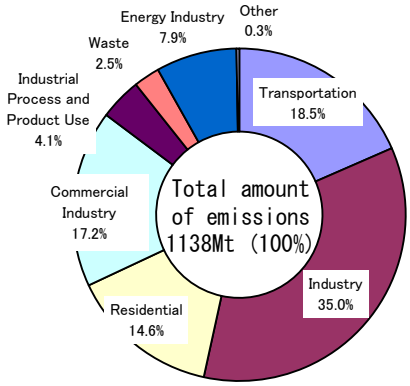
3-1 Mitigation of Climate Change

Associate Professor, Tokyo Institute of Technology
Yasunori Muromachi

Japan's total greenhouse gas emissions in fiscal 2018 were 1.240 billion tons, a 3.9% decrease from 2017 and a 12.0% decrease from 2013. The transportation sector's share of CO_2 emissions was 18.5%. The transportation sector's global warming countermeasure plan is in progress, and for most of these measures, target levels are expected to be achieved. However, the reduction rate in the transportation sector is -6% in 2018 compared the required -27% in 2030 under the Paris agreement. It is not easy to achieve the Paris Agreement and long-term goals, and necessary to strengthen measures.

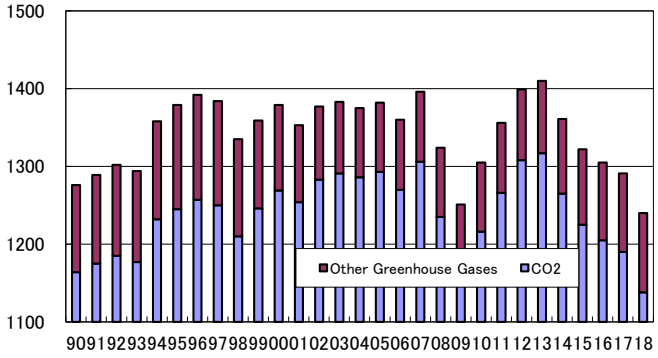
Figure 1 Breakdown of CO_2 Emissions by Sectors (FY2018)

■ About 18.5% of the total emissions derived from the transportation sector.



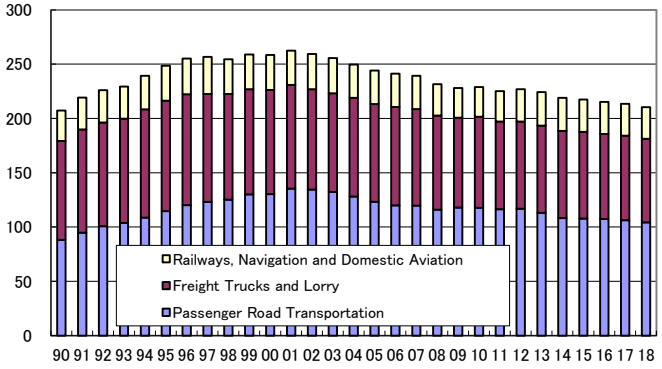
Source: Ministry of the Environment, 2020

Figure 2 Changes in the Amounts of Greenhouse Gas and CO_2 Emissions in Japan (Mt)



Source: Ministry of the Environment, 2020

Figure 3 Changes in the Amount of CO_2 Emitted from Transportation Sector (Mt)



Source: National Institute for Environmental Studies, 2020

Table 1 Long-term Strategy as a Growth Strategy Based on the Paris Agreement (Adapted Excerpt)

Chapter 1: Basic concept

2. Japan's long-term vision

・Japan will set a "decarbonized society" as the final goal and aim to achieve it with ambition as early as possible in the latter half of this century. To that end, we have set a long -term goal of reducing greenhouse gas emissions by 80% by 2050, and wi ll boldly implement measures to achieve that goal.

Chapter 2: Long-term vision of each sector and direction of measures and plans for it

Section 1: Emission reduction measures and plans

3. Transportation

(1) Current situation recognition

I. Status of the transportation sector
II. Structural changes in the automobile industry
III. Active contribution to climate change measures related to automobiles
IV. Trends in reducing greenhouse gas emissions in international shipping and aviation

(2) Vision to aim for

- It is important to evaluate CO_2 emissions from automobiles, including the process of manufacturing gasoline, electricity, etc., from the perspective of "Well to Wheel."
  The aim is to reduce greenhouse gas by 80% per Japanese automobile supplied worldwide compared to 2010.

(3) Direction of measures and plans for the vision

I. Basic policy of challenge for Well to Wheel Zero Emission
- Large vehicles (trucks/buses) are mainly used for commercial purposes, so there is a strong demand for "equal usability of existing vehicles" and "securing economic advantage", and given the current battery price and volume energy density, it is difficult to draw a sustainable diffusion model at this stage because it is not possible to secure economic efficiency simply by replacing the power source of existing vehicles with batteries.

II. Road/traffic system
- While recognizing that so-called induced/diverted traffic may occur with road construction, the efforts of strengthening the trunk road network such as ring roads that contribute to CO_2 emission control, and of taking pinpoint measures for congestion bottleneck locations based on scientific analysis of big data using ETC2.0 and AI cameras etc. are promoted for using roads wisely.

III. Long distance modes

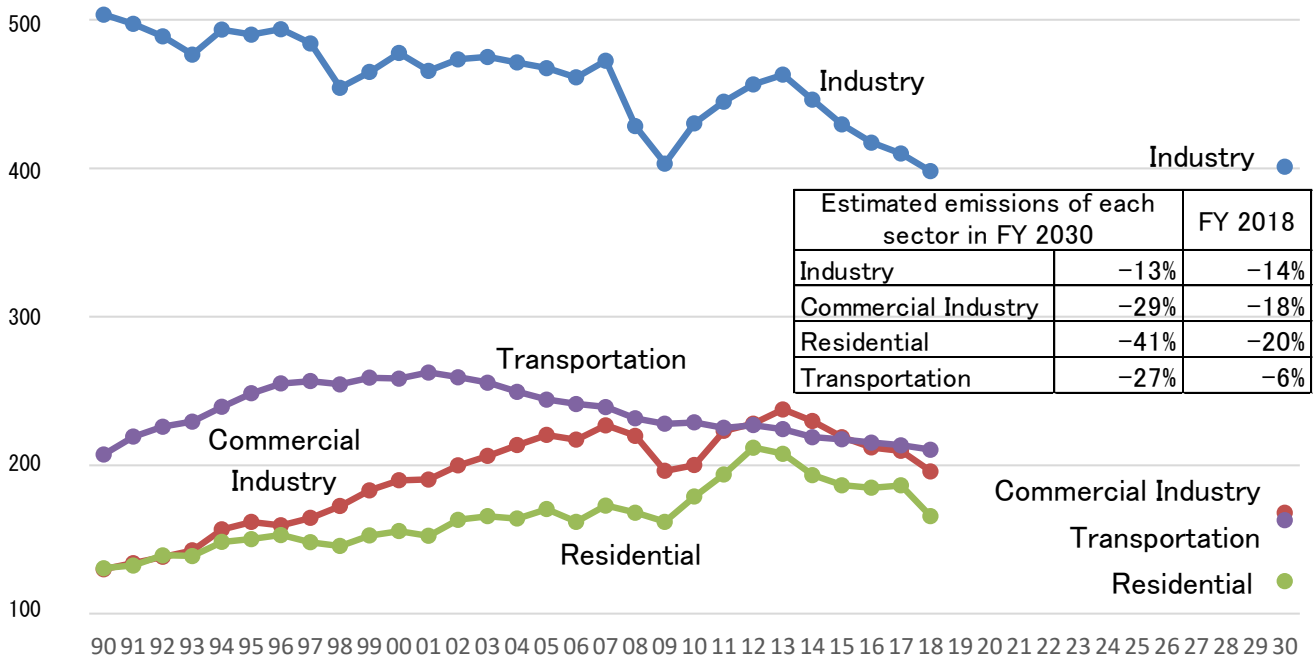
IV. Mobility revolution and compact city development
- The efforts for the improvement of services and convenience by promoting the development of public transportation such as railways, and new mobility services such as Mobility as a Service (MaaS), are promoted for realizing seamless public transportation.

V. Logistics revolution

Source: Global Warming Prevention Headquarters, 2019

Figure 4 Sector Targets for Paris Agreement and Current Status in Japan (Mt)

■ The transportation sector faces difficulty in attaining the sector target of Paris Agreement.



