CAREC High Technology Roadmap

-EE&C, BAT & BP

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

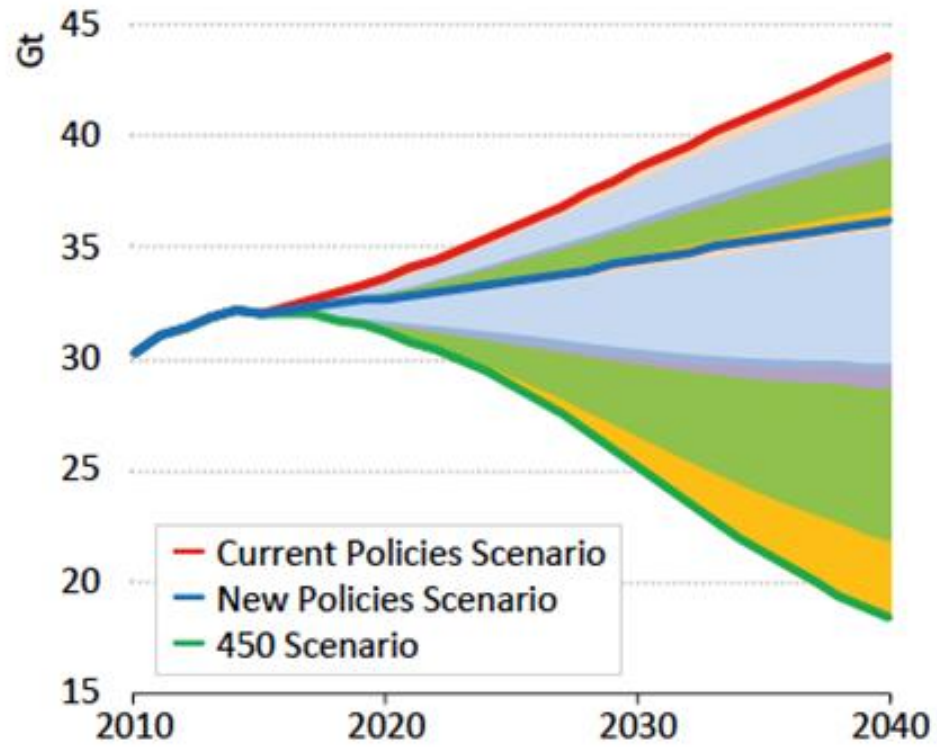
(1)Reduction of energy requirements
(2)High-efficiency equipment
(3)Energy management by using measurement and control systems
(4)Coordinated use of electricity and heat and the use of energy in stages
(5)Recovery of wasted energy
(6)Unutilized energy and stored energy

3. Best Available Technologies

4. Best Practices including BATS

CO2 reduction depends mainly on EE&C

Figure 7.8 ▷ World energy-related CO_2 emissions abatement by scenario



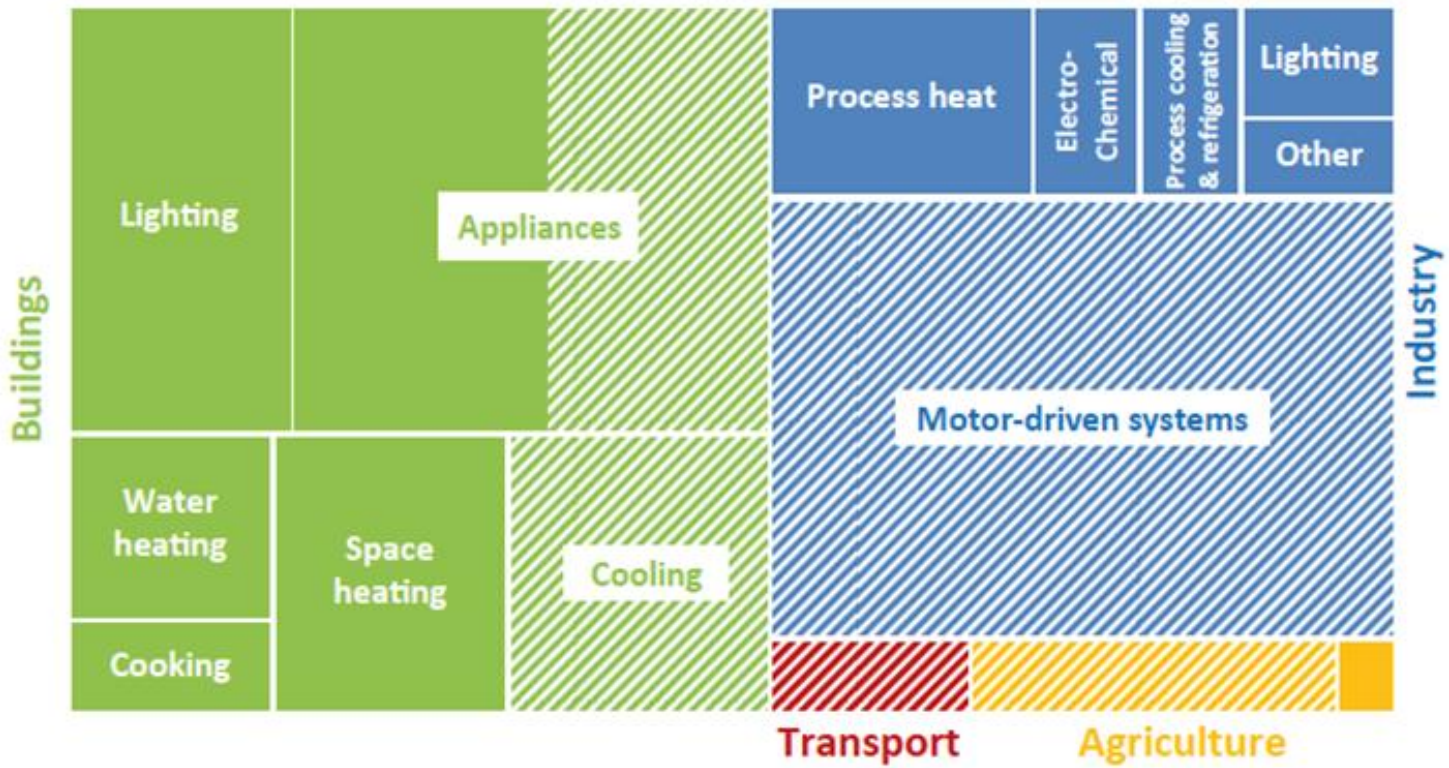
CO_2 abatement in 2040	CPS to NPS	NPS to 450
Activity effect	12%	2%
End-use efficiency	39%	33%
Supply efficiency	6%	2%
Fuel and technology switching	3%	4%
Renewables	32%	39%
Nuclear and CCS	9%	19%
Total (Gt CO_2)	**7.4**	**17.9**

