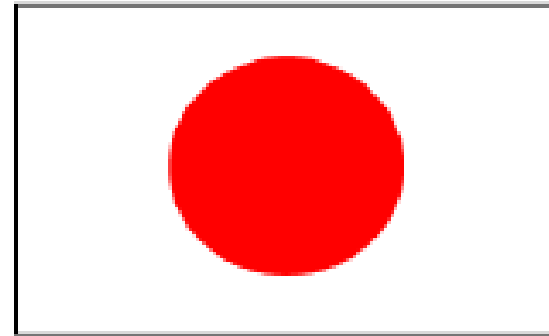


Latest Technology for Carbon Neutrality (Cold Chain Logistics)



December 2023

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ACE



METI



ECCJ

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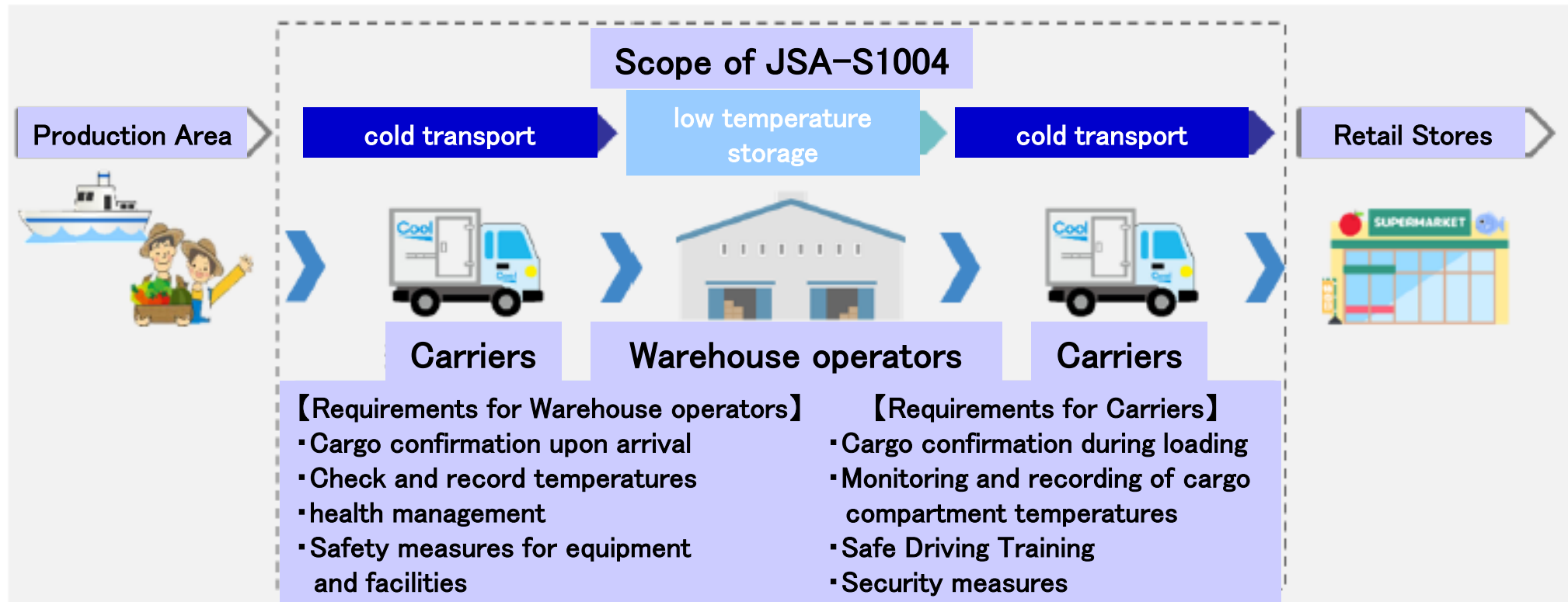
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History of Japan-ASEAN Cold Chain Logistics Project

- ◆ The following correspondence has been conducted with MLIT of the Japanese government.
 - October 2017: 15th Meeting of Ministers of Transportation approves logistics projects
→(1) Establishment of logistics guidelines, (2) human resource development, (3) pilot projects, (4) Promotion of the spread of logistics equipment
 - November 2018: 16th Meeting of Ministers of Transportation **approves logistics guidelines**
 - July 2020: BtoB cold chain **logistics service standard JSA-S1004 published**
 - March 2021: Develop a strategy to promote Japanese-style cold chain logistics
→Selected 5 priority countries: Malaysia, Indonesia, Thailand, Philippines, and Vietnam
 - March 2021: Establish action plan for Malaysia
 - November 2021: Certification audit guidelines approved at the 19th Meeting of Ministers of Transportation.
 - February 2022: Cold chain promotion and awareness seminar held in Malaysia
 - March 2022: Formulate action plans for Indonesia and Thailand

Scope of JSA-S1004

- ◆ Official name: Cold Chain Logistics Services – Cold Storage Service and Cold Transportation Requirements for Services (issued by Japanese Standards Association)
- ◆ Related standard: ISO23412 · · International standard for B-to-C small-lot cold delivery service



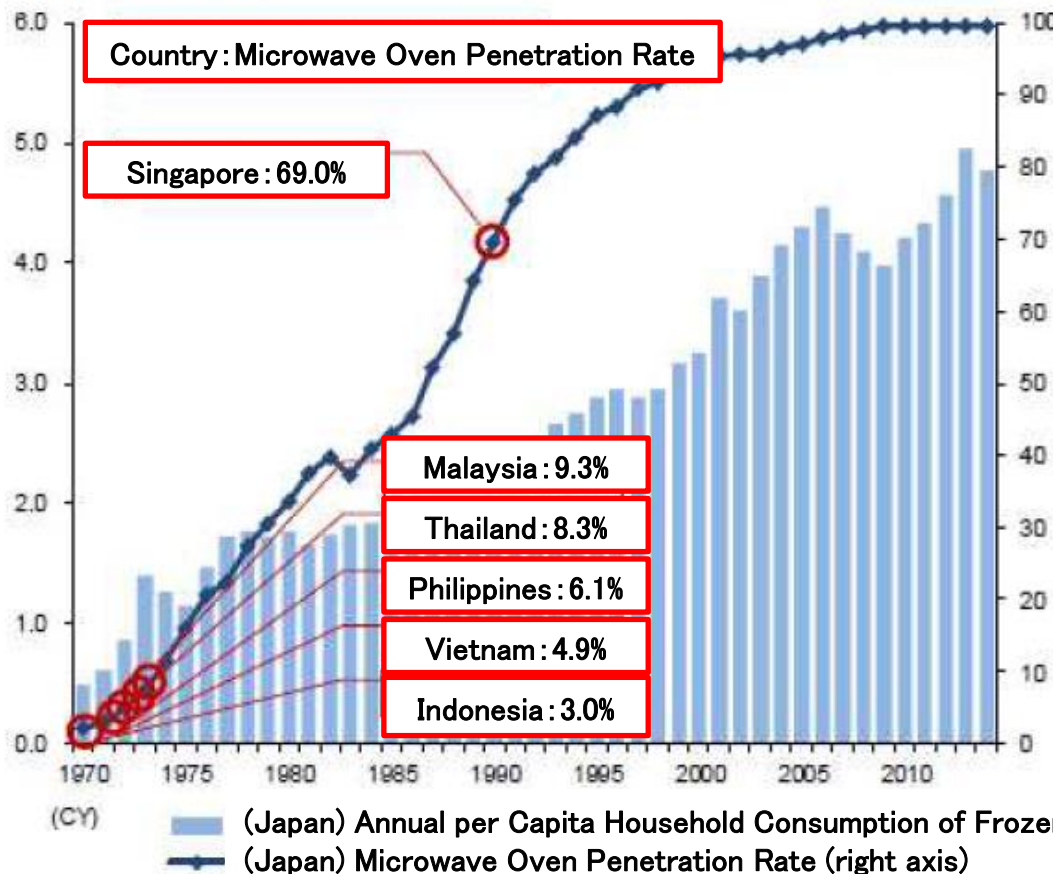
1. What is Cold Chain Logistics ?

Growing Demand for Cold Chain Logistics in Asia

- ◆ In ASEAN countries, demand for cold chain logistics, including cool takkyubin, is expected to increase due to rising living standards and a growing middle class, and logistics is expected to become more value-added.

Consumption of Frozen Processed Foods (%)

Microwave Oven Penetration Rate (%)

