Energy Conservation in Japanese Transportation Sector (Summary Centering on Logistics)

September 10, 2024

NX Logistics Research Institute and Consulting, Inc.

Contents

1. Status quo of energy conservation measures in Japanese transportation sector

Japanese transportation sector has two major energy conservation measures.

- **Measures for each vehicle (Fuel efficiency regulations)**
- **Promotion of business operator's efforts by Act on the Rational Use of Energy**

(Unfortunately, the measures for other than business operators such as road transportation companies include only the fuel efficiency regulations. Those for usage of vehicles, etc., only refer to the user's voluntary efforts such as eco-driving. The government's specific measures have not been implemented.)

(1) Fuel efficiency regulations

- Divide into passenger vehicles, trucks and buses to apply the fuel efficiency regulations to the vehicles marketed by the manufacturers.
- Official fuel efficiency has not been figured out as to electric vehicles (EVs) and fuel cell vehicles (FCVs). Currently, a fuel efficiency value is set only for the gasoline-fueled and diesel-fueled vehicles (including hybrid ones) as a 2020 target.
- The fuel efficiency target values will be set for the EVs and FCVs, starting from 2030.
- The following pages describe the specific fuel efficiency values.

1. Status quo of energy conservation measures in Japanese transportation sector

(2) Act on the Rational Use of Energy

- Two types of regulations are applied to consigners and carriers (detailed in Chapter III or later).

◎In case a transportation volume is 30,000,000 ton-kilometers (ton-km) or more, the consigner is obligated to submit a plan and a report and continuously improve energy conservation efficiency (estimated to occupy 60 to 70% of freight transportation in Japan).

◎The carriers of the following scales are obligated to submit a plan and a report and continuously improve energy conservation efficiency.

Category	Transportation capacity	Freight	Passenger
Railroads	Cars	300	300
Vehicles	Units	200	200 busses 350 taxis
Ships	Total shipping tonnage	20,000 gross tons	20,000 gross tons
Airplanes	Max. takeoff gross weight	9,000 tons	

2. Future goals

(1) Prevalence of next-generation vehicles

1) Current prevalence status

◎Of the next-generation vehicles developed with less (no) emission of air pollutants such as nitrogen oxides (NOx) and particulate materials (PM) and superior in fuel efficiency performance, the following lists the current number of prevailing units of fuel cell vehicles (FCV), electric vehicles (EV) and plug-in hybrid vehicles (PHV), respectively. The electric vehicles still have not prevailed in Japan.

Table: Number of owned units of next-generation vehicles (As of end of March 2022)

Types	EV	PHV	FCV	All types (Light vehicles and motorcycles included)
Units	140,490	174,448	7,113	82,174,944
Composition ratio	0.17%	0.21%	0.01%	100.00%

Source: Trend of Vehicles Owned in Japan (Website of Automobile Inspection & Registration Information Association: https://www.airia.or.jp/publish/statistics/trend.html)

2) Prevalence goal

- The government has positioned electrification, biofuels, and hydrogen fuels in the transportation sector as growth areas in its "Green Growth Strategy Accompanied by Carbon Neutrality" presented on June 18, 2021, with the following targets for each vehicle type.

◎Passenger cars: Achieve 100% electrification* of new passenger car sales by 2035.Electric vehicles include HVs, PHVs, EVs, and FCVs.

◎Commercial vehicles: light-duty vehicles weighing 8 tons or less; by 2030, 20-30% of new vehicles sold will be electric vehicles, and by 2040, 100% of new vehicles sold will be electric vehicles and vehicles suitable for using synthetic fuels and other decarbonized fuels combined.

◎Commercial vehicles: large vehicles over 8t; By 2030, based on technological development and technological demonstration, set a target for the spread of electric vehicles in 2040.

2. Future goals

(1) Prevalence of next-generation vehicles

● Estimation of alternation based on Japan's Green Growth Strategy

◎ Scenario of truck fuel type alteration (It is difficult to immediately increase the percentage of EVs and FCVs in all the manufactured trucks to 100%, so a model in which the percentage gradually increases was assumed.)

- Light-duty vehicles weighing 8 tons or less: The percentage of EVs will increase by 2.5% every year (2.5, 5.0……20.0%) from FY2023 to FY2030. Then, the percentage will increase by 8% every year from FY2031 to FY2040 and become 100% in FY2040.
- Large vehicles over 8t: FCV technologies will be established in FY2040, and the percentage of FCVs will increase by 10% every year from FY2041 to FY2050 and become 100%.

◎ The percentage of the new vehicles replacing to vehicles owned based on the trend of the length of vehicle ownership

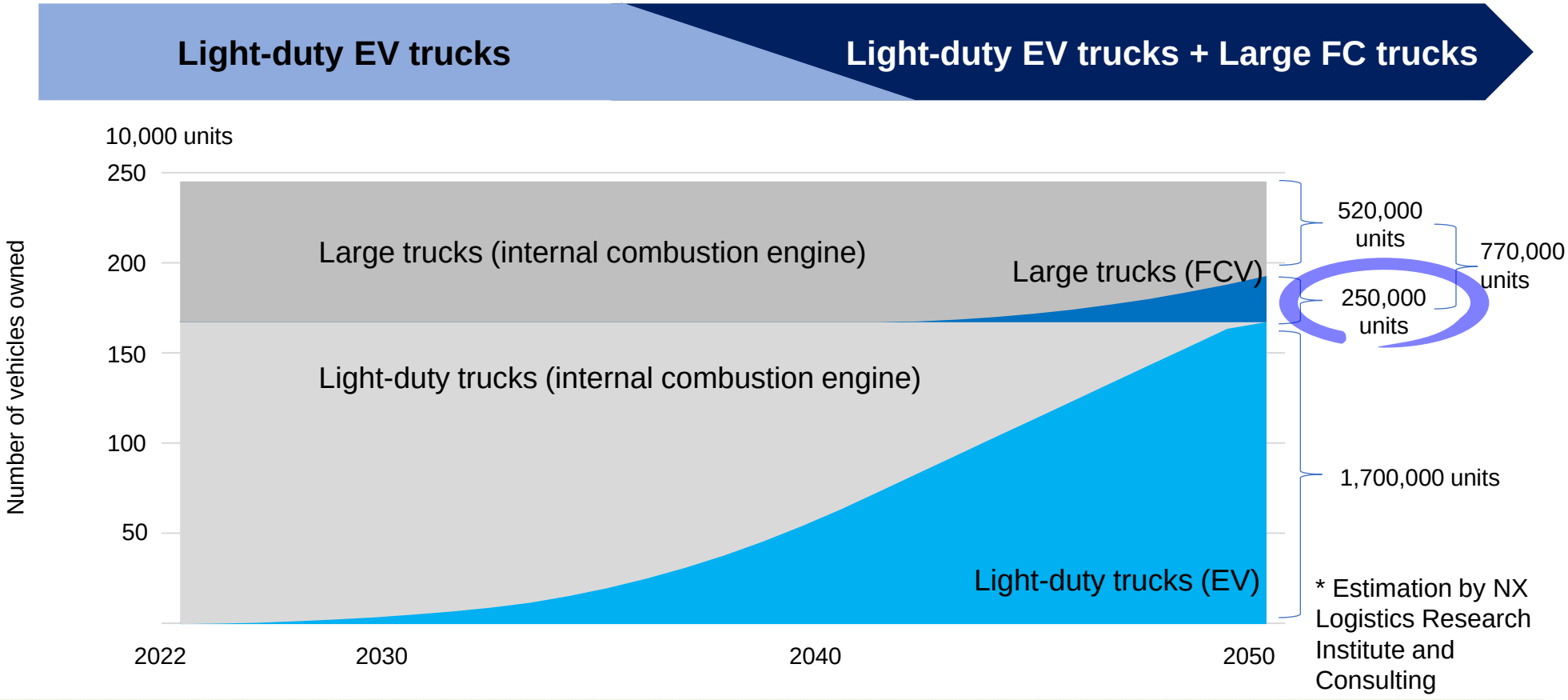
- The percentage of new vehicles purchased to vehicles owned is around 7% in the last 10 years, but estimated to be 6% because the length of vehicle ownership has been increasing.

2. Future goals

(1) Prevalence of next-generation vehicles

● Results of the estimation of alternation based on Japan's Green Growth Strategy

- Regarding 770,000 units of large trucks, it is estimated that, in FY2050, next-generation trucks will only be 250,000 units and the remaining 520,000 units will be internal combustion engine vehicles, because truck manufacturers have not established ambitious goals.



2. Future goals

(2) Movement toward carbon neutrality in international transportation

● **Review the movement toward carbon neutrality in the whole industry, before understanding the current status of companies relating to maritime and air transport services**

◎**Maritime transport: IMO (International Maritime Organization)**

- IMO reviewed the goal initially determined and announced in 2018 (at least 50% reduction by 2050), and adopted the following GHG reduction goal in Jul. 2023. (Unanimously adopted by all the 175 member countries.)
  (Reduction of CO_2 emissions as compared with 2008)
  Aim to reduce by 30% (at least 20%) by 2030 (checkpoint)
  Aim to reduce by 80% (at least 70%) by 2040 (checkpoint)
  Achieve net-zero emissions by 2050

◎**Air transport: ICAO (International Civil Aviation Organization)**

- In the 41st general assembly (Oct. 2022), ICAO adopted a long-term goal that aims to achieve carbon neutrality by 2050.
  Adopted the long-term goal of decarbonization aiming to achieve carbon neutrality by 2050.
  Changed the baseline used for the offset amount calculation in activities until 2035 to 85% of the emissions in 2019 (Carbon offset: Emissions exceeding the baseline are allocated to the operators, who must offset the emissions with carbon credits, sustainable aviation fuel (SAF), etc.)

◎**Air transport: IATA (International Air Transport Association)**

- In the general assembly in Oct. 2021, IATA adopted a goal to achieve net-zero greenhouse gas emissions in 2050 by a majority vote.

● It is highly possible that companies engaging in international (maritime and air) transportation services will realize carbon neutrality by 2050.

● In reality, however, it will be difficult to replace all the current ships and aircrafts powered by internal combustion engines with carbon-free ones by 2050. So, the remaining emissions will need to be offset with carbon credits. Users should be aware of the possibility that the cost will be passed on to transportation prices.

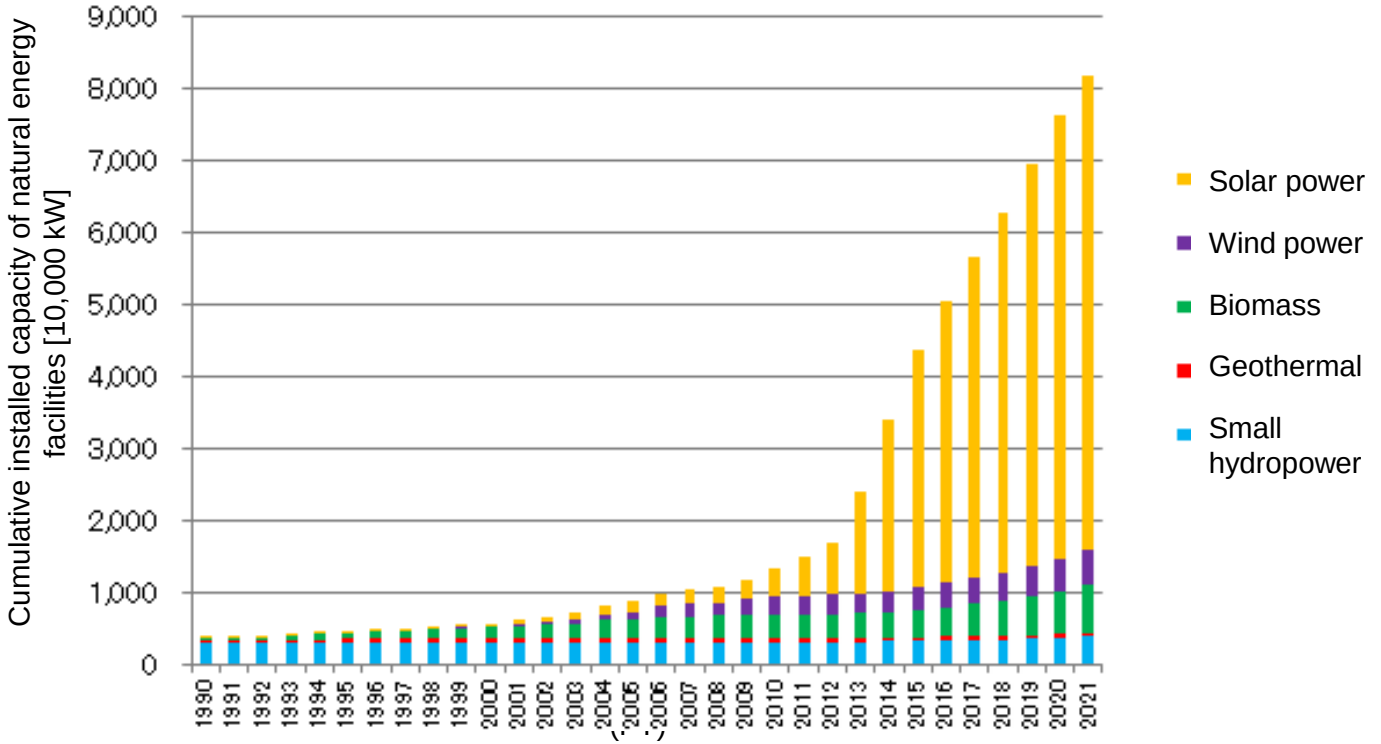
2. Future goals

(3) Renewable energy

● Current prevalence status

◎ Renewable energy in Japan has been expanding mainly through solar power generation.