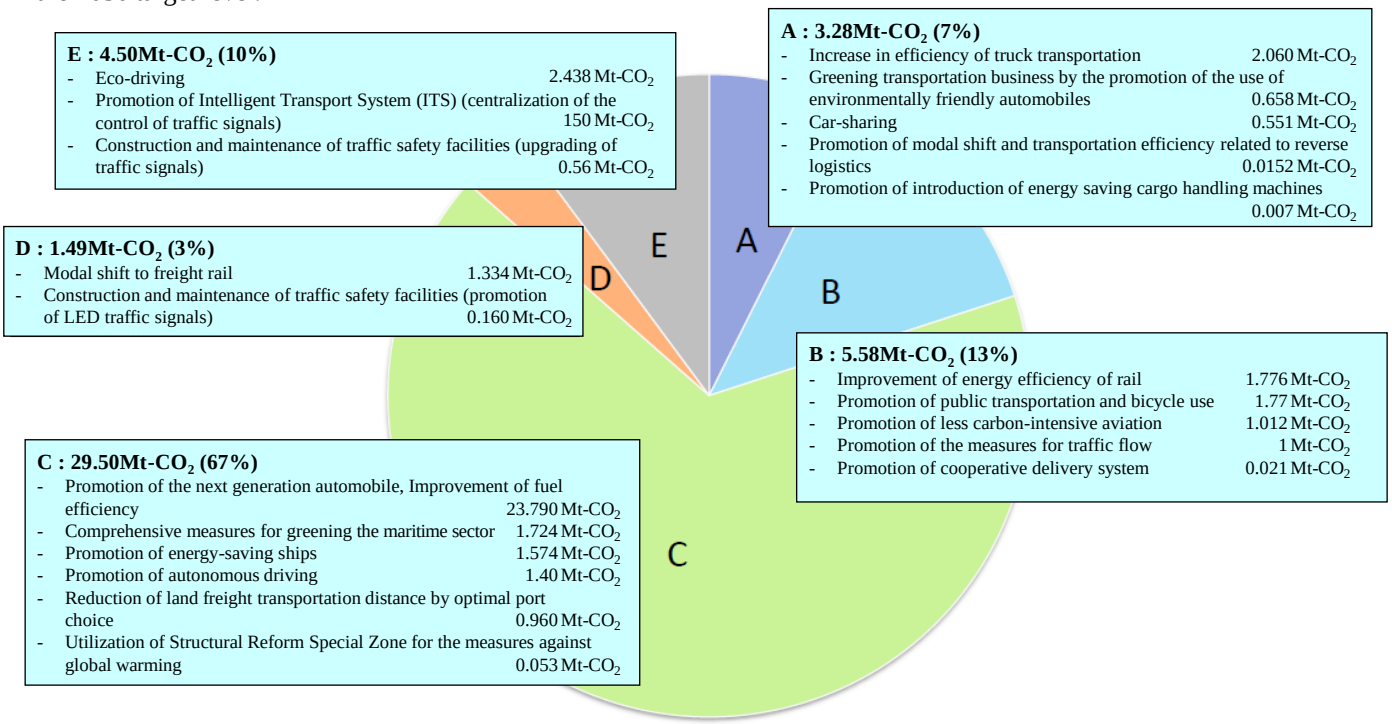
Estimated emissions of each sector in FY 2030		FY 2018
Industry	−13%	−14%
Commercial Industry	−29%	−18%
Residential	−41%	−20%
Transportation	−27%	−6%

Note: The figure is based on the Greenhouse Gas Emission Inventory in 2018.

Source: UNFCCC, Japan's Intended Nationally Determined Contribution, 2015, and Ministry of the Environment,, 2020

Figure 5 Transportation Sector Target for Paris Agreement and Current Status

■ The transportation sector's global warming countermeasure plan is in progress, and most of the measures are expected to reach the 2030 target level.



A. The target level for 2030 is likely to be exceeded, and the actual value for FY 2018 has already exceeded the target level for 2030
B. The target level for 2030 is likely to be exceeded.
C. The target level for 2030 is likely to be reached.
D. The target level for 2030 is unlikely to be reached.
E. Others (The quantitative data is not available, etc.)

Source: Global Warming Prevention Headquarters, The list of progress status of measures/plans related to emission reduction and absorption of greenhouse gases (for each evaluation), 2020

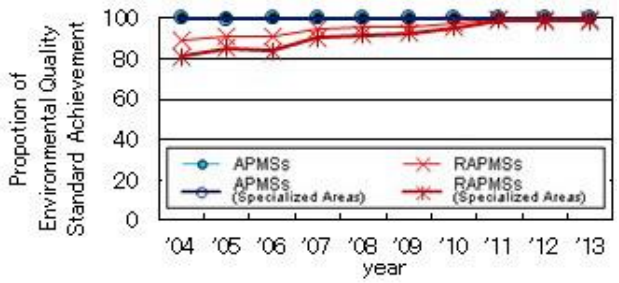
3-2 Current Status and Problems of Road Traffic Noise and Air Pollution

Professor, Tokyo Metropolitan University
Hiroyuki Oneyama

Due to the effects of vehicle emission regulations and vehicle type regulations such as Automobile NOx/PM Act, the achievement rate of environmental standards for nitrogen dioxide (NO_2), suspended particulate matter (SPM), and fine particulate matter ($PM_{2.5}$) is high. Although traffic noise condition has been improved, there are still many problems, especially under special road conditions such as complex road sections. For both air pollution and noise, comprehensive countermeasure promotion such as source measures, traffic flow measures, road structure measures, and roadside measures is necessary. Regarding vehicle exhaust gas and noise emission, regulations are being strengthened based on an international framework.

Figure 1 Environmental Quality Standard Compliance of Nitrogen Oxides (NOx)

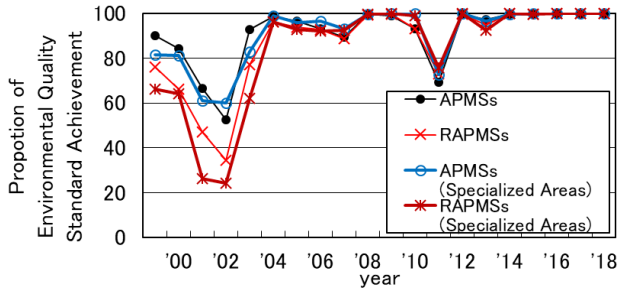
■ Environmental standards have been achieved at almost all locations in recent years.



Source: Transportation-related statistics (MLIT)

Figure 2 Environmental Quality Standard Compliance of Suspended Particulate Matter (SPM)

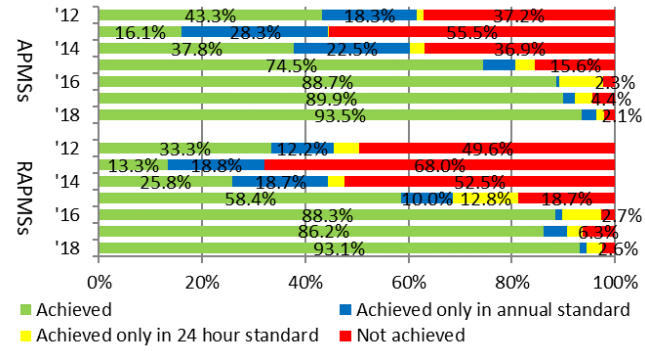
■ Environmental standards have been achieved at almost all locations in recent years.



Note: APMS: Air Pollution Monitoring Station. RAPMS: Roadside Air Pollution Monitoring Station. Specialized Area is designated for NOx and PM measures in “Automobile NOx and PM Act”, namely, a part of Tokyo, Kanagawa, Saitama, Chiba, Aichi, Mie, Osaka, Hyogo Pref.

Figure 3 Environmental Quality Standard Compliance of Fine Particulate Matter (PM2.5)

■ Dramatically improved from around 2015.



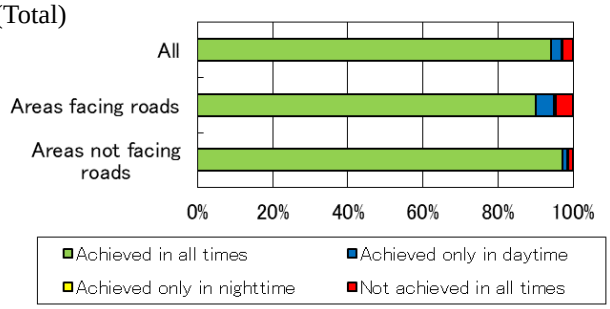
Note: The annual standard for $PM_{2.5}$ is less than or equal to 15.0 $\mu g/m^3$. The 24 hour standard, which means the annual 98th percentile values at designated monitoring sites in an area, is less than or equal to 35 $\mu g/m^3$.

Source of Figure 1, 2 and 3: "FY 2004 Status of Air Pollution", Ministry of Environment

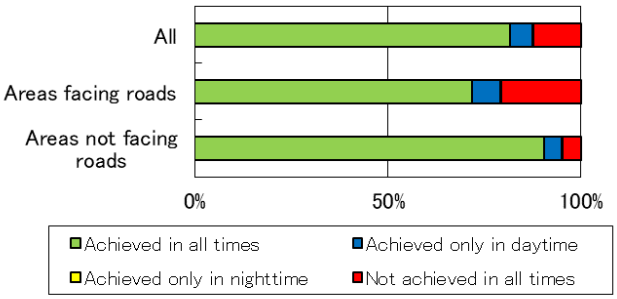
Figure 4 Environmental Quality Standard Compliance of Traffic Noise (2013)

■ Achievement of environmental quality standard in mixed road section is much lower than total.