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

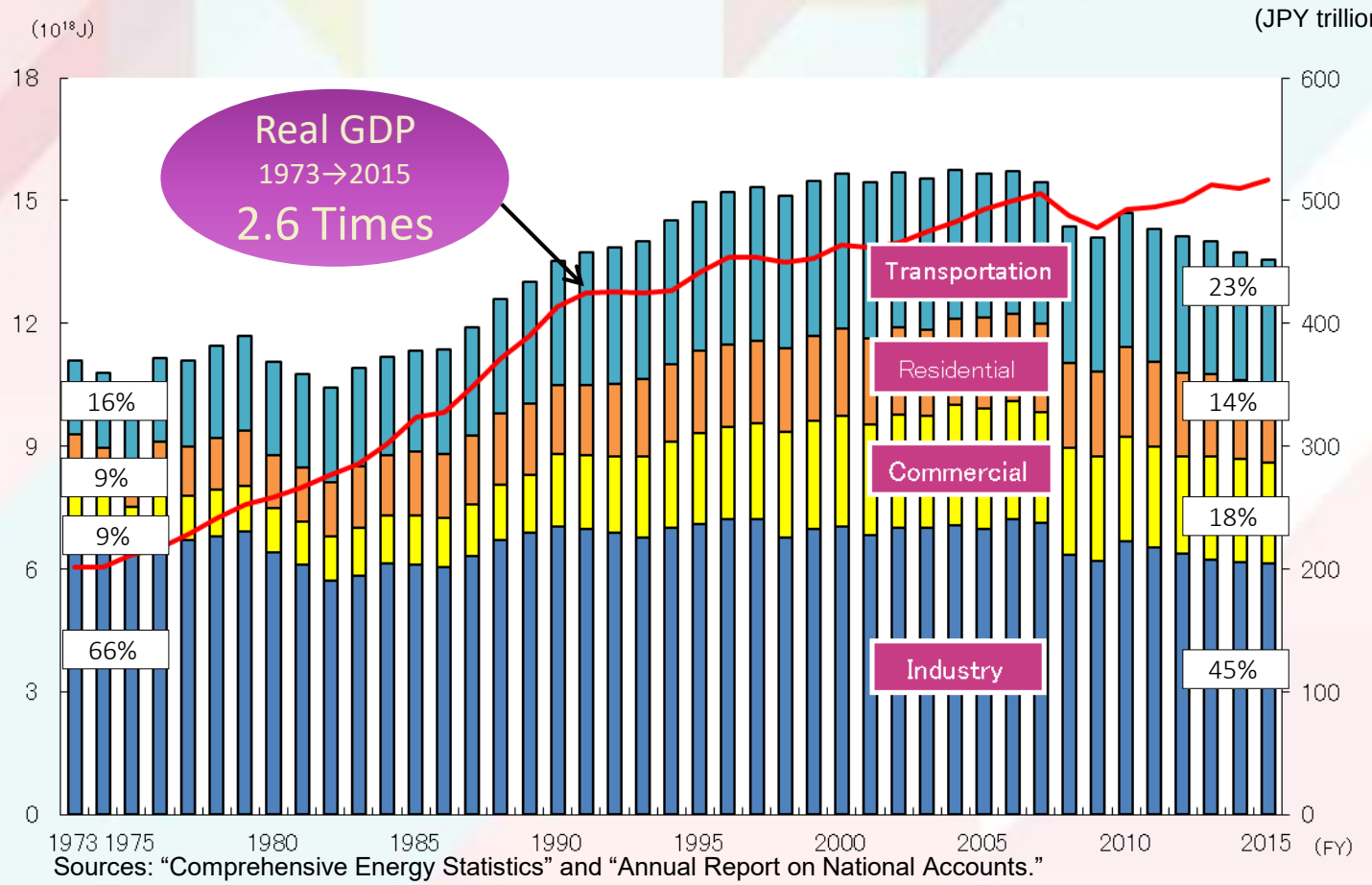


Motors account for more than half of today's electricity consumption

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



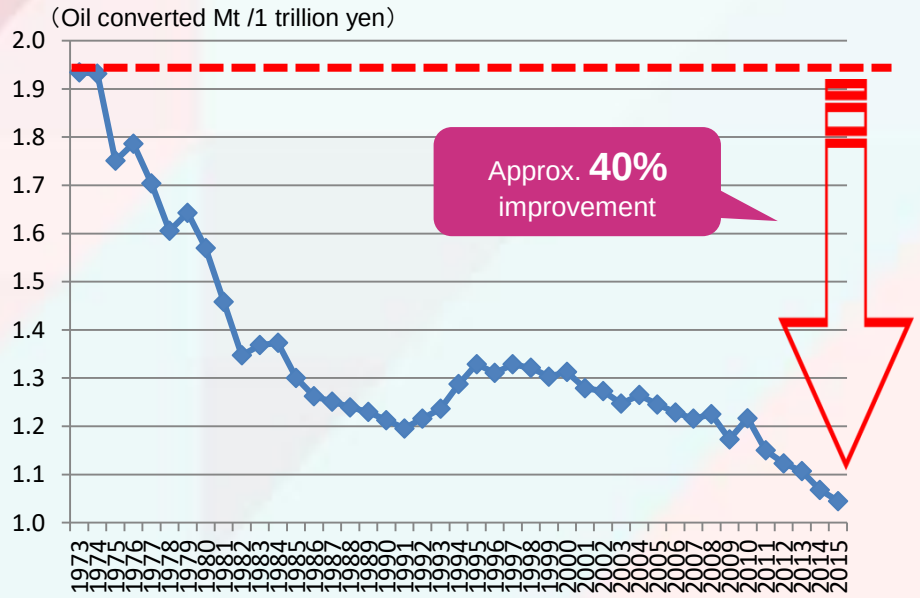
Sources: “Comprehensive Energy Statistics” and “Annual Report on National Accounts.”

Final energy consumption	
	1973→2015 **1.2-times**
Transportation	1973→2015 **1.7-time**
Residential	1973→2015 **1.9-time**
Commercial	1973→2015 **2.4-times**
Industry	1973→2015 **0.8-times**

Japan's Energy Efficiency Efforts after the Oil Crises

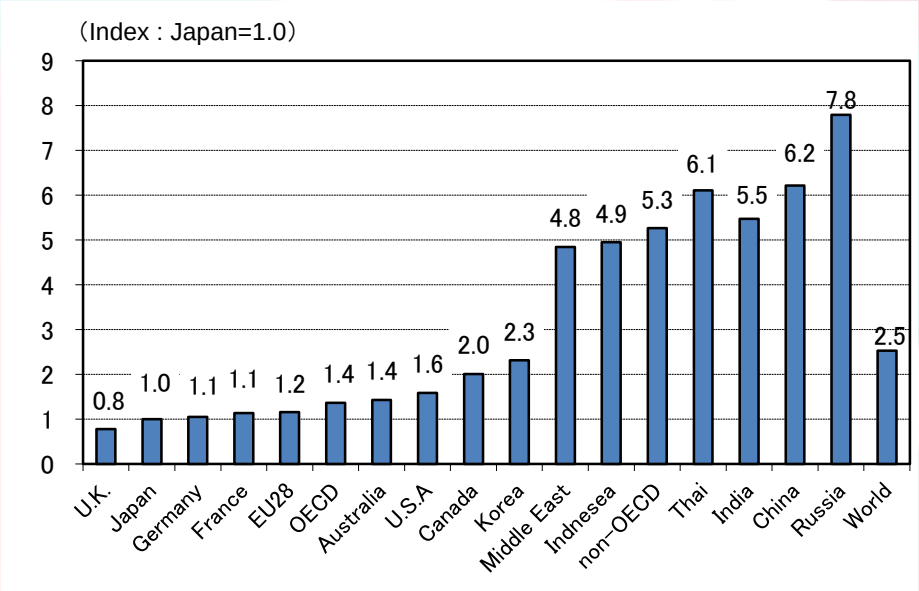
- Japan has improved energy efficiency by approx. **40% after the oil crises in the 1970s** as a result of positive actions by both public and private industrial sectors.
- Japan intensively introduced **"Energy Management System based on the Act on the Rational Use of Energy",** then achieved the lowest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

