# Energy Efficiency Policy Challenges for 2025

## –Two key elements for promoting energy efficiency: sustainable investment and consistent policies–

The Institute of Energy Economics, Japan

Seonghee Kim

Energy Efficiency Group, Climate Change and Energy Efficiency Unit

# Key points of this report

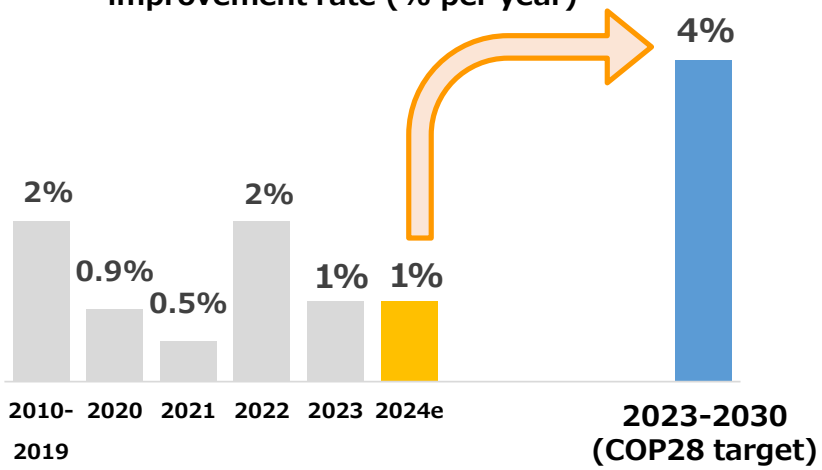
- ✓ The global energy efficiency improvement rate over the last few years has stood at 1%.
- ✓ Having peaked in 2022 (buoyed up by China, Europe, and the United States), energy conservation investment has since declined year-on-year in terms of energy demand-side initiatives. Investment in electrification, however, has steadily increased.
- ✓ There is little change regarding investment in energy conservation and electrification etc. in the industrial sector; developing countries are reinforcing their energy management regulations, while developed countries are requiring the disclosure of information at the corporate level.
- ✓ In the private sector, the EU is requiring the renovation of existing buildings, while China is supporting energy conservation relating to the replacement of building materials. In various countries, systems for the reporting and disclosure of energy usage volumes are being developed, against a backdrop of rising electricity demand from data centers.
- ✓ In the transportation sector, energy conservation is primarily taking the form of electrification. Globally, there has been a slowdown in the rapid growth of global EV sales.
- ✓ In Japan, future challenges include supporting business operators for whom improvements in energy efficiency have stalled, promoting energy conservation efforts among small and medium-sized enterprises, designing systems that not only conserve energy in equipment but also encourage a shift to non-fossil fuel energy, and promoting energy conservation efforts through the utilization of AI and digital technology.

# The world's energy efficiency rate has improved at a rate of around 1% in recent years

- At COP28, it was agreed to **double** the pace of global improvement in energy efficiency **by 2030** to achieve the 1.5°C target (from an actual performance of 2% in 2022 to 4% per year)
- However, with the actual improvement rate only around 1% over 2023 and 2024, achieving this target will be a difficult challenge

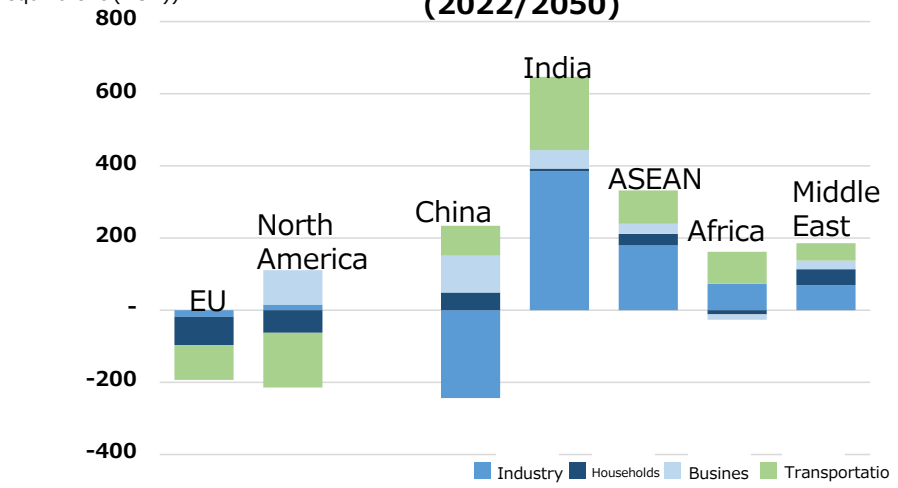
- There is significant growth in energy demand in emerging economies such as India and the ASEAN countries
- It will become increasingly important to strengthen energy conservation efforts in these countries in the future

