

The 7th IEA-Tsinghua Joint Workshop

“Achieving carbon neutrality pledges: The role of buildings”



Building Energy  
Research Center  
Tsinghua University



# Japan's Roadmap to Carbon Neutrality in the Building and Housing Sectors

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30 November 2021

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Ministry of Land, Infrastructure, Transport and Tourism

# GHG Emission Reduction Goals of Each Country

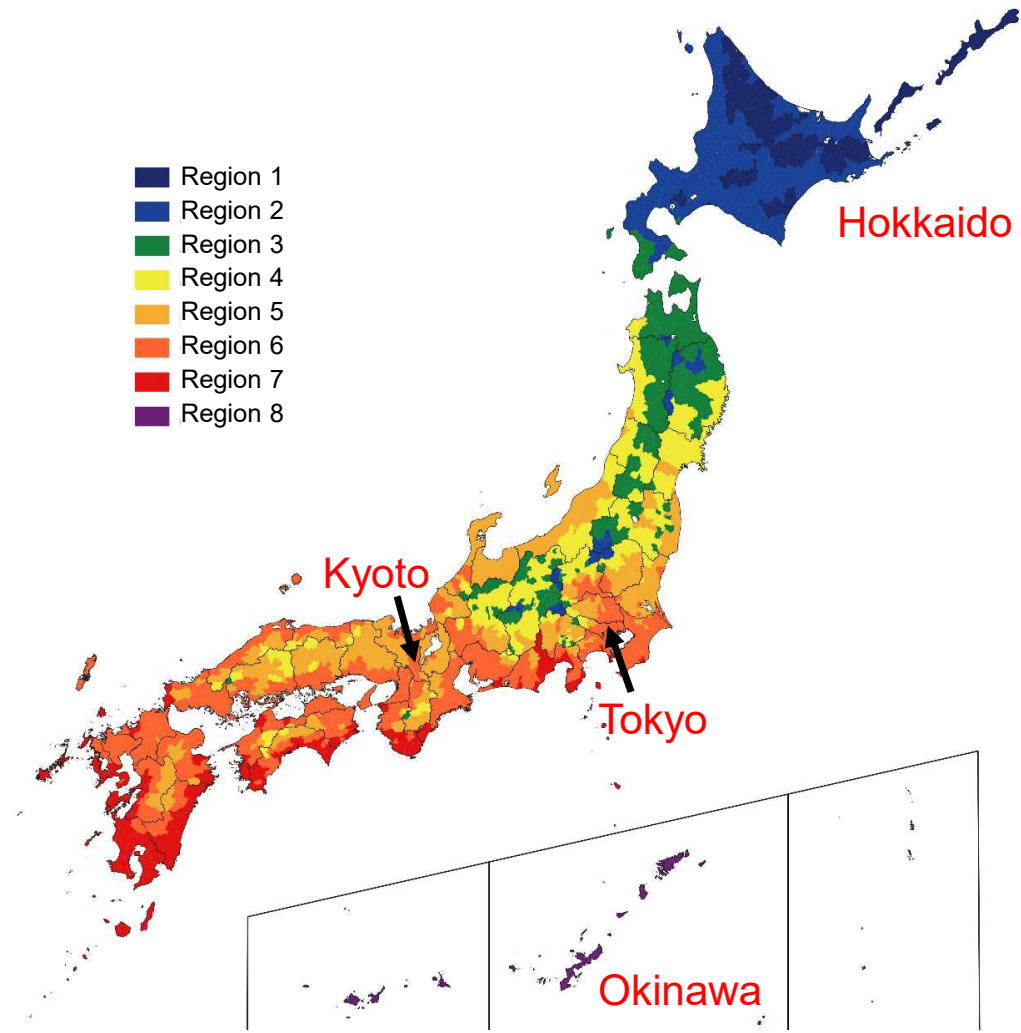
Country /Region	NDC (2030 goal)	Date of NDC submitted	Net zero by 2050
Japan	-46% (from 2013 level) Japan will continue efforts to meet the lofty goal of cutting its emission by 50%.	NDC submitted on 22 October 2021	Declared
China	(1) To reach peak CO <sub>2</sub> emissions before 2030 (2) To reduce CO <sub>2</sub> emissions per GDP by 65% or more (from 2005 level)	NDC submitted on 28 October 2021	Net zero CO <sub>2</sub> emissions by 2060
France, Germany, Italy, EU	-55% or more (from 1990 level)	NDC submitted on 18 December 2020	Declared
U.K.	-68% or more (from 1990 level)	NDC submitted on 12 December 2020	Declared
U.S.	-50 to -52% (from 2005 level)	NDC submitted on 22 April 2021	Declared
Canada	-40 to -45% (from 2005 level)	NDC submitted on 12 July 2021	Declared

Source: Compiled based on the website of UNFCCC and the Ministry of Foreign Affairs of Japan



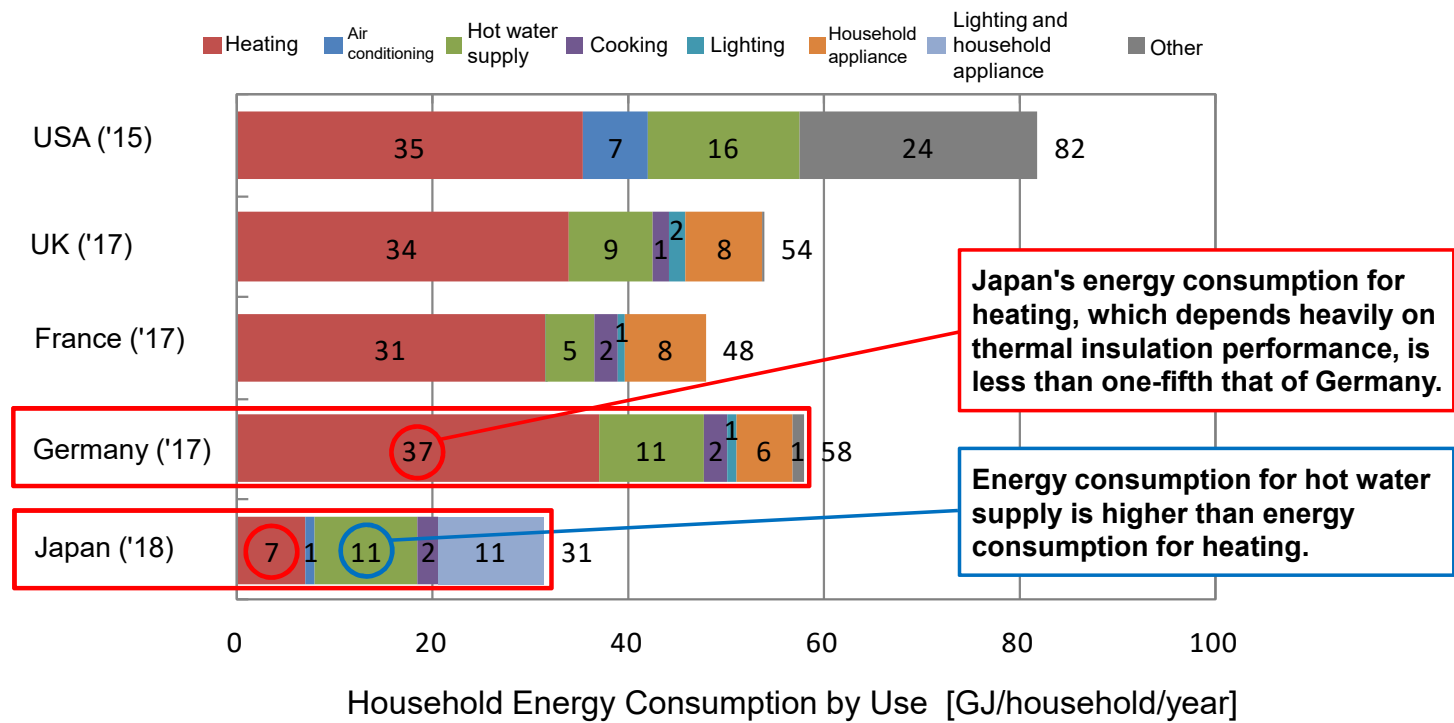
# Location of Japan on top of the European Map