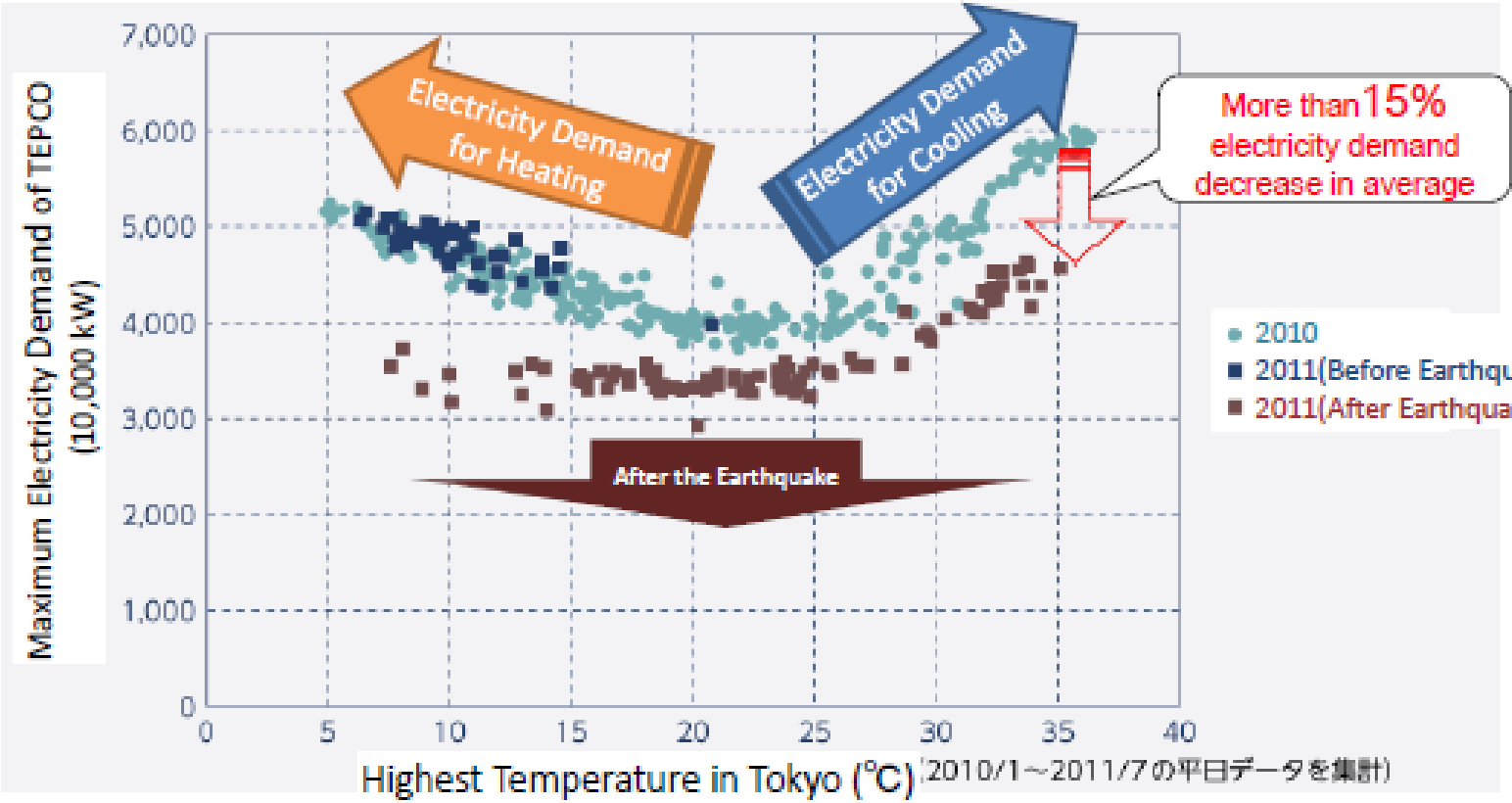


Calculated according to IEA statistics

Energy Saving after the Great East Japan Earthquake

Energy Saving after the Great East Japan Earthquake

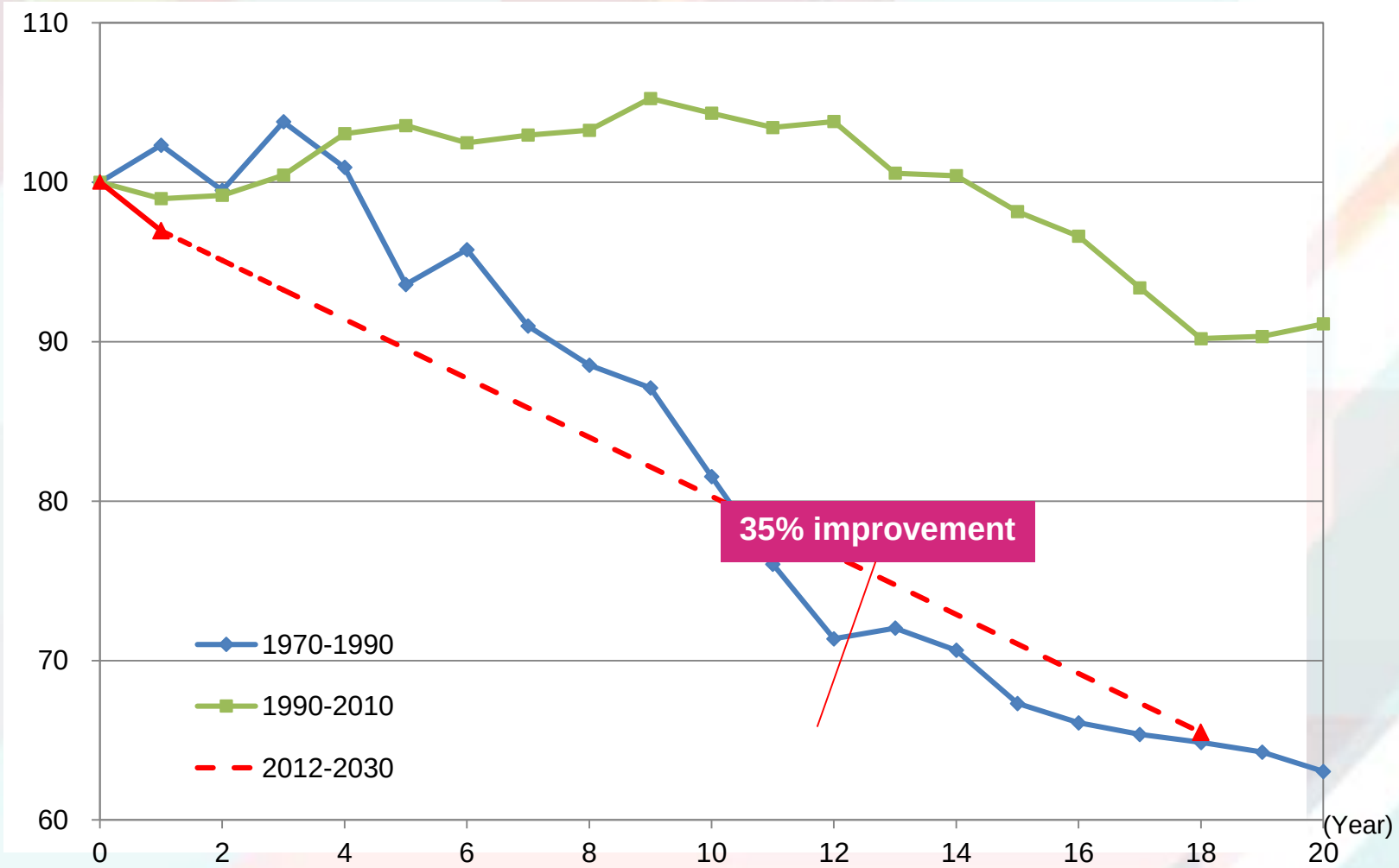
■ Achieved more than 15 % of Electricity Demand decrease in 2011 after the great east Japan Earthquake on March 11, 2011.