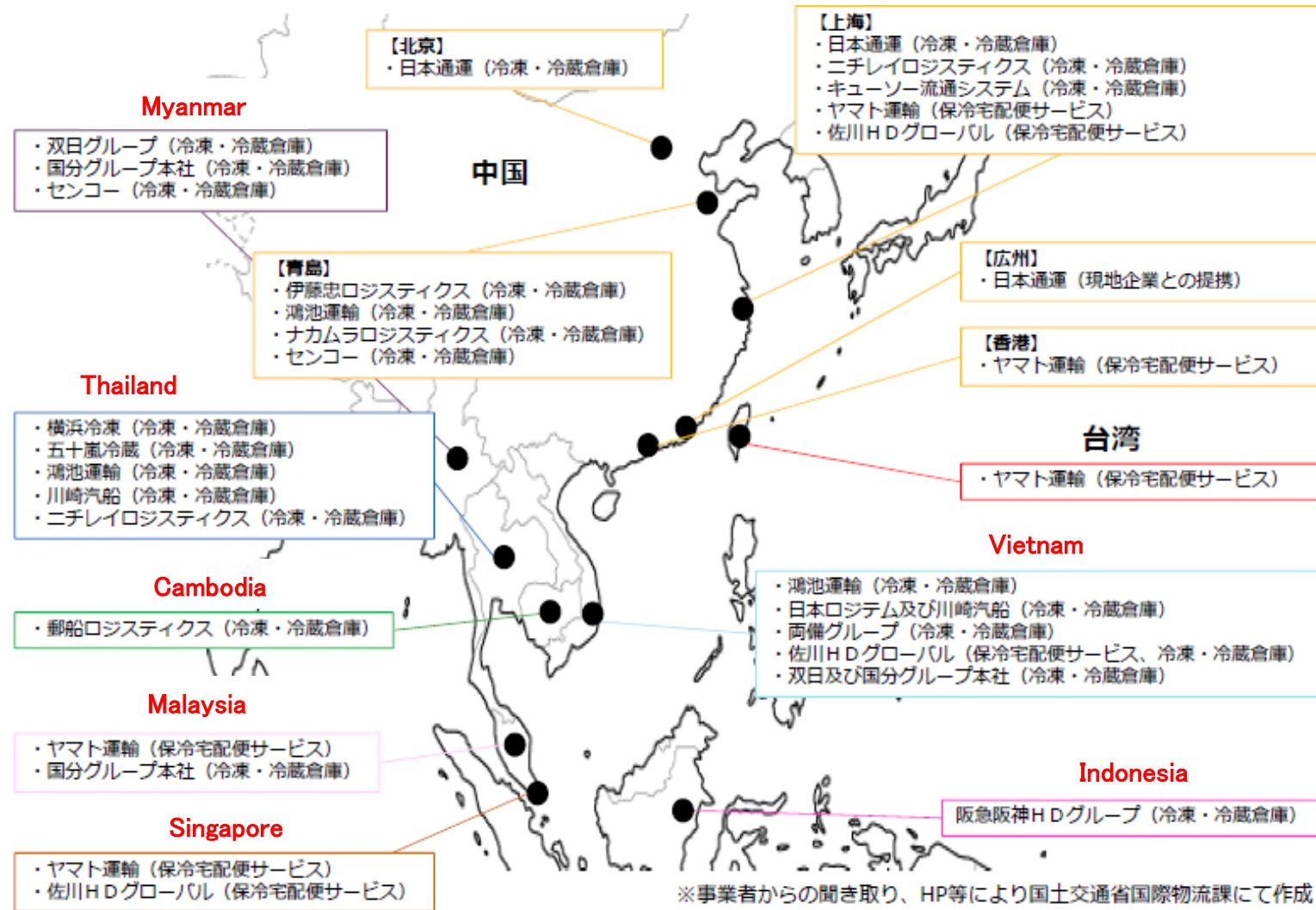


The diffusion of microwave ovens is currently accelerating in ASEAN. Based on the results in Japan, it can be inferred that the consumption of frozen processed foods will increase in the five major countries in the future, and that the cold chain logistics demand will increase at an accelerating pace.

【Microwave Oven Penetration Rate in 2013】

Singapore : 69.2%
Thailand : 40.0%
Malaysia : 28.3%
Vietnam : 19.0%
Philippines : 6.6%
Indonesia : 3.2%

Overseas Expansion of Japanese Cold Chain Logistics Companies



Temperature Classification and Target Products

- ◆ Three temperature categories: **frozen, refrigerated, and temperature-controlled**
The target products are **mainly food products**. (Note) In Japan, pharmaceuticals (including vaccines), chemicals, electronic parts, etc. are also included.

Temperature Classification		Temperature range	Target Products
low temperature	frozen	-40° C or lower	pacific bluefin tuna
		-40~-18°C	seafood, meat, frozen foods, ice cream, bread dough
	refrige-rated	-18~+10°C	dairy products, fish paste products, vegetables, meat, fresh fish and seafood
	constant temperature	+5~+18°C	mayonnaise, chocolate confectionery, rice cereals
normal temperature		---	seasoning

Means of transportation

- ◆ Refrigeration functions will be expanded on a large scale according to the three temperature categories of **constant temperature, refrigerated and frozen**.

【Container for **constant temperature**】 【Container for **refrigerated**】

Insulation and heat retention are possible
No refrigeration function

Refrigeration function available
Shared with automotive air-conditioning

【Container for **frozen**】

Dedicated refrigeration function
Independent of automotive refrigeration



Global greenhouse gas (GHG) emissions from cold chain logistics

- ◆ In cold chain logistics, in addition to CO₂, the selection of refrigerant (HFCs) for refrigeration equipment should be taken into account.

type		coefficient	type		coefficient
CO ₂		1	PFCs	PFC14	7,390
CH ₄		25		PFC116	12,200
N ₂ O		298		PFC218	8,830
HFCs	HFC32	675		PFC3-1-10	8,860
	HFC134a→ HFO1234yf	1,430→4		PFC4-1-12	9,160
	HFC22	1,810		PFC5-1-14	9,300
	HFC410A	2,090		PFC9-1-18	7,500
	HFC404A	3,920	SF ₆		22,800
	HFC12	10,900	NF ₃		17,200

(Note) HFC410A: for refrigeration equipment、HFC32: for room AC、HFC134a : for vehicle

A Case Study of Cold Chain Logistics in Indonesia

- ◆ Logistics companies and domestic shipping companies purchase containers and begin applying them to frozen fish transport, etc.

【Current Business Development (Fish Transportation)】



【Demonstration test (chili peppers, etc.)】



【Demonstration test (tropical fruits)】



A Case Study of Cold Chain Logistics in Philippines

- ◆ Foods (bananas) are stored in containers and transported from truck to ship to Japan.

【Current business development (banana transportation)】



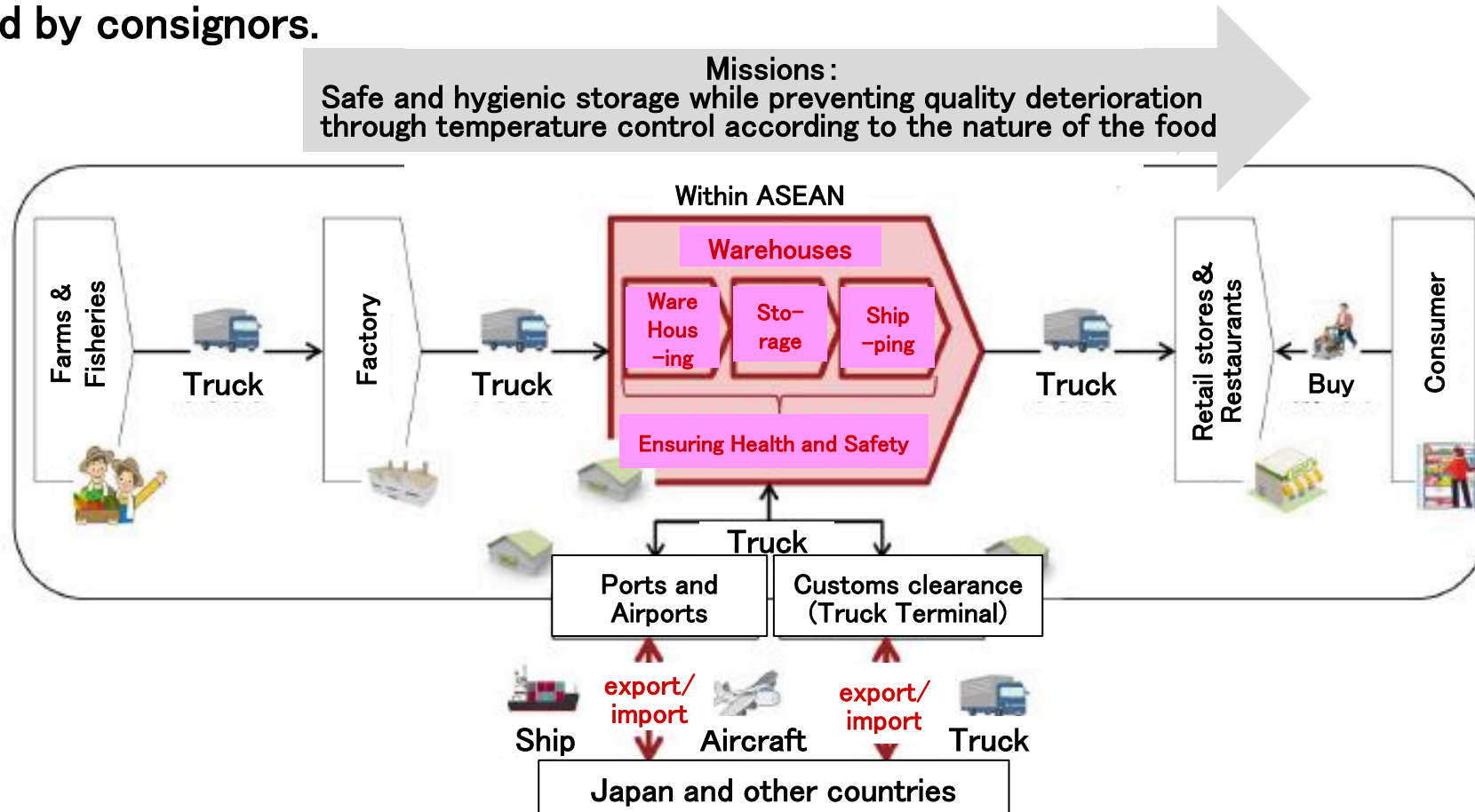
【Demonstration test (avocado)】



**2. Points to keep in mind
in Cold Chain Logistics Operations
(Risks and Responses of
Warehouse and Transportation Operators)**