# International Comparison of Household Energy Consumption (by Use)

- Consumption per household in Japan is about one-third of that in the U.S. and about half that in Germany and other European countries.
- Japan's energy consumption for "heating" is particularly low, while consumption of "hot water supply" is higher. While people in other countries heat/cool their homes continuously, most Japanese way of living is "intermittent heating/cooling". Most Japanese people, except for those in northern regions like Hokkaido, heat/cool their homes only when they are at home.



Japan's energy consumption for heating, which depends heavily on thermal insulation performance, is less than one-fifth that of Germany.

Energy consumption for hot water supply is higher than energy consumption for heating.

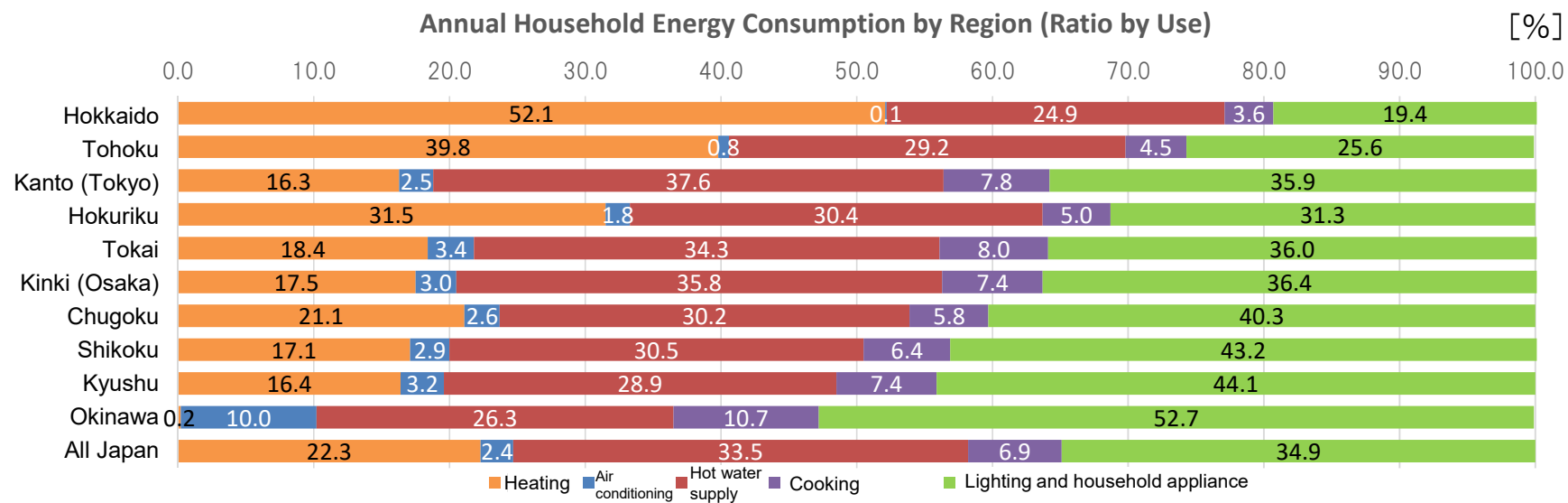
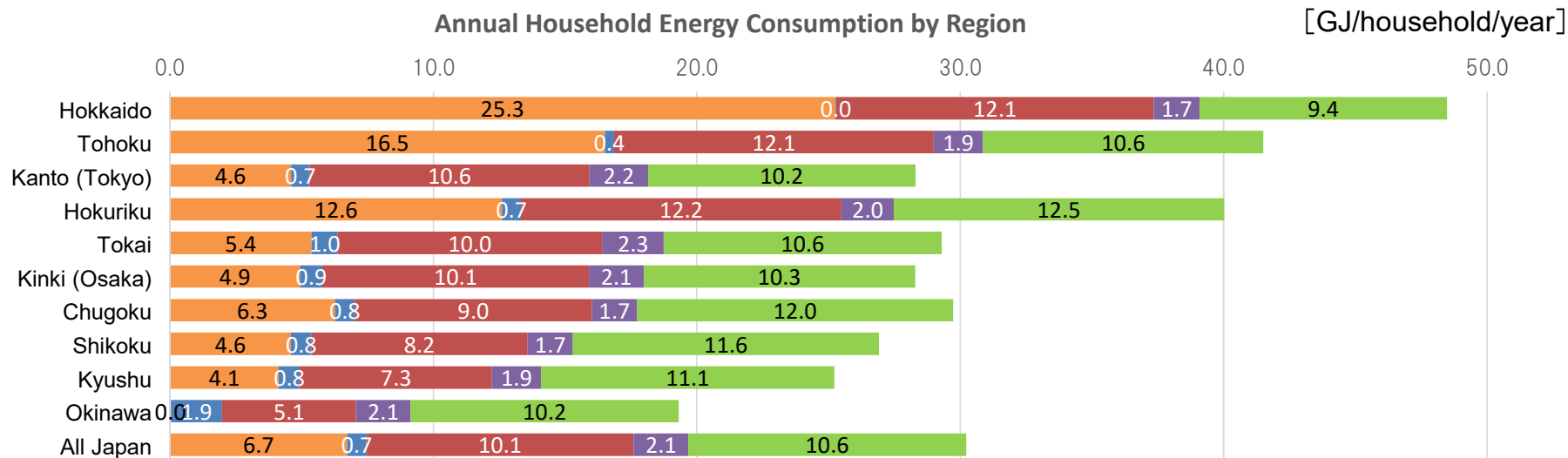


\* USA.(Other) includes cooking, lighting, and household appliances.