(Total)



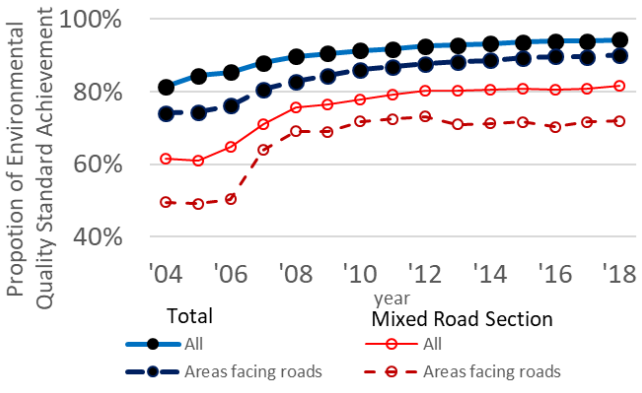
(Mixed Road Section)



Note: Evaluation of the number of dwellings in the area facing the road to be evaluated. The "space near the main road" is a certain distance (road Range of 15 to 20 m depending on the classification of the road) "Non-proximity space" refers to the area that faces the back ground of a section that is close to a road that carries highway traffic or a road other than a highway.

Figure 5 Trend in Proportion of Environmental Quality Standard Achievement of Traffic Noise

■ The status of achievement of environmental standards has been flat for the past 10 years. In particular, it is necessary to improve the achievement rate on complex section roads.



Source of Figure 4 and 5: "Status of Motor Vehicle Traffic Noise in FY 2018", Ministry of Environment

Table 1 Roadside Traffic Noise Measures

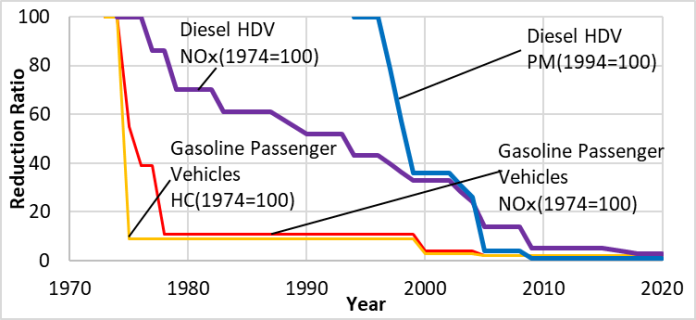
Classification of measures	Measures	Overview and achievements
Source measures	Vehicle exhaust noise measures	Reduction of vehicle exhaust noise by Improvement of vehicle structures - Harmonization with international standards (UN R41-04, R51-03) for acceleration noise test method - Move to relative regulations that require in-process vehicles to have the same proximity exhaust noise value as new vehicles - Introduction of noise regulation (UN R117-02) for automobile tires
Traffic flow measures	Traffic control and management	Sophistication of the traffic signal control, Effective traffic regulation, Traffic crackdown - Prohibition of large freight vehicles etc.: Within Ring 7 and part of Ring 8 (Saturday 22:00 to Sunday 7:00) - Regulations for center lanes of large freight vehicles etc.: Part of Ring 7 (all day) ・Part of National Route 43 (22-6) - Improvement of traffic signal control: 116,762 units (as of the end of 2018, total of centralized control, sensitive control, system control) - Maximum speed limit regulation : Part of Route 43/Route 23 (40km/h)
	Development of bypasses	Reduction of inner city heavy vehicles and dispersion of traffic by development of ring roads or bypass etc.
	Development of logistic centers	Reduction of inner city heavy vehicles by proper placement of logistics facilities, rationalization of logistics such as joint transport and delivery. - Development status of distribution business complex: 26 locations nationwide (number of planned districts for which city planning has been decided at the end of 2017) - Normal truck terminal development status: 3,354 berths (end of 2017)
Road structure measures	Installation of low-noise pavement	Installation of low-noise pavement in which there are a lot of voids. - Environmental improvement effect: about 3 dB on average
	Installation of noise barriers	Installation of high noise barrier with high sound insulation effect. This is effective in motorways with limited access. - Environmental improvement effect: Approximately 10 dB (calculated value at a height of 1.2 m above the ground, behind a sound insulation wall with a planar structure and a height of 3 m)
	Installation of environmental buffer zone	Securing of the buffer space for noise reduction of 10 or 20m between the roadside and roadway. - Environmental improvement effect (width about 10 m): 5-10 dB
Roadside measures	Development of roadside district plan	A roadside district plan is established in urban planning to promote the prevention of disorder caused by road traffic noise and the proper and reasonable land use. It promotes urban development worthy of the roadside of the main road. - Act on Improvement of Areas Along Trunk Roads - Roadside maintenance road designation requirements/night noise over 65 dB (LAeq) or daytime noise over 70 dB (LAeq), daily traffic volume over 10,000, etc. - Roadside maintenance road designation status / 11 routes 132.9 km designated by the prefectural governor (as of April 2016) National Road No. 4, National Road No. 23, National Road No. 43, National Road No. 254, Circular Road No. 7, 8 etc. - Roadside district plan formulation status / Roadside district plan formulated at 50 district 108.3km (as of April 2016)
Impact prevention measures	Implementation of grants for residential soundproofing	A reduction of the impact of road traffic noise by the soundproofing subsidies of housing such as emergency measures. ・House soundproof construction subsidy by road administrator ・Subsidy for soundproofing of houses around highways ・National interest-free loans for municipal land purchases ・Part of the cost of the buffer building by the road administrator
Development of promotion organization	Creating organization for road traffic pollution measures promotion	Work closely with related organizations to solve road traffic noise problems. - Promotion of road pollution countermeasures in close collaboration with the Ministry of the Environment/related ministries and agencies - Promotion of measures by councils with local governments/national departments, environment departments, road departments, city departments of prefectural governments, prefectural police, etc. (established by all prefectures)

Source: "White Paper for Environment, 2020", Ministry of Environment (modified)

Figure 6 Regulation of Vehicle Exhaust Gas and Noise

■ Vehicle emission regulations have been significantly strengthened.

■ Regulations based on the international framework of emission regulations and noise regulations are being strengthened.

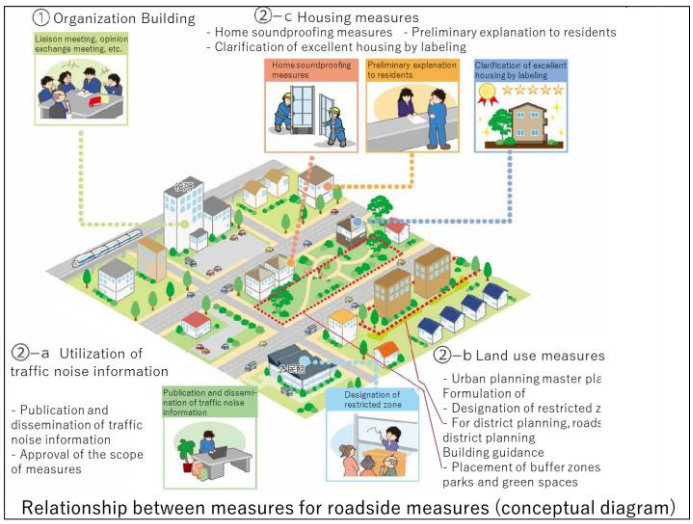


(Exhaust gas regulation)
Exhaust gas regulations using world-wide test modes (WHTC, WLTC) were applied from 2016 for diesel heavy vehicles, 2018 for passenger cars and light vehicles, and 2019 for light and medium-duty vehicles.
(Noise regulation)
Due to the revision of the vehicle safety standards in 2016, noise regulations have been strengthened by reviewing the standards for exterior noise of four-wheeled vehicles and clarifying the prohibition of modification to mufflers of unknown performance.

Source: "White Paper for Environment, 2020", Ministry of Environment and Document from Central Environment Council

Figure 7 Roadside Measures to Prevent Traffic Noise Problems

Guidelines for roadside/railway measures to prevent traffic noise problems
(background)
・As a result of residential land development in areas where people had not previously lived along the roadside of existing transportation facilities, there was a problem of traffic noise related to new residents.
・From the perspective of preventing traffic noise problems, there are still few cases where policy is sought to harmonize transportation facilities with land use along the roadside.
(Aim of guideline)
・ Organize options for various measures (roadside/railway measures) to harmonize transportation facilities with land use along the roadside/railway areas, and have the person in charge of the environment department of the municipality select appropriate roadside/railway measures. The guidelines that can be referred to are presented.



Relationship between measures for roadside measures (conceptual diagram)

Source: Guidelines for roadside/railway measures to prevent traffic noise problems, Ministry of Environment, 2017 (modified)

3-3 Improving Energy Efficiency

Japan Automobile Manufacturers Association
Masanari Meguro

In July 2015, the Japanese government launched the “long-term energy balance outlook”, which is based on the energy policy of Japan, assuming the policy objectives to be achieved, through the basic viewpoint of energy policy such as safety, stable supply, economic efficiency and environmental compatibility (3E+S). The expected primary energy reduction in 2030 is estimated about 50.3 million kilo-litter (about 13% compared to before measures) with the accumulation of all the feasible technologies and practical energy-saving measures. In this context, reduction of fuel consumption in transportation sector is expected about 16. million kilo-litter by improvements in fuel efficiency, deployment of next-generation vehicles and measures for smooth traffic flow.

