



How does Japanese railroad technology contribute to the low-carbon society?

*Masaki Ogata
East Japan Railway Company*





Outline

- CO₂ Emission and Energy Consumption Statistics
- Evolution of Energy-Saving Performance
- Features of Japanese Railroads
- Our challenge for an Energy Efficient Society





Outline

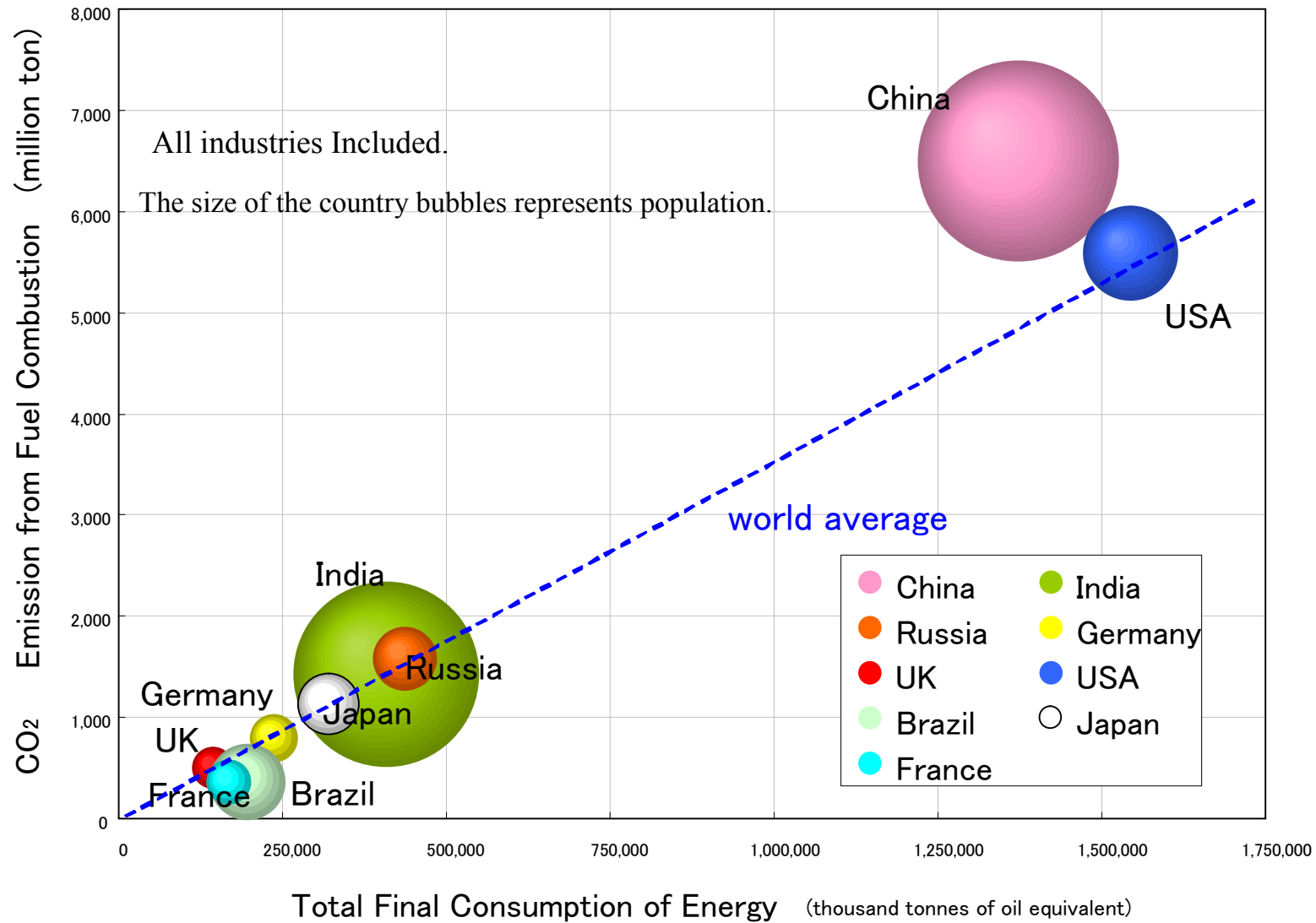
- CO₂ Emission and Energy Consumption Statistics
- Evolution of Energy-Saving Performance
- Features of Japanese Railroads
- Our challenge for an Energy Efficient Society





CO₂ Emission and Energy Consumption Statistics (World)

Comparison of country CO₂ Emission against Energy Consumption



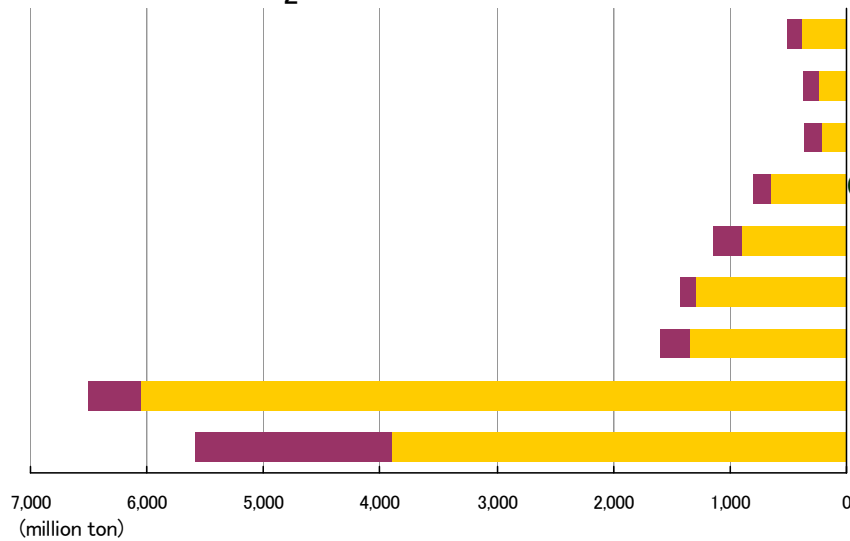
Sources: International Energy Agency 'Energy Statistics' 2008