**Trends in the world energy efficiency improvement rate (% per year)**




Note: This is the improvement rate for primary energy consumption per unit of GDP (2015 basis, PPP)
Source: Created from "World Energy Balances," IEA (2024)

**Changes in final energy consumption (2022/2050)**




Note: The above graph shows the change by 2050 from the 2022 level (the reference scenario)
Sources: IEEJ Outlook 2025, IEEJ (2024)

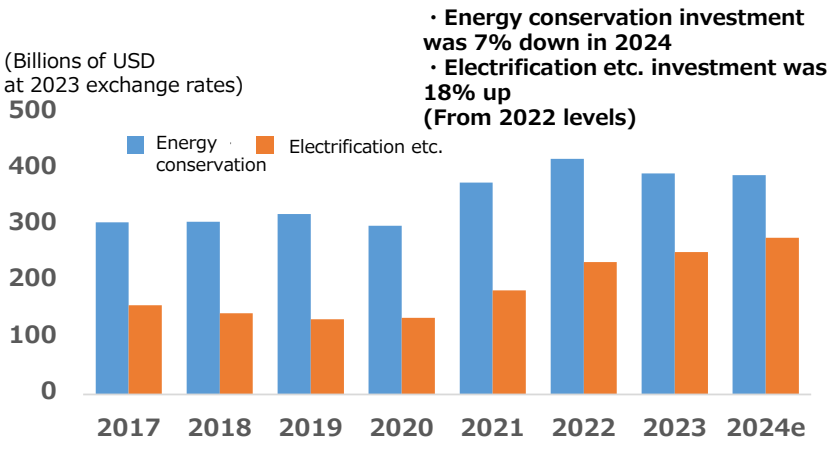
# Having peaked in 2022, energy conservation investments in demand-side initiatives have declined year-on-year
# Investments in electrification etc., however, have made steady progress

- Under the IEA's net zero scenario, by **2030,** the world will need **energy conservation/electrification, etc. investments** at **three times the 2022 level (an increase of 24% per year)**
- In reality, however, such investments in 2024 increased only **2.2%** over 2022
- However, among this, electrification investments such as electric vehicles (EVs) and heat pumps saw steady increases

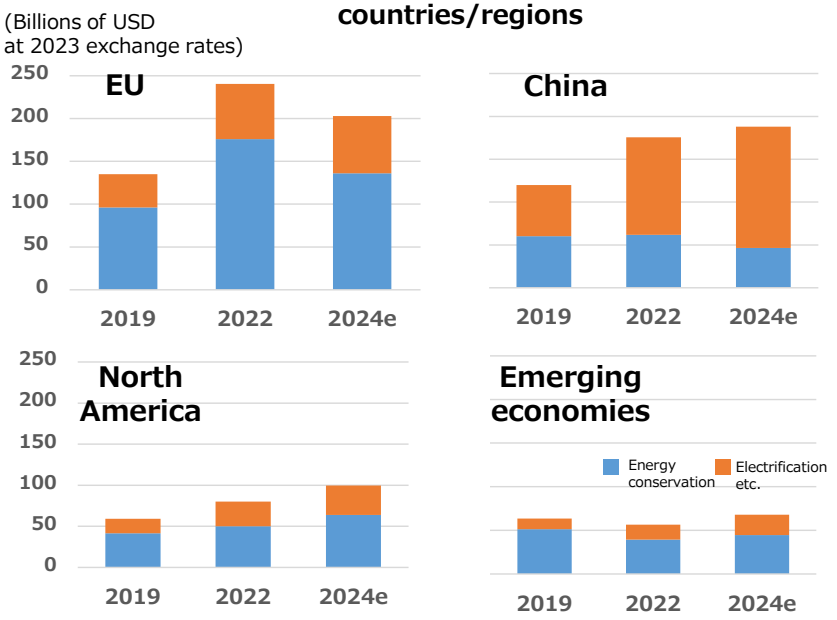
(Explanation) An EV's primary energy consumption is around half that of an internal combustion engine (ICE) vehicle