Source: Compiled by Jukankyo Research Institute Inc. based on statistical data from various countries



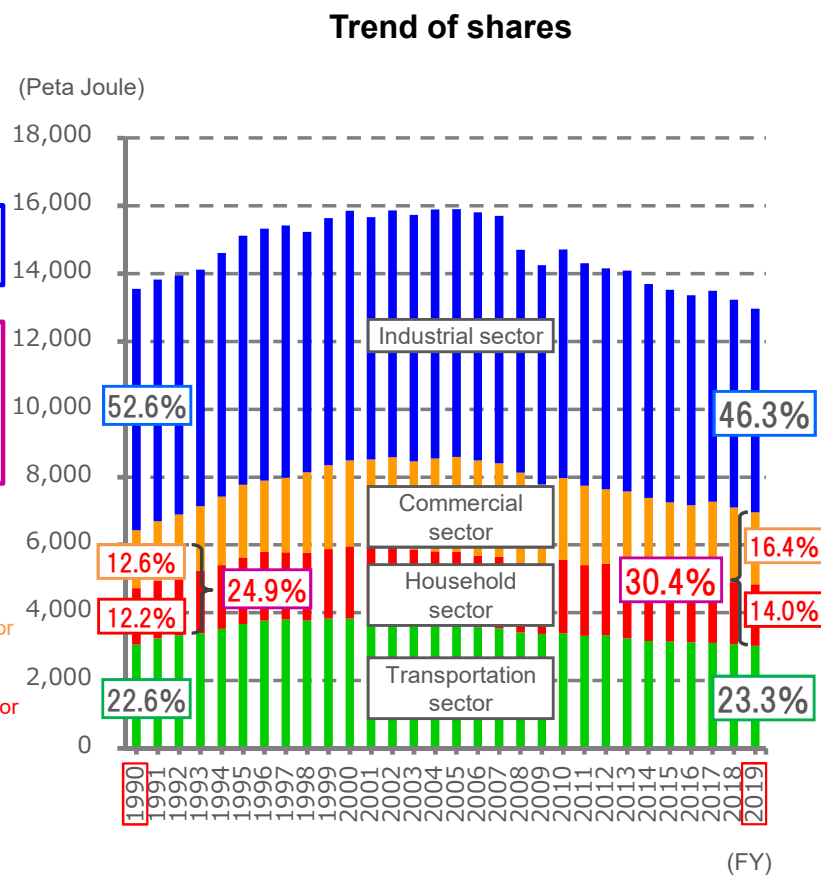
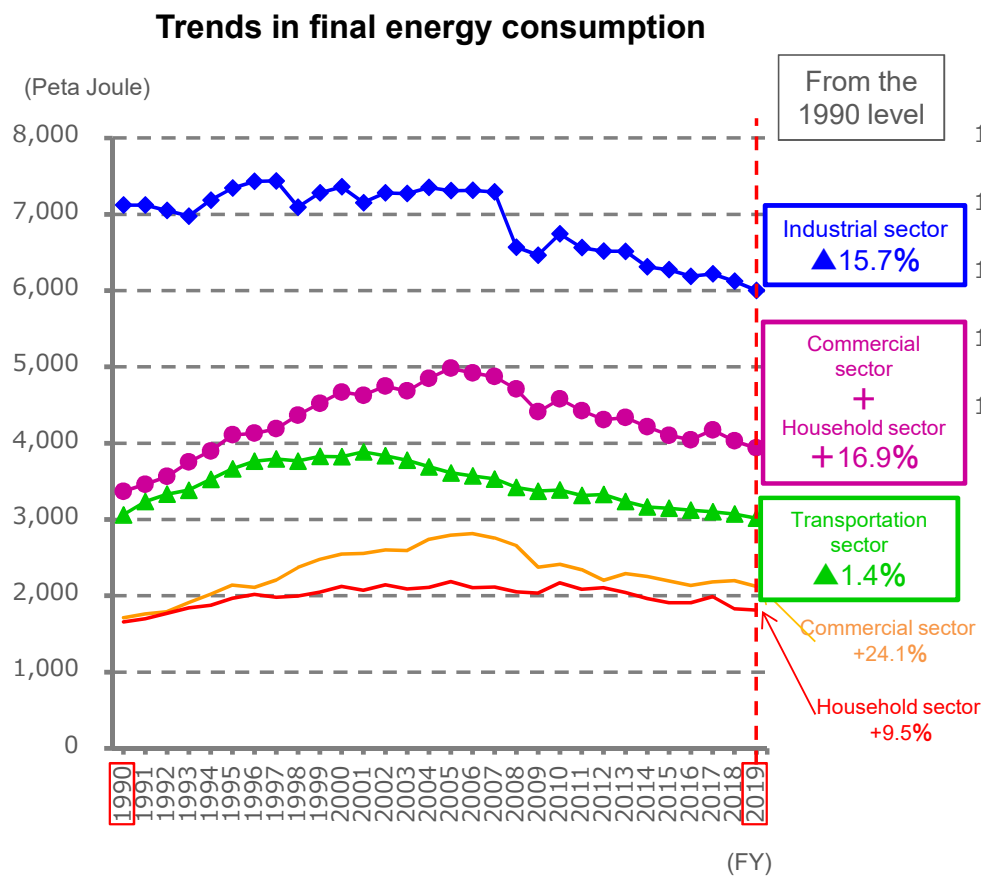
# Household Energy Consumption in Japan (by Region, by Use)



Source: Ministry of the Environment of Japan

# Trends in Japan's Energy Consumption by Sector

- While other sectors (industry and transportation) have decreased, energy consumption in the commercial and household sectors have increased significantly (16.9% from the 1990 level (left Figure)). They accounts for about 30% of total energy consumption (right Figure).
- Drastic reinforcement of energy-saving measures on houses and buildings is essential.



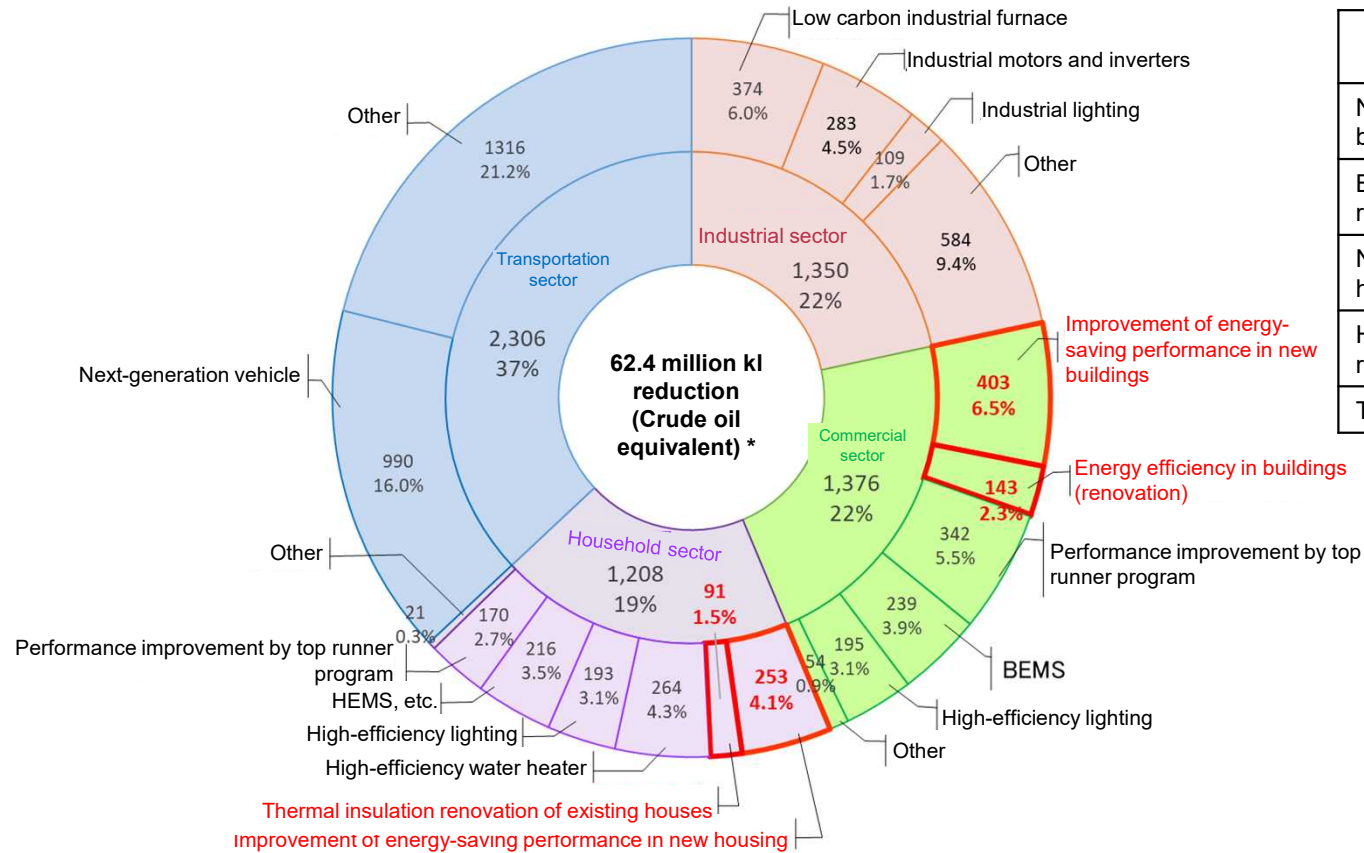
Source: Comprehensive Energy Statistics (ANRE)