Source : CRIEPI

Japan's EE&C target in 2030

Improvement of energy efficiency 1970-2010 vs 2012-2030



Energy efficiency = Final energy consumption/ Real GDP

BAT-1

High-performance triple-glazed vinyl windows APW430

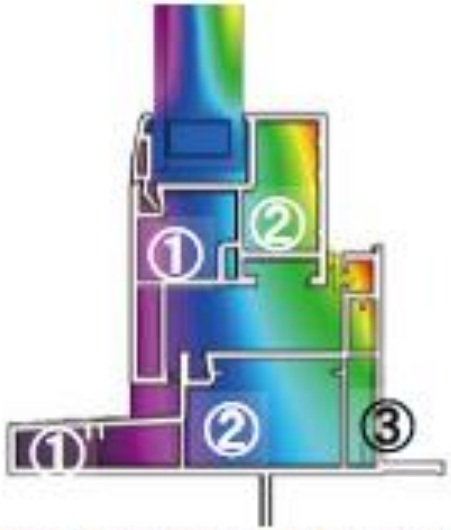
[Multi-chamber Structure]

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] 1.33W/m²K

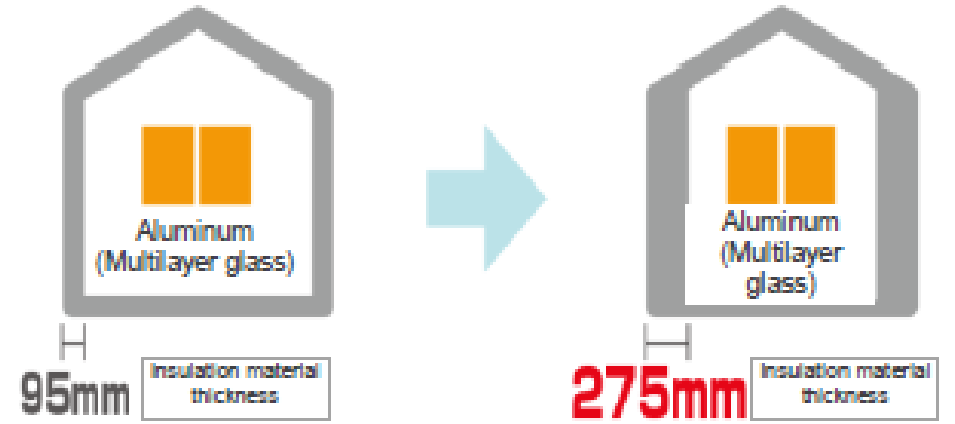
13% reduction

1.52 (W/m²k)

BAT-1

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)



Primary energy consumption
18.7(GJ)

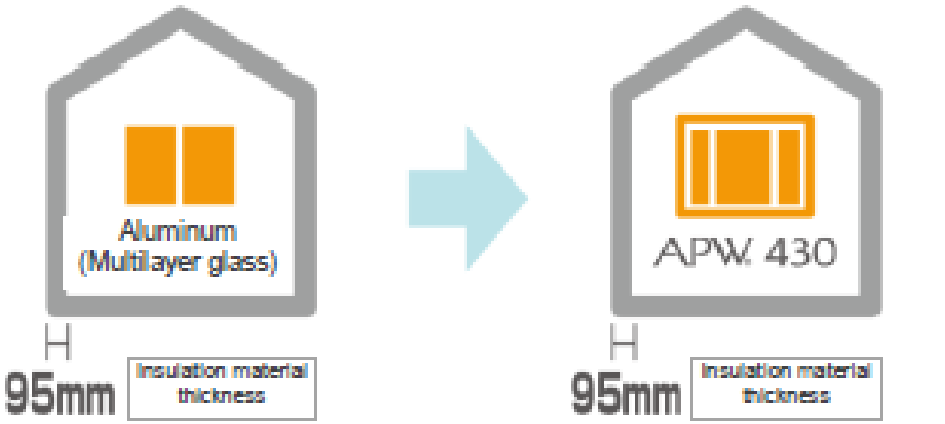
▲10%

Primary energy consumption
16.7(GJ)

* Next-generation energy conservation standards region IV

- 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)



Primary energy consumption
18.7(GJ)

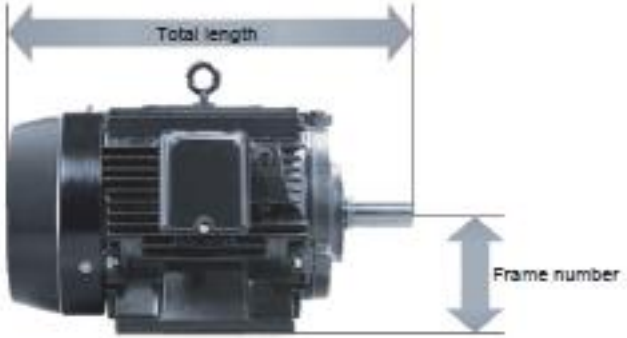
▲23%

Primary energy consumption
14.4(GJ)

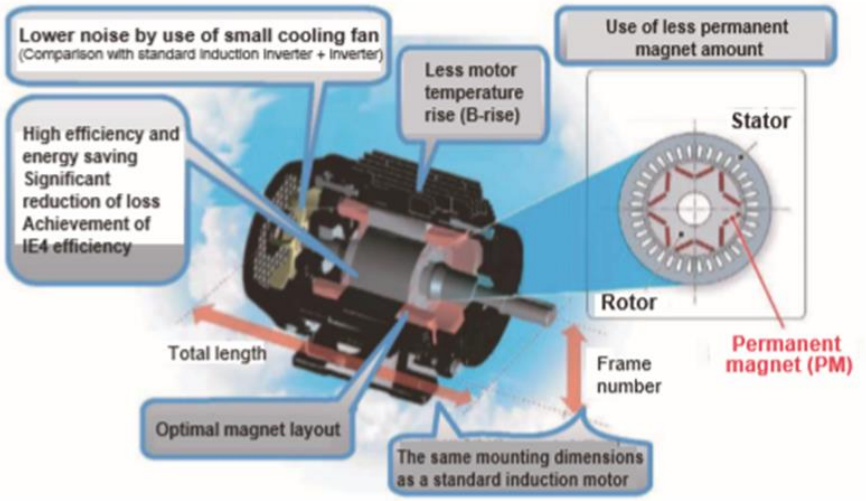
- Simply by changing the windows, there will be a 23% reduction in the cooling and heating energy
- The increase in cost will be around 500,000 yen.
- Temperatures in the rooms will be uniform

