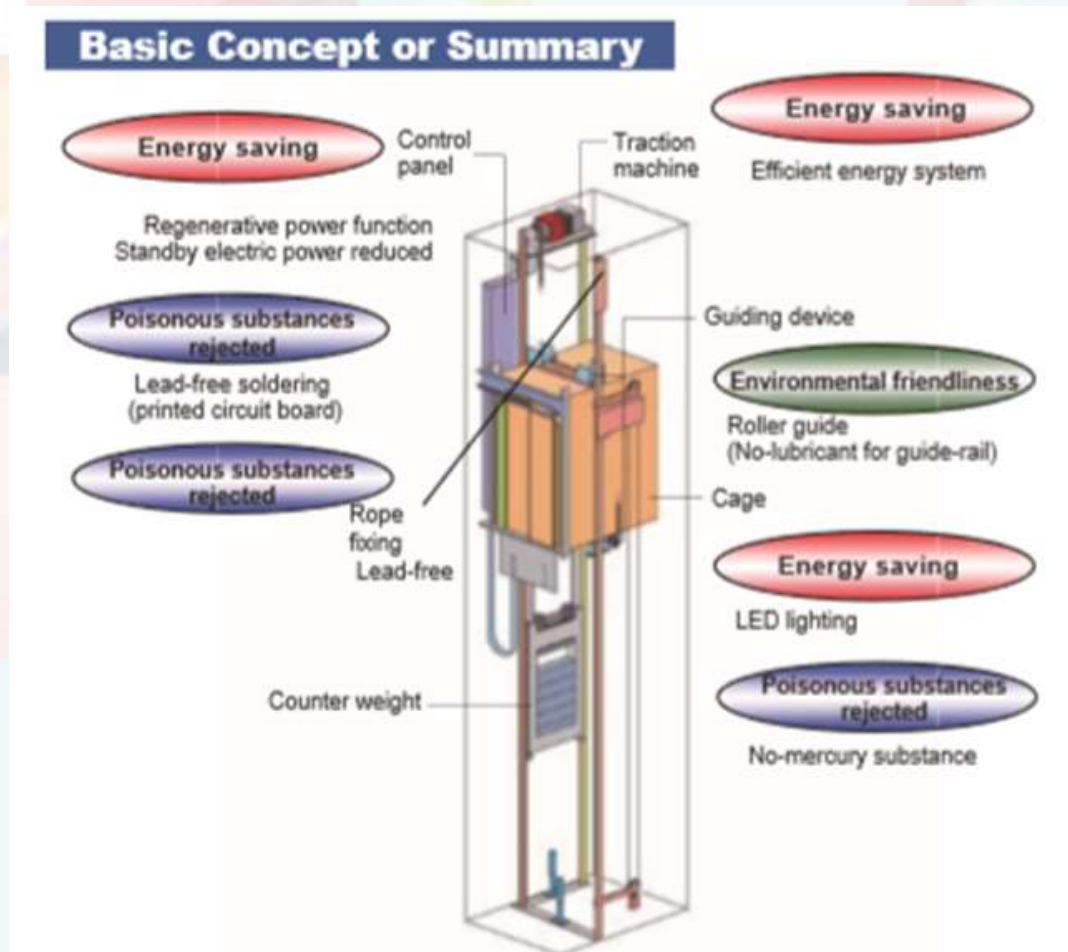


Figure 3: Schematic diagram of the regenerative charging mechanism in TOSMOVE NEO (Energy-saving oriented type)