Overview of Energy Balance Flow in Japan (FY2018)

- Energy passes through various stages before it reaches to end-consumers. Since there are losses in the process of power generation, during transportation, and self-consumption in power generation and in the conversion process, final energy consumption equals the primary energy input after deducting these losses. Final energy consumption in fiscal year of 2018 was approximately 66, if Japan's domestic primary energy input counts as 100.
- Much of the nuclear energy and renewable energy including hydro power is converted to electricity and consumed. Most of the oil is refined and consumed as various product as gasoline and light oil consumes in transportation sector, kerosene and heavy oil as petroleum products, and naphtha as a petrochemical raw material.

Table 1 Overview of Energy Consumption in Japan (FY2018)

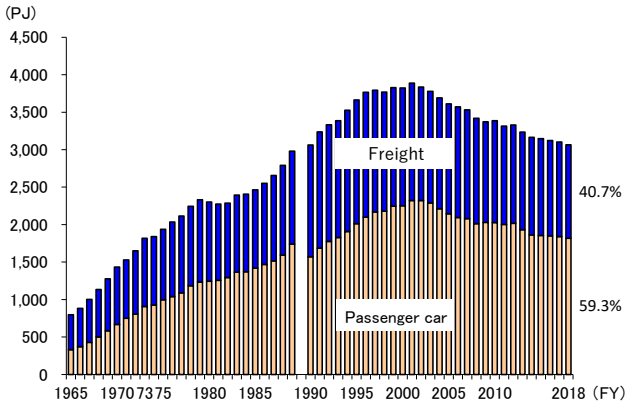
- Energy conservation is steadily progressing in each field, but further efforts are needed to realize the energy mix in FY2030.
- It is evaluated in governmental consultation that energy demand in transportation sector decreased mainly due to improved fuel efficiency of passenger vehicles.

	FY2013 (Actual)	FY2018	Saving	Major factor in Change
Total	363.8	338.9	▲24.9	[Note: Values are all in Mil. Kilo-litter basis]
Industrial Sector	168.3	158.0	▲10.3	Economic activity expanded moderately, but declined due to a decrease in steel and ethylene production and progress in energy conservation.
Business Sector	59.2	54.4	▲4.7	The efficiency of equipment such as lighting and air conditioning is improved, and the basic factor is improved.
Household Sector	52.8	47.3	▲5.5	The efficiency of equipment such as lighting and air conditioning is improved. At present, demand will decrease due to climate factors such as warm winter
Transportation Sector	83.6	79.2	▲4.4	Demand decreased mainly due to improved fuel economy of passenger vehicles (3.0 saving only by passenger vehicle sector)

Source：ANRE Energy Conservation subcommittee 2020 [in Japanese]

Figure 1 Passenger/Freight Consumption Ratio in Transport Sector

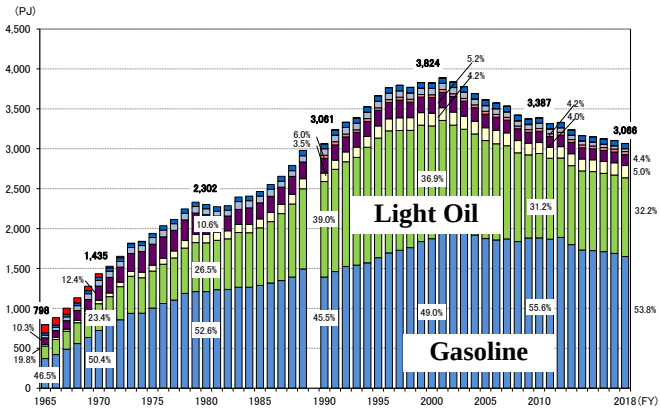
- Transportation sector in 2018 accounted for 23.4% of the total final energy consumption, of which the passenger sector energy consumption accounted for 59.3% and the freight sector 40.7%.



Source：ANRE Energy White paper 2020 [Fig. 212-3-1 in Japanese]

Figure 2 Changes in Consumption by Energy Source in the Transportation Sector

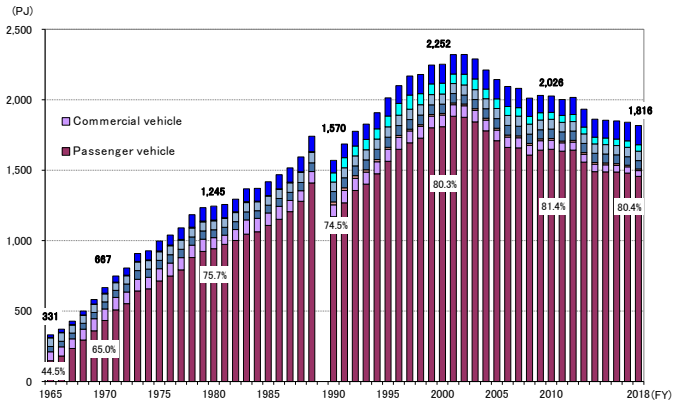
- Gasoline accounted for 53.8%, light oil 32.2%, jet fuel 5.0%, and heavy oil 4.4%, looking at the composition ratio by energy source in the transport sector in 2018.



Source：ANRE Energy White paper 2020 [Fig. 212-3-3 in Japanese]

Figure 3 Energy Consumption Trends in Passenger Sector

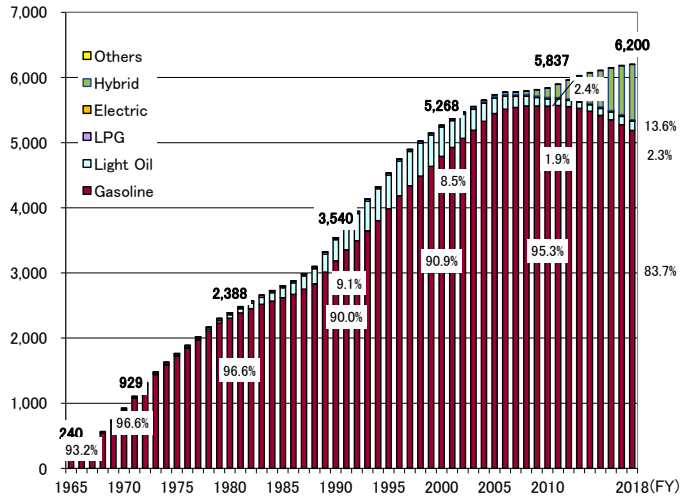
- Energy consumption in the passenger vehicle sector increased at a rate exceeding the GDP growth rate as the number of vehicles owned increased. Such tendency, however, peaked in fiscal 2001 and turned to a downward trend. In FY2018, it decreased by 20% compared to the peak period.
- This trend was achieved through the improvement of fuel efficiency of passenger vehicles and increasing share of fuel-efficient vehicle such as small size vehicle and hybrid vehicle. Spreading ETC system and deployment of advanced control in signal systems in traffic flow also contributed such improvement.



Source: ANRE Energy white paper 2020 [Figure 212-3-4 in Japanese]

Figure 4 Changes by Vehicle Type in the Number of Passenger Cars Owned

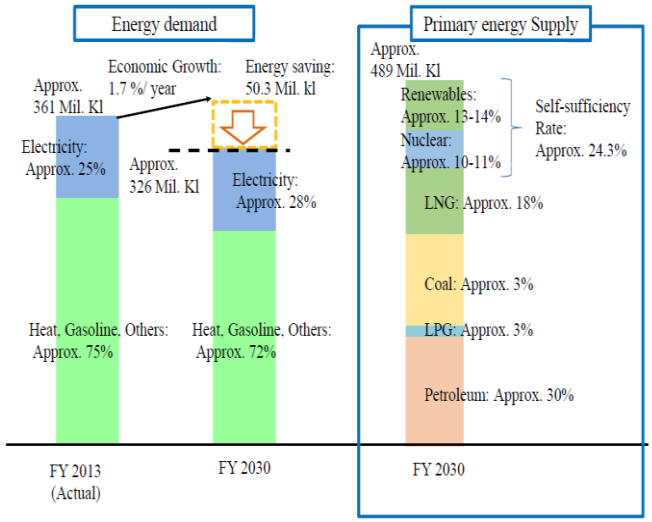
- 95.3% of all passenger vehicles at the peak, were gasoline vehicles. In 2011, hybrid vehicles accounted for 2.4% of all passenger vehicles, however, they have gradually increased since then to 13.6% in FY2018.
- As for the number of passenger cars owned (62million in total in FY2018), Gasoline vehicle accounted for 83.8%, light oil 2.3%, and hybrid vehicle 13.6%.