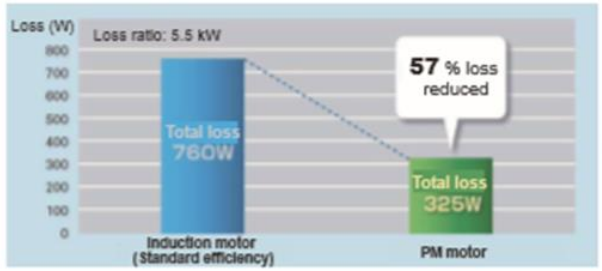
BAT-2

High Efficiency Motor



The same mounting dimensions as a conventional induction motor



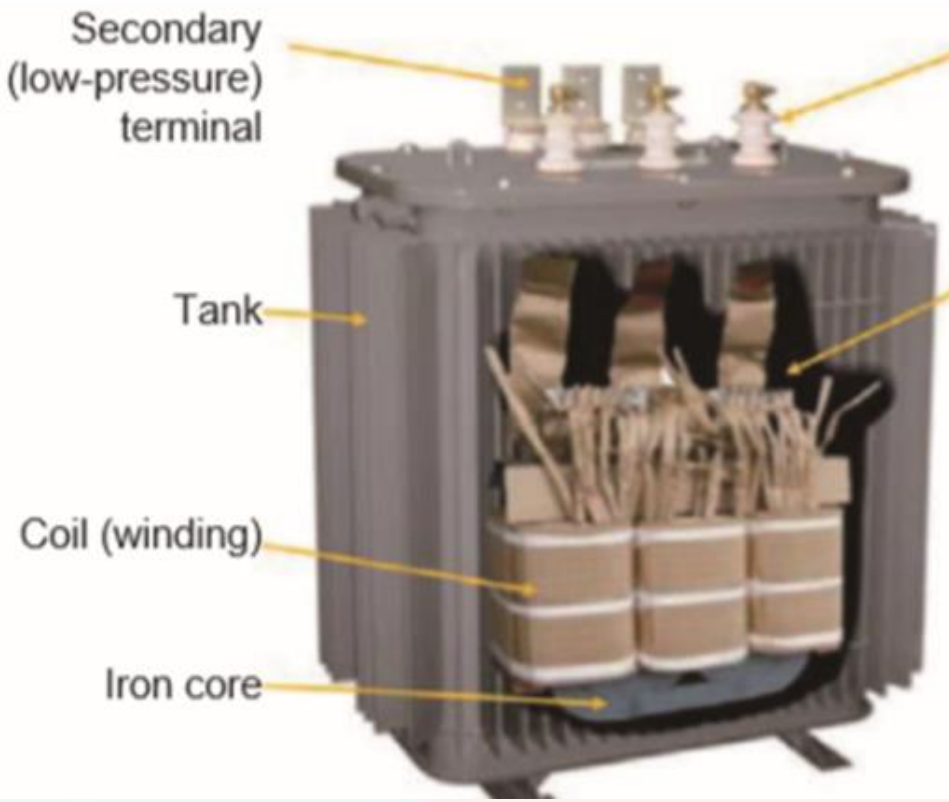


Loss comparison between induction motor and PM Motor

BAT– 3

High Efficiency Transformer

Structural drawing of a oil-immersed transformer

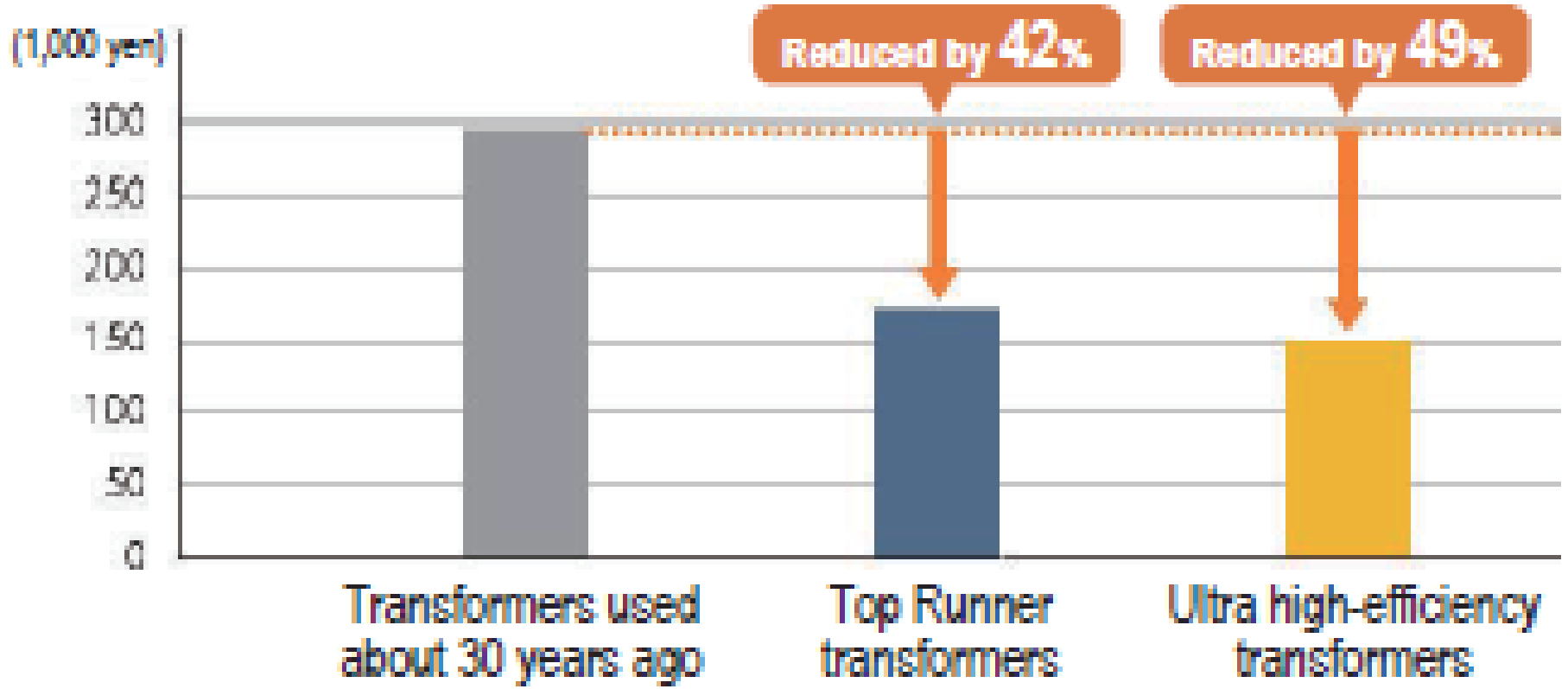


Low-loss technology