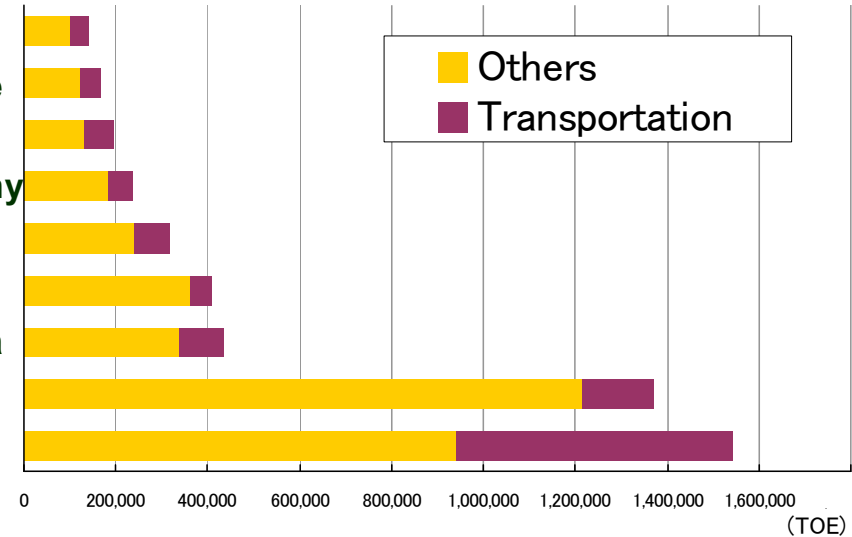
CO₂ Emission and Energy Consumption Statistics (World)

Share of Transportation Industry in CO₂ emission and energy consumption

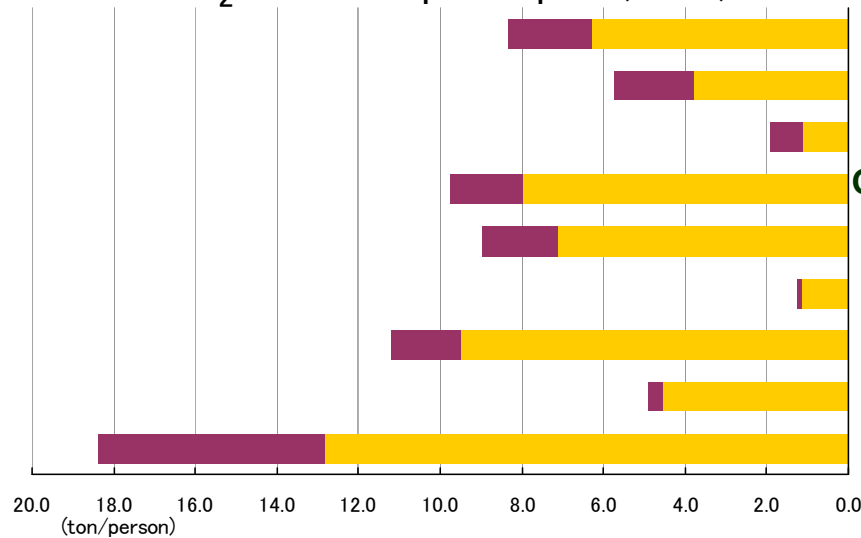
CO₂ Emission (2008)



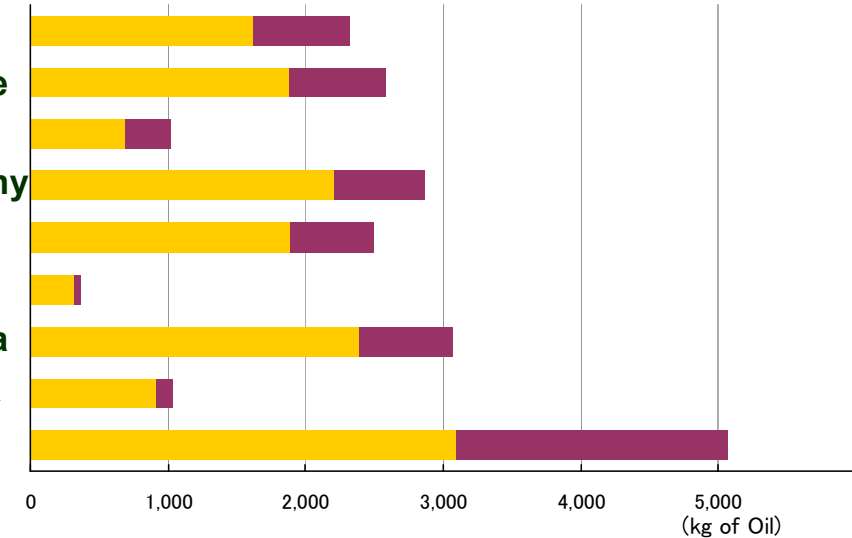
Energy Consumption (2008)



CO₂ Emission per capita (2008)



Energy Consumption per capita (2008)