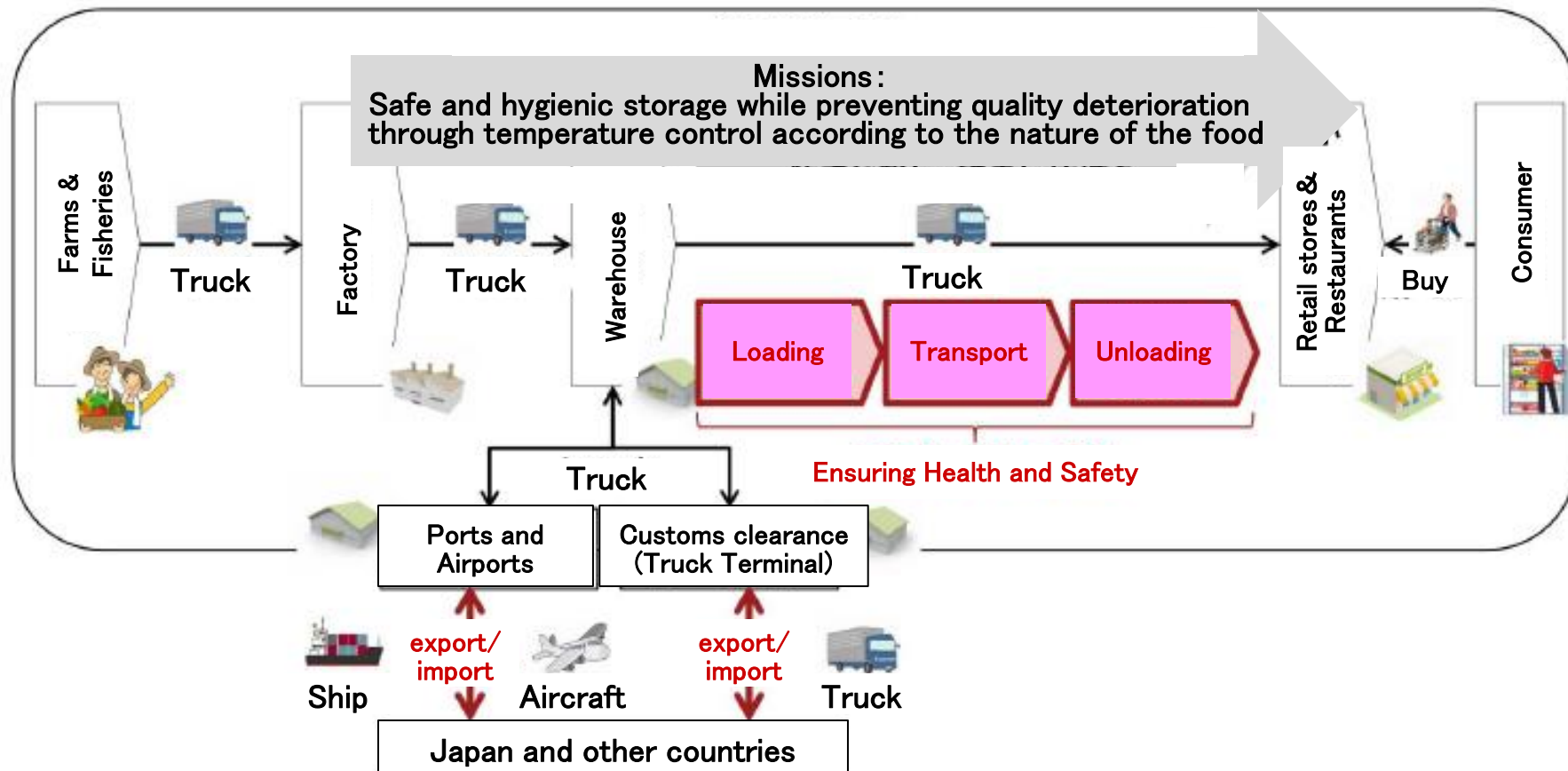
Positioning of warehouse operators in cold chain logistics and their missions and operations

- ◆ Properly operate refrigerated and frozen warehouses in compliance with temperature settings required by consignors.



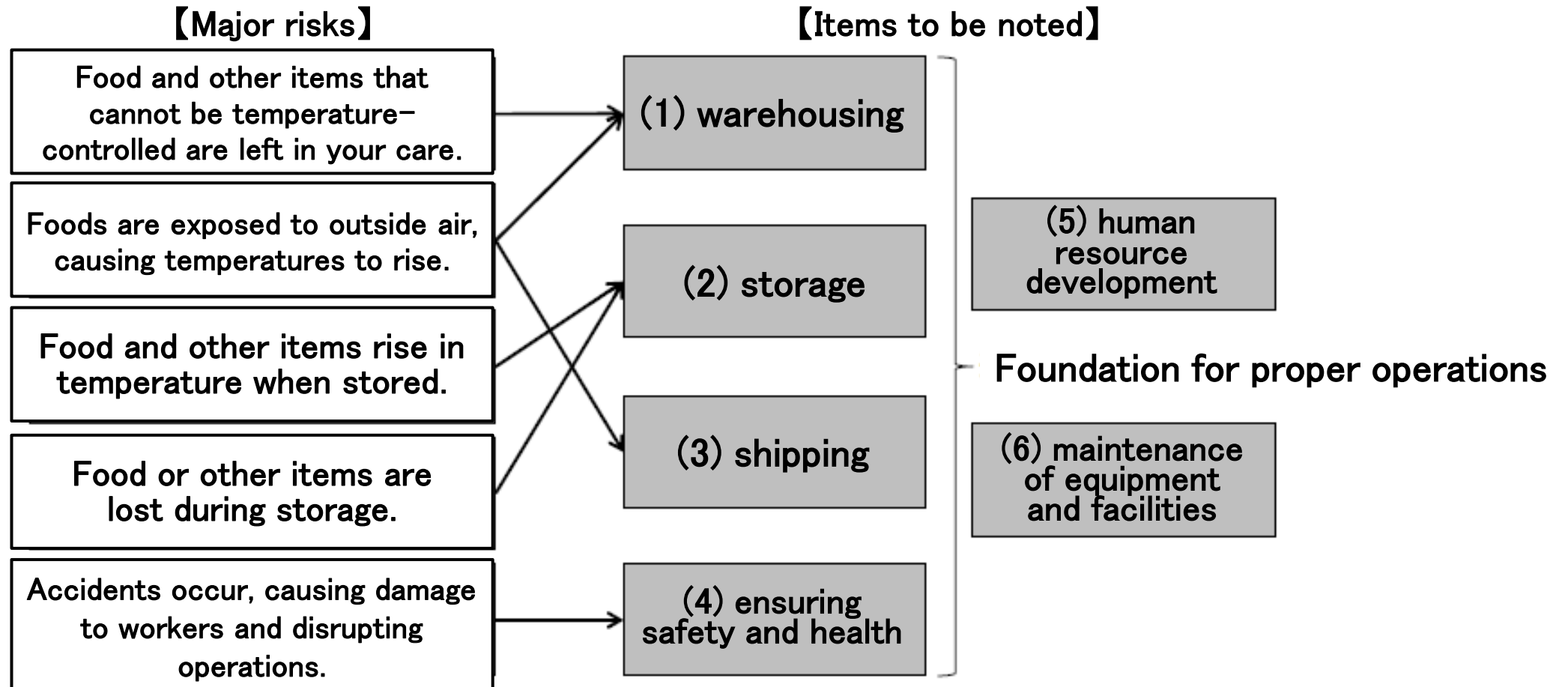
Positioning of carriers in cold chain logistics and their missions and operations

- ◆ Comply with temperature settings required by consignors and operate trucks for low-temperature use correctly.



Major Risks and Considerations for Cold Chain Logistics Disruption

- ◆ If care is not taken to ensure that the food is of good quality, it will be marketed with deteriorated quality.



**2. Points to keep in mind
in Cold Chain Logistics Operations
(Efforts required of Governments)**

1. Creation of an environment conducive to logistics operators : Development of related infrastructure

- ◆ The government is working to ensure a stable power supply so that warehouse operators can continue to operate refrigerated and frozen warehouses that require large amounts of electricity.
- ◆ The government will also develop ports and harbors to facilitate trade and transportation of food products to the islands, and will improve the environment for multimodal transportation.
To improve the environment for multi-modal transportation.
- ◆ The government will provide temperature-controlled inspection areas at ports, airports, and truck terminals to ensure that imported and exported food is not exposed to outside air during customs clearance and immunization.
- ◆ The government will develop distribution complexes equipped with refrigerated and frozen warehouses on sites that are close to consumption areas and have good accessibility, so that logistics companies can transport cargo efficiently.
- ◆ The Japanese government will introduce information on material handling equipment providers, refrigerated/frozen warehouse operators, etc. through the Japan-ASEAN Transportation Information Platform so that warehouse operators and transportation companies can provide high quality services in cold chain logistics.

2. Creation of an environment conducive to logistics operators : Institutional support (1)

- ◆ **The government will provide financial and other support for logistics companies to operate high-performance refrigerated/frozen warehouses and material handling equipment.**

(Specific examples)

- The government will provide tax incentives for logistics companies to build refrigerated/frozen warehouses, such as additional depreciation.
- The government provides subsidies to logistics companies for the introduction of energy-saving refrigeration equipment and facilities in refrigerated and frozen warehouses.
- ◆ **In order to ensure the quality of facilities and equipment, the government will 1) maintain and manage facilities and equipment, and 2) introduce regulations and standards regarding the performance and durability of facilities and equipment.**
- ◆ **The government is seeking to encourage foreign companies to enter the warehousing and transportation industry so that logistics companies in the home country can acquire superior know-how from foreign companies with extensive experience in cold chain logistics.**

2. Creation of an environment conducive to logistics operators : Institutional support (2)

(Specific examples)

- The government will ease restrictions on foreign investment in the warehousing and transportation industries.
 - The government will ease restrictions on foreign investment in the warehousing and transportation industries.
 - The government is reviewing regulations on dual employment in warehousing and transportation.
 - The government will promote the reciprocal passage of vehicles between multiple countries.
 - The government will provide preferential tax treatment to foreign companies that install facilities and equipment such as refrigerated/frozen warehouses and refrigerated/frozen trucks, and employ workers and drivers.
- ◆ The Government has established procedures for customs clearance and quarantine of food products that require temperature control in order to prevent deterioration of quality and loss of food products due to time-consuming customs clearance and quarantine procedures.

3. Creating an environment conducive to logistics operators : Consumer awareness

- ◆ Consumers understand the importance of nutritious, safe and convenient fresh and and frozen foods, and recognize the value of cold chain logistics. The government should raise public awareness of the value of cold chain logistics.

(Specific examples)

- The government, under the advice of experts, will publish an official document outlining the importance of cold chain logistics and the need for logistics providers. An official document summarizing the need for this service will be published.
- The government encourages logistics companies to include market tours of fresh food products in social studies field trips in school education as part of their CSR efforts. In addition, we will also use social media, which are becoming increasingly popular. social media, which are becoming increasingly popular, to provide opportunities for consumers to learn about the importance of cold chain logistics from a young age. the importance of cold chain logistics at a young age.