◎ Photovoltaic power generation has expanded through the feed-in tariff, a system under which the government commits to purchase electricity generated from renewable energy sources by households and businesses.



Source: Material of Institute for Sustainable Energy Policies

● Future possibility

◎ Power generation costs with renewable energy have been decreasing year after year in Japan, but still higher than in overseas countries. Technological development, regulation reform, etc. are required for lowering the prices, still leaving a lot to be desired for prevalence.

II. Features of Japanese Logistics

1. Comparison with European and American logistics

◎If Japanese large-scale logistics business operators are compared with those of Europe and America who are deploying their business globally, the following can be suggested.

(1) European and American type (efficient platform type)

○ Advantages

- High proposal presentation ability concerning how to formulate strategies, how to build systems, how to make frameworks, construction of logistics network which is optimal from a global supply chain's viewpoint, etc.
- Human resources who receive professional and high-level education on logistics at universities, etc. are available for management tiers, and there is know-how for building IT management systems with a great deal of investment.

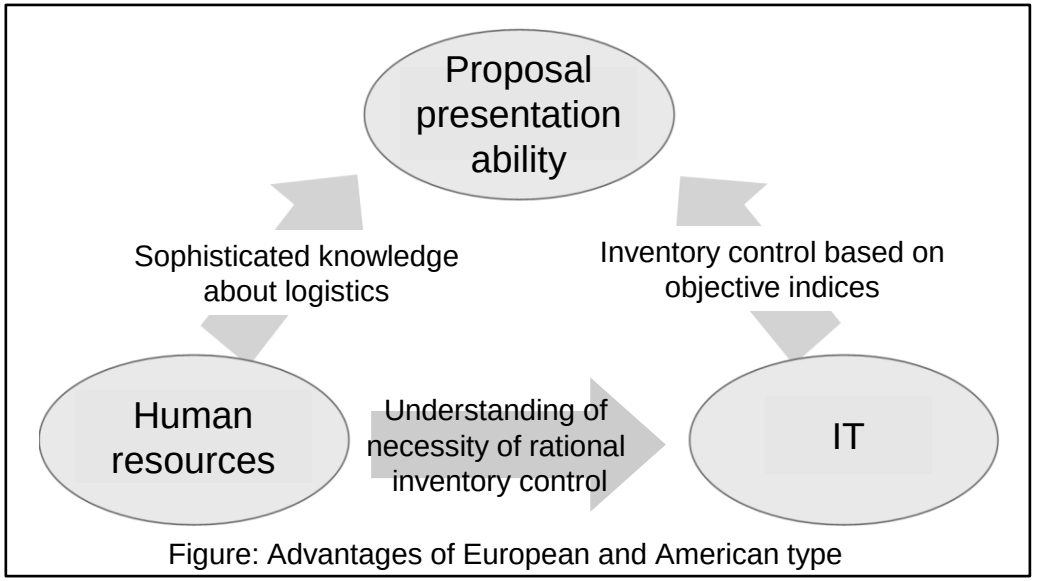


Figure: Advantages of European and American type

(2) Japanese type
(custom-made type suited to requests of customers)

○ Advantages

- Japanese logistics business operators focus on service for customers, and therefore, can provide meticulous and careful service that is suited to individual requests of consigners.
- Continuous "improvement" of transportation service at worksites is dynamic.

○ Disadvantages

- Japanese consigners often desire to control logistics on their own, and therefore, logistics business operators often tend to be satisfied if they "only meet requests of consigners".
- As a result, motivation to rationalize logistics or propose new systems becomes weak.

As systems of logistics are often built by consigner's intent in Japan, it is inevitable for logistics business operators to collaborate with consigners to realize energy conservation in transportation.

2. Frequent transportation of diverse items and small quantity

(1) Social background that gives impact to logistics

- As there are four seasons in Japan and products suited to each season are sold, product items become diverse. In addition, as a lot of product items are displayed in small stores, the quantity of each item displayed and stored becomes small.
- Therefore, in order not to lose sales opportunities due to shortage of products, the quantity sold must be refilled every day.

→ Frequent transportation of small quantity becomes routine.

(2) State of frequent transportation of small quantity shown in statistic data

- The freight lot per delivery (flowing lot) is 0.83 tons on average. Given transition from the past, the freight lot per delivery had been decreasing, but the extent of the decline has become smaller in recent years.
- Composition of flowing lots expressed by the number of deliveries shows that the freight less than 0.1 tons accounts for 82.2%. The transition from the past shows that the ratio of the freight less than 0.1 tons is expanding. It is presumed that this may be the result of expanded online shopping, etc.

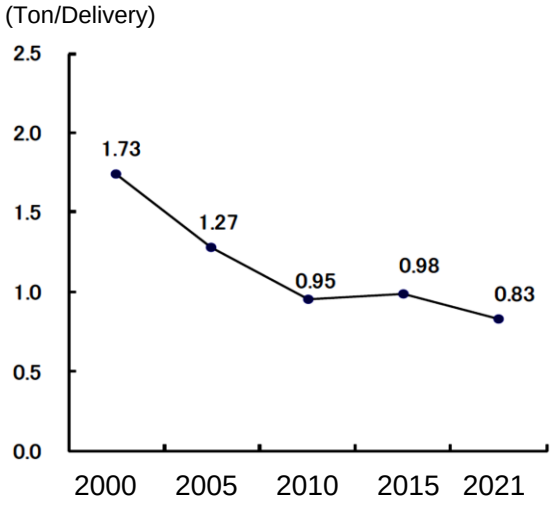


Figure: Transition of flowing lot

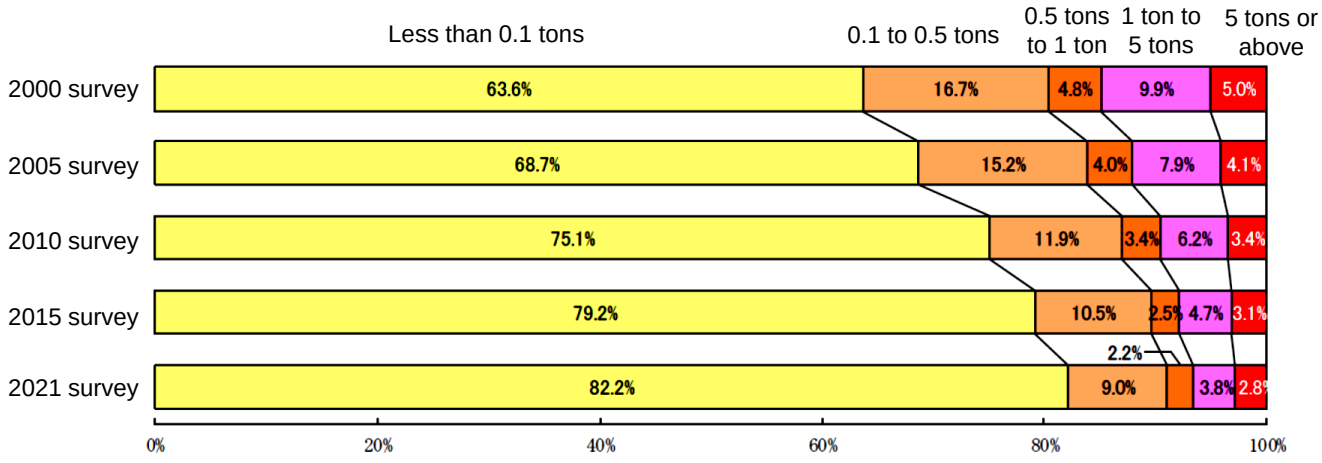


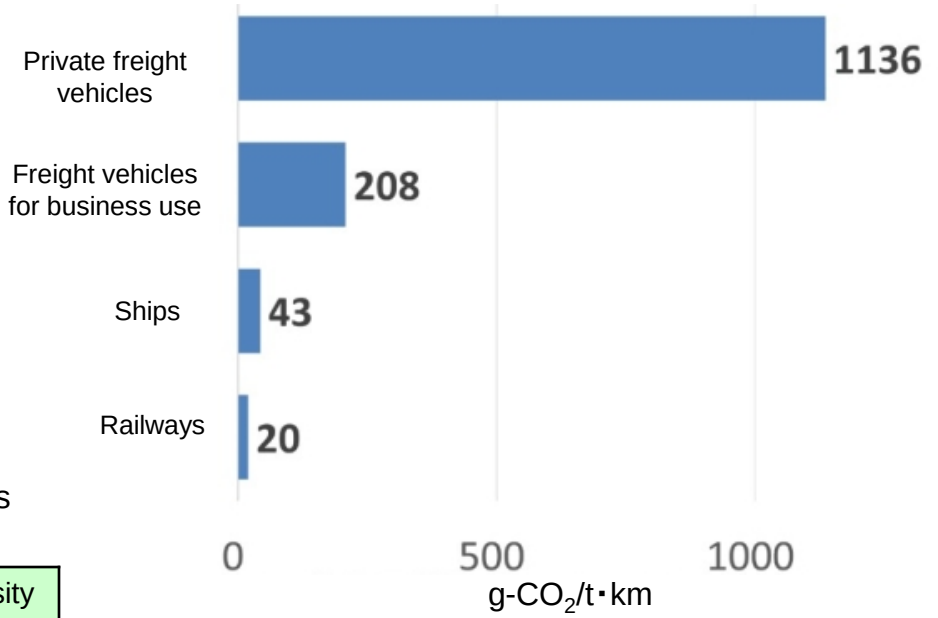
Figure: Transition of number of deliveries

Source: Survey on National Freight Net Flow, Ministry of Land, Infrastructure, Transport and Tourism

3. Establishment of method for calculating the energy consumption for consigners

(2) Japanese CO_2 emissions intensity

- CO_2 emissions intensity (g-CO_2/ton-kilo) of each Japanese transportation means is as per the figure on the right. (ton-km = t･km)
- Railways are the lowest, followed by ships.
- As private freight vehicles can only carry the freight of the company owning the vehicles, as requested by law, the efficiency is extremely low.
- In case of airlines, as it is difficult to separate passengers and freight, data is currently not publicized on the website of the Ministry of Land, Infrastructure, Transport and Tourism.



CO_2 emissions per transportation volume (FY22)

Source: Website of Ministry of Land, Infrastructure, Transport and Tourism

◎Examples of CO_2 emissions intensity of each transportation means of main areas of Japan and the world

Transportation means	Set value (g-CO_2/t･km)		Example of setting CO_2 emissions intensity for each transportation means
Container ships	Asian ocean route	**26.0**	According to the average ship type of each ocean route, the intensity is classified into 3 categories. Asian ocean route: up to 999 European ocean route: 5,000 to 7,999 North American ocean route: 3,000 to 4,999 (Unit is all in TEU)
	European ocean route	**14.2**	
	North American ocean route	**15.7**	
Airlines		**903**	Estimated based on Annual Air Freight Statistics (FY2009)

III. Visualization of Energy Conservation in Transportation

1. Necessity for consigners to take measures

(1) Significance of establishing a calculation method under the Energy Conservation Act

- **In order to take energy conservation measures, it is necessary to understand whether there is potential which will become a subject for reductions, and where this potential is.**
- **To realize this, it is necessary to establish methods for calculating the energy consumption (CO_2 emissions) in transportation, to enable an understanding to be gained of how much energy is being used in transportation.**
- **Accordingly, a calculation method used for gaining a more detailed understanding of the energy consumption was established under the Energy Conservation Act, so that the effects of measures could be quantitatively confirmed.**
- **In addition, the specific items of the energy conservation measures under the Energy Conservation Act were shown as Energy Conservation Guidelines, and the reporting of energy conservation plans, their application and the energy consumption was made mandatory.**

On the other hand, prior to the enforcement of the Energy Conservation Act, the issues described below had been predicted.

◎ Although the consigners control the transportation demand, it is difficult for consigners to gain an understanding of the direct energy consumption (fuel consumption).

◎ Because the freight that is loaded into trucks or other means of transportation is constantly changing according to the consigner and transportation section, it is difficult for each consigner to gain an understanding of the energy consumption. Particularly when conducting route delivery by combining loads, it is impossible to divide the energy consumption for each consigner based on the transportation volumes, order of delivery, running distances, etc.

◎ Additionally, in the truck transportation business which has an outsourced and subcontracted structure, in many cases the loads entrusted from the consigner are not all transported by the carrier's own vehicles, so that it is extremely difficult to gain an understanding of the energy consumption of each consigner, and the information for the consigner cannot be provided.