# Japan's Reduction Targets in the New "Plan for Global Warming Countermeasures" 国土交通省

(decided by the Cabinet on October 22, 2021)

## ➤ Reduction targets in the field of houses and buildings



	Amount of reduction
Newly constructed building	403
Building renovation	143
Newly constructed housing	253
Housing renovation	91
<b>Total</b>	<b>889</b>

\* Total does not match due to rounding.

\* Reduction target of the previous Plan for Global Warming Countermeasures (May 2016): about 50.3 million kl

Source: Energy Demand and Supply Outlook for FY2030 (Sep. 2021) (Agency for Natural Resources and Energy)

# Regulatory Measures under the Building Energy Efficiency Act of Japan 国土交通省

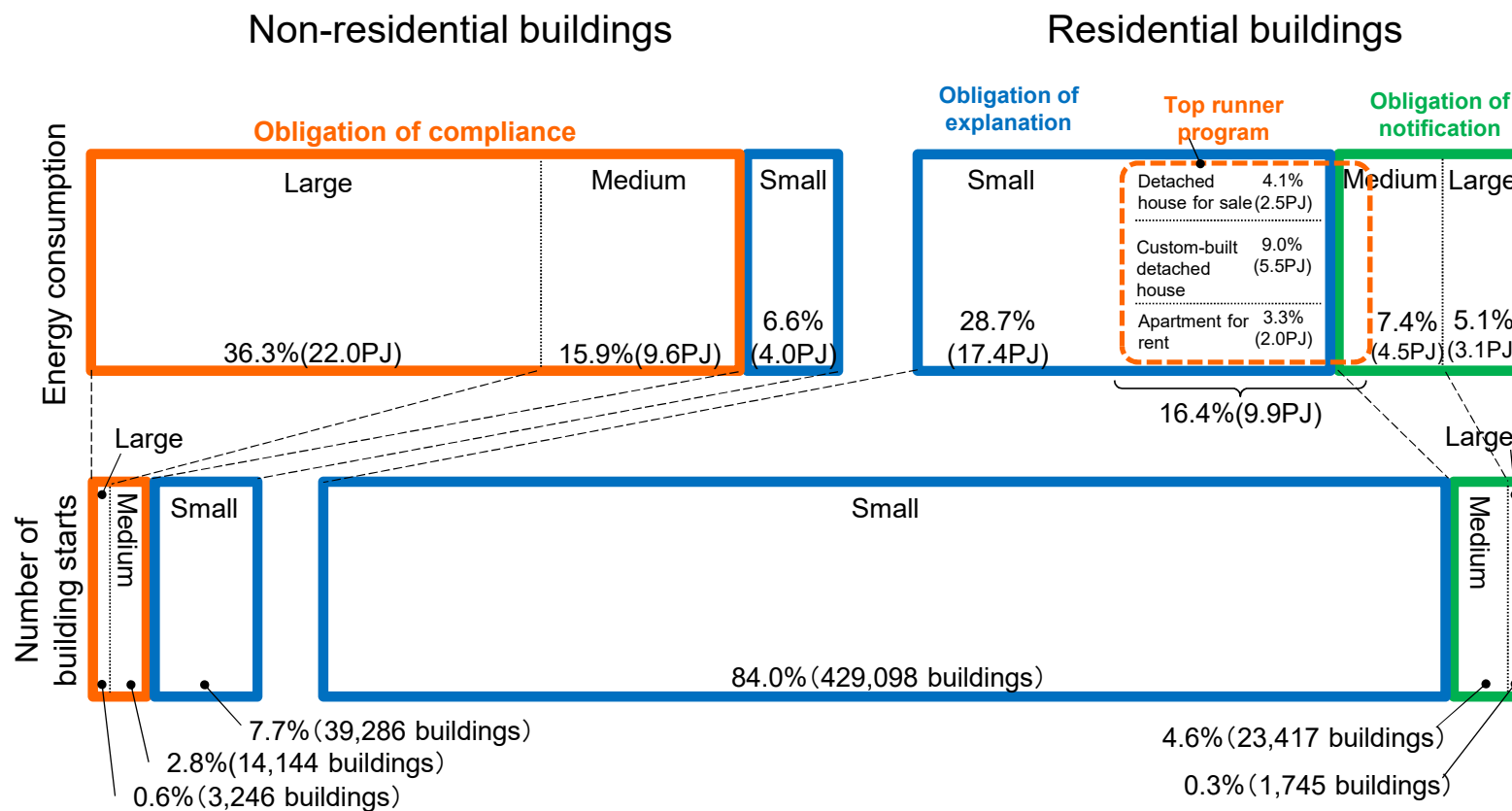
	Upon establishment of the Act (promulgated on July 2015)		After revision (promulgated on May 2019)	
	Non-residential	Residential	Non-residential	Residential
<b>Large</b> (2,000 m <sup>2</sup> or more)	<b>Specific building</b> Obligation of compliance [Linked to the building permission procedure]	Obligation of notification [Instruction, order, etc. to be issued when the standard is not met and issuance is deemed necessary]	<b>Specific building</b> Obligation of compliance [Linked to the building permission procedure]	Obligation of notification [Instruction, order, etc. to be issued when the standard is not met and issuance is deemed necessary]
<b>Medium</b> (300 m <sup>2</sup> or more but less than 2,000 m <sup>2</sup> )	Obligation of notification [Instruction, order, etc. to be issued when the standard is not met and issuance is deemed necessary]	Obligation of notification [Instruction, order, etc. to be issued when the standard is not met and issuance is deemed necessary]	<u>Obligation of compliance</u> [Linked to the building permission procedure]	<u>Streamlining the examination procedures in the competent administrative agency</u> ⇒ Focus on implementation of supervision (instruction, order, etc.)
<b>Small</b> (less than 300 m <sup>2</sup> )	Effort obligation [Improvement of energy-saving performance]	Effort obligation [Improvement of energy-saving performance]	Effort obligation [Compliance with the energy efficiency standards] + <u>Obligation of the architect to explain to the building owner</u>	Effort obligation [Compliance with the energy efficiency standards] + <u>Obligation of the architect to explain to the building owner</u>
	Owner-occupied house	Top runner program* [Compliance with the top runner standards] Target housing Detached house for sale	Top runner program* [Compliance with the top runner standards] + <u>Obligation of the architect to explain to the building owner</u> Expansion of the target Target housing Owner-occupied house: Detached house for sale, Custom-built detached house House for rent: Apartment for rent	Top runner program* [Compliance with the top runner standards] Expansion of the target Target housing Owner-occupied house: Detached house for sale, Custom-built detached house House for rent: Apartment for rent

To be revised to mandate compliance for all buildings!