4. Creation of an environment conducive to logistics operators : Cooperation with government agencies

- ◆ Cold chain logistics involves producers such as farms and fisheries, food manufacturers and processors, warehouse operators, transportation operators, retailers, restaurants, etc., as well as consumers. Therefore, the above-mentioned points to keep in mind should be discussed in cooperation with the Ministry of Transportation, Ministry of Agriculture, Ministry of Commerce and Industry, Ministry of Health, and other relevant government agencies.

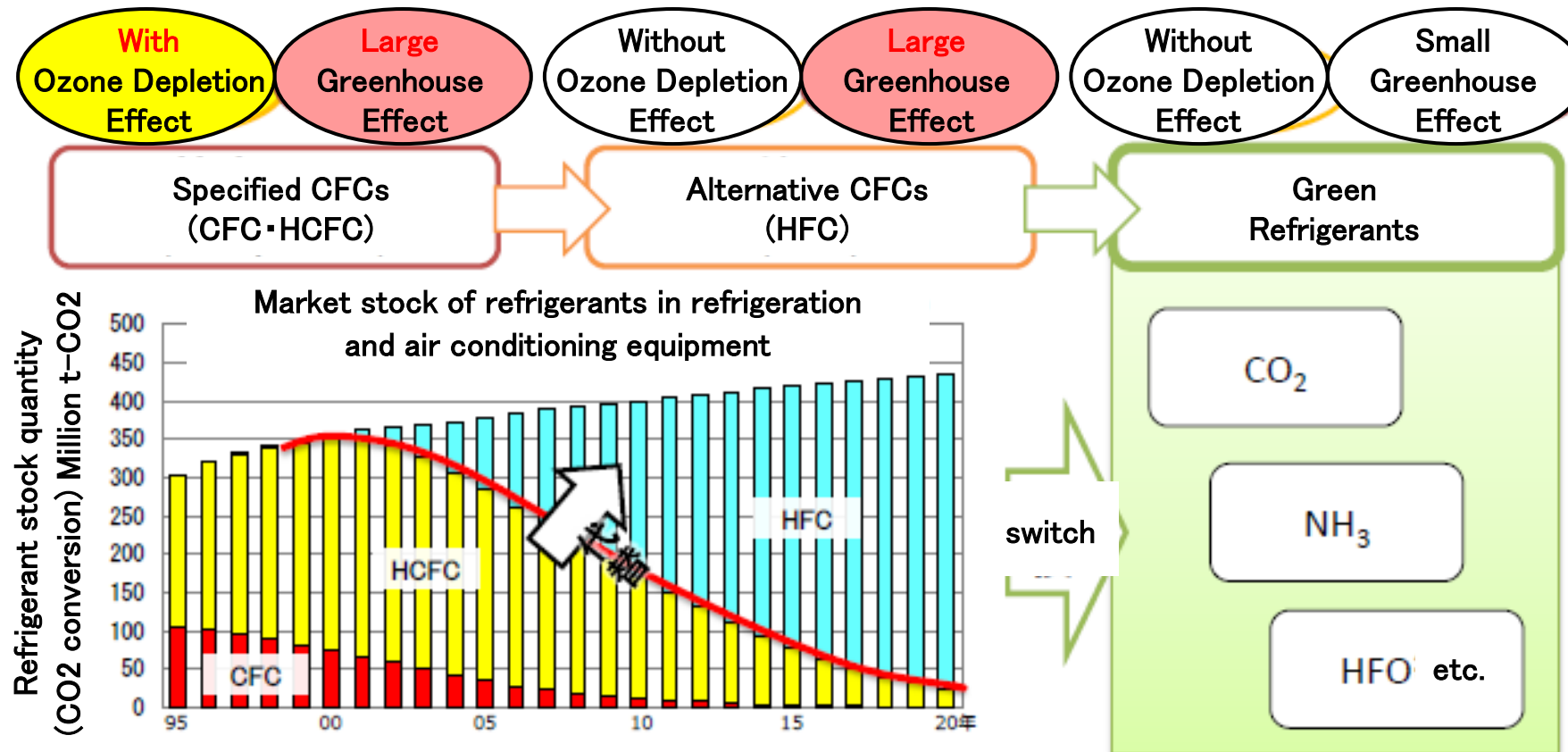
(Specific examples)

The government agencies and industrial organizations related to cold chain logistics will work together to establish a foundation for cold chain logistics. Government agencies and industry associations related to cold chain logistics will collaborate to create a platform, such as a committee, to build a foundation for cold chain logistics and to resolve issues. Consideration should be given to creating a platform, such as a committee, to work on the establishment of a foundation for cold chain logistics and the resolution of issues. Publicize an official document outlining the need.

3. Challenges and Responses in Promoting Carbon Neutrality (Reduction of Global Warming Potential and Improvement of Efficiency through the Use of Natural Refrigerants)

Refrigerant Conversions for Freezing and Refrigerated Warehouses (1)

- ◆ At present, natural refrigerants with a small greenhouse effect are being developed for CN.



Switchover to CFC alternatives and natural refrigerants in Japan (2)

◆ In ASEAN, the pace of progress is expected to be about 10 years behind that of Japan.

		low flame flammable	
field	object	Current CFC alternatives (GWP)	Natural refrigerants to replace CFC alternatives
①Substitution is in progress	Refrigerator-Freezers for Residential	(HFC-134a (1,430))	isobutane
	Vending machine	(HFC-134a (1,430)) (HFC-407C (1,770))	CO2 isobutane HFO-1234yf
	AC for vehicle	HFC-134a (1,430)	HFO-1234vf
②Alternative Candidates are available	Ultra-low temperature	HFC-23 (14,800)	Air
	Large and medium Commercial Refrigerator-Freezers	HFC-404A (3,920) HFC-410A (2,090)	NH3 ,CO2
	Small Commercial Refrigerator-Freezers	HFC-404A (3,920) HFC-410A (2,090)	CO2
③Considering Alternative candidates	AC for commercial	HFC-410A (2,090) HFC-32 (675)	(Under study)
	AC for Residential	HFC-32 (675)	

※新規出荷分は、全てグリーン冷媒に転換済

※今後代替が進む見通し。

※環境省が導入支援。

※GWP・・・地球温暖化係数（CO2を1とした場合の温暖化影響の強さを表す値）

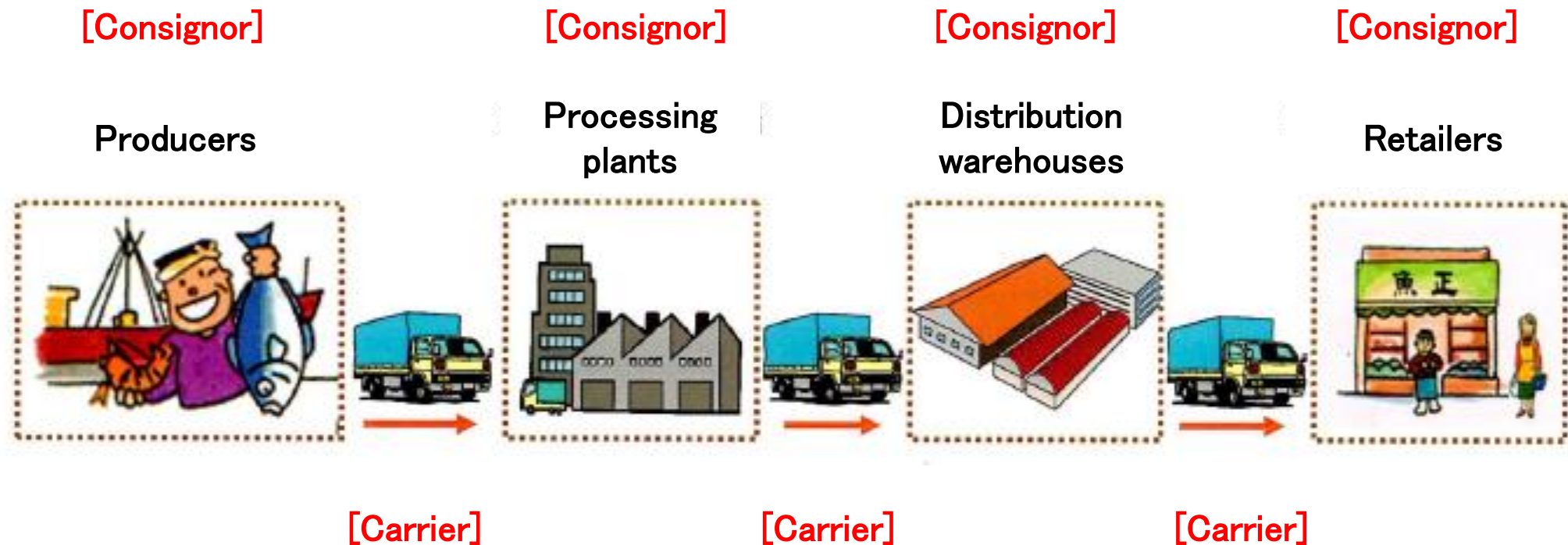
※HFC-407C・・・HFC-32、125、134aの混合冷媒（23:25:52）