- Figures are buoyed up mainly by **Europe, China, and the United States** (providing approx. 80% of the increase in investments from 2019 onwards)
- A challenge for the future is to **expand investments in emerging and developing countries** that have great potential for energy conservation

**Global trends in energy conservation/electrification etc. investments**




**Energy conservation/electrification etc. investments in key countries/regions**




Note: "Electrification etc." refers to investment in both electrification and renewable energy in terms of energy demand-side initiatives. Figures for 2024 are forecasts.
Source: Created from "World Energy Investment," IEA (2024)

# Energy conservation by industry
## Energy conservation investment levels show little change; developing countries are reinforcing regulations, while developed countries are making information disclosure mandatory

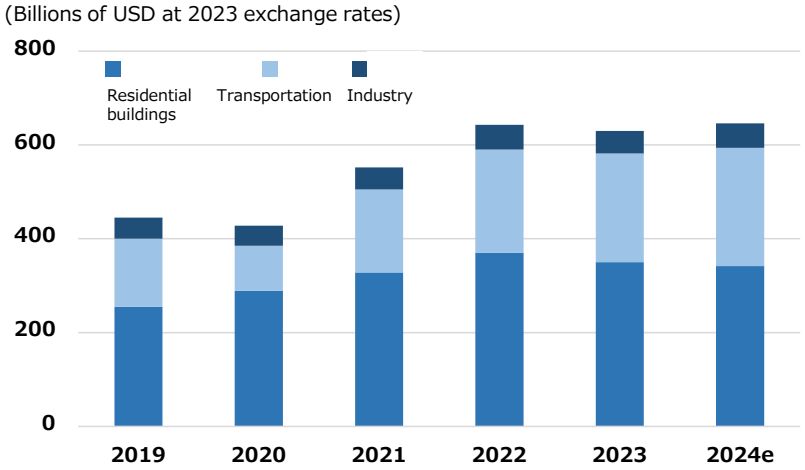
### Energy conservation investment

- Globally, **investment in energy conservation in the industrial sector declined in 2023** on the back of a fall in investment caused by the real estate downturn in **China,** but is expected to recover to 2022 levels in 2024. (Energy conservation investment in Chinese industry in 2023 was **down 30% year-on-year,** but is forecast to rise 5% year-on-year in 2024)
- Energy conservation investment has not grown as a share of total global capital investment by industry (2017: 14% ⇒ 2023: 13%)

### Energy conservation policy

- Developing countries are **making energy management systems mandatory** in the industrial sector and **expanding the scope of application**
  - The implementation of energy management systems and **periodic reporting** are becoming **mandatory in Thailand, Indonesia, Singapore, the Philippines,** and elsewhere
- In the EU, the trend towards **energy information disclosure companies** is gaining speed

**Trends in energy conservation/electrification etc. investment by sector**




Examples
In **Thailand**, operators consuming 20 TJ/year or more (approx. 516 kℓ*) are now required to:
(1) implement energy management systems
(2) issue reports to the government

*Based on a conversion rate of I TJ = 25.8 kℓ, with
1,500 kℓ or more being the scope covered by Japan's Act on Rationalizing Energy Use

Source: Created from "World Energy Investment," IEA (2024)

# Energy conservation in the private sector
# EU: Renovating/strengthening existing buildings; China: Expanding energy conservation support for replacement of building materials etc.