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

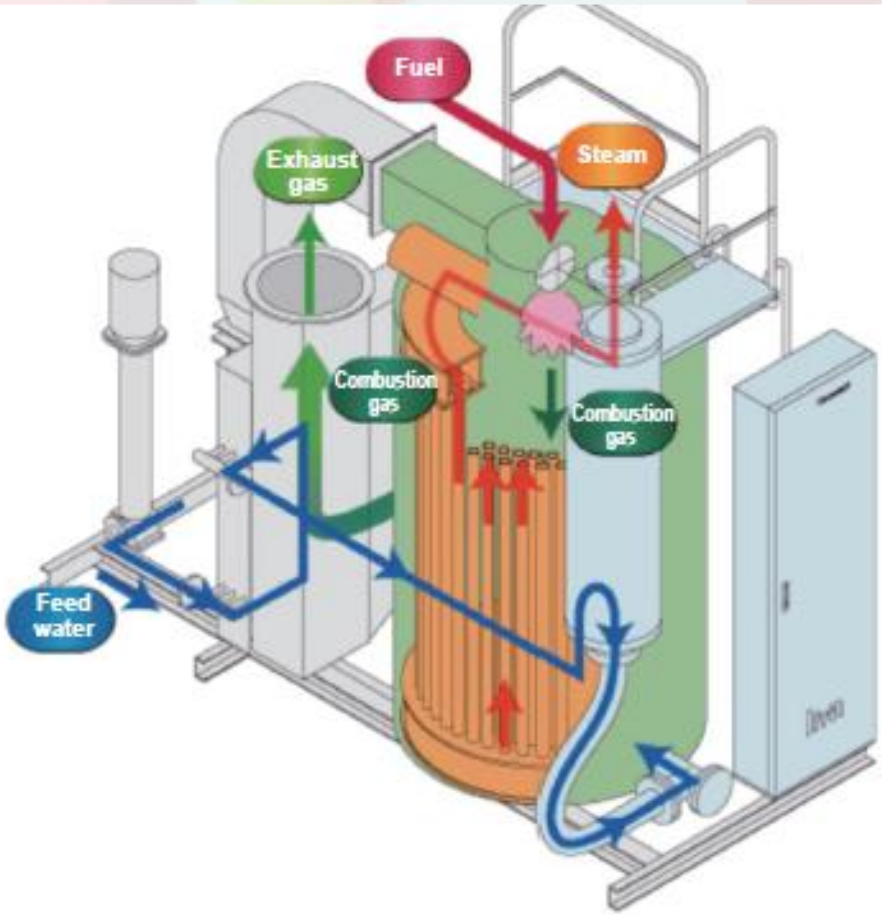
BAT– 3

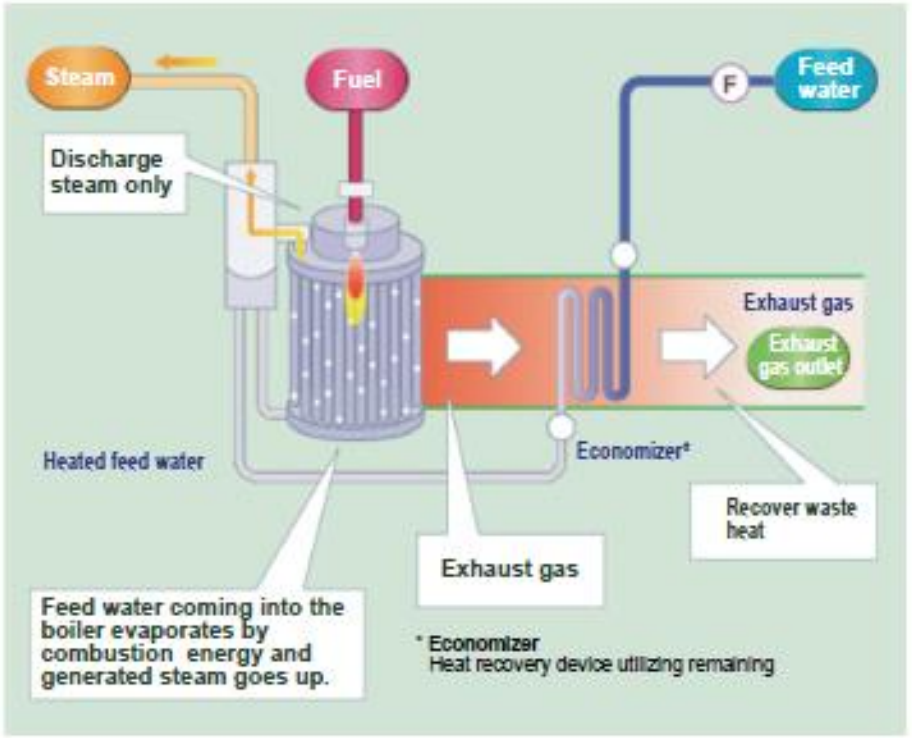
High Efficiency Transformer-(2)



BAT – 4

High efficiency Boiler





BAT – 4

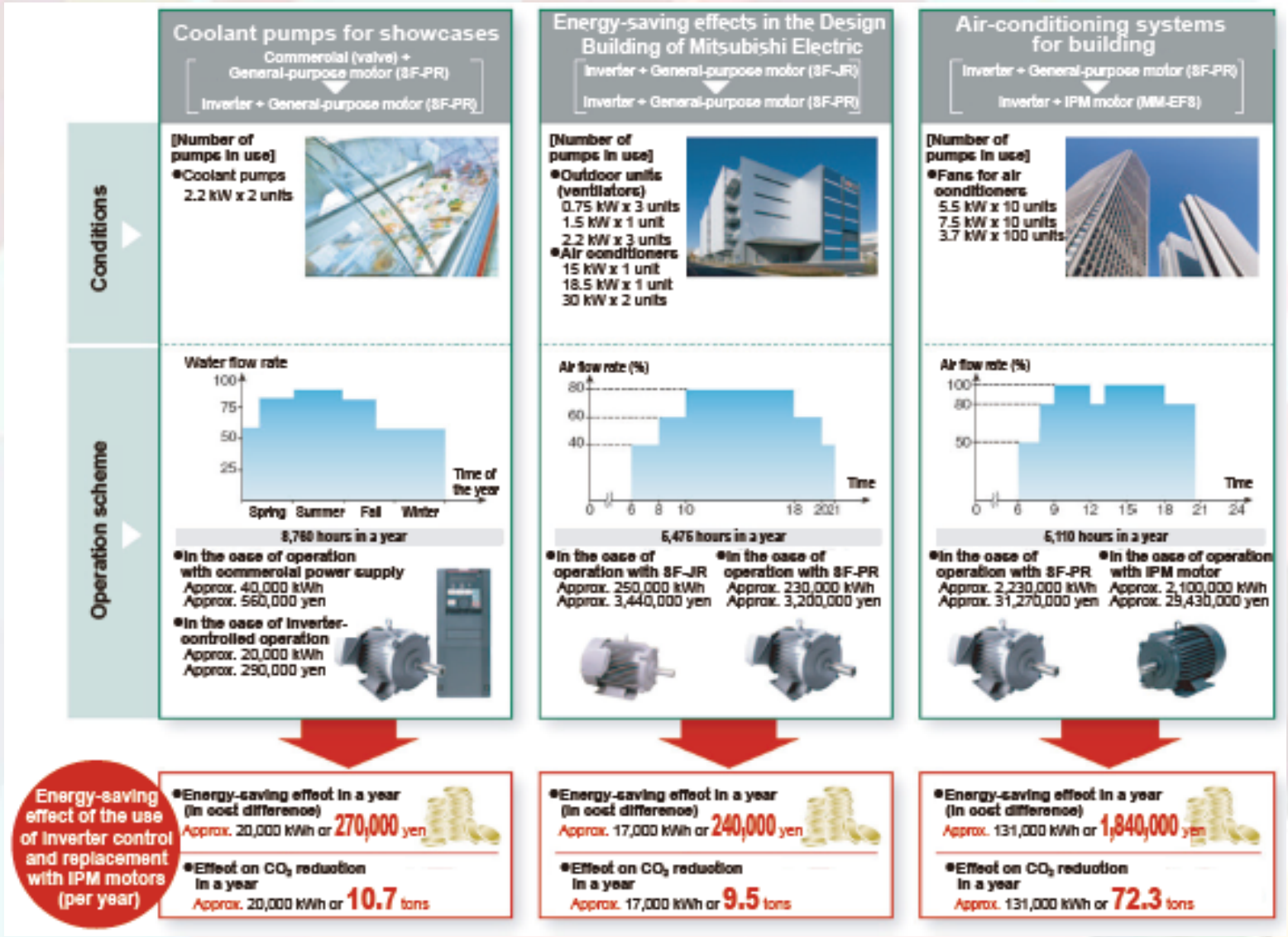
High efficiency Boiler–(2)

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_2 rate in exhaust gas (optional)**