Source: ANRE Energy white paper 2020 [Figure 212-3-5 in Japanese]

Figure 5 Long-term Energy Supply and Demand Outlook

- Energy-saving in long-term energy balance outlook contains technologically feasible and realistic energy-saving values that can be at most achieved. It is expected the energy demand in final energy consumption in fiscal year of 2030 will be around 326 million kl of petroleum equivalent, by implementing energy savings of about 50.30 million kl.



Note: In the "Comprehensive Energy Statistics", the method of calculating numerical values has changed since 1990. For that reason, some discontinuity is observed in Figure 1, 2, 3 and 4.

Source: Long-term Energy balance outlook (METI July 2015)

Table 2 Energy Saving Measures

- In the transportation sector, a reduction of 16.07 million kl is expected by improvements in fuel efficiency and the deployment of next-generation vehicles such as Hybrid vehicles (HEV), electric vehicles (EV), plug-in hybrid vehicles (PHV), fuel cell vehicles (FCV), clean diesel vehicles (CD) and measures such as eco-driving and traffic flow improvement.

Industrial Sector	▲10.42 Million kl
Business Sector	▲12.26 Million kl
Household sector	▲11.60 Million kl
Transportation Sector	▲16.07 Million kl

Measures for improvement

- Improvements in fuel efficiency and the deployment of next-generation vehicles
  - ・Number of next generation vehicle: 50% of annual sales
  - ・Number of Fuel cell vehicles: more than 100,000 per year
- Traffic flow improvement and Automatic driving

Source: ANRI Long-term energy balance subcommittee [In Japanese]

3-4 Environmentally Friendly Institutional Measures

Associate Professor, Tokyo Institute of Technology
Yasunori Muromachi

Due to the need to promote safe and attractive urban development, the Act on Special Measures concerning Urban Reconstruction was amended, and the institution for safe and attractive urban development was strengthened. The former reflects the growing interest in adaptation to climate change as well as the adaptation plan developed in recent years. In addition, a new vision was published that proposes the picture of Japanese society and the direction of policy in 2040 to be realized through road policy. Furthermore, there is growing interest in green infrastructure with the diverse functions.

Figure 1 Attractive Urban Development by the Act on Special Measures Concerning Urban Reconstruction Amendment

■ In order to respond to the declining production-age population and socio-economic diversification, it is necessary to create a space in the urban area where various people can gather and interact, and to improve the attractiveness of the city. At the same time, the Act on Revitalization and Rehabilitation of Local Public Transportation Systems was amended to realize sustainable local public transport.

Creating urban areas where "people feel comfortable and want to walk"

Designation of an area to work on Machizukuri of urban areas where "people feel cozy and want to walk" in urban reconstruction and maintenance plan*) and promotion of the following efforts.

* Urban reconstruction and maintenance plan: A plan for Machizukuri formulated by municipalities

Car-oriented station plaza

Creation of a pedestrian space by making a transit mall in front of the station and constructing the plaza

○ Creation of a space where "people feel comfortable and want to walk"

- Creation of a lively space by the public and private partnerships
  Example) Designing a street as public square by public and an open space provided by private
  (Budget) Support by grants for public space renovation, etc.
  (Tax system) Reduction of property tax on private businesses that provided public space
- Introduction of parking lot entrance / exit regulations in urban areas

○ Promotion of area management to liven up urban areas

- Facilitation of road / park occupancy procedures coordinated by an urban reconstruction promotion corporation*)

* Urban reconstruction promotion corporation: A corporation that carries out Machizukuri activities in the area such as NPOs and Machizukuri companies (designated by municipalities)

(Budget) Support for formulation of Machizukuri plans through public-private partnerships
(Budget) Support by low-interest loan to budget urban reconstruction promotion corporation

Improving the environment in the living area

○ Improving the convenience of daily life

- Establishment of a system to promote the location of facilities necessary for daily life such as hospitals and stores in residential areas within the residential priority zone of the location adjustment plan

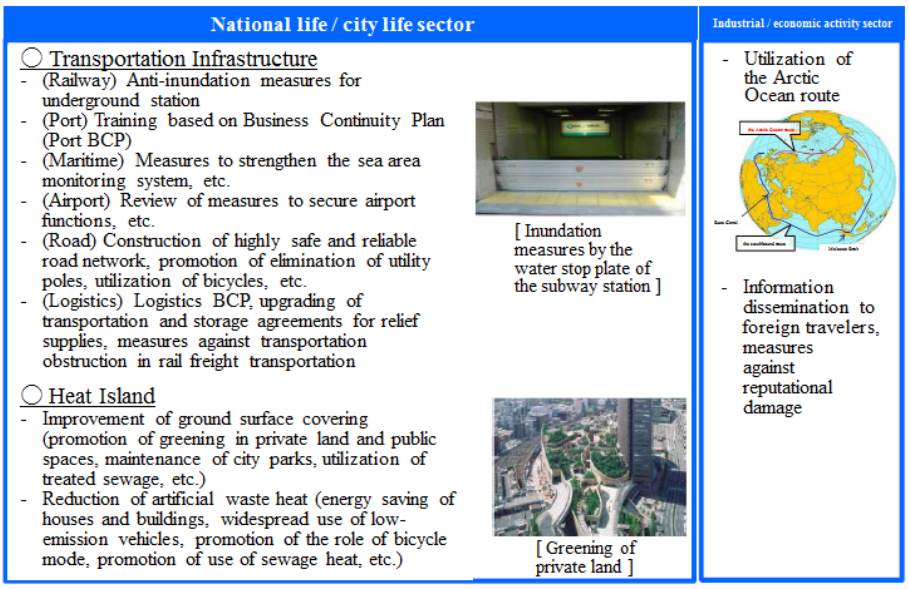
○ Measures against aging urban infrastructure

- Regarding the renovation of city planning facilities, it is positioned as a matter to be stated in the location adjustment plan.
  ⇒ Appropriation of city planning tax for the cost required for the renovation etc.

Source: MLIT, The bill of the amendments to the Act on Special Measures concerning Urban Reconstruction, 2020

Figure 2 Amendments to Climate Change Adaptation Plan

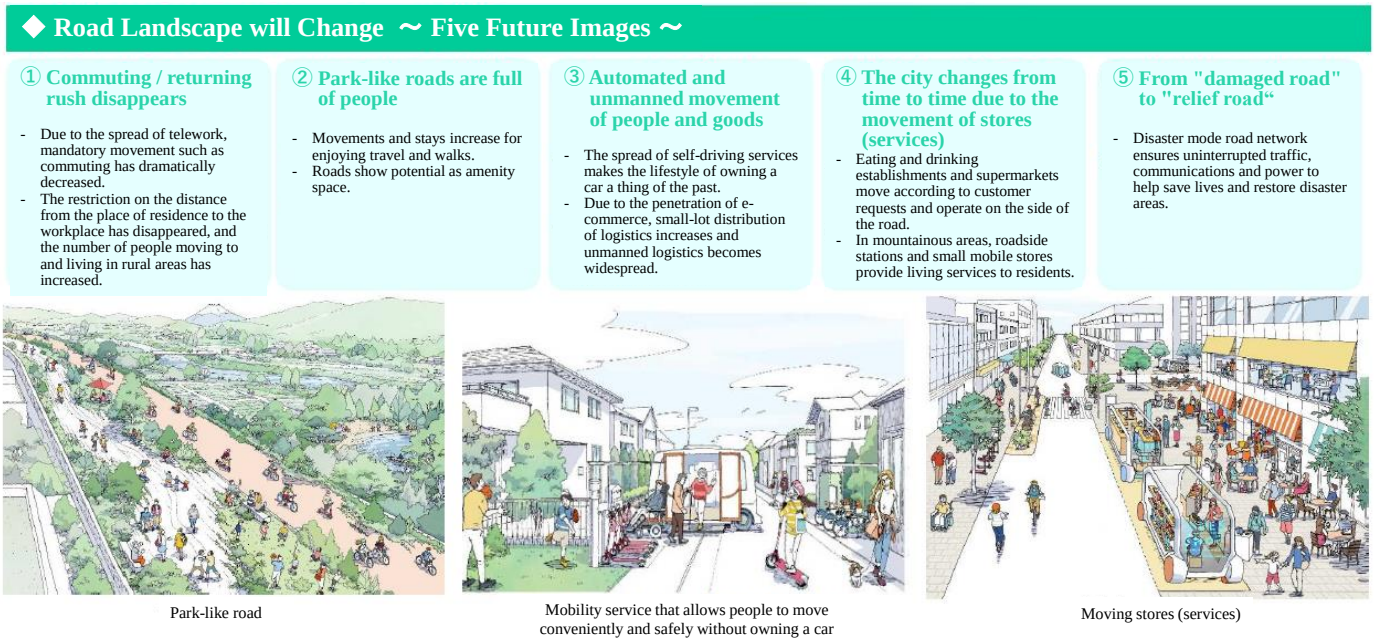
■ Based on the Climate Change Adaptation Act promulgated in June 2018, the Climate Change Adaptation Plan was approved by the Cabinet as a legal plan. In line with this, the Ministry of Land, Infrastructure, Transport and Tourism's (MLIT) climate change adaptation plan has also been revised to reflect the latest measures. According to the plan, some of the impacts on the land and transport sector concerned by climate change include increased risk of transport infrastructure, significant temperature rise in urban areas, and impacts on logistics and tourism due to wind and flood damages.