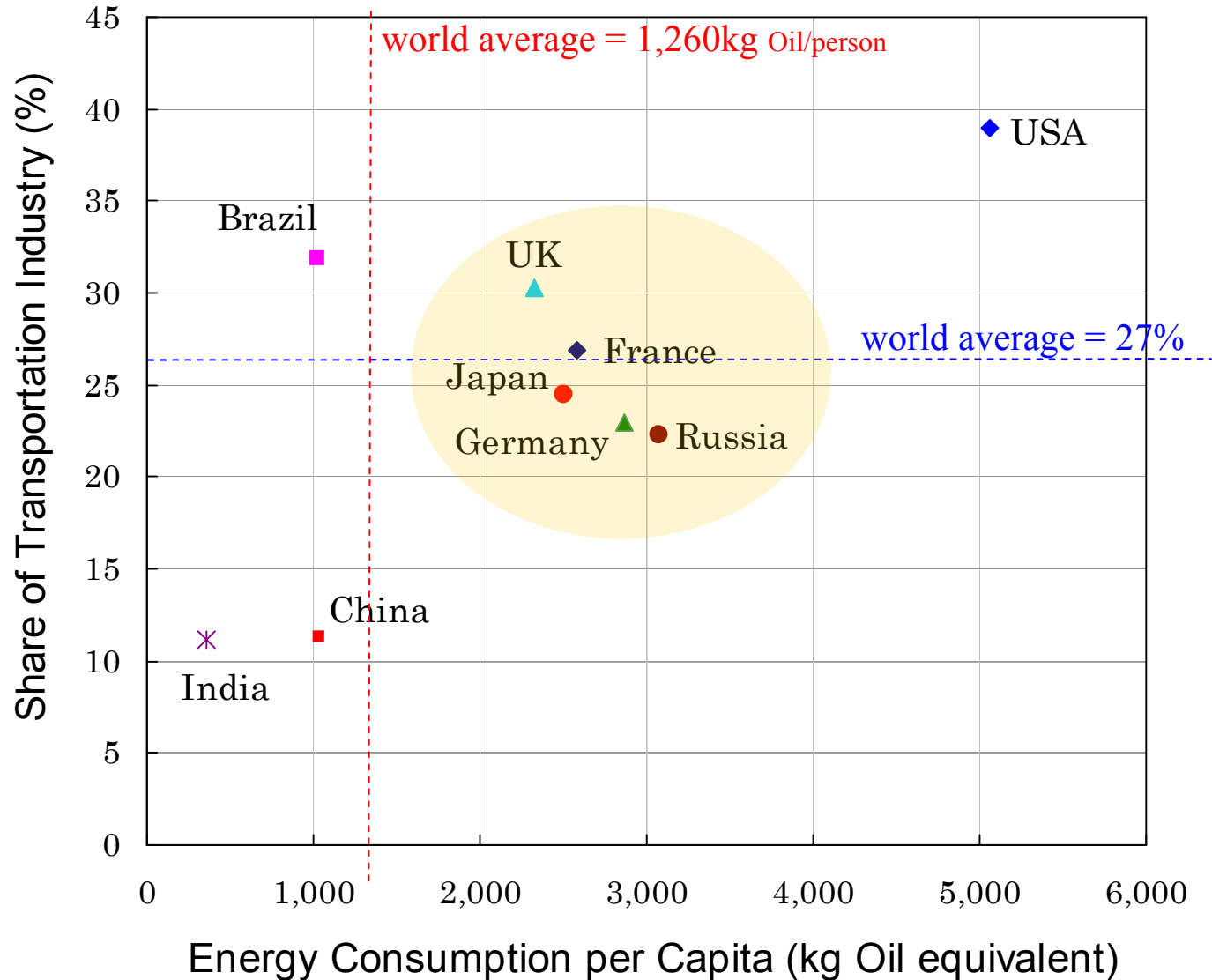


Sources: International Energy Agency 'Energy Statistics' 2008



CO₂ Emission and Energy Consumption Statistics (World)