\* If it is deemed necessary to improve the energy-saving performance of a major housing developer to a considerable extent, such as insufficient compliance with the top runner standards, the developer will be subject to the recommendation, order, etc. by the Minister of MLIT.

# Relationship between Energy Consumption and the Number of Building Starts (by Use, by Size)

➤ The number of buildings subject to the obligation of compliance accounts for 3.4% of the total number of building starts (0.6% for large buildings and 2.8% for medium buildings), but their energy consumption accounts for 52.2% of the total energy consumption (36.3% for large buildings and 15.9% for medium buildings).



\* Estimated by assuming that the average energy intensity of buildings is 878 MJ/m<sup>2</sup>/year, and average energy intensity of houses is 344MJ/m<sup>2</sup>/year, based on the 2017 Energy and Economy Statistical Abstract and the 2017 Statistics on Building Starts.

# Number of Buildings subject to Mandatory Compliance

➤ At present, the total number of large and medium-size non-residential buildings for which the building permission procedure is linked, and subject to mandatory compliance, is about 14,000, while the total number of small non-residential and residential buildings is about 445,000.

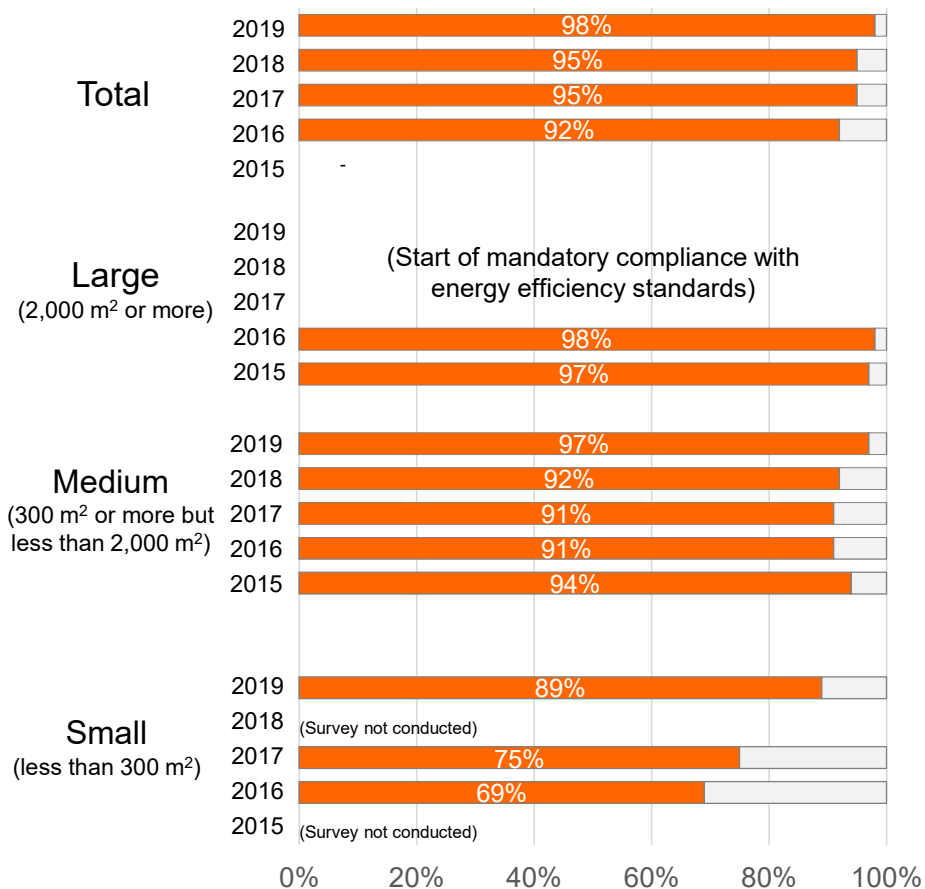
	Non-residential building	Residential building
<b>Large-size</b> (2,000 m <sup>2</sup> or more)	<b>Obligation of compliance</b> About 3,000 buildings	<b>Obligation of notification</b> About 18,000 buildings
<b>Medium-size</b> (300 m <sup>2</sup> or more, less than 2,000 m <sup>2</sup> )	About 11,000 buildings	About 18,000 buildings
<b>Small-size</b> (Less than 300 m <sup>2</sup> )	<b>Obligation of the architect to explain compliance</b>	
	About 32,000 buildings	About 395,000 buildings
	To be linked to the building permission procedure except for single-story houses, etc.	

Note: The number of buildings in the table is the number of new construction starts in FY2020.

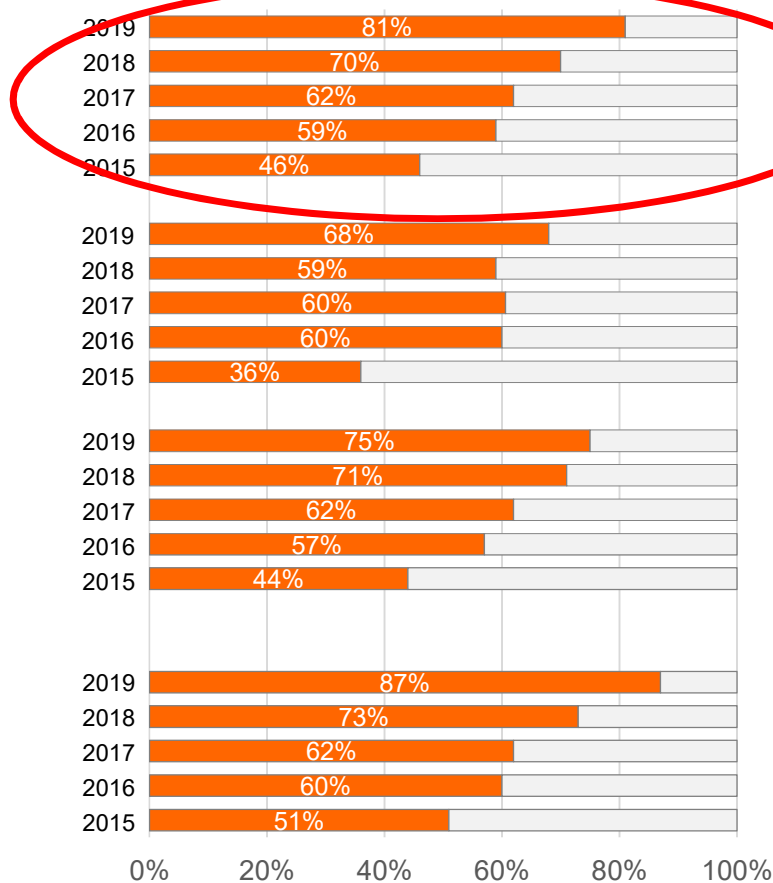
# Rate of Compliance with Energy Efficiency Standards (by Size)

➤ The rate of compliance with energy efficiency standards for newly constructed housing has been rising year by year, and the rate of compliance in total housing exceeded 80% in FY2019.