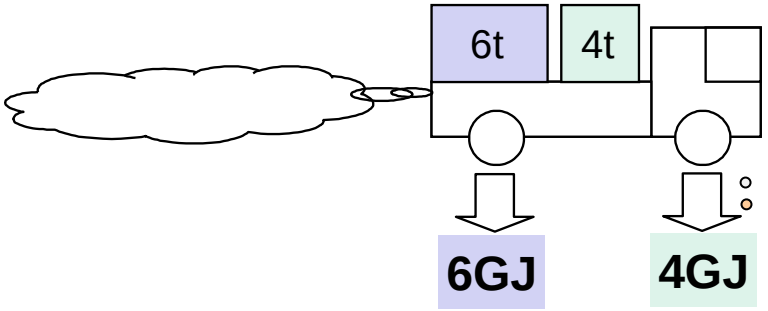
The key person for realizing efficiency in transportation is the consigner. The consigner must be able to calculate the anticipated values and the effects of taking the measures.
The energy consumption was made possible to be calculated using only the data and information (= t・km) that can be gathered by the consigner.

2. Establishment of method for calculating the energy consumption for consigners

◎Volume and distance of transportation should be available for consigners

◎Understanding of energy consumption of each consigner = Difficulty of fuel consumption

- Fuel consumption of each vehicle can be understood, but if multiple consigners use the vehicle, the fuel consumption must be allotted among them.
- Considering orders of transportation, etc., the allotment of the fuel consumption is extremely difficult.



To understand energy consumption of each consigner, allotment should be made for each transportation and total for each consigner should be calculated.

In case of improved ton-kilo method, the allotment is not necessary.

If the vehicle type and ton-kilo are understood, calculation is possible.

100-km transportation → 6 tons x 100 km + 4 tons x 100 km = 1,000 t･km

			Consigner A		Consigner B
ton-km	1,000 t･km	=	600 t･km	+	400 t･km
Energy	10 GJ	=	$10 \times \frac{600}{1{,}000}$	+	$10 \times \frac{400}{1{,}000}$
			6 GJ		4 GJ

As a consigner should be able to know volume and distance of transportation, energy consumption of transportation can be calculated with information of weight (ton) and distance (km).

3. Method for calculating the energy consumption in transportation

◎In addition to the energy consumption calculation method based on an understanding of the fuel consumption, etc., an improved tonne-km method was established.

Gasoline vehicles: log y = 2.67-0.927 log x -0.648 log z

Diesel vehicles: log y = 2.71-0.812 log x -0.654 log z

x = Loading ratio (decimal), z = Maximum loading capacity (kg),
y = Fuel consumption (liters/t･km)

● Conversion of fuel consumption to CO_2 emissions
◎ Gasoline: 2.32 kg-CO_2/liter
◎ Diesel: 2.58 kg-CO_2/liter

◎Previous ton-km method

Category		(g-CO_2/t･km)
Motor vehicles	Business use ordinary vehicles	173
	Business use small vehicles	808
	Business use light vehicles	1,951
	Private use ordinary vehicles	394
	Private use small vehicles	3,443
Railways		22
Domestic coastal vessels		39
Domestic air transportation		1,490

The values of railways, domestic coastal vessels and domestic air transportation values are used as they are.

0.0390 liter/t･km x 2.58 kg-CO_2/liter = 101 g-CO_2/t･km

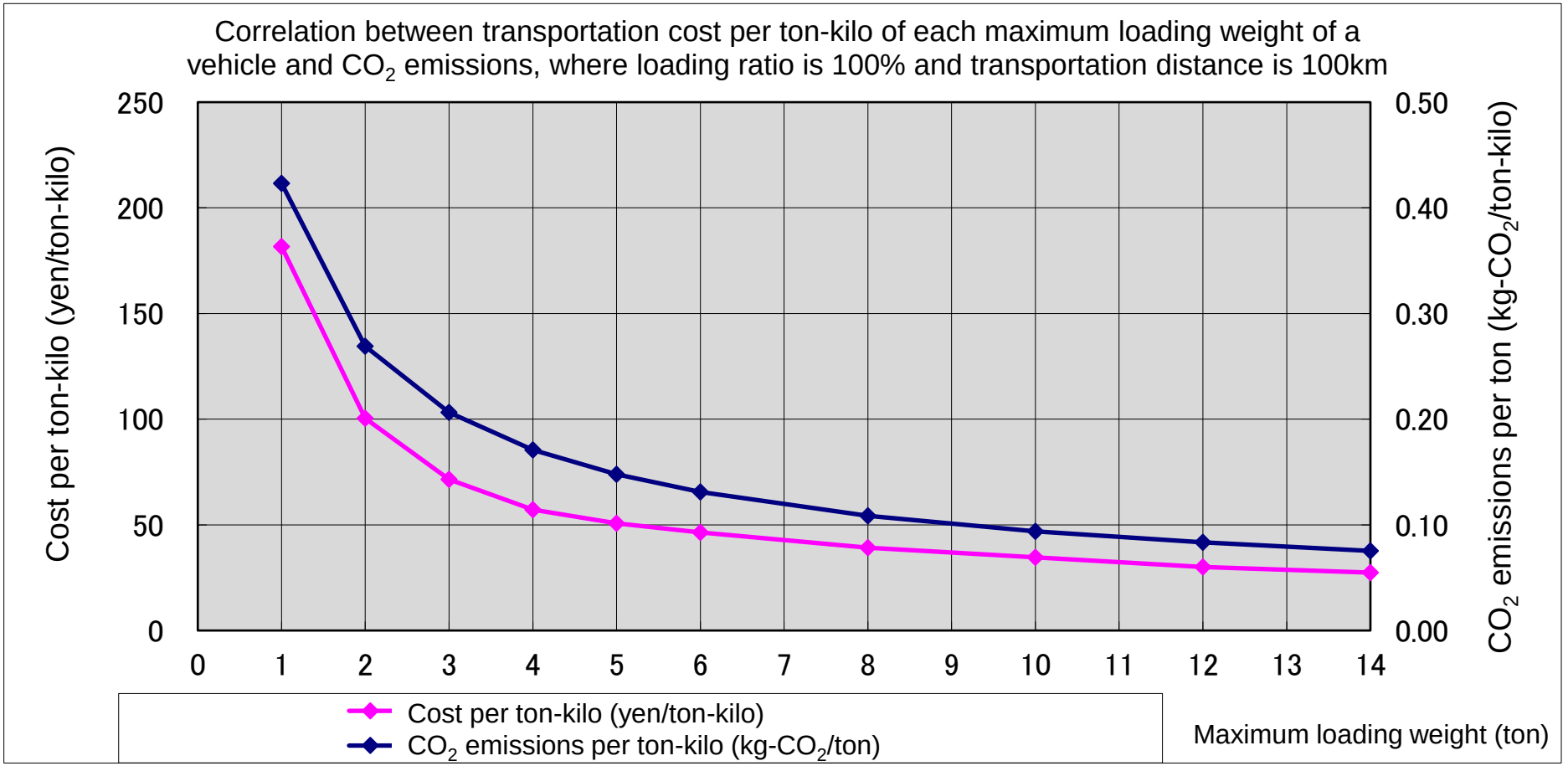
◎Improved ton-km method (allowing detailed calculation of motor vehicles)

Vehicle type	Fuel	Maximum loading capacity (kg)	Central value of maximum loading capacity	Fuel consumption for each transportation tonne-km (liter/t･km) Loading ratio (%)					
				10%	20%	40%	60%	80%	100%
Light, small, and ordinary freight vehicles	Gasoline	Light freight vehicle	350	2.74	1.44	0.758	0.521	0.399	0.324
		Up to 1,999	1,000	1.39	0.730	0.384	0.264	0.202	0.164
		2,000 kg or more	2,000	0.886	0.466	0.245	0.168	0.129	0.105
Small and ordinary freight vehicles	Diesel	Up to 999	500	1.67	0.954	0.543	0.391	0.309	0.258
		1,000-1,999	1,500	0.816	0.465	0.265	0.191	0.151	0.126
		2,000-3,999	3,000	0.519	0.295	0.168	0.121	0.0958	0.0800
		4,000-5,999	5,000	0.371	0.212	0.120	0.0867	0.0686	0.0573
		6,000-7,999	7,000	0.298	0.170	0.0967	0.0696	0.0551	0.0459
		8,000-9,999	9,000	0.253	0.144	0.0820	0.0590	0.0467	0.0390
		10,000-11,999	11,000	0.222	0.126	0.0719	0.0518	0.0410	0.0342
		12,000-16,999	14,500	0.185	0.105	0.0601	0.0432	0.0342	0.0285

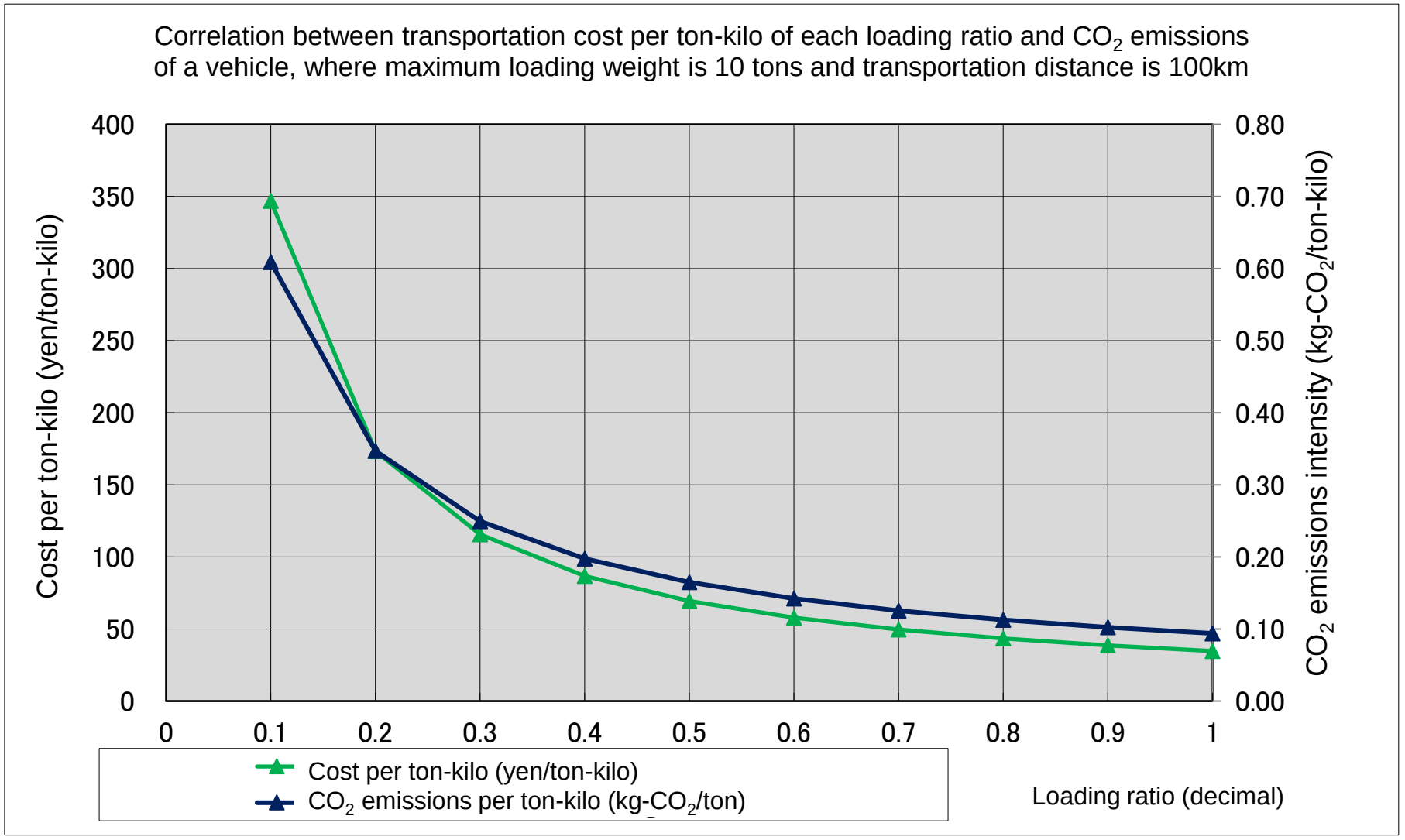
■ Energy conservation = Compatibility of CO_2 emission reduction and cost reduction

- ◆ Correlation of transportation cost per ton-kilo calculated based on truck transportation cost* and CO_2 emissions per ton-kilo (kg-CO_2/ton-kilo) is very high.
- ◆ Therefore, reduction of CO_2 emissions leads to cost reduction, greatly benefiting consigners.