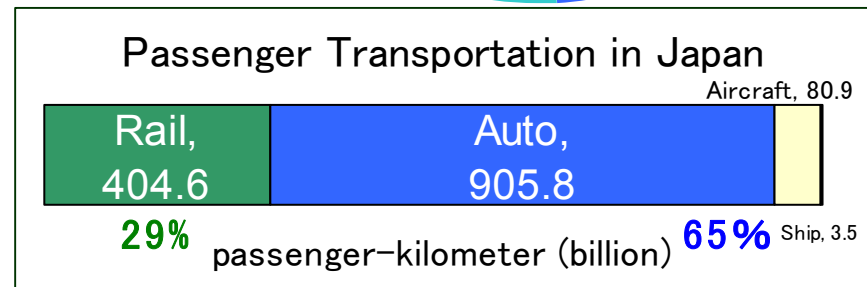
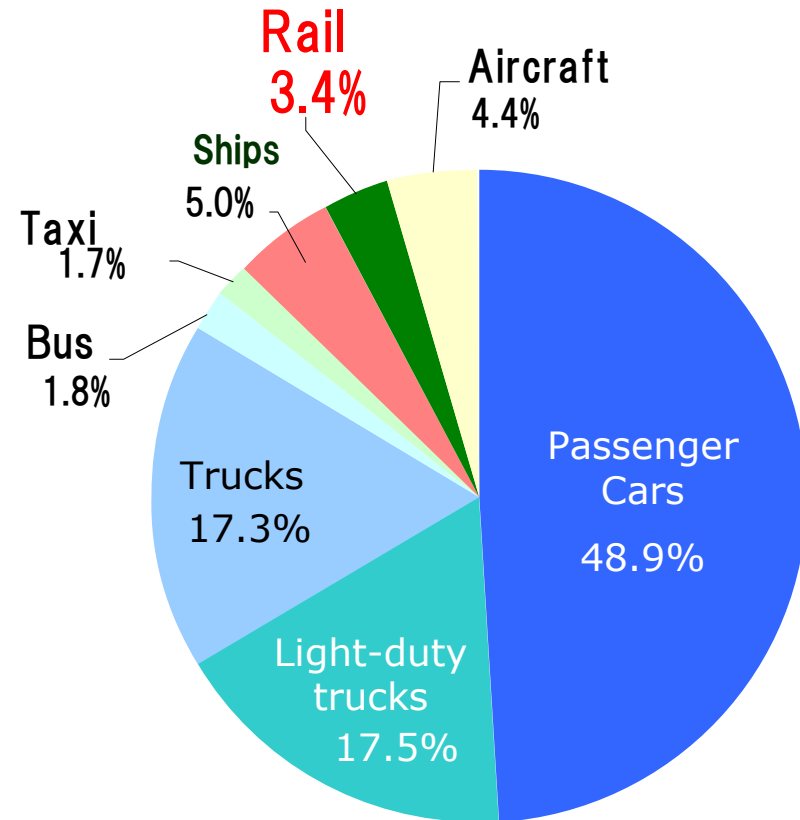
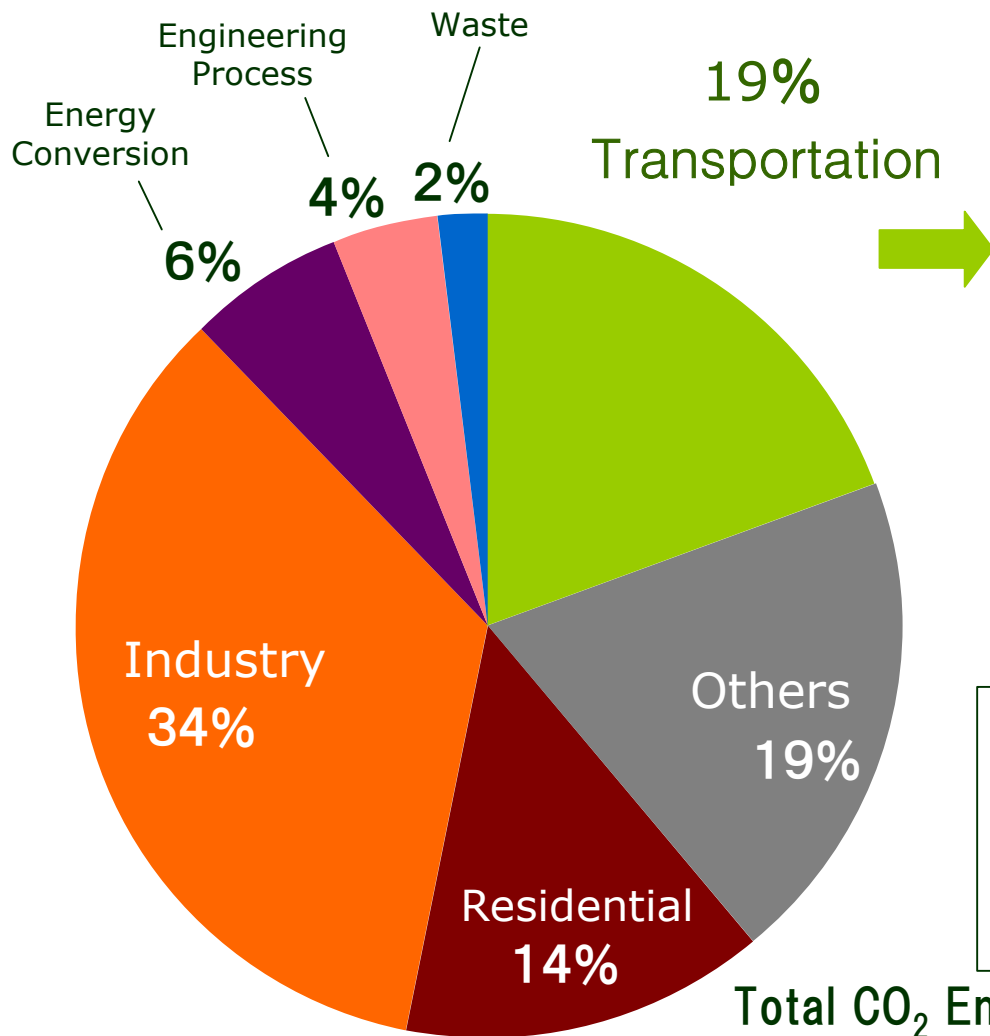
Classification based on Energy Consumption and Share of Transportation Industry





CO₂ Emission and Energy Consumption Statistics (Japan)