HFC-404A・・・HFC-125、143a、134aの混合冷媒（44:52:4）

HFC-410A・・・HFC-32、125の混合冷媒（1:1）

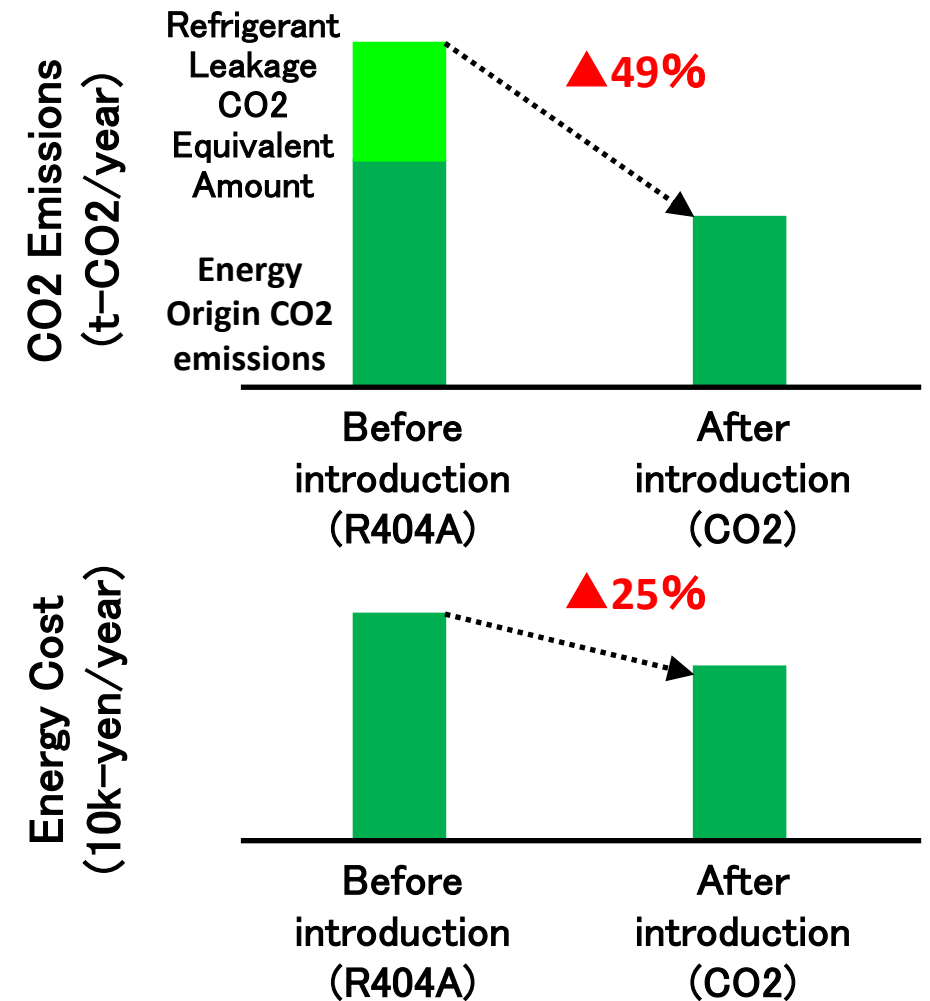
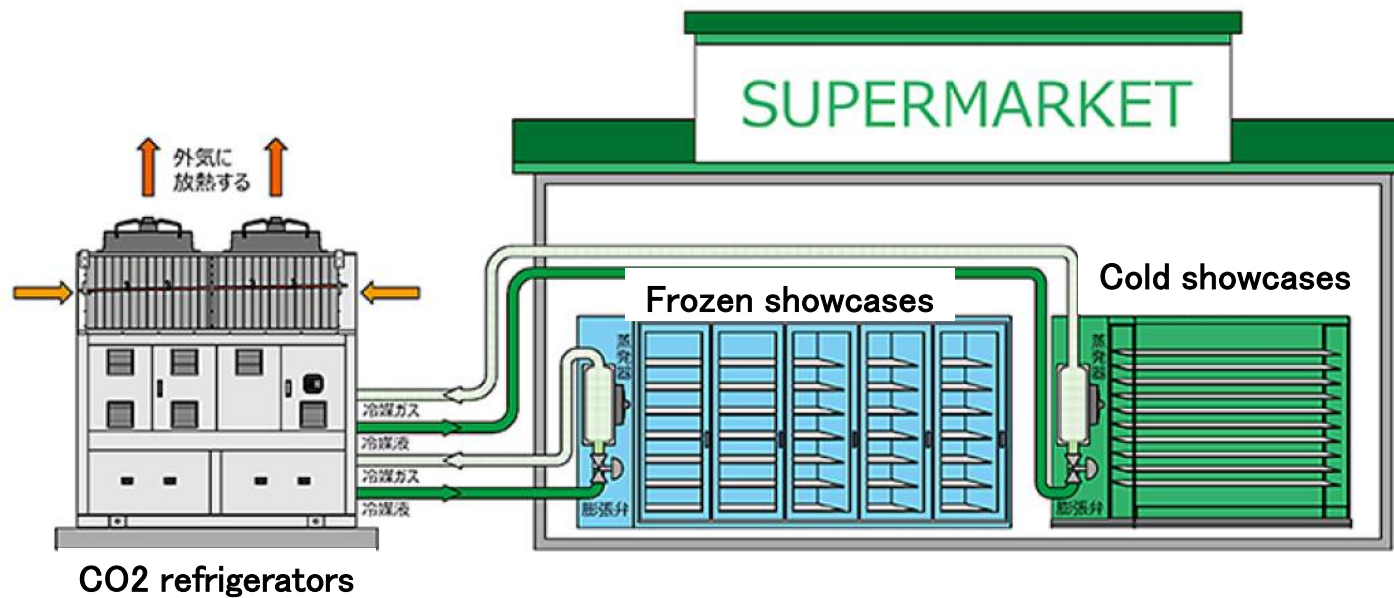
Location of Refrigeration Equipment in Logistics

- ◆ They are installed at the production sites, processing plants, distribution warehouses, and retail stores shown in the figure below, which correspond to shippers.
- ◆ Refrigeration capacity varies depending on the refrigerant used, in the order of $\text{NH}_3/\text{CO}_2 > \text{CO}_2 > \text{HFO}$.



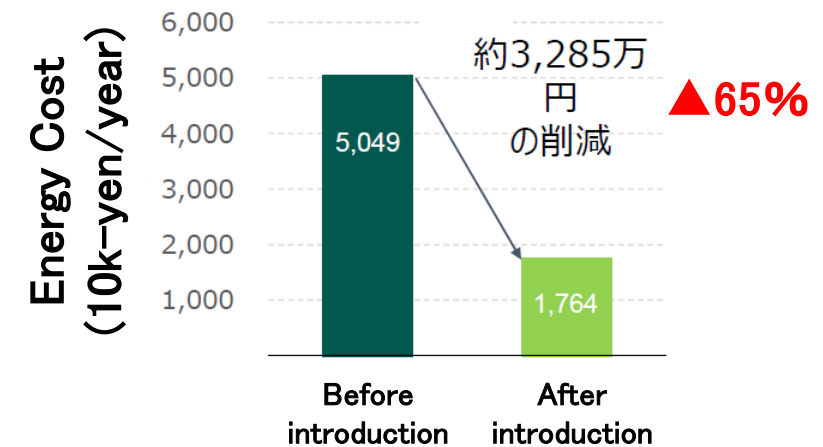
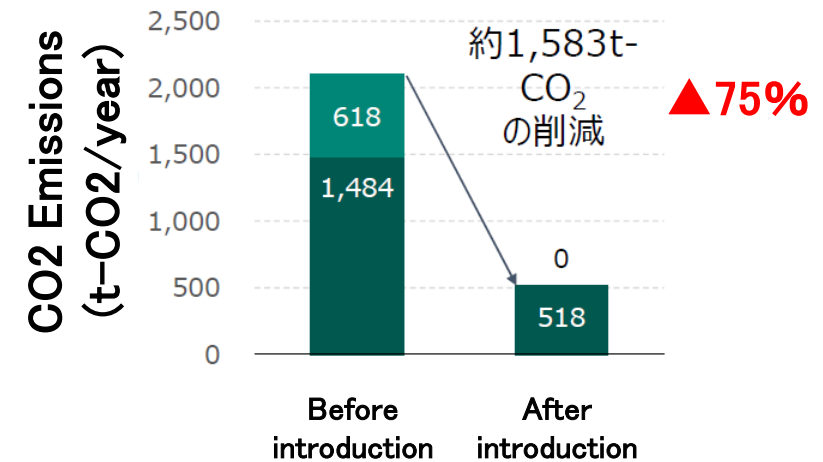
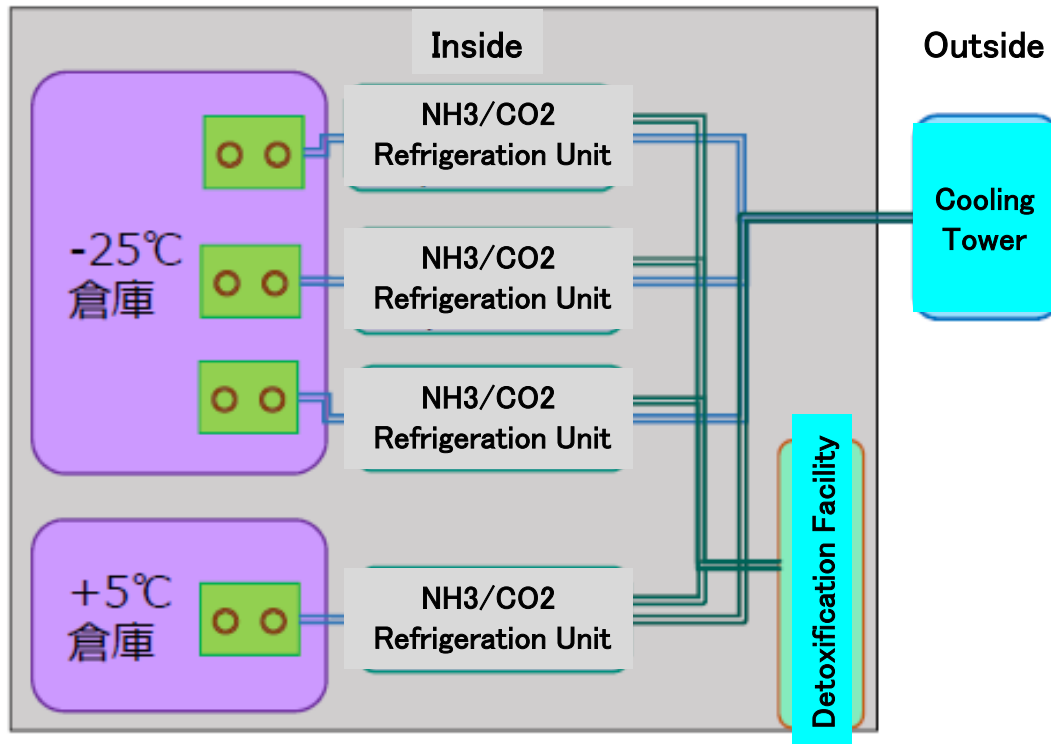
Frozen showcases in supermarkets

- ◆ A significant reduction in CO2 emissions was achieved by converting to a natural refrigerant (R404A → CO2).