BAT – 5

High Efficiency Inverter



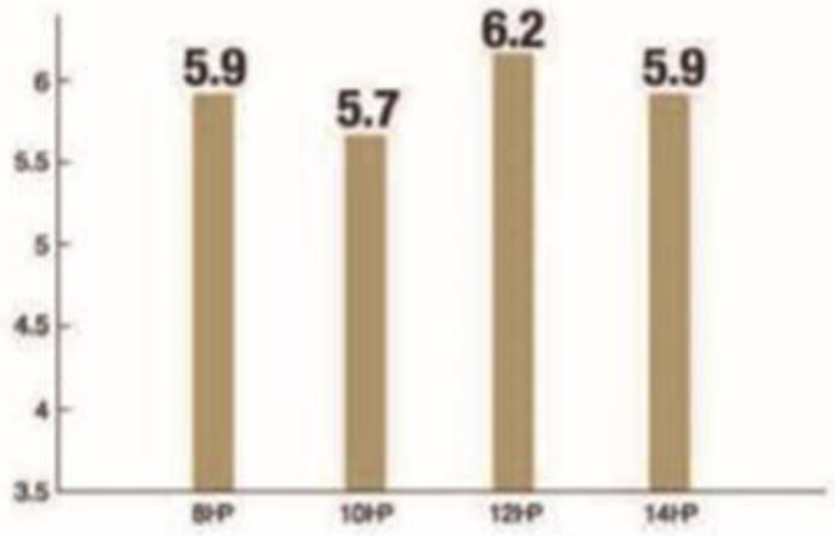
BAT– 6

High Efficiency Air Conditioner

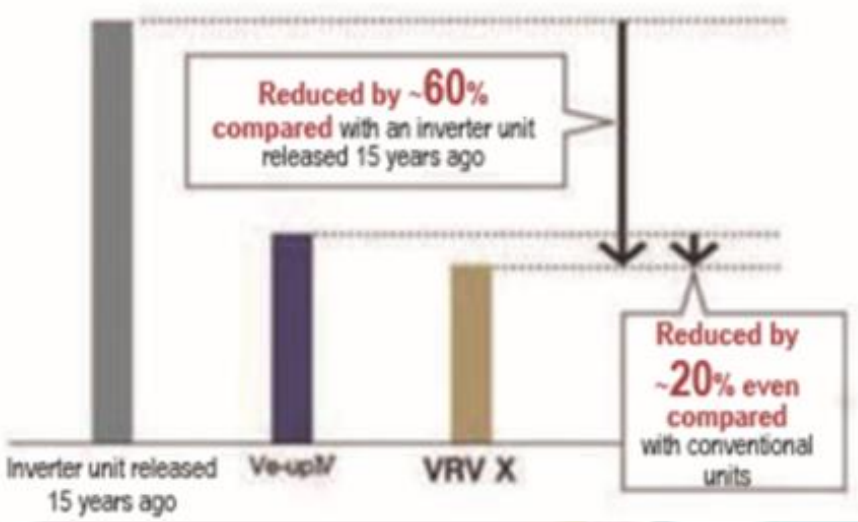
Efficiency of multisystem air conditioner for highly-efficient buildings