CO₂ Emissions, by industry, 2008

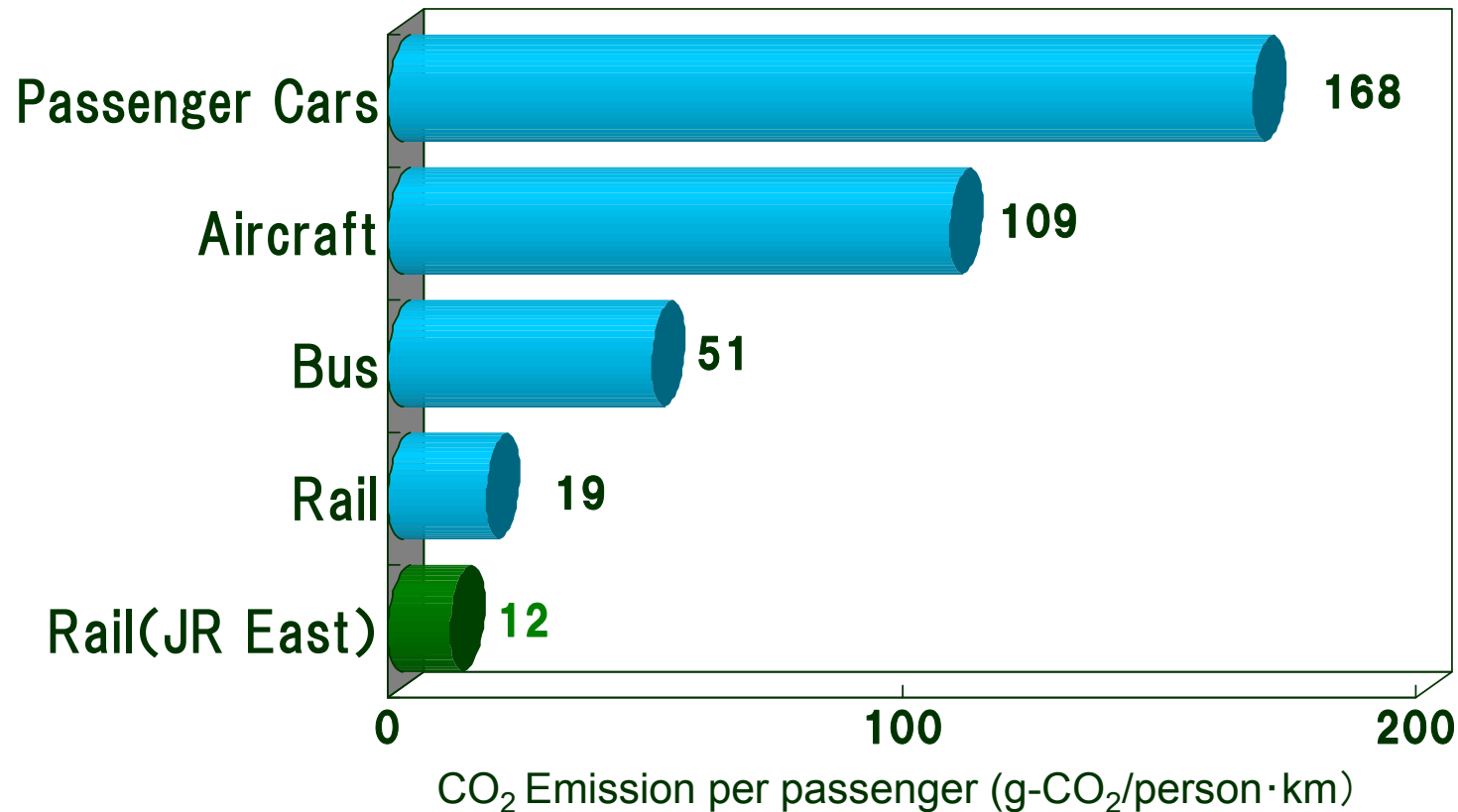


Total CO₂ Emission in Japan: 1.15 billion tons
of which railways: 7.63 million tons (0.7%)



CO₂ Emission and Energy Consumption Statistics (Japan)

Comparison of CO₂ emission per passenger by transportation mode, 2008



Source: Ministry of Land, Infrastructure, Transport and Tourism (2008)

* The figure for JR East is based on the result for fiscal 2009.



Outline

- CO₂ Emission and Energy Consumption Statistics
- Evolution of Energy-Saving Performance
- **Features of Japanese Railroads**
- Our challenge for an Energy Efficient Society





Features of Japanese Railroads

Safety

Punctuality

High speed

High frequency

Large capacity

Through service

(Coupling and Uncoupling technology)

Disaster countermeasures

(snow, earthquake)

Environmental friendliness



Comfort

Suica (Smart IC Card)