Refrigerated warehouse in distribution center

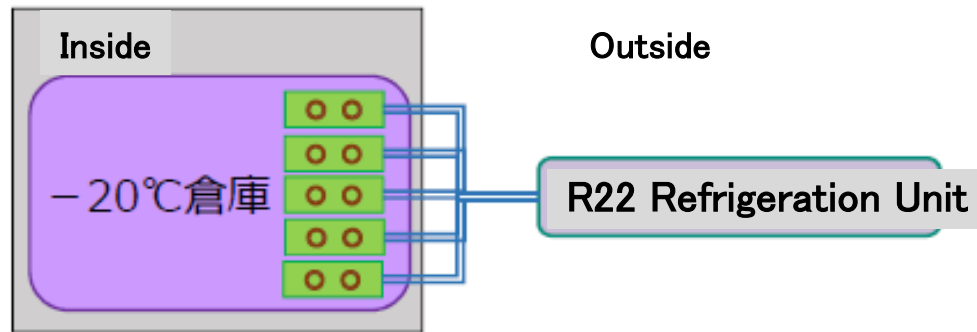
- ◆ A significant reduction in CO₂ emissions was achieved by converting to natural refrigerants (newly installed: NH₃/CO₂).



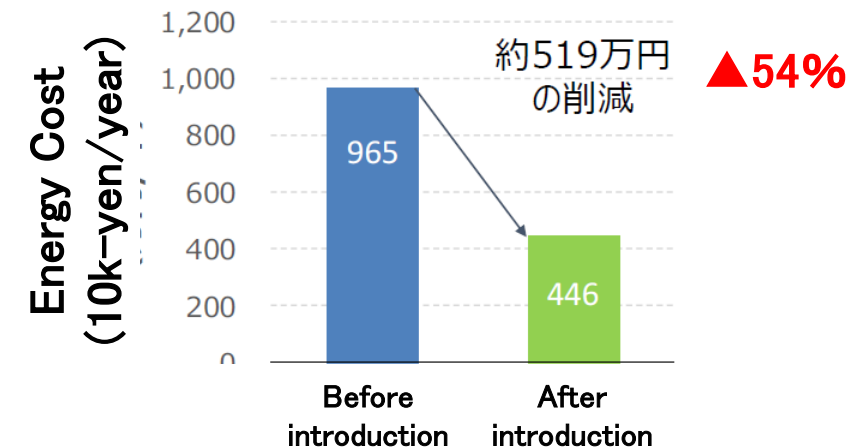
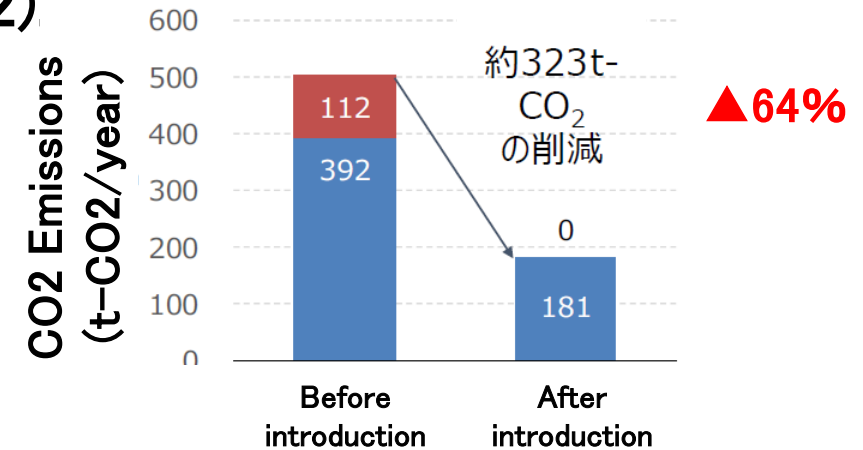
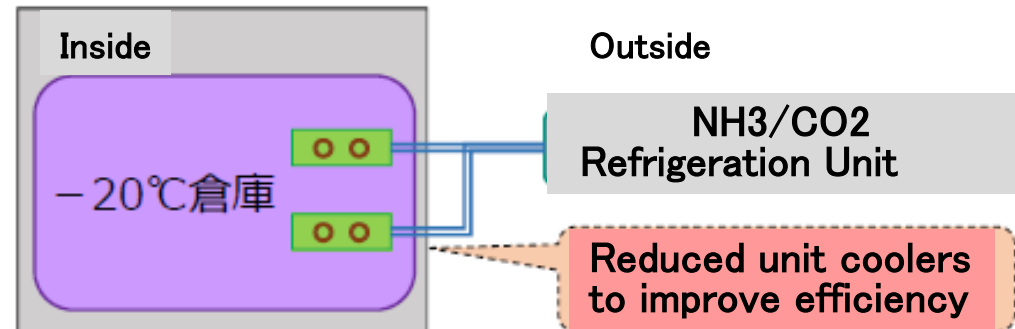
Refrigeration equipment in food factories

- ◆ A significant reduction in CO2 emissions was achieved by converting to a natural refrigerant (R22 → NH3/CO2)

Before introduction



After introduction

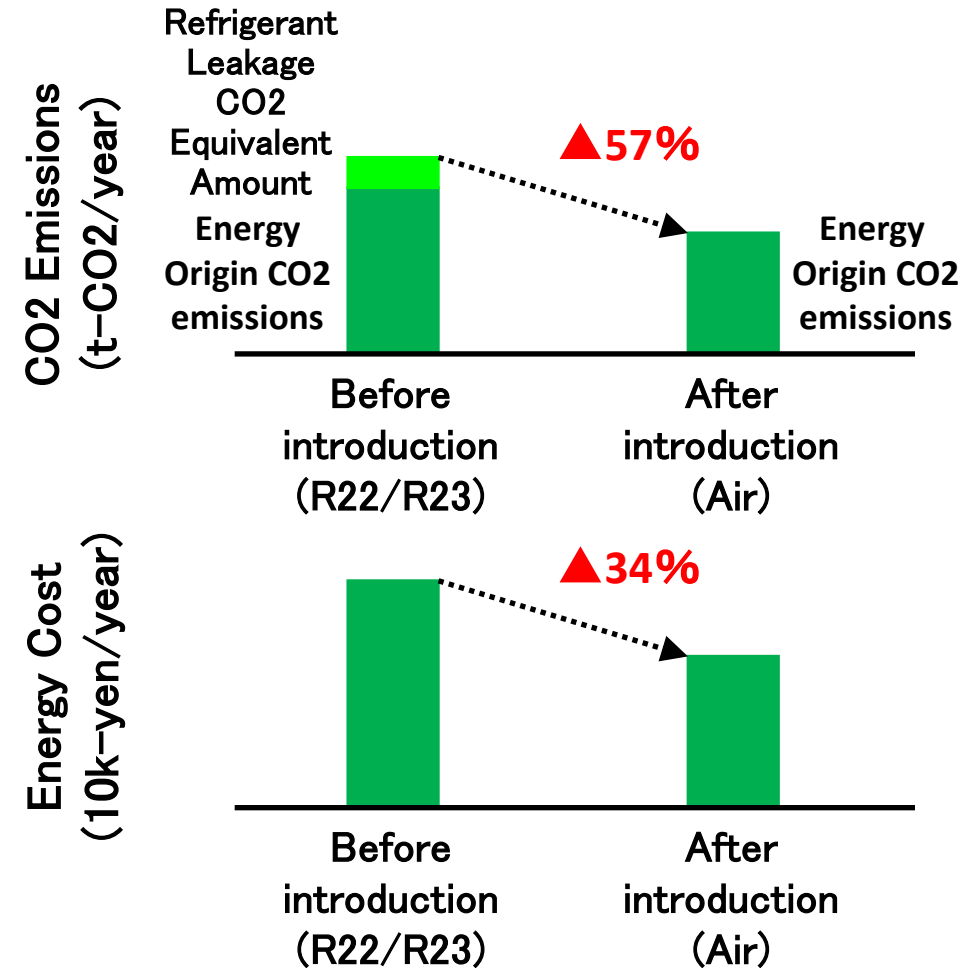


Freezers at production sites (tuna and skipjack fishing ports)

- ◆ Achieved significant reduction of CO₂ emissions with ultra-low temperature refrigerated storage (−60°C).



Air Refrigeration Systems



3. Challenges and Responses in Promoting Carbon Neutrality (Greening of Transportation Trucks)

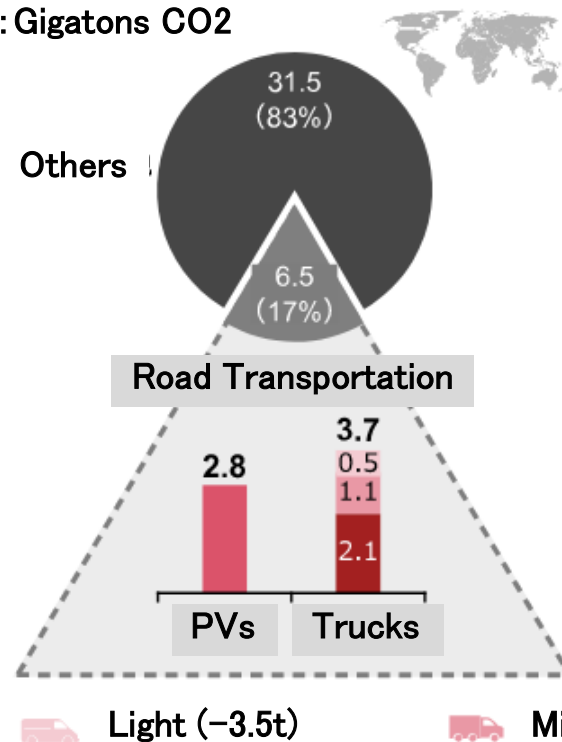
CO2 Emissions from Trucks for Transportation

- Trucks are a major contributor to global CO2 emissions, with heavy trucks accounting for 66% of CO2 emissions from road transport in Germany.