Source: MLIT, 2018

Figure 3 Road Landscape Will Change in 2040 -Roads that Lead to People's Happiness-

■ A vision was published that proposes the picture of Japanese society and the direction of policy in 2040 to be realized through road policy. As basic ideas, the origin of road policy is "realization of people's happiness", "evolution" of roads by making full use of digital technology to solve problems, and "return" to the function of roads as a communication space, are indicated.



Park-like road

Mobility service that allows people to move conveniently and safely without owning a car

Moving stores (services)

Source: MLIT, Road Landscape will Change in 2040 -Roads that Lead to People's Happiness-, 2020

Figure 4 Green Infrastructure Promotion Strategy

■ Green infrastructure is an initiative to promote sustainable and attractive national land, cities, and regional development by utilizing the various functions of the natural environment in terms of both hardware and software such as social infrastructure development and land use. An example of comfortable utilization of urban space is the formation of green infrastructure in line with urban regeneration and renewal.

Creation of a plaza space by abolishing 4-lane road in the city center (Kumamoto City)

- The plaza space is integrated with the adjacent park by abolishing roads in order to embody human-centered walkable and enjoyable urban development.
- Design guidelines for landscape harmony with Kumamoto Castle and planting are formulated, and new ordinances on public utilization and operation management are planned (under construction).

Creation of symbol road by land readjustment (Oita City)

- The 100m-wide road in front of the station, which was constructed by land readjustment, will be used as a lawn plaza full of greenery as a base for citizens' activities.

Integrated construction of parks, green roads, waterside spaces, etc. (Okazaki City)

- As one of the bases of the city's circulating walking paths, a lawn plaza, a green road, a promenade, etc. are constructed where citizens can relax on a daily life (under construction).

Source: MLIT, 2019

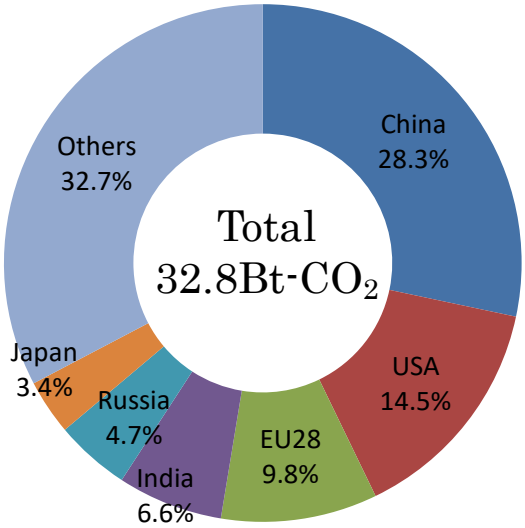
3-5 Actions for Sustainable Transport

Associate Professor, Tokyo Institute of Technology
Yasunori Muromachi

Global CO_2 emissions have reached 32.8 billion tons. By country, China's share of CO_2 emissions has expanded, almost doubling that of USA. GHG emissions in the transportation sector have been on the rise in recent years in some developed countries. Meanwhile, most developed countries have introduced several measures for attaining the target of the Paris Agreement and afterwards in the transportation sector. There is also a growing awareness that EVs can supply power in the event of a disaster due to climate change, and has attracted attention from the perspective of environment and disaster prevention.

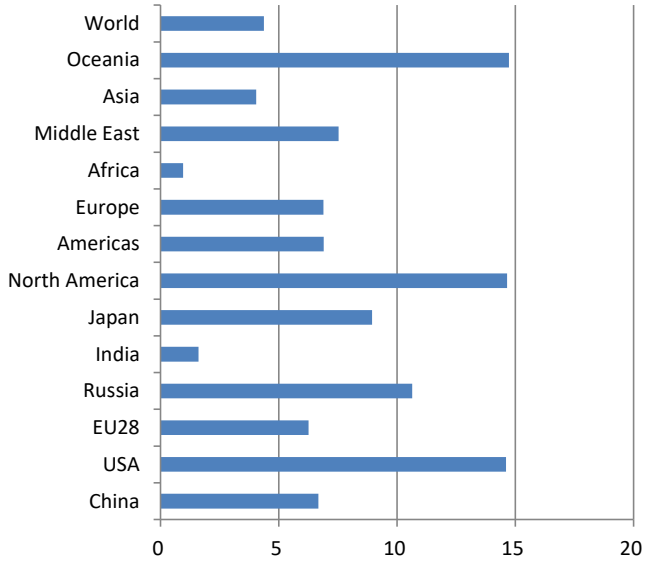
Figure 1 Share of CO_2 Emissions from Fuel Combustion in Major Countries and Regions (2017)

■ China's share of CO_2 emissions has expanded, almost doubling that of USA.



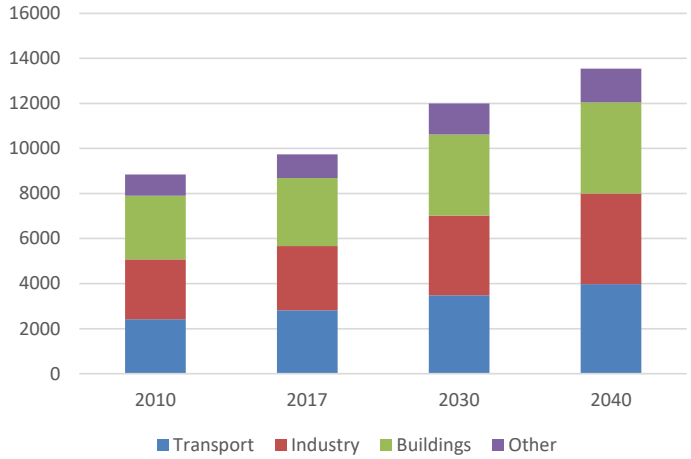
Source: IEA, CO_2 Emissions from Fuel Combustion Highlights 2019, 2019

Figure 2 CO_2 Emissions Per Capita in Major Countries and Regions (2017, t-CO_2)



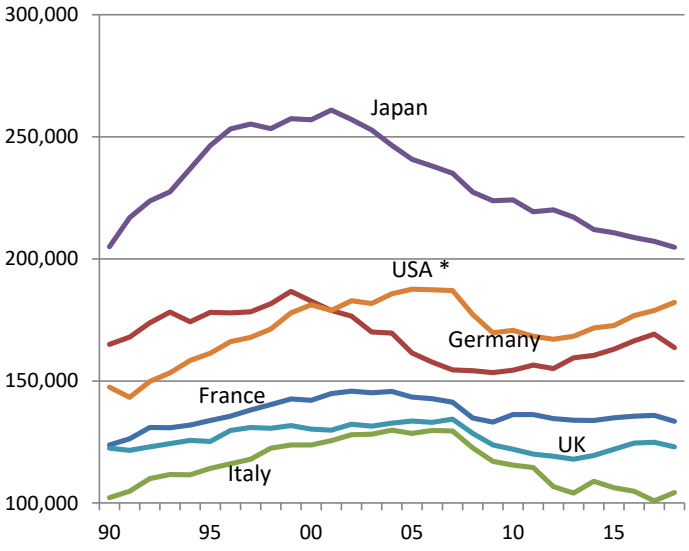
Source: IEA, CO_2 Emissions from Fuel Combustion Highlights 2019, 2019

Figure 3 Trend and Forecast of World Final Energy Consumption by Sector (Mtoe, Current Policies Scenario)



Source: IEA, World Energy Outlook 2019, 2019

Figure 4 Trend of GHG Emissions from Transportation Sector in Major Countries (1,000t-CO_2, except for USA, 10,000t-CO_2)



Source: UNFCCC, 2020

Figure 5 Promotion of the Use of EVs in the Event of a Disaster

- For the purpose of broadening the awareness that EVs can supply power in the event of a disaster due to climate change, etc., a reference manual is prepared for EV owners and local governments considering the use of EVs. For reference, the pictures of power supply from the EVs are also shown.

Power supply from FCV: Touring the area and using the FCV for lighting, microwave oven, etc. in private homes
Source: Toyota Motor Corporation

Power supply from EV: Using the EV for mobile phone charging, electric fans, refrigerators, etc. at evacuation shelters, etc.
Source: Nissan Motor Corporation

Power supply from FCV: Using the FCV for charging air conditioners and small storage batteries in old people's homes
Source: Honda Motor Co., Ltd.