* Estimated referring to licensed fare which can omit attachment of cost calculation sheet, etc. designated by the Ministry of Land, Infrastructure, Transport and Tourism (Handbook for Freight and Other Fares: Published by Kotsu Nihon Sha K.K. FY2013 edition)



■ Energy conservation = Compatibility of CO_2 emission reduction and cost reduction



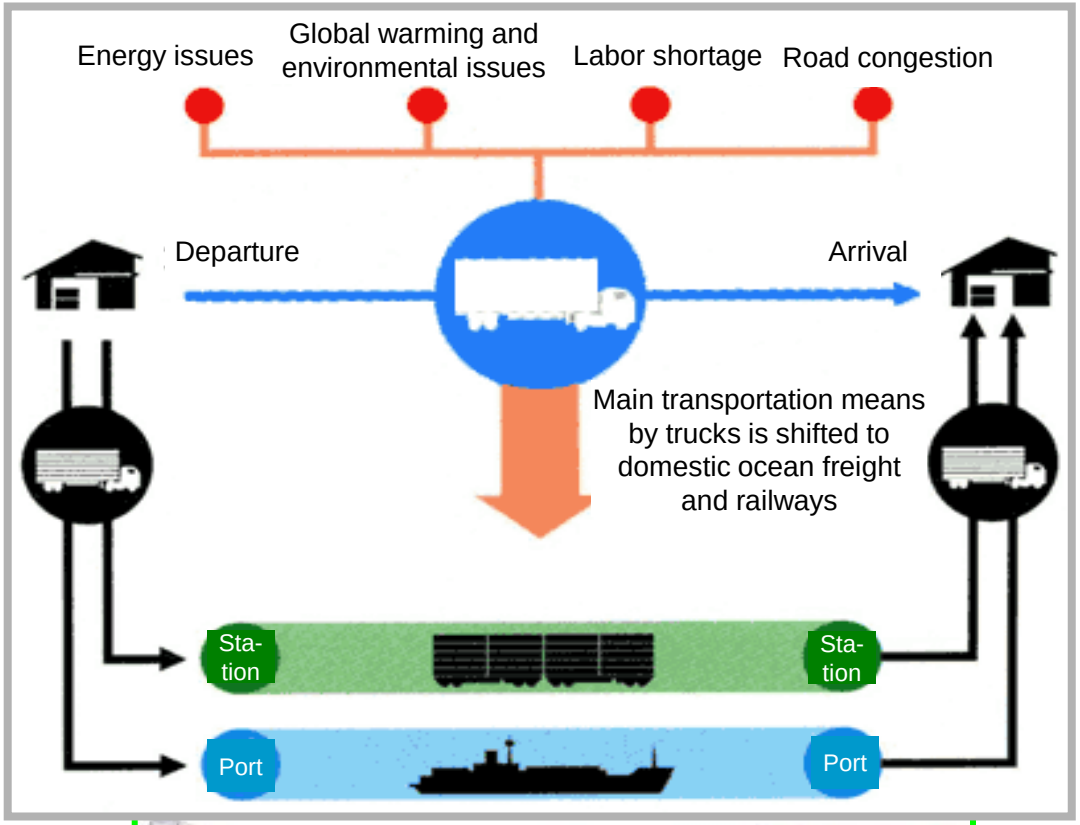
IV. Energy Conservation Measures by Consigners

Overview

◎The following shows the measures that should be taken by consigners designated in the Energy Conservation Act.

1. Consigners shall gain an **understanding** of the energy usage **actual situation** relating to the freight transportation conducted by freight carriers, and of the **measures taken** relating to the rational use of energy.
2. Consigners shall determine policies showing the measures for the rational use of energy relating to the freight transportation conducted by freight carriers, and shall **prepare a system for promoting** the said measures.
3. Consigners shall plan for the **effective application of transportation means and transportation methods** which have low energy consumption rates for the transportation volumes.
4. In order to improve the transportation efficiency, consigners shall place orders that allow freight carriers to implement **consolidated transportation** and **selection of vehicle types** according to the transportation volumes.
5. In order to improve the transportation efficiency, regarding product development in manufacturing industries, consigners shall plan to realize **product package standardization** and **reductions in the weights of products and packing** which contribute to improving the loading ratio.
6. Consigners shall coordinate with a consignee to reduce freight transportation frequency and delivery count, and review a lead time through the larger unit of transaction, etc. Particularly, they review high-frequency small-quantity transportation with no planning and necessity and just-in-time (specified day of the week and time) freight transportation.
7. Consigners shall mainly address improved delivery efficiency of small-lot freight for consumers. (Less redelivery, etc.)

1. Selection of transportation means and transportation methods



<Features of each means>

- **Trucks**
  - ○ No restriction of delivery time
  - ○ Direct delivery to the destination
  - ○ Small lot freight transportation possible
- **Railways (vs. trucks)**
  - ○ Large lot, long distance transportation possible
  - ○ Less CO_2 emissions compared to vessels
  - ○ Fast and scheduled transportation
- **Vessels (vs. trucks)**
  - ○ Increased capacity for large lot, long distance transportation compared to railways
  - ○ Less CO_2 emissions
  - ○ Less freight damage

*** Features vary depending on transportation conditions.**

BIG ECO LINER 31
(31 feet large-scale container)

RORO vessel "Himawari 5"

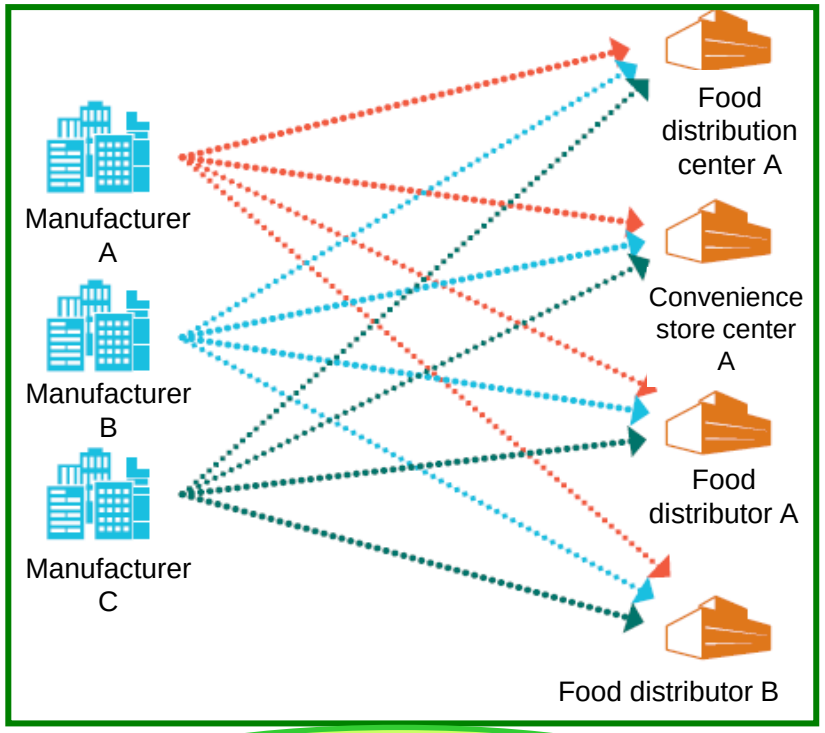
Source: Webpage of Nippon Express Co. Ltd., CSR report

2. Improvement of transportation efficiency and implementation of consolidated freight transportation

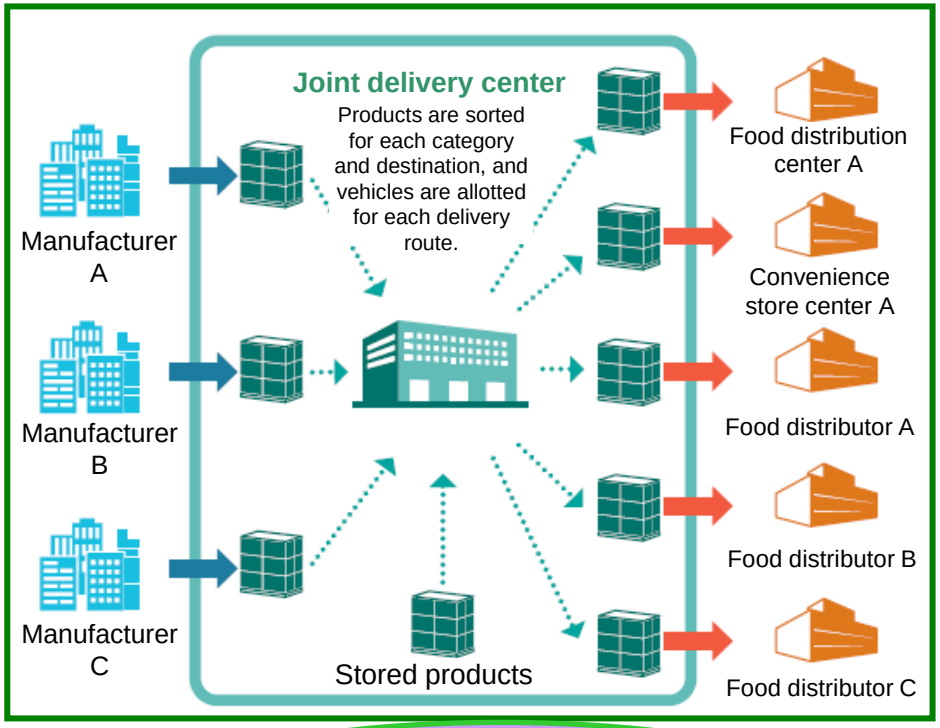
(1) Joint transportation, joint freight distribution

* Joint logistics by same business types, joint logistics by different business types

◎Energy conservation realized by improving loading ratio or shortening transportation distance.



General freight distribution system



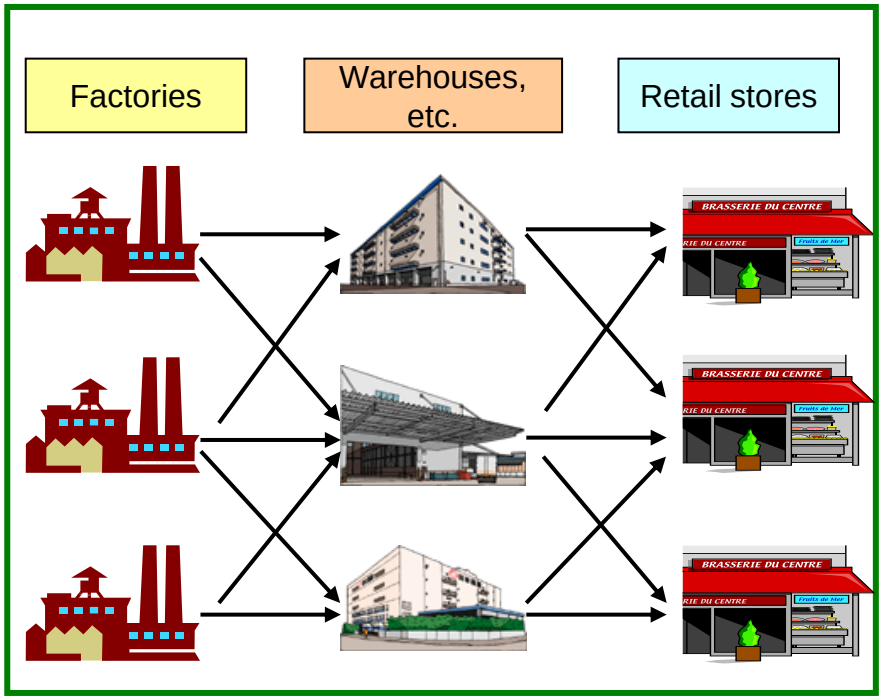
Joint transportation and delivery system

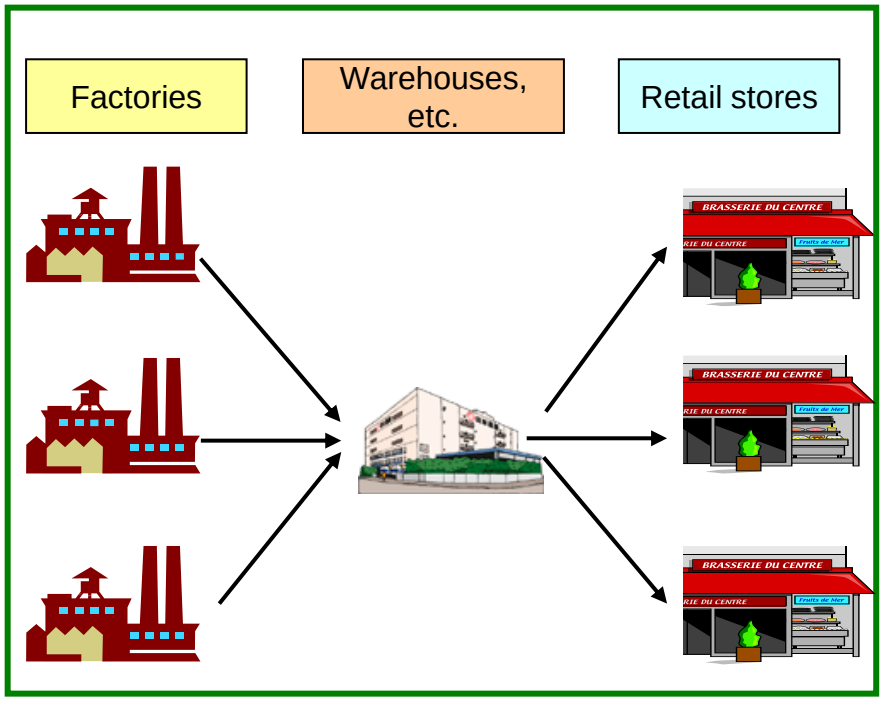
2. Improvement of transportation efficiency and implementation of consolidated freight transportation