## Non-residential buildings



## Residential buildings



\* Calculated in the same manner as the FY2015 standard compliance rate in the Summary of the workshop on the actual state of energy consumption performance in housing and buildings (March 30, 2018).

# Outline of the Energy Efficiency Standards for Buildings in Japan

➤ The Japanese energy efficiency standards for buildings are the standards that are necessary to ensure the energy-saving performance required for buildings as well as building equipment. They consist of two standards: “primary energy consumption” standards and “envelope insulation” standards.

## Primary energy consumption standards (Apply to both residential and non-residential buildings)

**Primary energy consumption shall be equal to or less than the standard value.**

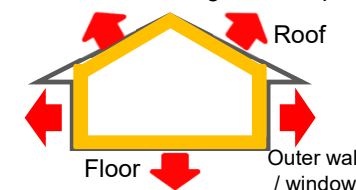
- \* "Primary energy consumption"
  - = Air conditioning energy consumption
  - + Ventilation energy consumption
  - + Lighting energy consumption
  - + Hot water supply energy consumption
  - + Elevator energy consumption
  - + Other energy consumption (OA equipment, etc.)
  - Energy creation by solar power generation equipment, etc. (limited to self-consumption)

## Envelope insulation standards (apply only to residential buildings)

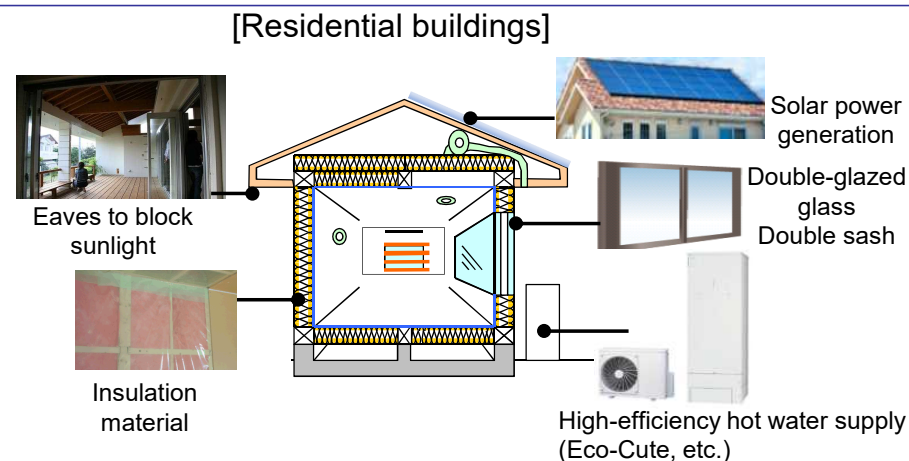
**Heat loss per surface area of the “envelope” (outer wall, window, etc.), or envelope average heat transmission coefficient, etc. shall be equal to or less than the standard value.**

\* Envelope average heat transmission coefficient  
= Total heat loss / Envelope surface area

<Image of heat loss through “envelope”>

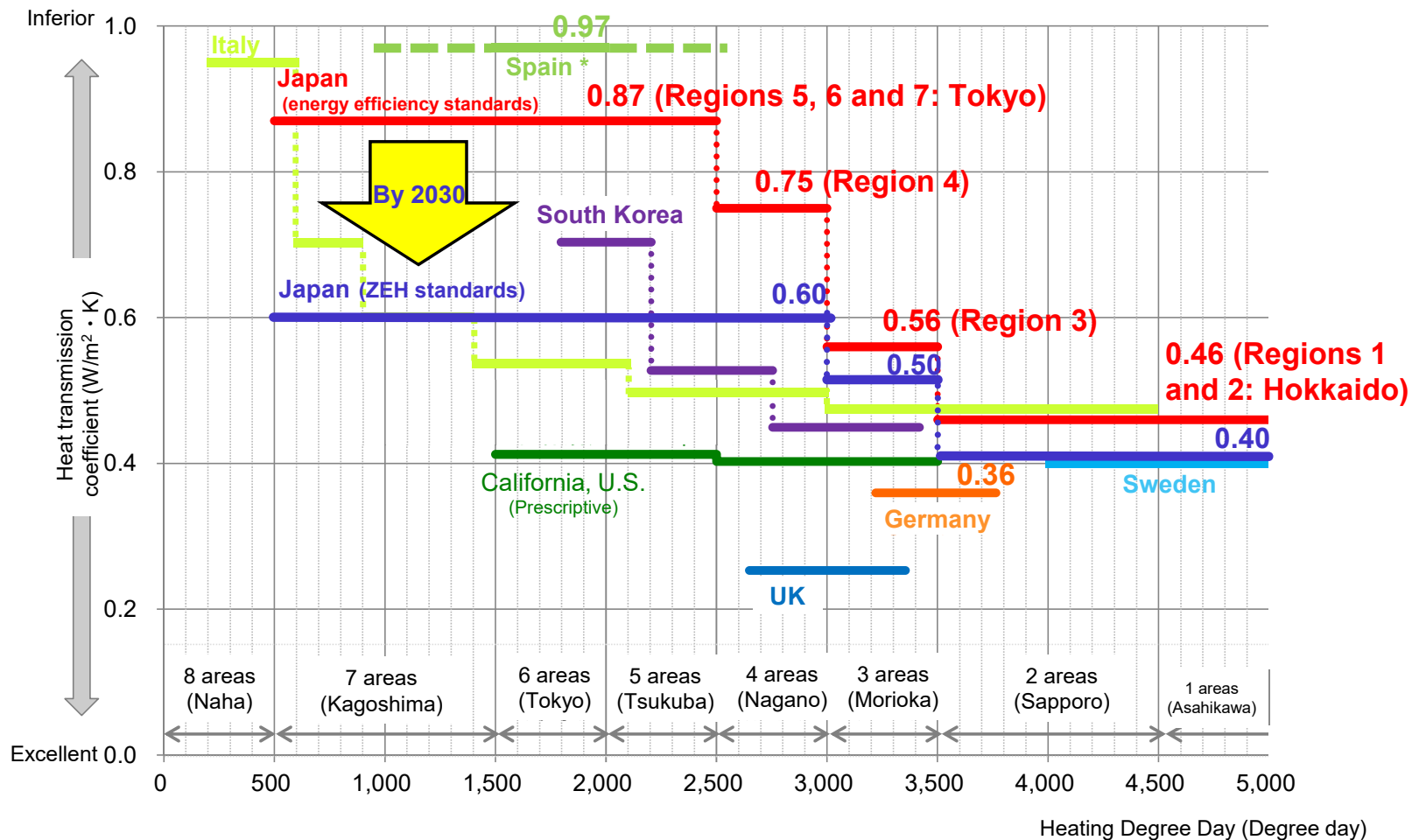


## Examples of initiatives to improve energy-saving performance





# International Comparison of the Envelope Average Heat Transmission Coefficient Standards (UA Value) for Residential Buildings



Source: FY2014 Commissioned research by the MLIT

"Commissioned research on energy efficiency regulations, standards, etc. in overseas housing and buildings.