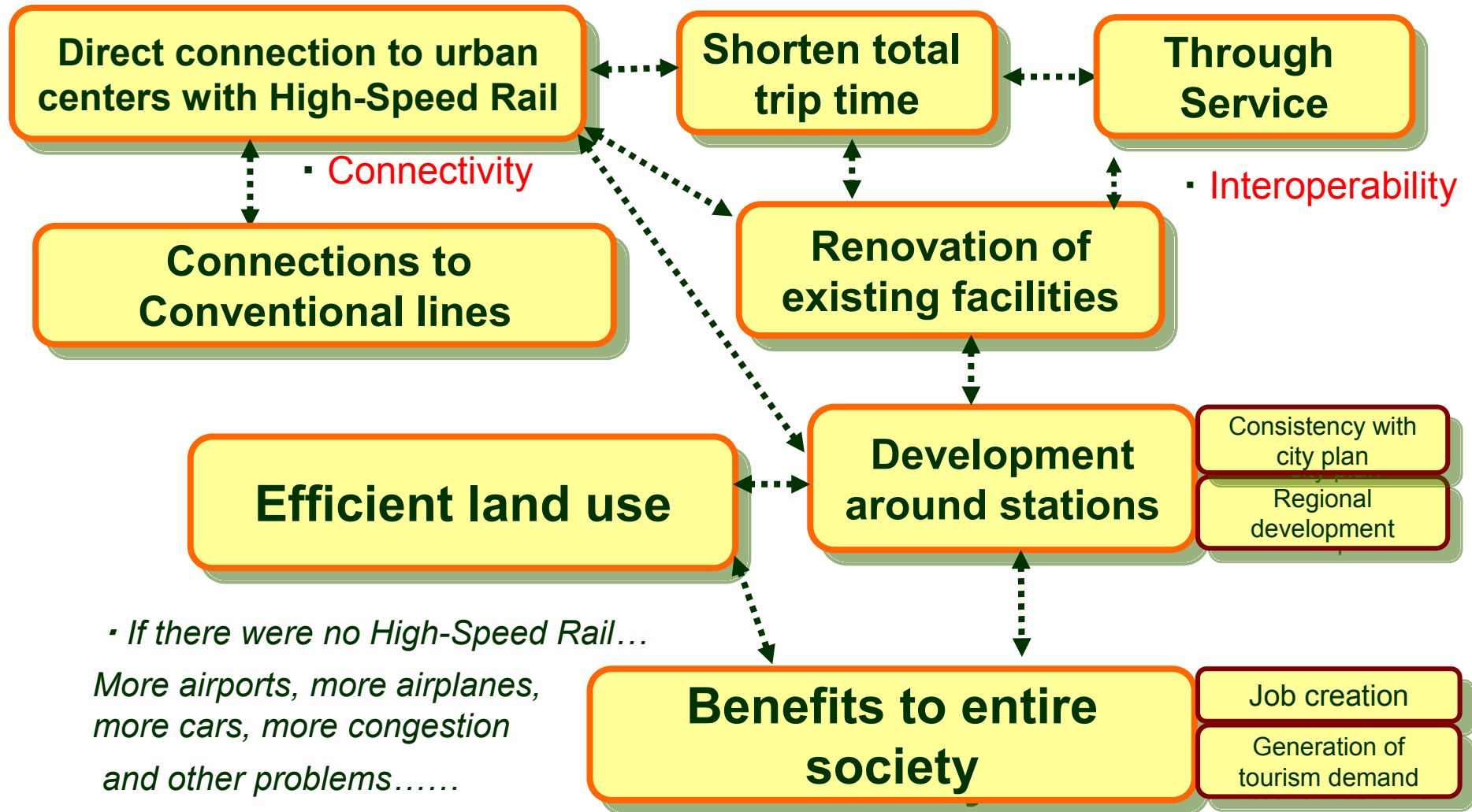
**Commercial development
of stations**

Cost efficiency

Profitability (No subsidies)



Relationships among the effects of High Speed Rail



JR East has all of these!

■ Characteristics of the management of East Japan Railway Company

Integrated management which holds all technologies related to the railway

1. We own, operate and maintain all the railway infrastructure with all the other activities of the railway operator
Stations, rolling stock, track, electric power supply, signals, IT system, infrastructure of railway related business, and so on
2. We own all kinds of systems related to energy, especially electricity, from the supply side to the demand side. 【the only railway company in the world】

Electricity generating plants (one hydroelectric and one thermal power), power lines, substations, stations, rolling stock, shopping centers, retail shops, hotels, offices, and so on.
3. We implement all stages in the whole life cycle of rolling stock.
【the only railway company in the world which owns a rolling stock manufacturing plant】

(Rolling stock) development concept, development, design, manufacturing, operation, maintenance, feedback for new rolling stock development, recycle



Outline

- CO₂ Emission and Energy Consumption Statistics
- Evolution of Energy-Saving Performance
- Features of Japanese Railroads
- **Our challenge for an Energy Efficient Society**





Our challenge for an Energy Efficient Society (1)