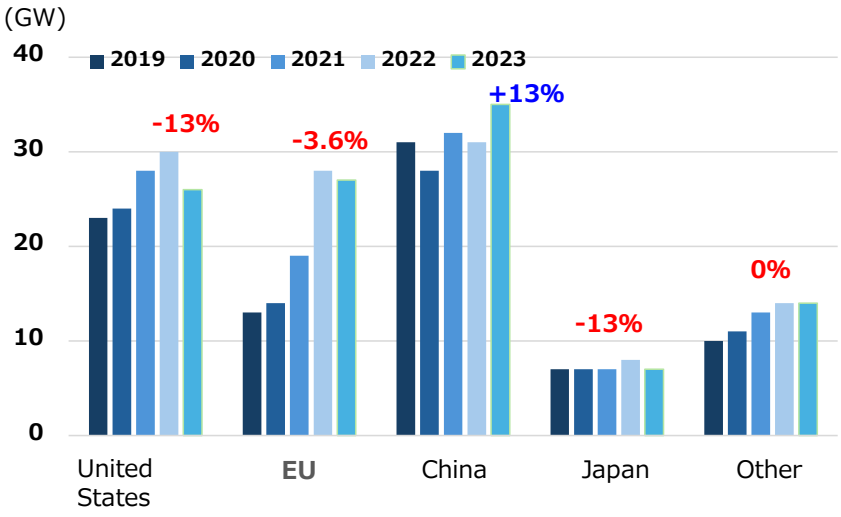
## Energy conservation investment

- Due to the impact of high interest rates, the slowdown in China's construction industry, and EU measures to reduce subsidies, etc., **energy conservation/electrification investment in buildings** declined year-on-year in 2024 after peaking in 2022
- Globally, heat pump unit sales **declined 3%** in 2023

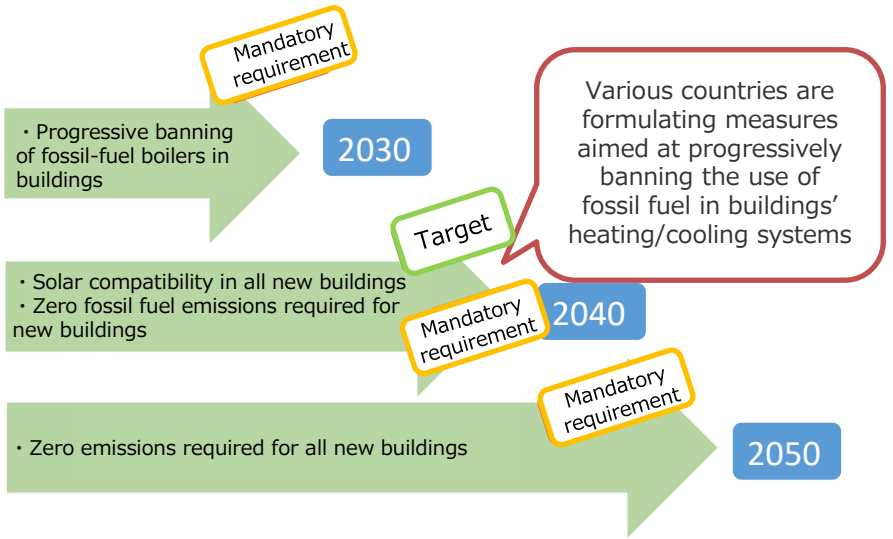
## Energy conservation policy

- In the EU, there is a move to **reform/strengthen energy performance disclosure systems and renovate/strengthen existing buildings** (Energy Performance of Buildings Directive, April 2024)
- In China, **support** has begun for **replacing** building materials and equipment (2024 onwards, Action Plan for Promoting Replacement of Products For Large-Scale Facility Renewal and Consumers)

**Global trends in heat pump unit sales**




**Key points of the EU's revised Energy Performance of Buildings Directive**




Source: Created from IEA data

# Energy conservation in the private sector
# Development of systems for enabling improved efficiency at data centers

- As of March 2024, there were around 10,655 data centers worldwide, **around half of these being in the United States.**
- The percentage of total electricity demand in 2026 coming from data centers is forecast to grow to **6% for the United States, 5% for the EU, and 3% for China,** according to the IEA (IEA Electricity 2024)
- In Japan, the data center industry was added to **the scope of the energy conservation benchmark system in 2022.**

| Country | Initiatives aimed at improving data center efficiency |
|---|---|
| EU | • The EU has made **annual information disclosure on the energy consumption and efficiency performance of data centers mandatory** for the owners and administrators of **data centers of 500kW and above** (Amended Energy Efficiency Directive)<br>• Going forward, an EU-level database will be built/made public<br>• **Further measures for introducing minimum performance standards etc.** will be considered going forward |
| Germany | • Germany has made it mandatory for data center operators to **make information public and submit it to federal governments.** It has also set out requirements for data center efficiency, including power usage effectiveness (PUE) standards and the use of waste heat |
| China | • China **stepped up its PUE targets** for newly established and existing data centers (July 2024)<br>• China will also establish **advanced standards** for average PUE and energy efficiency per unit of power calculated for all data centers across China by 2030 |

| | Power usage effectiveness (PUE) |
|---|---|
| **Japan** | **1.4 or less (BM target, 2030)** |
| **Germany** | **1.5 (2027) or less<br>1.3 (2030) or less<br>1.2 (for new centers, 2026) or less** |
| **China** | **1.5 (2025) or less<br>1.25 or less (for new centers and additions to facilities, 2025)** |

Note: The Japanese figure is the level that operators must aim towards as a benchmark for energy conservation. It is a target value for operators, not for individual data centers. The regulation values in Germany and China are for individual data centers.