\* Compiled by Nomura Research Institute based on the energy efficiency standards for homes in various countries.

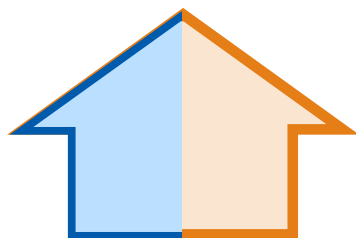
\* The MLIT made addition to the standards for Spain and Sweden.

\* Created in consideration of heating degree days (degree day) in Madrid.

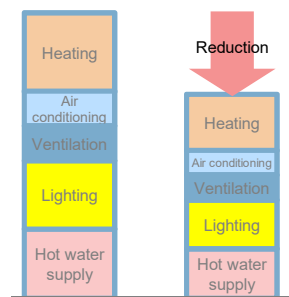
# Definition of ZEH (Net Zero Energy House) in Japan

➤ **"ZEH" is defined as "a house in which energy consumed per year is approximately zero or less on a net basis by striving to save as much energy as possible through high envelope insulation and high efficiency equipment in the house while maintaining a comfortable indoor environment, and by creating energy through solar power generation and other means."**

(1) High envelope insulation



(2) High efficiency improvement of equipment, etc.



(3) Energy creation



## Envelope insulation standards

### High envelope insulation standards that are stricter than the energy efficiency standards

(Standards for the envelope average heat transmission coefficient)

Regional classification	Regions 1 and 2 (Sapporo, etc.)	Region 3 (Morioka, etc.)	Regions 4 (Nagano, etc.)	Regions 5, 6 and 7 (Tokyo, etc.)
ZEH standards	0.4	0.5	0.6	0.6
Energy efficiency standards	0.46	0.56	0.75	0.87

## Primary energy consumption standards

High efficiency improvement of equipment, etc.

(Energy creation)

### 20% reduction from the energy efficiency standards

Without considering the energy creation by solar power generation, etc.

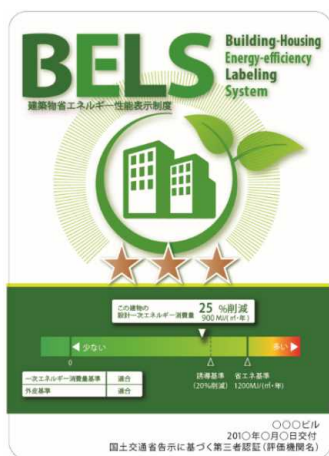
### Reduce primary energy consumption to net zero or less

Taking into account the energy created by solar power generation, etc., including the surplus electricity sold,

# Energy-Saving Performance Indication System

- In order to indicate excellent energy-saving performance in houses and buildings, the Building-housing Energy-efficiency Labeling System (BELS) is operated as a system that conforms to the guidelines based on Article 7 of the Act.
- Indicated in five levels according to energy-saving performance through evaluation by a third party.

## BELS (Building-housing Energy-efficiency Labeling System)



Records of BELS (as of the end of July 2021)

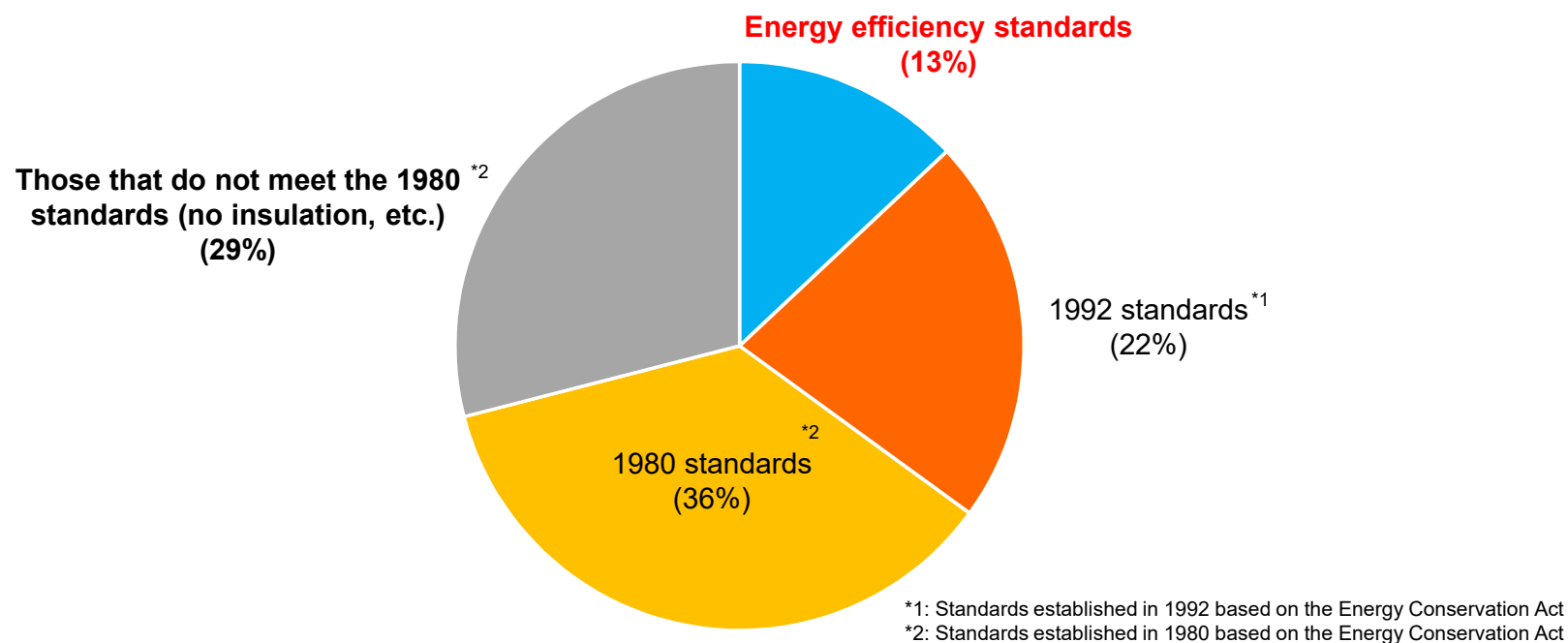
Building type	Number of type
Detached housing	130,577
Residential complex	31,440
Non-residential building	2,195
Total	164,212

Item	Overview
System management entity	<b>Housing Performance Evaluation and Labeling Council (General Incorporated Association (GIA))</b>
Target buildings	<b>Newly constructed</b> and <b>existing houses and buildings</b>
Evaluation target	<b>Energy-saving performance at time of design</b> for entire building *Depending on the evaluation method, floor unit, etc. is also possible.
Evaluator	<b>Third-party evaluation by evaluation organization</b> Evaluator: <b>First-Class Registered Architects, Building Service Engineers, etc.</b> who have <b>taken and completed training</b> held by a third-party
Evaluation indices (Primary energy)	<ul style="list-style-type: none"> <li>• <b>Primary energy consumption</b> and <b>BEI</b> (Building Energy Index)</li> <li>= <b>Design primary energy / Standard primary energy</b></li> </ul>