Improving our transportation service

Through service

Improvement of railway network
Including links to other railways

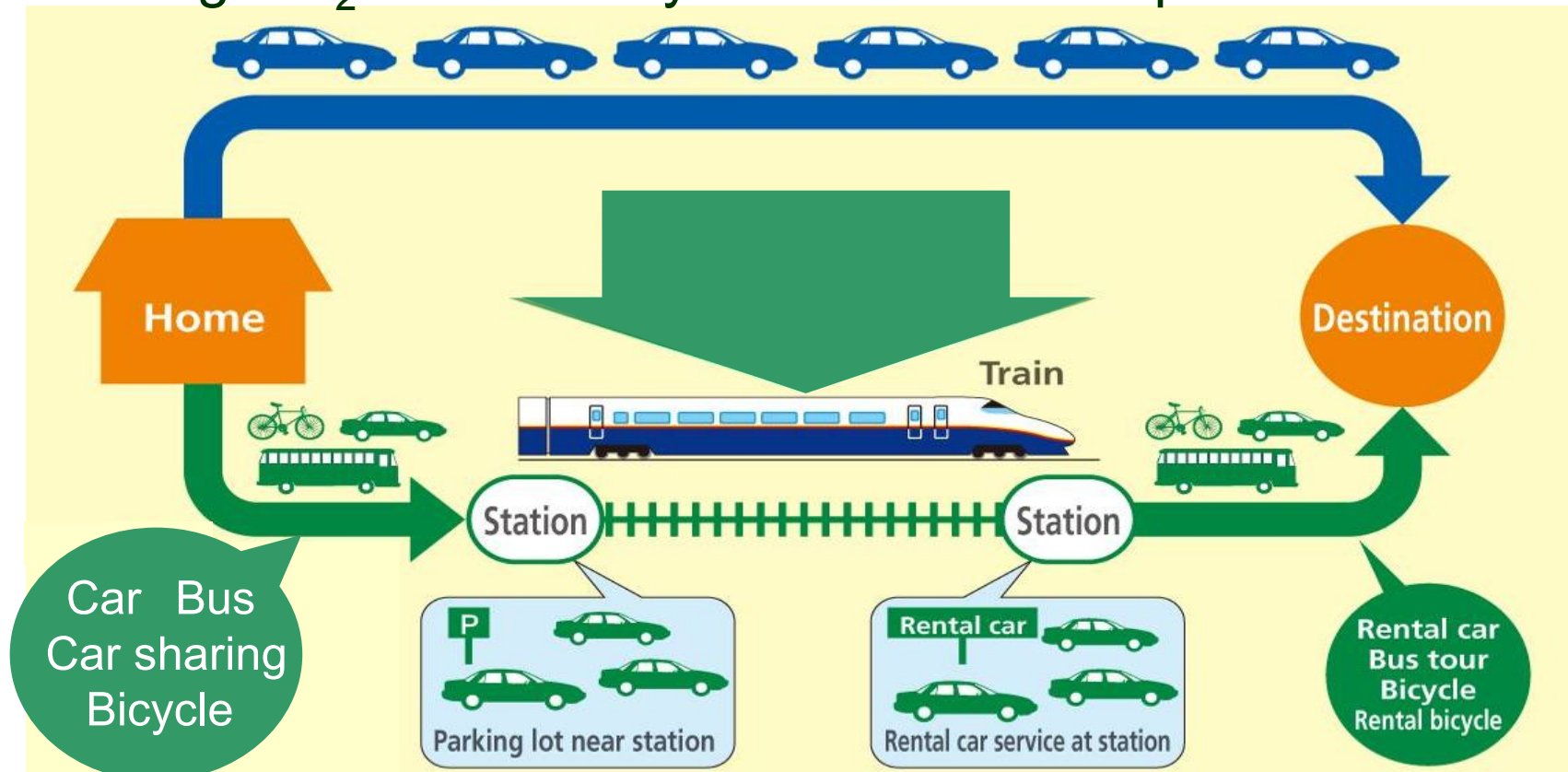
Barrier-free stations

Elevators, Escalators

Seating service

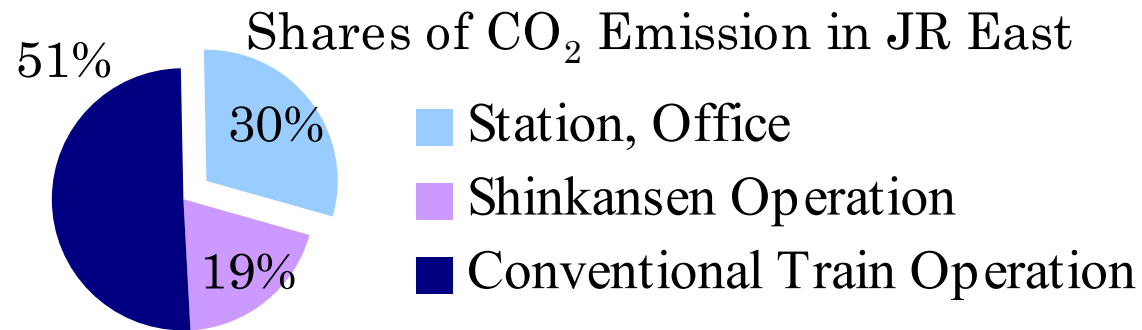
Business class on commuting
lines, with guaranteed seats

Reducing CO₂ Emission by Intermodal Transportation





Our challenge for an Energy Efficient Society (2)



Save Energy
37%



LED Display, Lighting, etc

Generate Energy
3%



Solar Power Generation Panels

Ecoste

Environment earth COnscious STation
of East Japan railway company



40% Reduction of CO₂ emission in Stations.




Conclusion

Railroads are:

- the most environmentally-friendly transportation mode
- still improving their technologies to reduce environmental load
- able to contribute to the benefit of all of society throughout the world
- holding the potential to achieve entire energy system optimization by making use of smart grids and other up to date technologies





We can contribute to the global environment
by railroad innovations that lead
to energy efficient low-carbon communities.



The background of the slide is a stylized illustration of Mount Fuji. The mountain is depicted with a yellow and white peak, and its slopes are rendered in various shades of green and blue. The sky is a light blue gradient. The text is centered over the mountain.

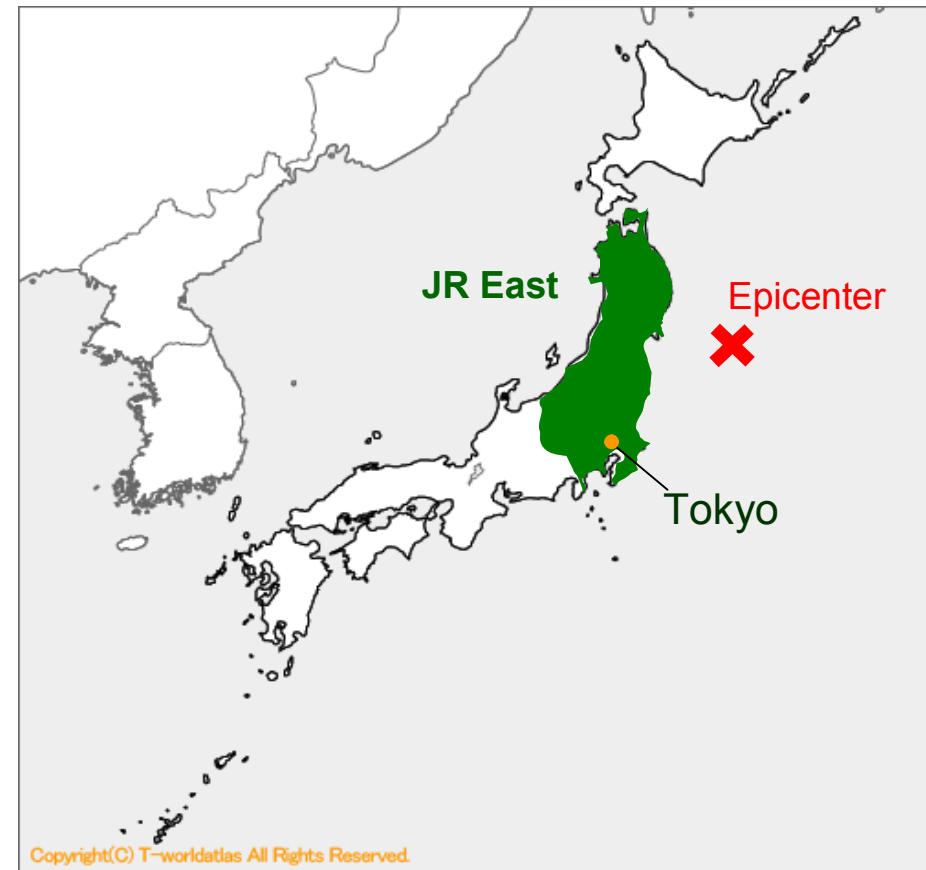
The March 2011 Earthquake & our Response