Sources: Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation 2023/955 (EU) (recast); Gesetz zur Steigerung der Energieeffizienz in Deutschland (Germany); "Special Action Plan for the Green and Low-Carbon Development of Data Centers" (China)

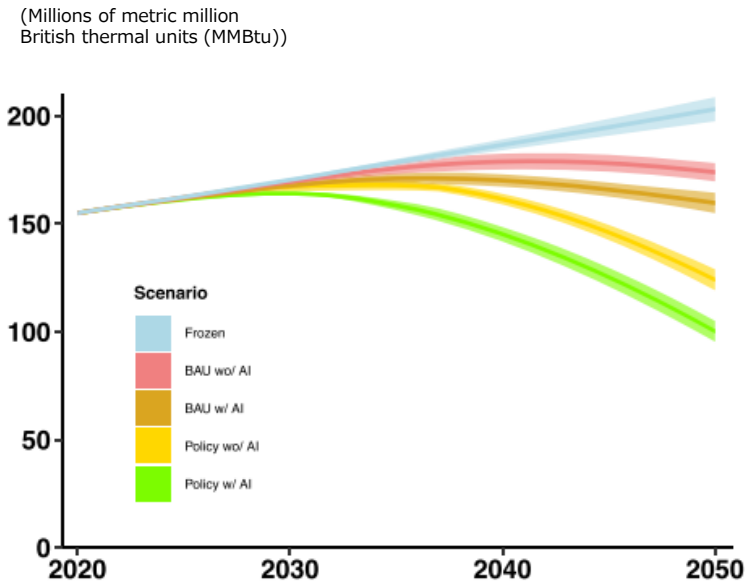
# Can the use of AI/digital technology help conserve energy? Or does it increase consumption?

- While attention has been focused on the increase in electricity demand due to the use of AI, research and demonstrations on the use of AI and energy conservation are also progressing around the world.
- There are also studies suggesting that the use of AI clouds could reduce energy consumption and $CO_2$ emissions of commercial buildings in the United States by 8%-19% in 2050 compared to BAU levels (Chao Ding et al., 2024).

**Examples of energy conservation efforts that use AI**

| | |
|---|---|
| **Manufacturing** | ・Among iron/steel manufacturers, the use of AI to predict the optimal manufacturing method for each batch has cut the use of steel agents by 8% and $CO_2$ emissions by 7.5% |
| **Buildings** | ・The introduction of building optimization solutions has reduced power consumption by 30% and heat by 42% |
| **Road transportation** | ・The use of AI to optimize the charging schedules for EVs can alleviate the load on the grid and extend battery lifespans |
| **Electrical systems** | ・Predicting electricity demand patterns etc. in terminals such as EVs and household electrical devices including lighting and air-conditioning systems, and using settings in such devices that improve efficiency can enable energy conservation |