(2) Consolidation of distribution bases

*** Consolidation of distribution bases such as warehouses and distribution processing factories dispersed across various places.**

◎Energy conservation realized by improving loading ratio or shortening transportation distance





General freight distribution system

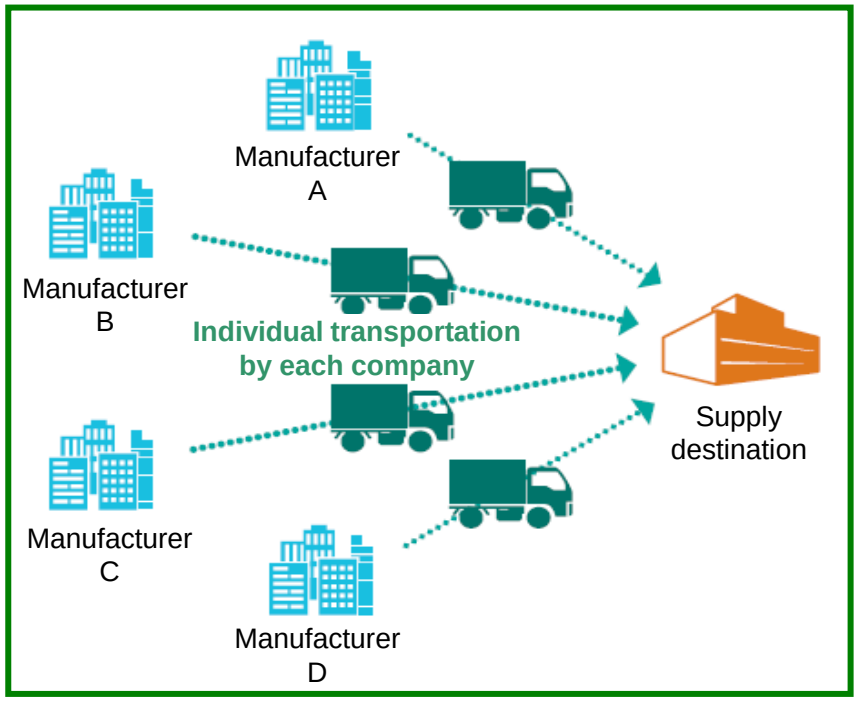
Consolidated freight distribution system

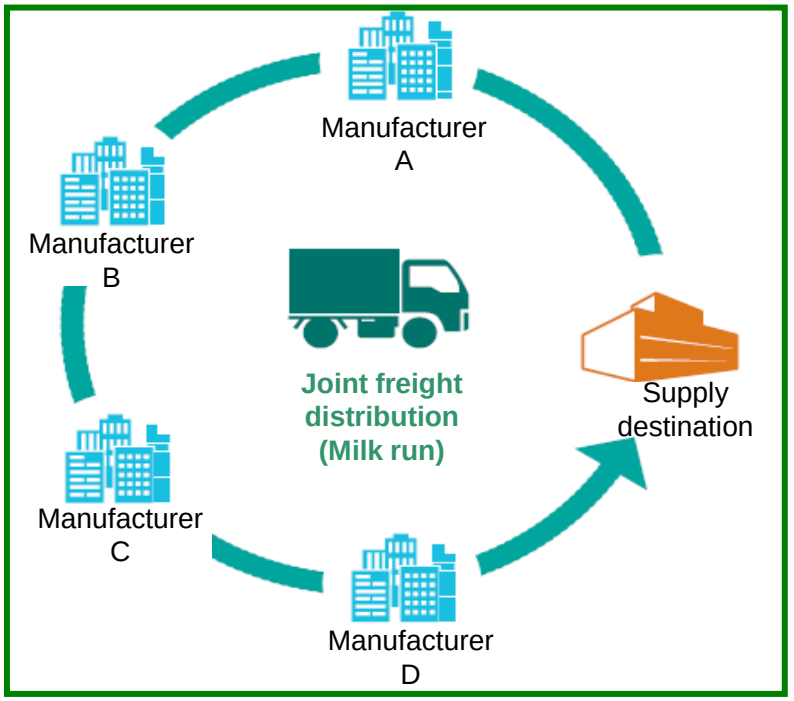
2. Improvement of transportation efficiency and implementation of consolidated freight transportation

(3) Milk run

*** Freight distribution system in which a vehicle visits multiple manufacturers to collect freight (called "milk run" because it resembles collecting milk by visiting multiple farms)**

◎Energy conservation realized by improving loading ratio or shortening transportation distance





General freight distribution system

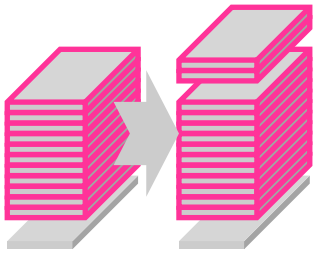
Milk run freight distribution system

3. Consideration of product design, etc. for manufacturing business

Change of transportation packing specifications (Use of slip sheets and large containers)

・Volume is reduced by getting rid of pallets.

・Loading volume is improved by promoting use of HC containers and changing number of loading layers.



Downsized packing (Compact packing, cushion materials, products)

・Volume is reduced by changing shape and material of cushion materials.

・Volume is reduced by changing position of attachment parts.
・Volume is reduced by downsizing product itself.

◆Achievement of Energy Conservation Act (Consigners)

Total energy consumption of consigners reported in FY2018 was 202,950,530 GJ (5.5% more than previous fiscal year), equivalent to approx. 20% of energy consumption pertaining to national freight transportation.

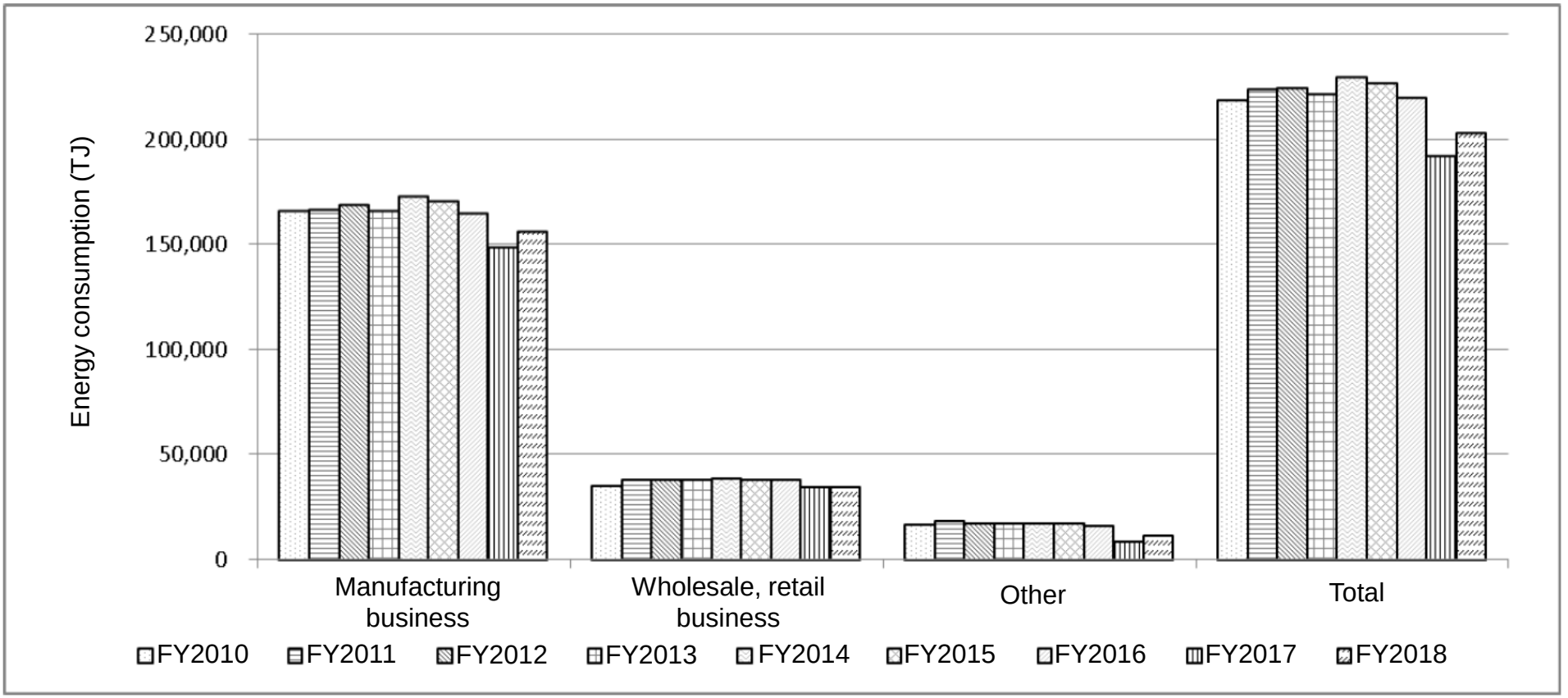


Figure: Transition of energy consumption

Source: “Analysis of Compliance Status of Factories and Consigners with Energy Conservation Guidelines and Research Report on Promotion of Computerization (March 2017)” by Energy Conservation Center, Japan

◆Achievement of Energy Conservation Act (Consigners)

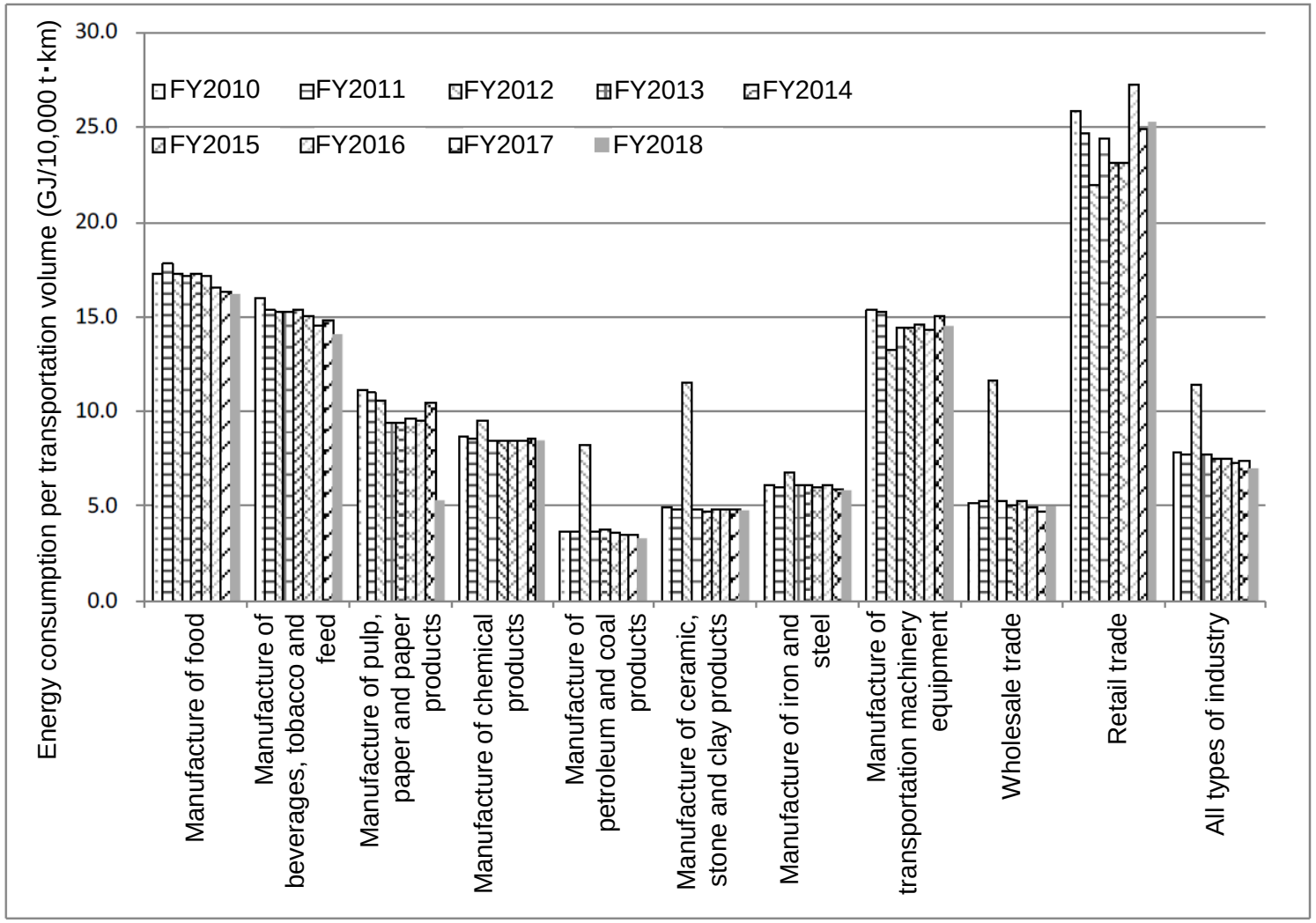


Figure: Transition of energy consumption per transportation volume in major types of industry

Source: “Analysis of Compliance Status of Factories and Consigners with Energy Conservation Guidelines and Research Report on Promotion of Computerization (March 2017)” by Energy Conservation Center, Japan

○The average energy consumption intensity of all types of industry in FY2018 was 7.0 GJ/10,000 t・km. This is 0.4 GJ/10,000 t・km lower than in the previous fiscal year.