Power supply from PHV: Using the PHV for washing machines and washer / dryers in old people's homes
Source: Mitsubishi Motors Corporation

Source: METI and MLIT, A reference manual for promoting the use of EVs in the event of a disaster, 2020

Table 1 Mitigation Measures in Transportation Sector in the United States

- On 1 June 2017, the United States announced its intention to withdraw from the Paris Agreement based on perceived costs to the US economy. The withdrawal will not take effect until next year as the United Nations Framework Convention on Climate Change (UNFCCC) rules dictate that the earliest a signatory can withdraw is four years following the Agreement's entry into force, or on 4 November 2020. Under the Paris Agreement, the United States in 2015 established a target to reduce GHG emissions by 26-28% below 2005 levels by 2025.
- In 2017, energy-related emissions amounted to 4,759 million tonnes of CO_2 ($MtCO_2$), a 17% reduction since the peak in 2005. Power generation accounted for 38% of energy-related emissions and transport for 36%. The rest was from industry (9%), residential (6%), commercial (5%) and other energy sectors (5%). If continuing on the current trajectory, the transport sector will soon surpass the power sector as the largest source of CO_2 emissions in the United States.
- In response to the 1973 Arab oil embargo, the United States has had Corporate Average Fuel Economy (CAFE) standards in place since 1975 to mitigate oil consumption growth. The EPA laid out standards for two periods, 2012-16 and 2017-25. The standards are supposed to reach 163 gCO_2-eq/mile for model year 2025 vehicles. In 2017, the administration reopened the review in conjunction with NHTSA, and in August 2018 announced a new proposal, the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks. The SAFE rule proposes to revise the standards on both economic and safety grounds, with the preferred option to freeze 2021 standards through 2026 at around 204 gCO_2-eq/m for passenger cars and 284 gCO2-eq/m for light-duty trucks.
- The main policy tool offered by the federal government is a tax credit for purchases of EVs. The United States also offers tax credits for EV charging stations. California has in place an Advanced Clean Cars Program to lower both GHG and particulate emissions from cars and light trucks. Part of the programme includes a Zero-Emission Vehicle (ZEV) programme, which mandates automakers to sell a growing share of ZEVs each year, starting with a 4.5% threshold in 2018 and reaching a 22% share in 2025. Nine other states have since adopted ZEV programmes.
- In 2017, ethanol accounted for 5.2% of total energy use in transport, which was by far the highest share among IEA member countries. Biodiesel consumption has also increased rapidly in recent years.

Source: IEA, Energy Policies of IEA Countries Review United States, 2019

3-6 Development and Popularization of Eco-Vehicle

Japan Automobile Manufacturers Association
Masanari Meguro

Automanufacturers have developed and applied various technologies for conventional gasoline passenger vehicle and freight vehicle not only as a measure against global warming but also effective use and utilization of the limited resources to ensure a sustainable economy. In addition, taking into account the demand for reduction of greenhouse gas emissions over the medium to long term and consistency with the energy mix in Japan, member companies are promoting the development and popularization of so-called next-generation vehicles consisting of hybrid vehicles (HEV), electric vehicles (EV), plug-in hybrid vehicles (PHVs), fuel cell vehicles (FCVs) and clean diesel vehicles (CDs). Next fuel efficiency standards for the passenger cars including EV and PHV targeting 2030 were compiled in June 2019.

Table 1 Fuel Consumption Standards for Gasoline Vehicles

- The target fuel efficiency of vehicles is set for passenger car, small freight car, and heavy vehicle respectively by the top runner method with the maximum fuel efficiency value when the next target values are examined.
- Currently, the target values are set for categories such as passenger cars, heavy vehicles, and small freight vehicles.

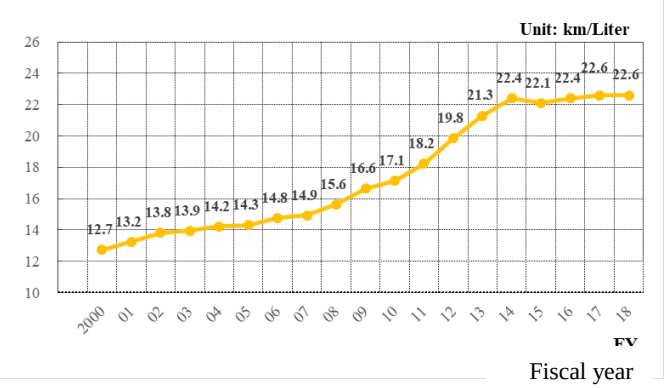
Fuel Efficiency Standards (FY2015)		
Passenger Vehicle	16.8km/L (Passenger vehicle mode: JC08)	29.2% up against FY2010 Standard 23.5% up against FY2004 actual
Freight Vehicle not more than 3.5tons (GVW)	15.2km/L (Passenger vehicle mode: JC08)	12.6% up against FY2004 actual
Bus not more than 3.5tons (GVW)	8.9km/L (Passenger vehicle mode)	7.2% up against FY2004 actual
Freight Vehicle more than 3.5tons (GVW)	7.09km/L (Heavy duty vehicle mode:JH15)	12.2% up against FY2002 actual
Bus more than 3.5tons (GVW)	6.30km/L (Heavy duty vehicle mode：JH15)	12.1% up against FY2002 actual
Fuel Efficiency Standards (FY2020)		
Passenger Vehicle	20.3km/L (Passenger vehicle mode:JC08)	19.6% up against FY2015 Standards 24.1% up against FY2009 actual
Fuel Efficiency Standards (FY2022)		
Freight Vehicle more than 3.5tons (GVW)	17.9km/L (Passenger vehicle mode: JC08)	26.1% up against FY2015 Standards
Fuel Efficiency Standards (FY2025)		
Freight Vehicle more than 3.5tons (GVW)	7.63km/L (Heavy duty vehicle mode：JH25)	13.4% up against FY2015 Standards (Calculation with FY2014 Sales mix)
Bus more than 3.5tons (GVW)	6.52km/L (Heavy duty vehicle mode：JH25)	14.3% up against FY2015 Standards (Calculation with FY2014 Sales mix)

※GVW：Gross Vehicle Weight

Source: Japan Automobile Manufacturers Association

Figure 1 Average Fuel Consumption of Passenger Car (Gasoline)

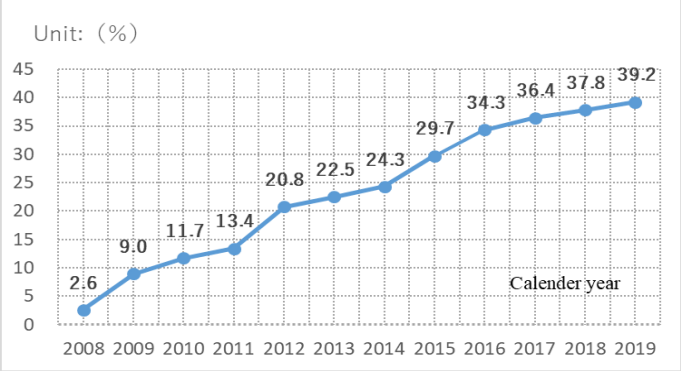
- Automobile manufacturers are improving fuel efficiency through technology development and introduction of next-generation vehicles.



Source: Japan Automobile Manufacturers Association

Figure 2 Next-generation Vehicle Sales Ratio

- The proportion of next-generation vehicles in automobile sales has greatly increased since 2009 when the government started promotion policies, with next-generation vehicles accounting for 39.2% of all the new passenger vehicle sold in 2019.
- While automobile manufacturers are working hard on various issues toward next-generation vehicles, installation of infrastructures such as charging stations and hydrogen stations with effective supporting measures for their deployment as well as various governmental support for promotion of next-generation vehicles is also indispensable.



Source: Japan Automobile Manufacturers Association

Table 2 "Automotive Industry Strategy 2014" Goal of Next-generation Automobiles

- As part of its revitalization strategy (2015), the Japanese government expects that between 50% and 70% of all new vehicle sales are next generation vehicles.
- In addition, in March 2016, the “EV/PHV Roadmap” was established setting a maximum target of 1 million vehicles in Japan by 2020.

		FY2019(Actual)	FY2030
Conventinal Vehicle		61.2%	30～50%
Next-Generation Vehicle		38.8%	50～70%
	Hybrid Vehicle (HEV)	34.1%	30～40%
	EV & PHV	0.46% 0.41%	20～30%
	FCV	0.02%	～3%
	Clean Diesel (CD)	4.0%	5～10%

Source: METI

Table 3 EV and PHV Roadmap (Outline)

- In March 2016, the Ministry of Economy, Trade and Industry (METI) launched a roadmap for popularization of EVs and PHVs after discussions with academic experts, automobile manufacturers, infrastructure companies, etc.
- Regarding the charging infrastructure, the following deployment policy was indicated.
- Regarding public chargers, the Japanese government and its parties concerned will fill up vacancy to eliminate anxiety against power shortages, and determine the policy regarding installation of charging facility in the locations such as Michi-no-Eki and SAs and PAs on highways. The locations of such installation will be chosen focusing on the number of visitors there.
- For non-public purpose, installation of chargers at apartment house is reconfirmed as the most effective way because approximately 40% of population who are the potential users for EVs and PHVs live in.