**Potential for energy conservation in commercial buildings through use of AI (United States)**

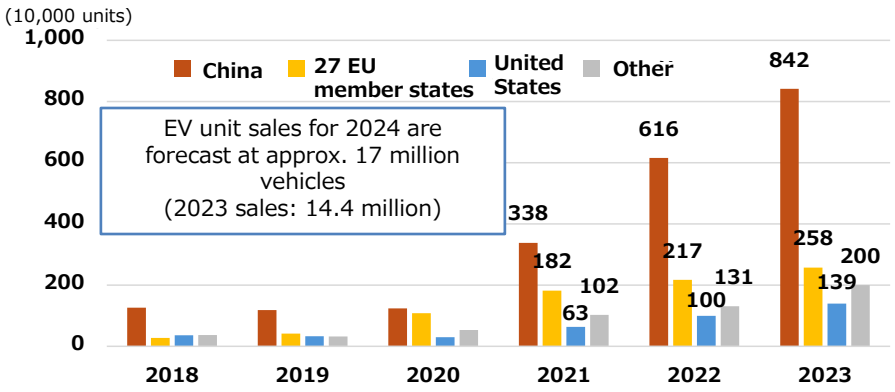


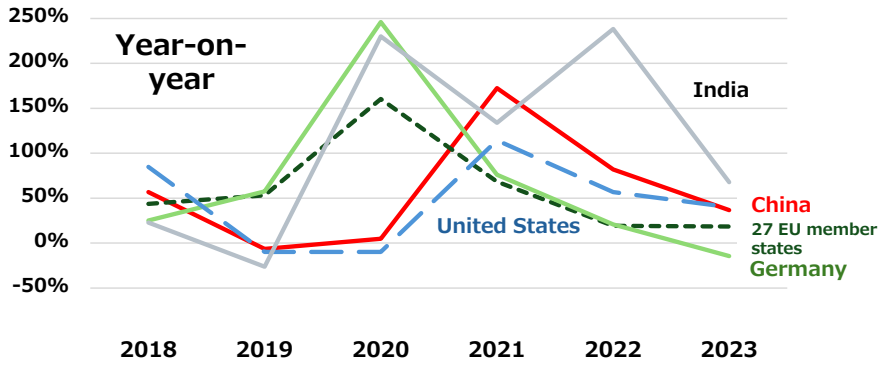

Source: (Table on the left) "ICEF Roadmap" (2024) https://www.icef.go.jp/jp/roadmap/, UKGBC https://ukgbc.org/resources/building-optimisation-software-using-ai-and-digital-twins/; (Graph on the right) Chao Ding et al. Potential of artificial intelligence in reducing energy and carbon emissions of commercial buildings at scale. Nature Communications 15, 5916 (2024)

# There has been a slowdown in the rapid growth of global EV sales

## Energy conservation investment

### Global EV sales trends




## Energy conservation policy

- In France, subsidies have been reduced from 7,000 euros/vehicle to **4,000 euros in 2024.** In Germany, too, the 4,500 euro **subsidy** formerly provided for purchasing new EVs has been **abolished**
- The US Department of Transportation tightened its fuel economy standards for passenger vehicles and light delivery vehicles (LDVs) over model years 2027 to 2031 ⇒ **However, this could be reviewed under the Trump administration**

| | Corporate Average Fuel Economy (CAFE) standards (2026) |
|---|---|
| Obama (2012) | 48.7-49.7 mpg (20.7~21.1 km/ℓ) |
| Trump (2020) | 40.4 mpg (17.1 km/ℓ) |
| Biden (2022) (2024) | 49.1 mpg (20.8 km/ℓ) 50.4 mpg (2031) (21.4 km/ℓ) |

Source: Created from press release materials from the joint session (9th session) of the Automobile Fuel Economy Standards Subcommittee, Ministry of Economy, Trade and Industry (METI) (March 2024)

Note: "EVs" include battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell electric vehicles (FCEVs). Figures for 2024 are forecasts based on the actual performance in FY2024 Q1. Source: Created from "Electric car sales (2012-2024)," in the Global EV Data Explorer, IEA

# Japan: Transition from fossil fuels in the industrial sector, and mandatory energy conservation standards for new homes

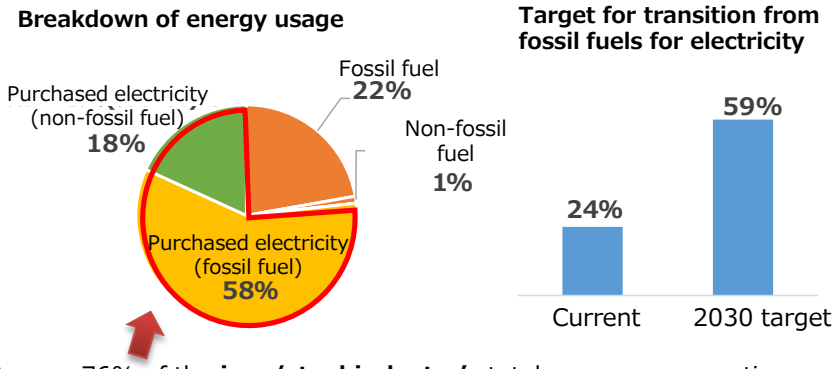
| Report on targets for the transition from fossil fuels | April 2024 |
|---|---|

- Based on the 2022 amendment of the Act on Rationalizing Energy Use (which came into force in April 2023), **Japan has stepped up measures for promoting the transition away from fossil fuels on the demand side** ⇒ The greatest challenge will be **ensuring stable procurement of renewable energy**

| Start of building energy conservation performance disclosure | April/November 2024 |
|---|---|
| Raising of energy conservation standards for large-scale non-residential buildings | April 2024 |