○Of major 10 types of industry, the energy consumption intensity is lower than the average of all types of industry in the manufacture of petroleum and coal products, manufacture of ceramic, stone and clay products, wholesale trade (including major petroleum products wholesale trade) and manufacture of iron and steel which transport a large volume of heavy objects by ship, etc. but it is higher than the average of all types of industry in the retail trade, manufacture of food, manufacture of beverages, tobacco and feed, manufacture of transportation machinery and equipment, etc.

○Given annual transition for each type of industry, the energy consumption intensity tends to decline in the manufacture of food and the manufacture of beverages, tobacco and feed, but it levels off in other major types of industry.

V. Energy Conservation Measures by Logistics Business Operators

Overview

1. Creation of policies to be addressed and gaining an understanding of their effects
(→ Establishment of a management system)

(1) Logistics business operators formulate and review the policies to be addressed for realizing rational use of energy, and clarify the promotion structure and the persons responsible.

(2) Logistics business operators set the target values for realizing rational use of energy, implement periodical effect measurement, and review the rationalization measures.

2. Use of transportation machinery and equipment which have an outstanding performance regarding energy consumption

(1) Logistics business operators introduce low fuel consumption vehicles such as hybrid vehicles, natural gas vehicles, vehides satisfying the top runner fuel efficiency standards and vehicles incorporating idling stop devices.

(2) Logistics business operators introduce heat storage heating mats, air heaters, etc.

3. Driving which contributes to the rational use of energy in transportation machinery and equipment

(1) **Promotion of eco-driving**

- Logistics business operators make eco-driving common knowledge among drivers and give instruction.
- Logistics business operators establish an eco-driving promotion system through activities such as establishing chief administrators inside companies and preparing manuals.
- Logistics business operators have chief administrators and drivers participate in courses which have the objective of popularizing eco-driving.
- Logistics business operators manage energy use of each driver and vehicle type by using digital driving recorder, etc.

(2) Operations using efficient transportation routes

- Logistics business operators select highly energy efficient transportation routes in advance, and make these routes well known to the drivers.
- By introducing information and communication devices utilizing GPS, etc., logistics business operators ensure that they will be able to gain an understanding of the truck vehicle locations and can give instructions to drivers based on road traffic information.
- Logistics business operators introduce information terminals such as VICS to allow drivers to know congestion information, etc.

(3) Logistics business operators appropriately control the temperature of freight for vehicles transporting frozen freight.

Overview

4. Use of transportation machinery and equipment with high transportation capacity

- According to the transportation volumes, logistics business operators promote the change to large-sized trucks and the use of trailers.

5. Effective application of the transportation capacity of transportation machinery and equipment

(1) Logistics business operators improve the loading ratio using efficient distribution.

- Logistics business operators gain an understanding of the weights, shapes and characteristics (small and heavy items, large and lightweight items, etc.) of the transportation products, determine transportation lots and implement vehicle allocation to effectively utilize the transportation capacity of the transportation machinery and equipment.
- Logistics business operators introduce a system that enables guidance to be given to drivers relating to the improvement of loading ratio according to the transportation ordering situation, etc. by allowing logistics business operators to gain an understanding of the truck vehicle locations and loading situation.
- Regarding business use trucks, logistics business operators implement joint transportation and delivery and joint operations in cooperation with other logistics business operators.
- Regarding business use trucks, logistics business operators share loading information in cooperation with other logistics business operators.
- Regarding business use trucks, logistics business operators clearly understand the transportation demand, and promote consolidated transportation.

(2) Logistics business operators secure the return freight.

- Logistics business operators introduce a system that enables guidance to be given to drivers relating to the securing of return freight according to the transportation ordering situation, etc. by allowing logistics business operators to gain an understanding of truck vehicle locations and loading situations.
- Logistics business operators share loading information in cooperation with other logistics business operators .
- Logistics business operators gain an appropriate understanding of the transportation demand.

1. Establishment of environmental management system

◎In logistics field, there are two major systems.

◎To further promote activities pertaining to environmental conservation at each workplace, an international standard ISO14001 for environmental management system and a green management certificate are often acquired.

◎As 99% of trucking business operators are small and medium-sized enterprises, ISO14001 whose certification cost is high is not diffused well among them. Accordingly, a simplified certificate system was developed for small and medium-sized enterprises. While it covers all of environmental measures, emphasis is placed on the eco-driving (education on driving methods, fuel management, routine check, etc.).

→ **Effect of the green management certificate (Practice of the PDCA cycle)**

◎Images of routine check (energy conservation effect is described later)

Check of air pressure using a tire gauge

Check of air pressure using a tire gauge (pen type)

Check of black smoke using a black smoke chart

Source: Nippon Express Co. Ltd., CSR report

1. Establishment of environmental management system

◎**Effect of green management promotion (Comparison of average fuel consumptions between certified business operators and national average: trucks)**

◎**CO_2 emissions intensity, comparison of 2 years before and after certification (other than trucks)**

Vehicle type	Improvement ratio during 2 years after certification
Truck（GVW of 8 tons or more）(N=1,231)	3.2% improvement
Truck（GVW of less than 8tons）(N=1,173)	3.2% improvement
bus(N=140)	2.7% improvement
taxi(N=325)	1.6% improvement

Category of CO_2 emissions intensity	Improvement ratio during 2 years after certification
Ordinary warehouses (per managing area)	4.0% improvement
Refrigeration warehouses (per equipment ton)	3.0% improvement
Coastal transportation (per handling ton)	7.8% improvement
Coastal transportation (per handling container)	4.4% improvement
Passenger vessels (per distance kilo)	1.0% improvement
Domestic vessels (per distance kilo)	3.8% improvement
Tow boats (per towing hour)	2.1% improvement

To calculate CO_2 emissions of various energy types used for warehouses, coastal transportation, passenger vessels and domestic ocean freight, CO_2 conversion coefficient stated in the calculation ordinance issued by the Ministry of Economy, Trade and Industry and the Ministry of the Environment in 2011 was used.

Electricity (general)	**: 0.561 $kgCO_2$/kWh**	**Heavy oil A**	**: 2.71 $kgCO_2$/L**
City gas	**: 2.23 $kgCO_2$/Nm^3**	**Heavy oil B/C**	**: 3.00 $kgCO_2$/L**
Light oil	**: 2.58 $kgCO_2$/L**	**LPG (liquid):**	**: 3.00 $kgCO_2$/kg or 1.67 $kgCO_2$/L (LPG: 1 kg = 1.795 L)**
Gasoline	**: 2.32 $kgCO_2$/L**	**LPG (gas)**	**: 7.81 $kgCO_2$/m^3 (LPG: 1 kg = 0.384 m^3)**
Kerosene	**: 2.49 $kgCO_2$/L**		

Source: Foundation for Promoting Personal Mobility and Ecology Transportation, Effect of green management certification - 2019 edition -

1. Establishment of environmental management system

◎Number of traffic accidents and vehicle troubles

■Number of traffic accidents

The number of traffic accidents per driving distance encountered by certified business operators who replied to the questionnaire decreased by 24.9% in case of trucks, 20.7% in case of buses and 6.2% in case of taxis during a year after the certification compared with those of the previous year.

Vehicle type	The first year after certification, comparison with previous year
Trucks	24.9% decrease
Buses	20.7% decrease
Taxis	6.2% decrease

■Number of vehicle troubles

The number of vehicle troubles per driving distance encountered by certified business operators who replied to the questionnaire decreased by 19.3% in case of trucks, 3.6% in case of buses and 15.3% in case of taxis during a year after the certification compared with those of the previous year.

Vehicle type	The first year after certification, comparison with previous year
Trucks	19.3% decrease
Buses	3.6% decrease
Taxis	15.3% decrease

Source: Foundation for Promoting Personal Mobility and Ecology Transportation, Effect of green management certification - 2019 edition -

2. Promotion of eco-driving (overview of environment-friendly fuel-saving and energy-saving driving)

→ leading to safety of driving as well (very important for logistics business operators)

●10 recommendations for eco-driving

- Do not spend too much time on warming-up.
- Stop the engine when parking.
- Do not rapidly start or accelerate.
- Keep a moderate speed.
- Drive at a stable speed.
- Avoid sudden braking.
- Check air pressure of tires.
- Do not leave unnecessary items in the vehicle.
- Do not use air conditioner when not necessary.
- Choose appropriate gear.

Nippon Express Co, Ltd. Izu training center

●Wearing a key rope

*** Wear it around your waist and make sure to pull out the key when you leave the vehicle.**

●Introduction of digital tachometer

Installed to all vehicles by March 2005.

●Eco-driving training

Annual trainees: approx. 1,400

Driver training lecture

Source: Webpage of Nippon Express Co. Ltd.

2. Promotion of eco-driving (Specific driving methods)

◎“10 recommendations for eco-driving” prepared in 2012

1. Gentle acceleration “eStart”

Fuel efficiency improvement of around 10%

When moving the vehicle off from a standstill, gently press the accelerator to begin moving the vehicle. (Over the initial 5 seconds, aim for a vehicle speed of around 20 km/hr.)

2. Maintain adequate space between vehicles to allow driving with few accelerations and decelerations

When the distance between vehicles is short, there will be a 2% worsening in urban areas, and a 6% worsening in suburban areas.

While driving, try to ensure that you maintain a steady speed.

3. When decelerating, lift your foot off the accelerator earlier

Fuel efficiency improvement of around 2%

As soon as you know you will have to stop, such as when a traffic light changes to red, lift your foot off the accelerator.

4. Use air conditioning appropriately

If the temperature setting in the vehicle is set to the same temperature as the outside air at 25ºC, switching on the air conditioner will worsen the fuel efficiency by 12%.

When you only require heating, set the air conditioner switch to OFF. Further, when you need cooling, take care not to set the temperature too low.

5. Stop wasteful engine idling

Around 130 ml of fuel is consumed for every 10 minutes of idling.

When parking your vehicle while waiting for someone or when unloading luggage, stop unnecessary engine idling.

2. Promotion of eco-driving (Specific driving methods)

◎“10 recommendations for eco-driving” prepared in 2012

6. Avoid becoming caught in traffic congestion, and leave with extra time to arrive at your destination

Before departing, confirm your destination and route beforehand by utilizing road traffic information regarding traffic congestion and traffic restrictions, as well as maps and car navigation, and leave with more than enough time to arrive at your destination.

If 10 minutes of unnecessary driving is added to one hour of driving, there will be an approximately 17% increase in fuel consumption.

7. Conduct inspections and maintenance starting with tire air pressure checks

Make a habit of checking the tire air pressure.

If there is an insufficiency of 50 kPa (0.5 kg/cm^2) from the normal tire air pressure, there will be an approximately 2% worsening of fuel efficiency when driving in urban areas and a 4% worsening in suburban areas.

8. Offload unnecessary luggage

Unload luggage that does not need to be in your vehicle.

When driving with 100 kg of luggage, there will be an approximately 3% worsening of fuel efficiency.

9. Avoid parking your vehicle in locations that will impede the driving of other vehicles

Stop nuisance parking.

On roads which have no nuisance parking, the average driving speed increases, preventing the worsening of fuel efficiency.

10. Understand your own fuel consumption

Make a habit of gaining an understanding of your own vehicle’s fuel consumption.

By gaining an understanding of your daily fuel consumption, you can really appreciate the effect of your eco-driving.

3. Other efforts

◆Articulated trucks (Practical implementation stage)

- Full trailers that enable transportation of loads corresponding to two large-sized trucks using one truck
- On January 29, 2019, the Ministry of Land, Infrastructure, Transport and Tourism increased the limit on the length of full trailers in the special vehicle passage permission standards from 21 m to 25 m.
  The main route subject to the regulations was a section of the Shin-Tomei Expressway (Ebina Junction to Toyota-Higashi Junction).
- On August 8, 2019, the subject routes were expanded: Tohoku Expressway – Ken-O Expressway – Tomei Expressway – Meishin and Shin-Meishin Expressways – Sanyo Expressway – Kyushu Expressway (Kitakami-Ezuriko Interchange to Dazaifu Interchange)
- As of March 2020, 32 trucks from seven companies have obtained approval.

Effects: Response to insufficient numbers of drivers, approximately 40% reduction in CO_2 emissions (Results of verification testing by the Ministry of Land, Infrastructure, Transport and Tourism)

Issues: Expressways with four or more lanes, and the infrastructure preparation of ordinary roads leading from expressways to distribution bases (provisional expansion of two-lane roads to four-lane roads) will be required.