Items	Targets
Number of EV/PHV vehicles	**Up to 2020:** a million on stock basis (EV&PHV total) **Up to 2030:** 20-30% in New sales (EV&PHV total)
Quick charger en route (Public use)	**Up to 2020:** Fill up vacancy to eliminate anxiety against power shortages, and promote charging facility in Michi-no-Eki, SAs and PAs on highways
Quick chargers at destination (Public use)	**UP to 2020:** Approx. 20,000 locations focusing on large-scale commercial facilities and lodging facilities
Normal chargers in apartments	**Up to 2020:** Approx. 2,000 units at apartment to be newly constructed and large-scale repairment
Normal chargers at workplaces	**Up to 2020:** Approx. 9,000 units at office / Apartment

Source: METI EV/PHV road map

Table 4 Hydrogen/Fuel Cell Strategy Road Map

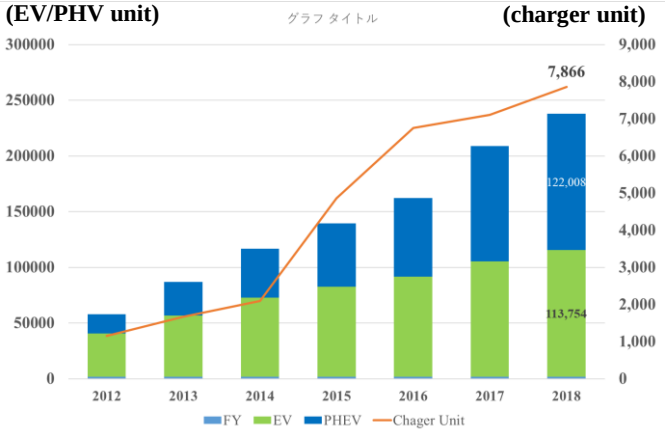
- METI set up the "Hydrogen/Fuel Cell Strategy committee" in December 2013, and members from industry, academia, and government have started to study how to utilize hydrogen energy in future. The “Hydrogen/Fuel Cell Strategy Roadmap” was released in June 2014 as a result, showing the activities of the parties involved in realizing a hydrogen society.
- This roadmap was revised again in March 2019 based on the latest situation in terms of the spread of house-use fuel cells, commercialization of fuel cell vehicles, the deployment of hydrogen station and setting of new goals.

Facility	Targets
Fuel Cell Vehicle	Up to FY2020： 40,000 units on a stock basis Up to FY2025：200,000 units on a stock Equivalent price level to Hybrid car Up to FY2030：800,000 units on a stock basis
Hydrogen station	Up to FY2020： • Hydrogen station: 160 locations • Hydrogen price: Not more than fuel price of HEV Up to FY2025：320 location UP to FY2030：900 location

Source: METI Hydrogen-Fuel cell strategy roadmap

Figure 3 The Spread of EV/PHV and Quick Chargers

- The number of EVs/PHVs sold and the number of quick chargers have been increasing year by year since the introduction of i-MiEV in September 2009.



Source: METI, Next-generation Vehicle Promotion center

Table 5 Introduction of Fuel Cell Vehicle

- FCV has been in the market since December 2014.

Vehicle	Current situation
FCV	**Toyota MIRAI（in Market Dec. 2014）** ■One filling mileage：Approx.650km (Note3)* ■H2 filling duration：3 min.  **Honda CLARITY FUEL CELL** （launched in lease market in Mar. 2016） ■One filling mileage：750km (Note3)* ■H2 filling duration：3min.  ＊In-house measurement with JC08 mode

Source: Toyota Website, Honda Website

Table 6 Status of Charging and Hydrogen Infrastructure Development in Japan

- Planned development is required for charging unit both en route and at-destination, when installing such public chargers/stations. Rapid chargers have been installed in approx. 7,500 facilities in Japan as of the end of FY2018.
- Commercial hydrogen stations are being installed nationwide to promote FCVs. 130 locations have been installed and 27 others are planned. (As of June 2020)

Facility	Deployment Target in number
Charging station for public use	● Every 10km interval: 18,400 in nationwide ● Every 30km interval：6,100 in nationwide ● Every 50km interval: 3,700 in nationwide
Hydrogen station for commercial use	● 160 Station: by FY2020 ● 320 Station: by FY2025 ● Installed: Over 130 in Nation wide (Planning at 27 location (June 2020)

Source: METI, FCCJ website

☐ New Fuel Efficiency Standards for Passenger Vehicles

METI jointly established the working group for fuel efficiency standards for passenger vehicles in March 2018 with Agency for Natural Resources and Energy (ANRI) and Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and started the consultation for new standards toward 2030 to meet the energy policy in Japan and activities against global warming.

Table 7 Range of Vehicles Covered by the New Fuel Efficiency Standards

- When the current standard was considered, EV & PHV was decided not to be subject to the standard because the number was very small. It is, however, included this time, since it is expected to spread to a considerable extent.
- Fuel cell vehicles, on the other hand, are not subject to the new fuel efficiency standards due to the limited number of vehicles at the present time. Appropriate evaluation from a medium- to long-term perspective shall be necessary in future.

	Seating Capacity	GVW
Passenger Vehicle	Not more than 9	Not More than 3.5 ton
		More than 3.5 ton
	Not less than 10	Not More than 3.5 ton
		More than 3.5 ton
Cargo	－－	Not More than 3.5 ton
		More than 3.5 ton

※Excludes passenger vehicles other than type-certified

※With the introduction of WLTP, passenger vehicle with a seating capacity of 10 and GVW of more than 3.5 tons were excluded.

Source: Report of fuel efficiency standards for passenger vehicle

Table 8 Target Year, Energy Consumption Efficiency and Measurement Mode, etc.

- Since WtW(Well-to-Wheel) method is introduced instead of TtW(Tank-to-Wheel), energy consumption by EV/PHV can be compared with those of gasoline vehicle.
- And EVs and PHVs as well as gasoline vehicles are subject to evaluation with the Corporate Average Fuel Efficiency (CAFÉ) method under the new standards.
- In addition, WLTC mode is introduced as the evaluation index and calculate the TtW fuel consumption value, while the extra high phase of WLTC is eliminated in Japan.
- Since EV and PHV use electric power from the grid, energy efficiency of from the grid to vehicles becomes very important, “the value obtained in WtW divided by the energy efficiency of grid” is introduced as the new fuel efficiency in order to ensure continuity with the current standard and its unit is “km/L”.

Table 9 Fuel Efficiency Improvement with New Standards

- If the new fuel efficiency standard is achieved, the fuel efficiency improvement in FY2030 is estimated to be 32.4% compared to the actual value in FY2016 and 44.3% compared to the value in the current standards (FY2020 standard).

(i)Fuel efficienty improvement compared to FY2016 actual value

FY2016 Actual value※Note 1	FY2030 Standards Achievement※Note 2	Improvement
19.2（km/L）	25.4（ｋｍ/L）	32.4%

(ii)Fuel efficiency improvement against current standards

FY2020 Standards Calculated Value※Note 1	FY2030 Standards Achievement※Note 2	Improvement
17.6（km/L）	25.4（ｋｍ/L）	44.3%

※Note1 Fuel consumption value in WLTC mode converted from JC08 mode

※Note2 Calculated value based on the number and weight of passenger vehicles in FY2016

Source: Report of fuel efficiency standards for passenger vehicle

Table 10 Flexibility in Judgement of Achievement

- In Europe and the United States, so-called "credit system" has been introduced to judge the achievement of standards.
- The new fuel efficiency standards require manufacturers to make extremely ambitious efforts to improve fuel efficiency in widespread use of EVs and PHVs and therefore, flexibility for judgement shall be considered.

Outline of credit system in US and EU	
Off-cycle	• Introduction of fuel efficiency improvement technology that cannot be evaluated in mode test (LED lamp)
Promotion for introduction	• allowance for easing fuel consumption standards and raising CAFÉ for EVs and PHVs under certain conditions
Multiple years	• Allowing carry-over and carry-back to the target year in a certain period before and after the target year
Between corporations	• An unachieved corporation is allowed to take over the excess from an achieved corporation

Source: Report of fuel efficiency standards for passenger vehicle

Items	Decisions in fuel standard report
Target Year	•FY2030 (From the viewpoint of ensuring sufficient development period for improving fuel efficiency)
Method for judgement	•Corporate average fuel efficiency (CAFÉ) method is applied. EV and PHV are newly added. •Achievement of technical development that responses to strengthen safety and environmental regulations, and social demands (e.g. automatic driving) to be considered.
Indication of capability	•TtW value for energy consumption efficiency is newly added to the values in the catalog. •For EV & PHV, “Distance driven electrically by one charge" is added to the catalog.
Next-gen. vehicle	•The total spread of EV and PHV is considered to be 20%.
Others	•An appropriate method for indication for fuel efficiency based on the WtW concept shall be considered since it is important to enable the comparison of energy consumption efficiency between vehicles with different power sources and to encourage consumers to select a vehicle with higher performance.

Source: Report of fuel efficiency standards for passenger vehicle