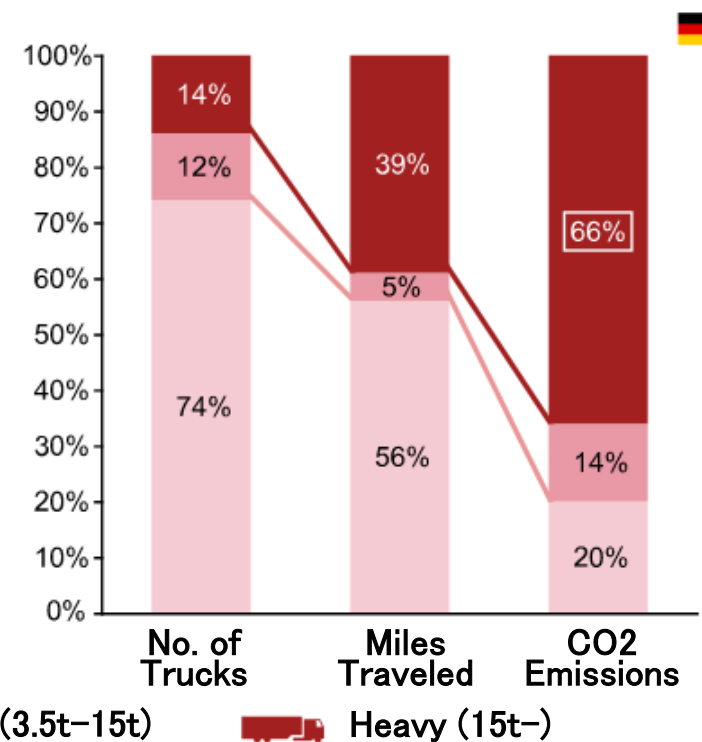
Global CO2 Emissions and Major Market Trends

Global anthropogenic CO2 emissions

Unit: Gigatons CO2







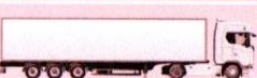


Number of Trucks, Miles Traveled, and CO2 Emissions in Germany



Characteristics of user requirements by transport truck segment

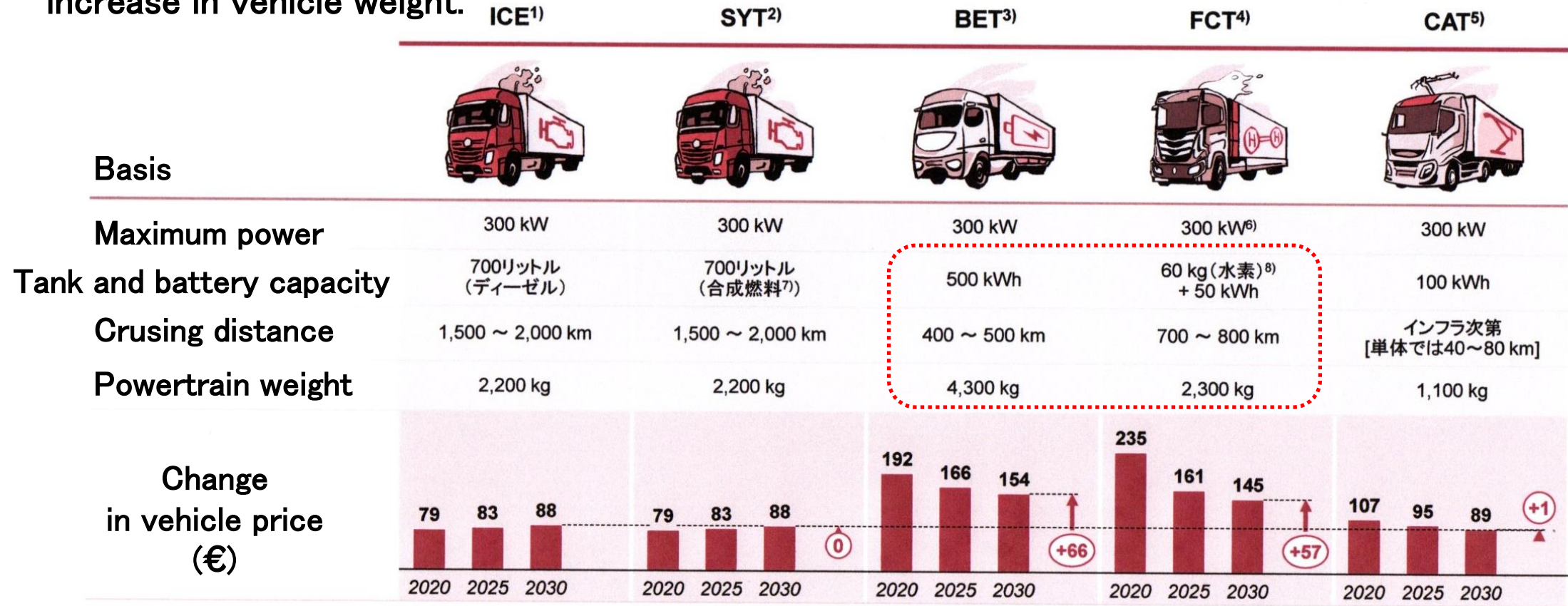
- ◆ The electrification of long-haul trucks with a daily mileage of 400 km or more is most difficult.

Segment	Light-duty truck			Medium-size truck		Heavy-duty truck	
Use cases	Vendor	Urban Cargo	Municipal	Refuse collection	Freight	Construction	Long distance
Typical Vehicle							
Summary	Mostly used by small and medium enterprises	Delivery of parcels and mail	Equipment works, public works, road preparation	Refuse collection and delivery to waste disposal facilities	Transport of relatively heavy goods	Construction vehicles tailored to local needs	Mostly used by small and medium enterprises
Transport Distance	Within the same region	Within the same city	Within the Same city	Within the same city	Between different regions	Between different regions	Between different regions
Daily mileage (km)							
<200	60%	50%	95%	90%	50%	80%	5%
200-400	35%	45%	5%	10%	40%	20%	45%
>400	5%	5%	0%	0%	10%	0%	50%

Technical hurdles are higher than 400

Potential greening measures for long-haul trucks and their impact on vehicle prices

- ◆ Changes in vehicle prices are significant for BET and FCT. In particular, BET shows a significant increase in vehicle weight.



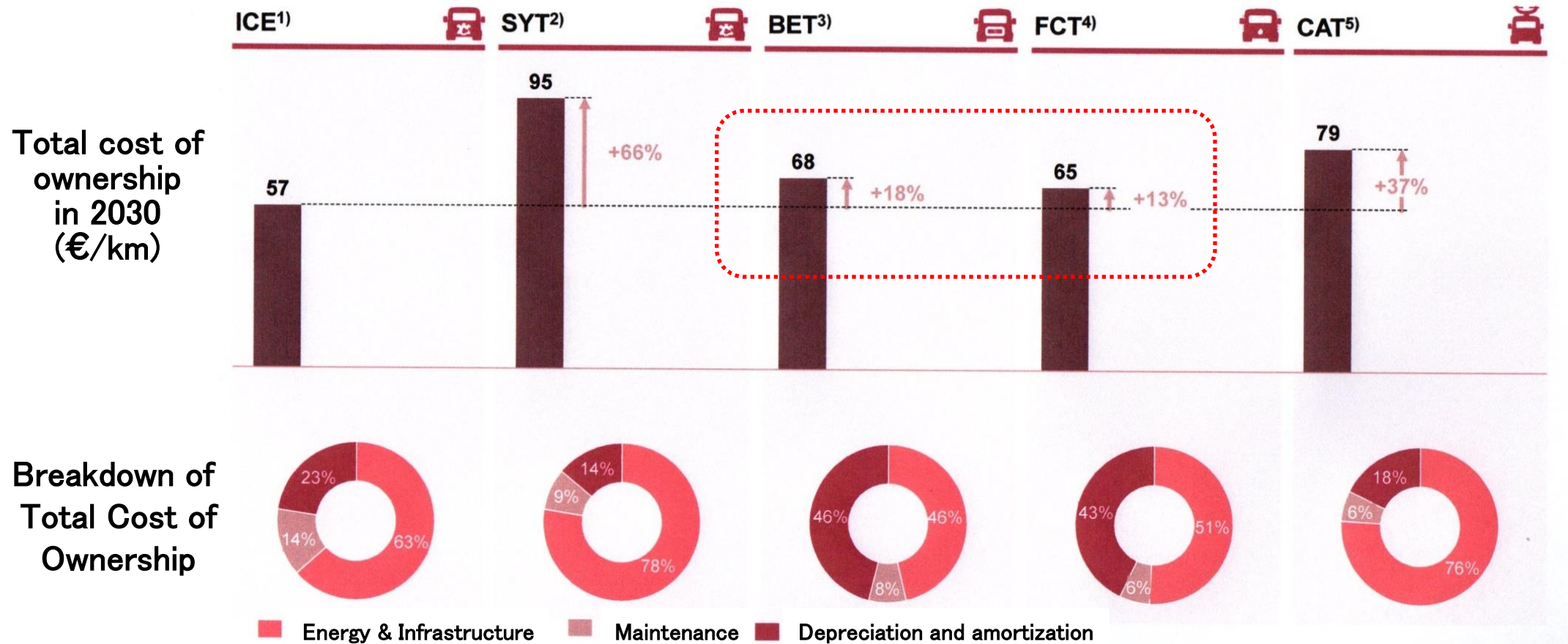
■ パワートレインの
コスト(単位: キューロ)

XX 2030年のICEと比較
した追加コスト

1) ICE= 内燃機関搭載のトラック、2) SYT= 合成燃料トラック、3) BET= バッテリー式電気トラック、4) FCT= 水素駆動燃料電池トラック、
5) CAT= 架線式ハイブリッドトラック、6) 200kWが燃料電池の出力、7) 合成ディーゼル燃料、8) 水素は70MPaで保管
出所: Strategy&分析

Total cost of ownership of Next Generation Transportation Trucks as of 2030

- ◆ Total cost of ownership of BET and FCT goes closer to ICE (current diesel vehicles).