Currently Normal large-sized truck (10-ton truck)

Approximately 12 m

Going forward **Articulated truck: Possible to transport a two-truck portion of load using one truck**

Increase of the vehicle length in the special vehicle permission standards

(Investigation into increasing the existing length of 21 m to a maximum of 25 m)

Articulated truck in operation (25 m vehicle)

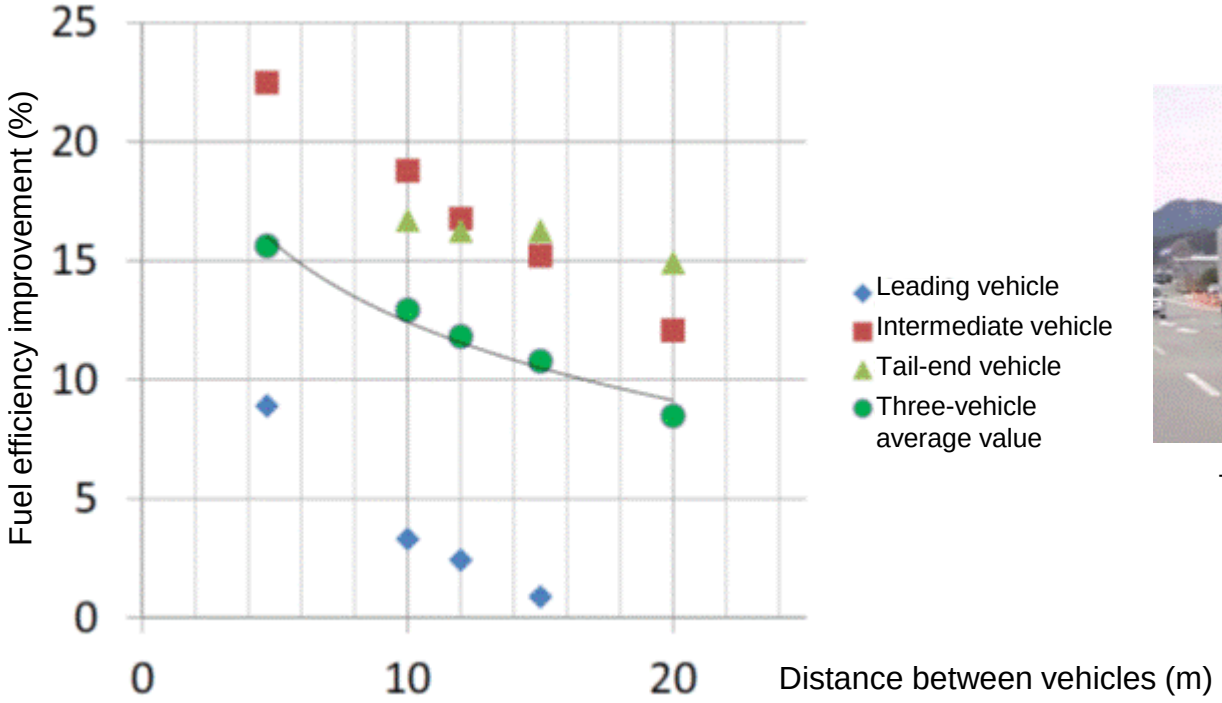
Articulated trucks (Source: Ministry of Land, Infrastructure, Transport and Tourism)

◆Truck platooning (Verification testing stage)

- Manual driving of leading vehicle, with electronically linked driving of unmanned following vehicles using methods such as communications between vehicles (unmanned platooning of following vehicles)
- Public road verification was conducted on the Shin-Tomei Expressway (Hamamatsu-Inasa Interchange to Nagaizumi-Numazu Interchange).
- Japan Automobile Manufacturers Association policy: Commercialization of manned platooning of following vehicles in FY2021
  Commercialization of unmanned platooning of following vehicles from FY2025

Effects: Response to insufficient number of drivers, approximately 10% reduction in CO_2 emissions (Energy conservation effect by reduction of air resistance*)

Issues: Securing of driving space (dedicated lanes, etc.), forms of platooning and separation space, preparation of infrastructure for diverging and merging lanes, high prices of vehicles



Truck platooning (Source: Ministry of Land, Infrastructure, Transport and Tourism)

* Energy conservation effect regarding the distance between vehicles for three-truck platooning at a driving speed of 80 km/h (Source: “Energy ITS Promotion Project”, Post-project evaluation report: https://www.nedo.go.jp/content/100564241.pdf)

◆Electric trucks (EV) (Verification testing to practical implementation stages)

- Electricity from the storage cells mounted in the truck is used as the energy source to power the motor and drive the truck.

  Advantages: While running, there are no emissions of CO_2 or harmful substances (Zero emissions vehicle)

  Issues: Short cruising distances, preparation of charging infrastructure, charging times, high vehicle prices, and storage cell durability

◆Main trends in Japanese electric trucks

Mitsubishi Fuso Truck and Bus Corporation	• 2017: Started production of the “eCanter”, the world’s first mass-produced small-sized electric truck From 2017: Utilized by Seven-Eleven (25 trucks) and Yamato Transport (25 trucks) • Delivery of more than 450 trucks completed worldwide up to 2022 • Charger and charger installation service, a charger installation service for EV (electric vehicle) trucks, will begin in September 2022
Isuzu Motors Ltd.	• 2019: Started monitoring the small-sized truck “Elf EV” • 2022 Start sales of mass-produced light-duty trucks
Hino Motors Ltd.	• November 2021 Commenced demonstration tests of pickup and delivery operations using the Hino Dutro Z EV, an ultra-low floor, walk-through, compact BEV (Battery Electric Vehicle) truck • June 2022: Start sales of Hino Dutro Z EV

eCanter of Seven-Eleven and Yamato Transport (Source: Mitsubishi Fuso)

small electric trucks.by Hino Motors Ltd
(Source Hino Motors Ltd)

Elf EV
(Source Isuzu Motors Ltd.)

VI. Systems for Evaluating Energy Conservation Activities

1. Results report system on use of vehicles and advise

● Overview

◎ Municipalities in metropolitan areas obligate the business operators having many vehicles to report their driving distances and fuel consumptions to grasp their usage conditions under a results report system for vehicle environmental management, etc. (Tokyo, Yokohama City, Saitama City, Kawasaki City, Chiba City, Osaka City, Kyoto City, etc.)

◎ The municipalities are making various efforts based on these report data.

(1) Not only do they obligate the business operators to report, but give some **feedback** to them to enhance their awareness.

(2) They **evaluate and commend the business operators** advanced in addressing **by objective indexes**.

(3) They give concrete **advice or an addressing clue** to the backward business operators (advise).

	Operation	Outline
(1) Feedback	(1) Evaluation of the business operators by analysis of results data (preparation of record)	Analyze results report data to calculate numerical values which serve as efficiency indexes such as average fuel consumption corresponding to a gross vehicle weight category. Prepare graphs and tables comparing this average fuel consumption and the actual average fuel consumption value of the operator, introduction ratios of fuel efficient vehicles, etc., and provide the data for each business operator.
(2) Evaluation by objective indexes	(2) Preparation of benchmarks by analysis of results data	Statistically process vehicle CO_2 emissions intensity (kg-CO_2/ton-km, kg-CO_2/km) for each category classified by divisions such as type of business and gross vehicle weight according to Japan Industrial Classification, and utilize average values and standard deviations to prepare benchmark indexes, thereby selecting the business operators having excellent CO_2 emissions intensity (extract bad business operators).
(3) Advice, etc.	(3) Advise, etc. to a business operator problematic in rational use of vehicles	Based on an original guide to reduced CO_2 emissions, etc., visit and give advise or consulting to the business operators who have not reached their reduction goals, the introduction goals of fuel efficient vehicles, etc.

1. Results report system on use of vehicles and advise

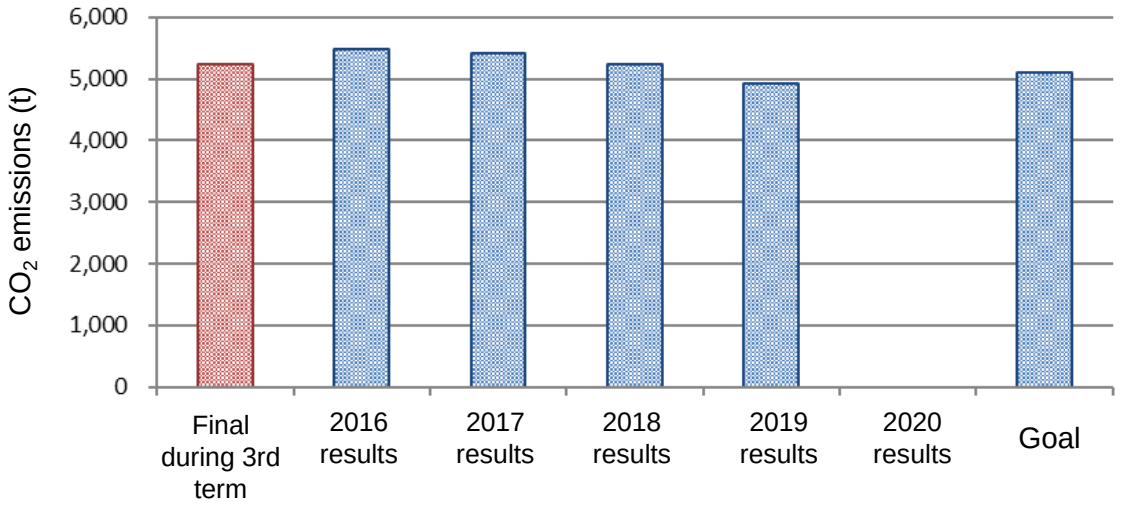
●Evaluation of the business operators by analysis of results data (preparation of record)

◎Based on the business operator's vehicle results report, prepare a "record" through analysis (= diagnosis) of his/her results and give advise, likening to a diagnosis by a medical doctor.

[Record items] (Output sample image)

CO_2 emissions, introduction status of specified low-pollution/fuel efficient vehicles, CO_2 emissions per travel distance and gross vehicle weight (average), etc.

◎CO_2 emissions



◎Introduction status of specified low-pollution/fuel efficient vehicles*

FY	Introduction ratio (%)		
	Your company	Same business	Same business, same scale
2016 results	10.0	11.0	6.5
2017 results	15.0	18.0	10.5
2018 results	20.0	27.0	17.5
2019 results	28.0	35.0	23.5
2020 plans	35.0	36.0	34.0

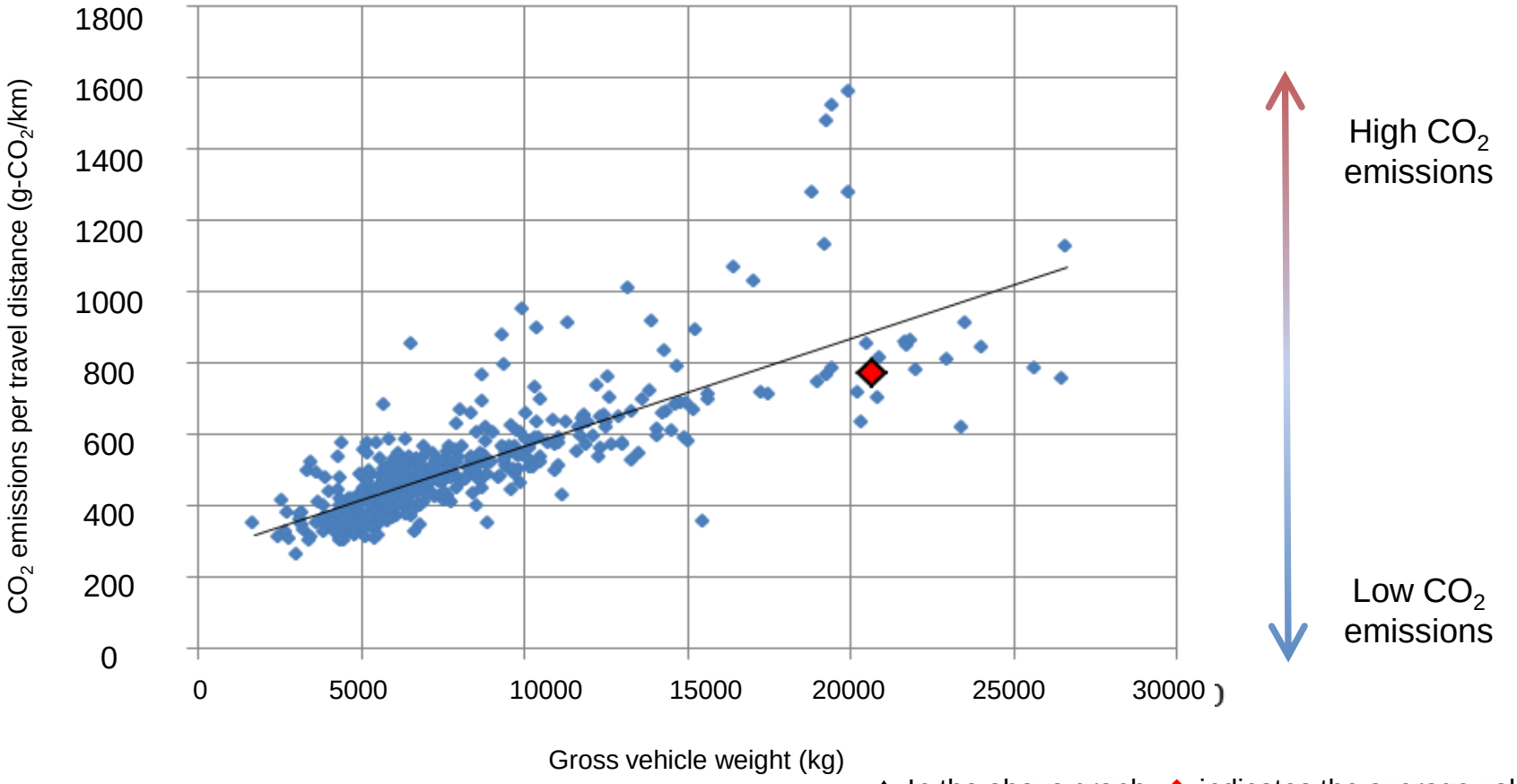
↑ It is confirmed that your values exceed the business operators' average of the same business and same scale, but are below that of the same business.