# Thermal Insulation Performance of Housing Stock

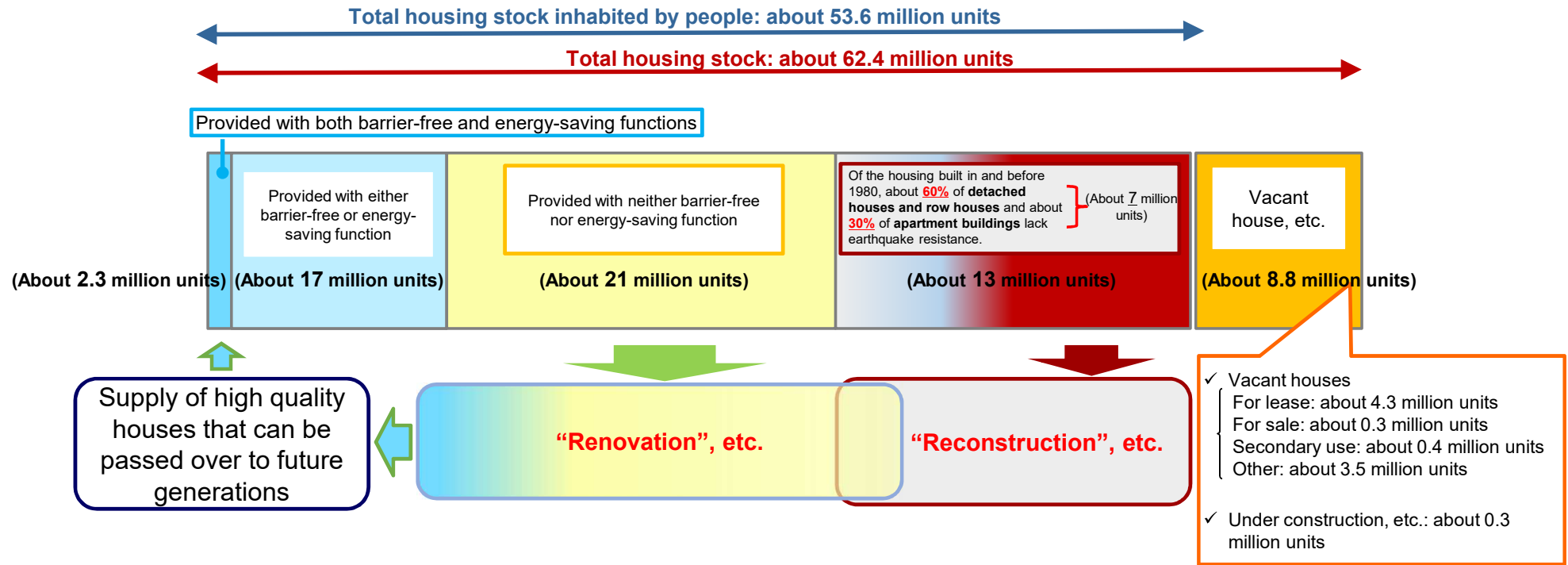
- As of FY2019, about 13% of the total housing stock (about 50 million units) complies with the energy efficiency standards, and about 29% of the total housing stock is uninsulated.
- According to the Housing and Land Survey (2018), the actual number of thermal insulation renovations for the housing stock in less than five years from January 2014 to October 2018 was about 720,000 units.

## Thermal insulation performance of housing stock (about 50 million units)



Source: Calculated based on the distribution of housing stock by performance according to the MLIT survey, reflecting the number of renovations according to the Housing and Land Survey and the estimated number of newly constructed housing units by performance based on business operator's questionnaire, etc. (FY2019).

- Of the stock of housing inhabited by people in Japan, about 13 million houses were built before 1980, and many of them are insufficient in energy-saving performance as well as anti-seismic performance, etc. Therefore, the performance of these houses needs to be improved through reconstruction, etc.
- Promote the supply of high-quality houses that can be passed over to future generations, while responding to various needs of the public for housing in new and existing housing as a whole.

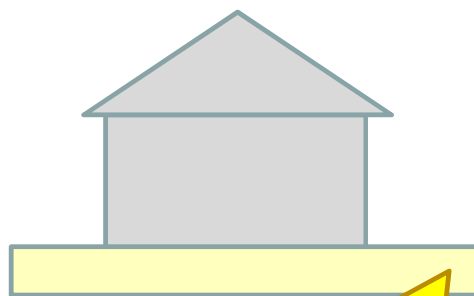


Source: 2018 Housing and Land Survey (Ministry of Internal Affairs and Communications)

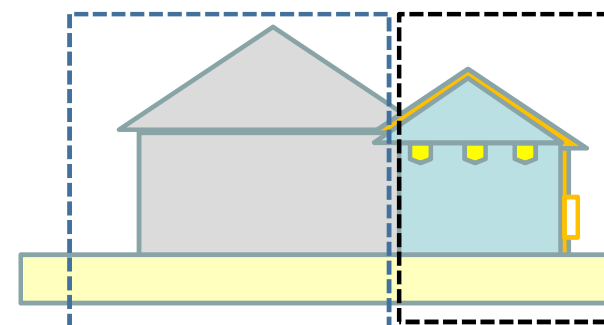
# How to Promote Energy Saving in Existing Building Stock?

- Considering the expensive cost of energy efficiency renovation in the existing building stock, it may be appropriate to apply regulatory measures only to parts of building renovations.
- If the Act mandates compliance for existing parts of buildings as well, building owners may give up renovations, which we call a **“freezing effect”**. In addition, we are also planning to gradually upgrade energy efficiency standards in the future.
- Therefore, as for the existing parts, Japan would like to promote energy efficiency renovations by taking all possible support measures such as subsidies, taxation, and low interest loans, etc. instead of requiring the mandatory compliance.

Before addition, etc.



After addition, etc.



**Mandatory compliance may cause a “freezing effect”!**

**Strengthen support measures such as subsidies, taxation, low interest loans, etc.**

**Obligation of compliance**

*\*If the Act mandates compliance for existing parts, it would not be easy to provide support measures for such renovations.*



## Conclusions (Future Policies for Building Energy Efficiency in Japan)

- For energy-saving measures on housing and buildings, the Building Energy Efficiency Act was established in 2015 to achieve the reduction target based on the Paris Agreement. The Act was revised in 2019 and the measures to achieve the target had been sequentially strengthened.
- Since April this year, we have been considering the direction of strengthening energy-saving measures in the housing and building sectors. We have provided a roadmap for strengthening measures based on this consideration. The new “Plan for Global Warming Countermeasures” also includes the following:
  - **Strengthen the Building Energy Efficiency Act**
    - ✓ Mandatory compliance with the energy efficiency standards for all the newly constructed buildings, including residential buildings, by FY2025.
    - ✓ Gradual upgrade of the energy efficiency standards to the level of ZEH/ZEB standards by FY2030 at the latest.
    - ✓ Strengthen the display/indication of the energy-saving performance of residential and non-residential buildings when they are sold or leased.
    - ✓ Other measures (Note: Existing buildings should be supported by all possible support measures!)
  - Promote introduction of renewable energy (by financial incentives, etc.)
    - ✓ Install solar power generation equipment for 60% of newly constructed detached houses by FY2030. (The target is set by the new “Plan for Global Warming Countermeasures”)

The image shows the interior of a modern building, likely a city hall, featuring a prominent wooden ceiling with exposed beams and a grid of recessed lighting. The walls are a mix of wood and light-colored panels. In the background, there is a reception desk and some seating areas. The overall atmosphere is warm and contemporary.

ありがとうございました！  
Thank you very much!  
Merci beaucoup!  
謝謝！