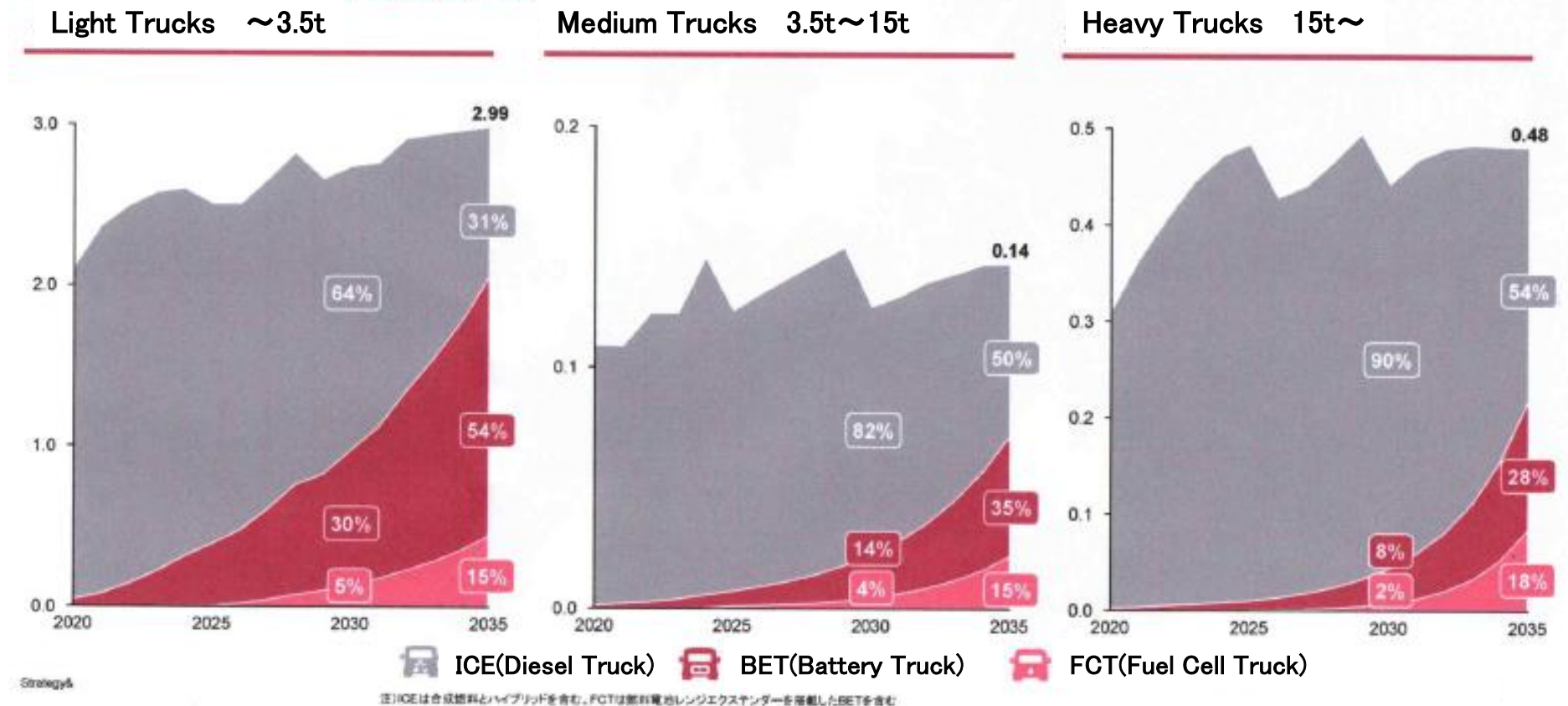


(note) Overall Parameters: Annual mileage 100,000km, All periods 4 years, Tolls, insurance, vehicle taxes, and interest rates are not included.
All energy prices are net prices excluding VAT.

Forecasting the Diffusion of Next Generation Transportation Trucks

- ◆ The electrification rate is highest for light-duty trucks, and a certain level of sales is expected for heavy-duty trucks.

Western Europe Truck Manufacturing Forecast Unit: 1 Million Vehicles

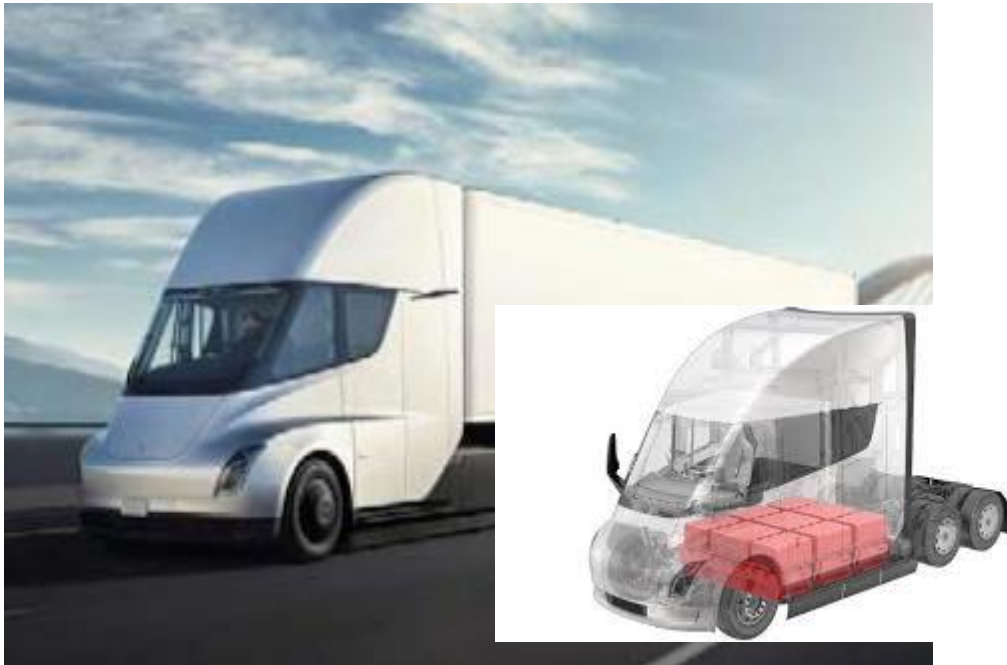


The State of Truck Electrification in the U.S.

- ◆ BET and FCET are now represented. However, Class 8 can run only in the United States.

(BET)

Start of introduction: December 2022
Class 8 • Maximum payload: 37 tons
Cruising distance: 480–800km (100km/h × 4 hours)
30 minute break after every 4 hours of driving
Established by rapid recharging at each break



★(FCET)

Approved in California in April 2023
Class 8 • Maximum payload: 37 tons
Cruising distance: 480km+ α
(Liquid hydrogenation under consideration)



The State of Truck Electrification in China

- ◆ BEVs are the majority for passenger cars, while both BET and FCET are offered for commercial vehicles.

★(BET)

Maximum payload: 1 ton、Vehicle price: 3.8 million yen
Cruising distance: 200km、Normal charging is OK



(BET)

Maximum payload: 37 tons (same as Tesla)
Battery capacity: 1,165kWh(replaceable)



★(FCET)

Microbus

Vehicles provided for the Beijing Olympics



★(FCET)

Maximum payload: 37tons (same as Tesla)

Vehicle prices are about 4 times higher and fuel costs are 2-3 times higher
However, due to subsidies, operating expenses: -10% (vs. DE)



The State of Truck Electrification in EU

- ◆ The cruising range is by far superior due to the use of liquid hydrogen in FCETs.

(BET)

Start of introduction: 2024

MW-class high-performance charger: 500,000 bases

Cruising distance: 360km(80km/h × 4.5hours)

45 minute break after every 4.5 hours of driving

Established by rapid recharging at each break



★(FCET)

Start of introduction: 2027

Fuel fill: liquid hydrogen (40 kg x 2)

Hydrogen stations: Construction scheduled for 2023

Cruising distance: 1,000km or more

Advantageous for long-distance transportation of heavy cargo



liquid
hydrogen
tanks

The State of Truck Electrification in Japan

- ◆ The lineup is enhanced and the choices are diversified. (Subsidy: 3/4 for FCET, 2/3 for BET)

(BET)

Maximum payload: 2 tons、Cruising distance: 100–



★(FCET)

Maximum payload: 2 tons、Cruising distance :



★(FCET)

Maximum payload: 14 tons

Cruising distance : 600km



4. Summary

Introduction of CO2 Refrigeration Systems to ASEAN

【Malaysia】

Subsidized by the Ministry of the Environment
Installation started in May 2017



【Indonesia】

Started installing
in 13 stores



Summary

- ◆ It is estimated that **30% of food products in developed countries and 50% in developing countries** are discarded due to inadequate temperature control of food products. In ASEAN countries, demand for frozen and refrigerated foods is also increasing. MLIT has started an initiative to introduce cold chain logistics for food products.
- ◆ Standardization of logistics guidelines has been completed, and action plans for **Malaysia, Indonesia, Thailand, the Philippines, and Vietnam** have been formulated and are in the implementation phase.
- ◆ The issues in the promotion of carbon neutrality are **the reduction of global warming potential and improvement of efficiency by converting refrigeration equipment in warehouses to natural refrigerants, and the greening of transportation trucks.**

In Japan, the shift to natural refrigerants for refrigeration equipment is underway, and replacement is steadily progressing with subsidies from the Ministry of the Environment.

In the transportation truck market, **fuel cell trucks are positioned as the future mainstream, especially for heavy-duty trucks**, but battery-powered trucks are also expected to become popular for last-mile applications limited to home-delivery.

As technological innovations continue to advance in both areas, it is necessary to keep track of trends.

Thank you for your attention.



Symbol of energy conservation

SMART CLOVER