* The Ministry of Land, Infrastructure, Transport and Tourism has periodically published the models of specified low-pollution vehicles and fuel efficient vehicles based on the fuel consumption of the latest vehicles, etc. A ratio of vehicles with excellent fuel efficiency, etc. is calculated based on these criteria.

1. Results report system on use of vehicles and advise

● Evaluation of the business operators by analysis of results data (comparison with others)

◎ CO_2 emissions per travel distance and gross vehicle weight (average)



↑ In the above graph, ◆ indicates the average value of the target business operators. It is confirmed that the gross vehicle weight is high and CO_2 emissions are low.

2. Results evaluation system

(1) Necessity of preparing the evaluation criteria by analysis of results data

[Current issue]

- Since some business operators are gradually approaching the limits such as running out of possible CO_2 emissions reduction measures, it is becoming harder to continue their efforts simply by continuous improvement based on their own previous situation.

[Possible solution]

- Introduce a system for setting the indexes to compare the implementation status of measures **within the same type of business**, clarifying whether CO_2 emissions reduction efforts of a business operator are more advanced or backward comparing to other companies, commending advanced business operators, and urging backward ones to make further efforts.

[Evaluation system for logistics operators]

- As mentioned in the beginning, logistics business operators centering around trucking business operators transport freights at request of consigners. Accordingly, it is tough for them to independently make efforts to improve logistics efficiency.
- As a result, they have to focus on eco-driving, and fuel efficiency tends to be adopted as an index to evaluate their active efforts for energy conservation.

2. Results evaluation system

(2) Evaluation system for trucking business operators

◎Tokyo Metropolitan Freight Transportation Evaluation System (freight transportation department)

a) Background (Purpose)

- The Tokyo Metropolitan Freight Transportation Evaluation System is enforced in order to evaluate fuel consumption reduction efforts by eco-driving, etc. conducted by the trucking business operators and contribute to reduction of carbon dioxide, nitrogen oxide, etc. emitted from the freight vehicles in Tokyo.

b) Target type of business

- Trucking business operators

c) Target vehicle models

- See the tables on the following pages.

d) Evaluation method

- Using the calculation method* on the right, calculate the deviation value (hereinafter referred to as the “average deviation value”) of the evaluated business operator and determine conformity to the following evaluation categories.

(1) Average deviation value being 58.5 or more: “★★★ (3 stars)”

(2) Average deviation value being 55.5 or more and less than 58.5: “★★★” (pre-3 stars)

(3) Average deviation value being 52.6 or more and less than 55.5: “★★ (2 starts)”

(4) Average deviation value being 50.0 or more and less than 52.6: “★★” (pre-2 stars)

(5) Average deviation value being less than 50.0: “★ (1 star)”

*** Average deviation value calculation method**

・Divide the sum of deviation values in the evaluation group in the tables on the following pages for actual driving fuel consumption of each vehicle by the number of evaluated vehicles.

$$P = \frac{1}{N} \sum P_i$$

P: Average deviation value

N: Number of evaluated vehicles (units)

Pi: Deviation value of actual driving fuel consumption of each vehicle

* *Pi*: Annual average fuel consumption of vehicle differs depending on the vehicle model such as light vehicles, passenger vehicles or freight vehicles, gross vehicle weight, etc. Average fuel consumption and standard deviation were calculated for each evaluation group, taking account of these elements, and a deviation value was calculated for the relevant evaluation group for each vehicle used by the business operator.

〇Calculation example: When using light vehicles for sales personnel and freight vehicles having the gross vehicle weight of 2 tons

(“Deviation value P1 of light vehicles : 60” + “Deviation value P2 of freight vehicles : 50”) / 2 = Average deviation value: 55

Reference: Direction of Higher Logistics Efficiency in Japan

◎Response to concentrated logistics demand to the buildings

*** Japan is expected to experience changes such as a population decline (shortage of labor force and drivers), depopulation and concentrated population in 3 major metropolitan areas (concentration of people and products) in the future.**

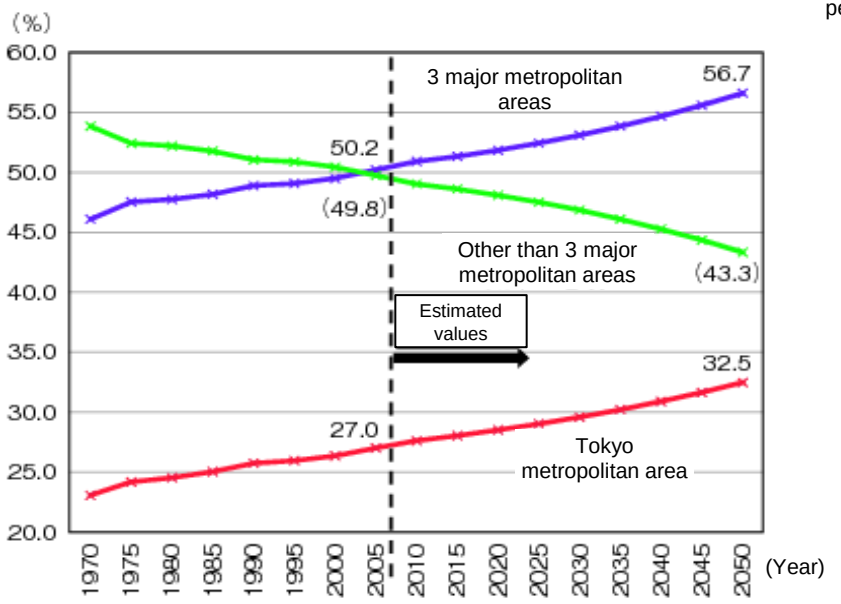
*** Furthermore, the urban areas will have more large-scale commercial facilities and high-rise condominiums due to redevelopment, resulting in concentrated logistics.**

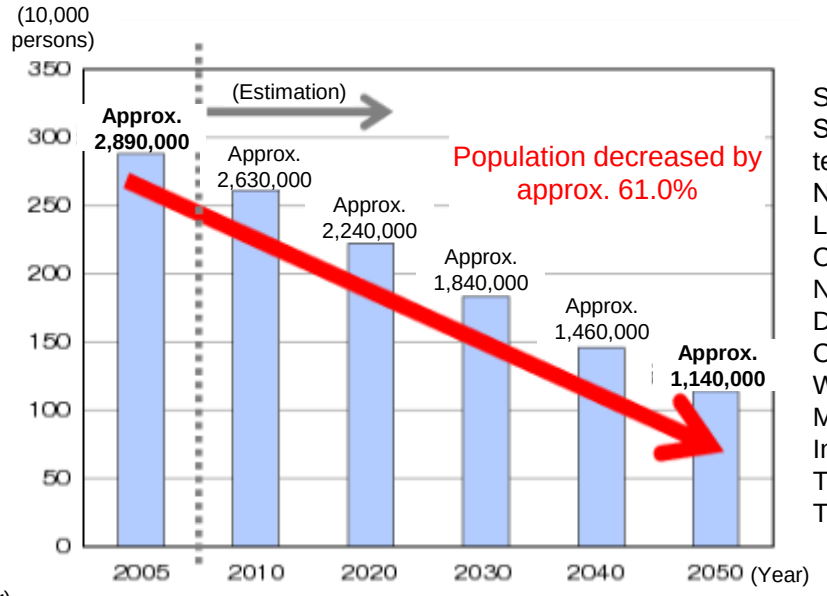
→ "Joint" transportation in urban logistics is conceived essential as their solutions.

◎Action items for large-scale commercial facilities: Do not ask too much such as specifying a time; request a supplier to utilize a carrier who agrees to joint transportation; ask a freight-handling vehicle parking on the street to not park there, etc.

◎Trucking business operators: Do not park on the street; participate in joint transportation, etc.

◎Administration: Provision of freight-handling areas (discounted land rent, etc.)　　and so on.





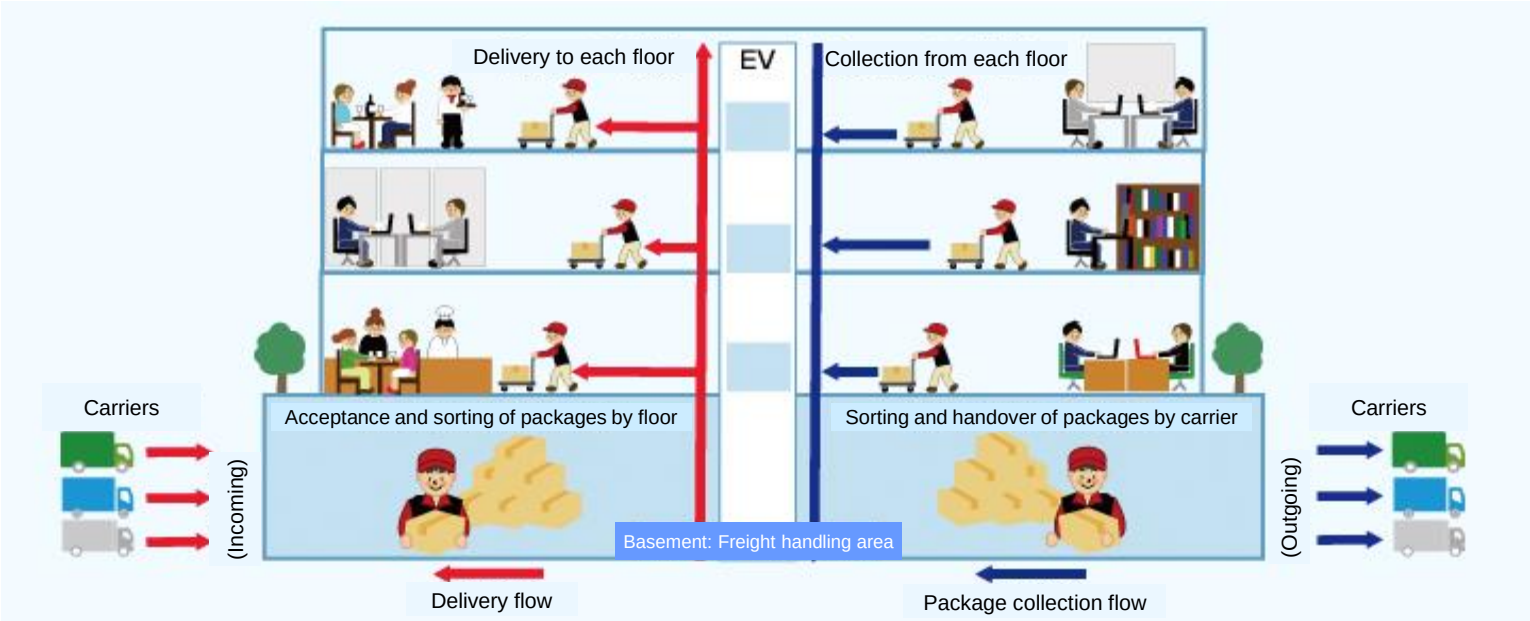
Source: Interim Summary of "Long-term View of National Land" by Long-term View Committee, National Land Development Council Policy Working Group, Ministry of Land, Infrastructure, Transport and Tourism

Figure: Population change in depopulated regions

Possible measure: A specialized in-building joint distributor handles freights to be delivered to a large tall building.

■ **Project to improve the dignity of a superhigh-rise building by Collabo Delivery (currently 5 buildings, including the following examples)**

- **Unified incoming and outgoing freights by introducing "in-building logistics"**
- **Improved safety and security values by enhancing in-building security**
  - No more entry/exit of unauthorized people, providing a reassuring in-building environment for PM companies and tenants.
- **Contributive to an environment and eased traffic congestion around the building**
  - Because freights are picked up altogether at a collection spot in the building (delivery center), a parking time will be shortened, a full-parking condition will be solved, trucks will not wait to park around the building, reducing an ambient environmental load.



Source: Website of Collabo Delivery

Yebisu Gardenplace Tower

Tokyo Square Garden

“Beautiful Earth for the Future”

Thank you very much for your attention.