- **From April 2025, all new residences and buildings** must **comply with energy conservation standards** as a general principle ⇒ **The challenge, therefore, is the renovation of existing buildings**

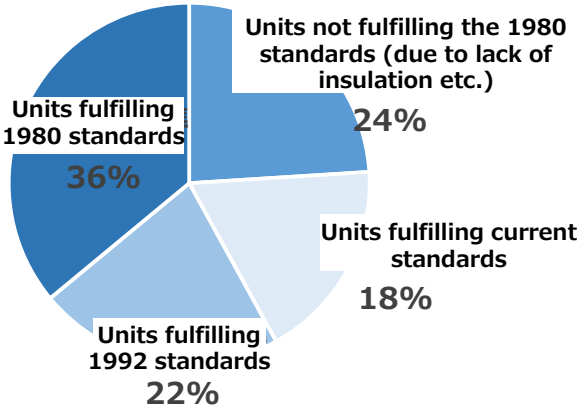
**Iron/steel industry (electric furnaces)**




Approx 76% of the **iron/steel industry's** total energy consumption consists of electricity **(for electric furnaces)** for regular steel, and approx. 57% when producing specialty steels.

Source: Created from "Measures Based on the Amended Act on Rationalizing Energy Use, 4th Session of the Working Group on EC Guideline for Factories etc., (2022)" Agency for Natural Resources and Energy (23 December 2022)

**Insulation performance of the housing stock (approx. 54 million units) (As of FY2022)**



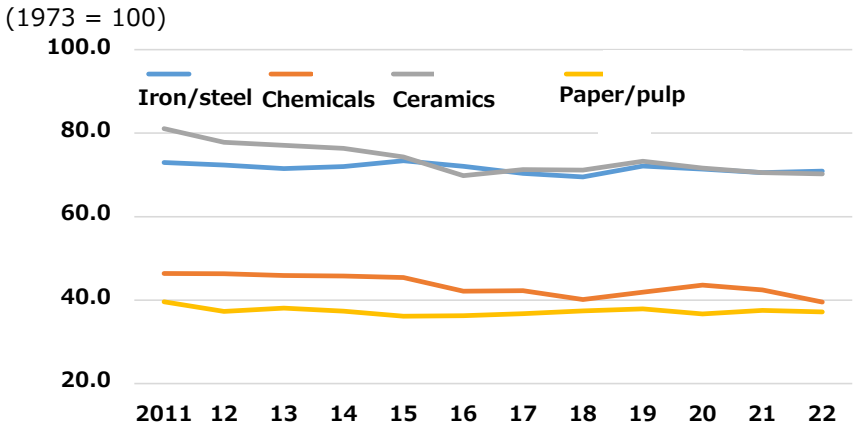

Source: Created from interview materials, Japan Federation of Housing Organizations, Energy Efficiency and Conservation Subcommittee (Session 46), METI (September 2024)

# Japan: 2025 discussion points for energy conservation/fossil fuel transition policy

## Industrial/business sector

- Supporting **business operators for whom improvements in energy efficiency have stalled,** among those operators who are subject to the Act on Rationalizing Energy Use (i.e. whose annual energy consumption is 1,500 kl or more)
- Promoting energy conservation efforts among **small and medium-sized enterprises**

**Energy intensity (IIP basis) for high-energy-consumption industries**




Source: Created from the EDMC Handbook of Energy & Economic Statistics in Japan, 2024 edition

## Household sector

- Developing concrete systems for encouraging **energy conservation in devices and a shift to non-fossil fuels**

(Setting and publicizing targets for water heaters)

- Promoting **demand response (DR) readiness** in household electrical devices: Water heaters, household storage batteries, vehicle-to-home (V2H) devices

## Transportation sector

- Discussion of **the various routes available,** combining widespread adoption/improvements to technology of electric vehicles (EVs, FCVs, PHEVs, and HEVs) with the use of biofuels/synthetic fuels
- Promoting **greater efficiency in logistics** through the use of digital technology

## Cross-sectoral initiatives

- Improving readability etc. of **disclosure sheets used in periodic reporting**
- Discussions on **activities not covered** by the Act on Rationalizing Energy Use (company vehicles, public vehicles etc.)



Contact: report@tky.ieej.or.jp