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

APF value by capacity of VRV X *1

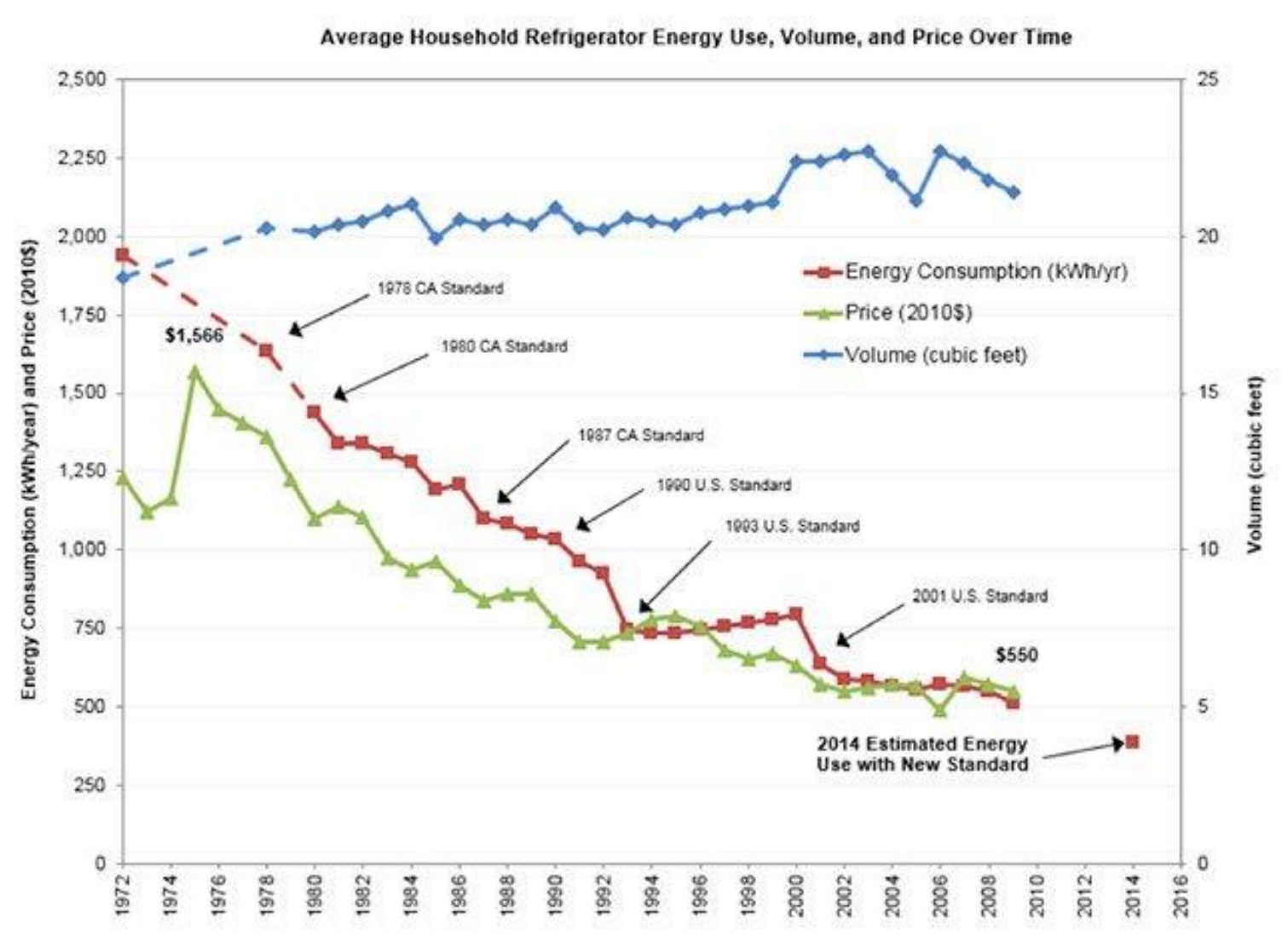


Power consumption comparison *2



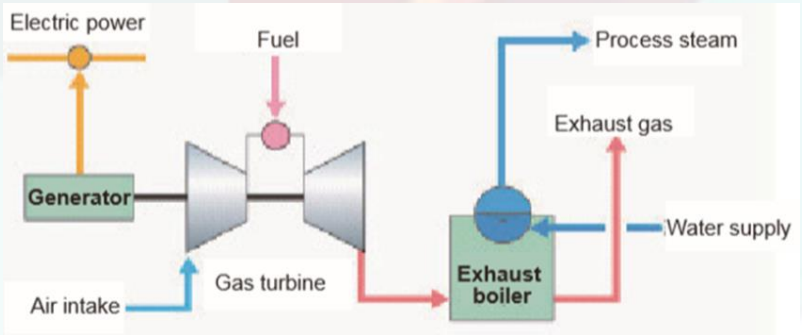
BAT- 7

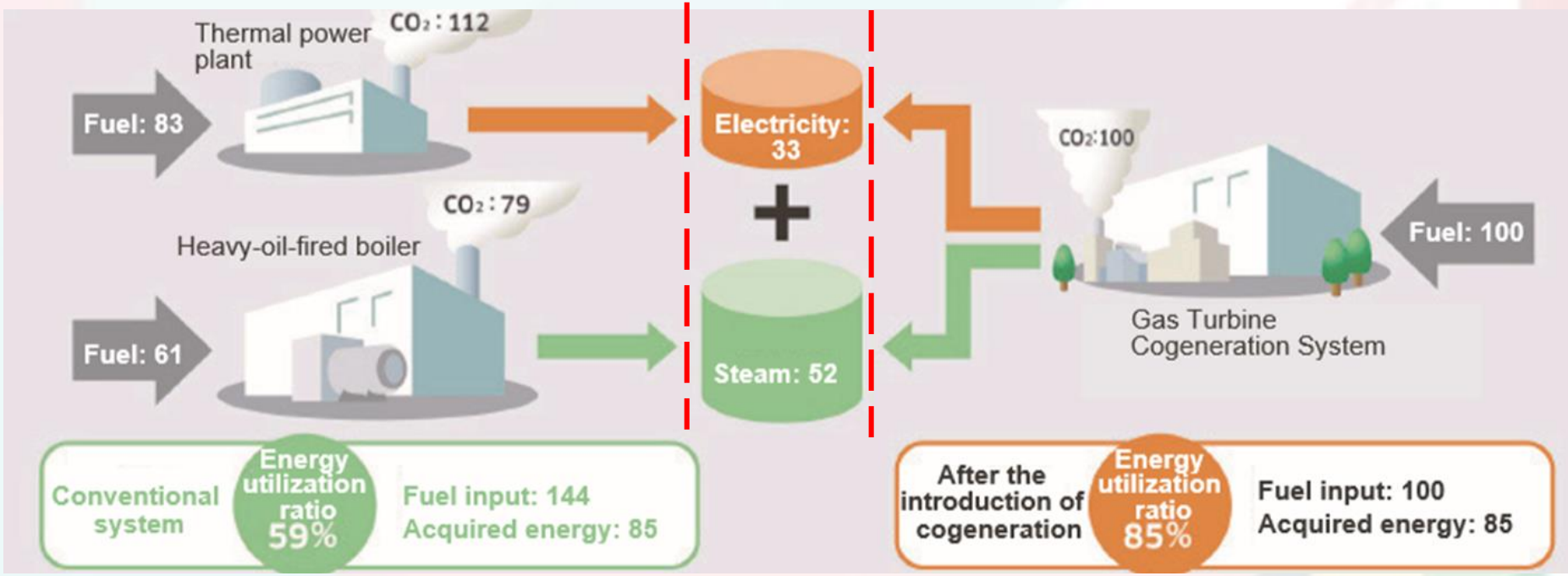
Household Refrigerator



BAT– 8

Cogeneration System

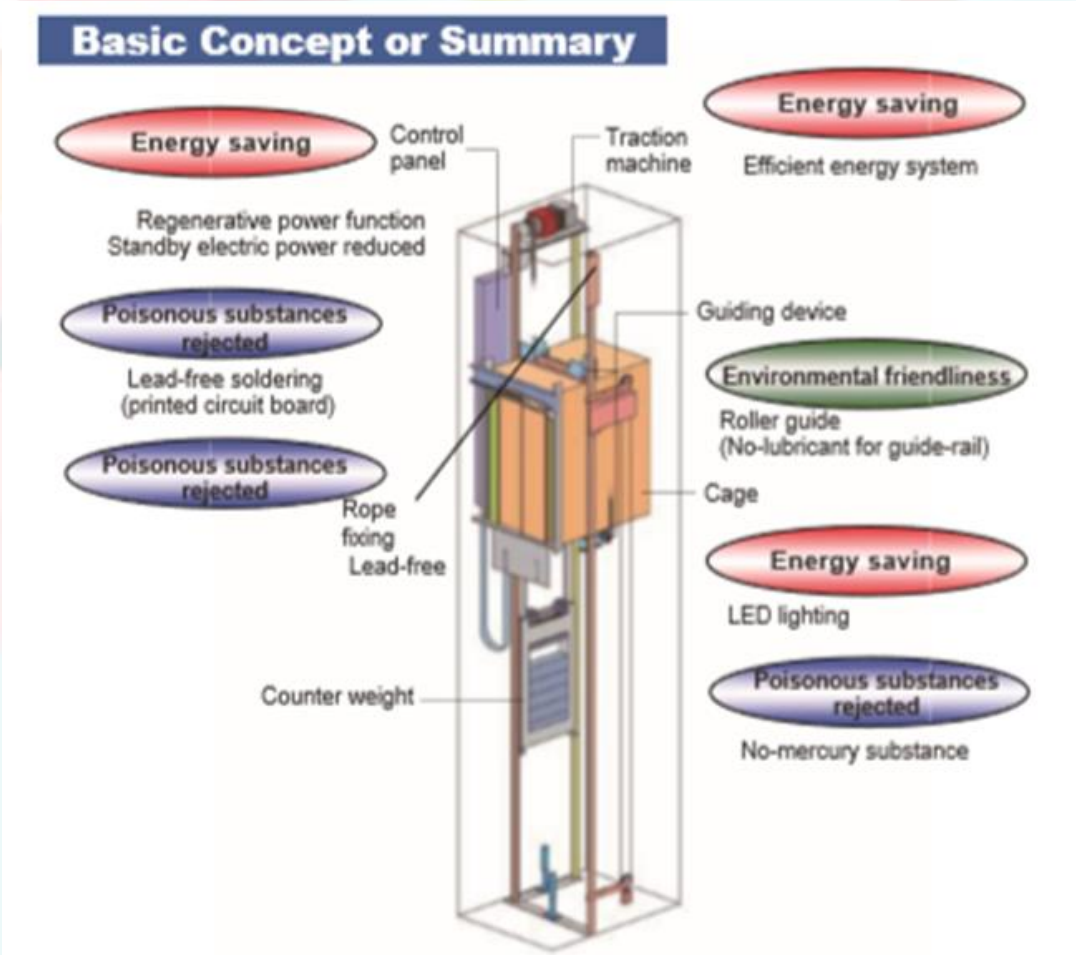




BAT– 9

Green Concept Elevator

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



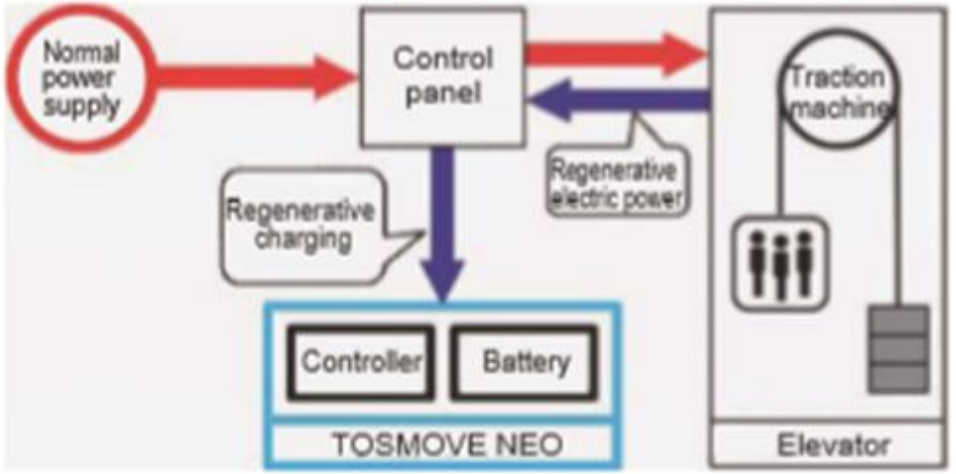


Figure 3: Schematic diagram of the regenerative charging mechanism in TOSMOVE NEO (Energy-saving oriented type)