The March 2011 Earthquake & our Response

Outline of Great East Japan Earthquake

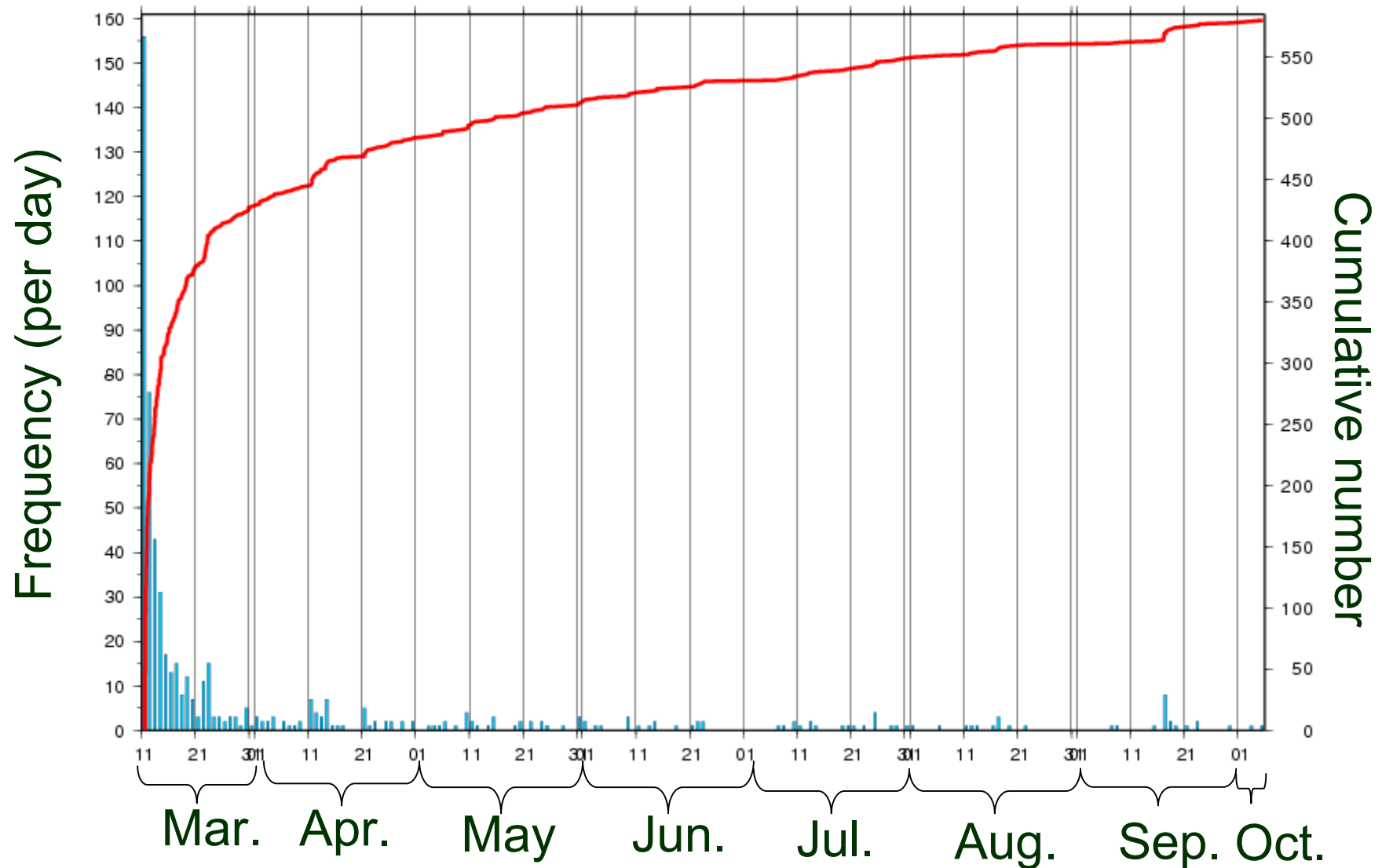
- **Date and time of occurrence:**
At approximately 14:46 on Friday,
March 11, 2011
- **Strength of the earthquake:**
Magnitude 9.0 on the Richter
scale
(The largest in the recorded history
of Japan)
- **Number of deaths and missing:**
19,750 (As of Oct. 5, 2011)
(Resulting from earthquake-
induced shock and vibration,
tsunami and fire)





Frequent aftershocks

Number of aftershocks (Magnitude 5.0 and over)





Japan: A country with frequent earthquakes

Great East Japan Earthquake and Past Major Earthquakes

	Great East Japan Earthquake ("Off the Pacific Coast of Tohoku Earthquake")	Niigata Chuetsu Earthquake	Great Hanshin-Awaji Earthquake (Southern Hyogo Prefecture Earthquake)
Date and Time	March 11, 2011	October 23, 2004	January 17, 1995
Epicenter	Off the Sanriku Coast	Chuetsu region of Niigata refecture	Near Awaji Island
Magnitude	9.0	6.8	7.3
Prefectures recorded a JMA seismic intensity of lower 5 or stronger	Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima, Gunma, Tochigi, Ibaraki, Saitama, Chiba, Tokyo, Kanagawa, Niigata, Yamanashi, Shizuoka, Nagano	Fukushima, Gunma, Saitama, Niigata, Nagano	Shiga, Kyoto, Hyogo

Source: Reports issued by Japan Meteorological Agency, Fire and Disaster Management Agency



Countermeasures against earthquakes

- ① Prevent collapse of viaducts
- ② Detect the earthquake and stop the trains as quickly as possible
- ③ Prevent trains from a large off-track deviation in case of a derailment
- ④ Operation in case of an emergency, education and training



Countermeasures against earthquakes ①

Reinforced pillars



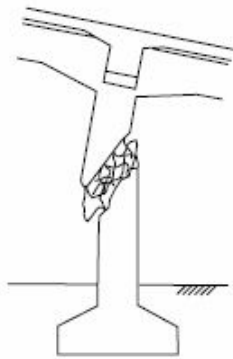
Viaducts:

- Aseismic reinforcement to prevent shear failures
- No critical destruction to major structures by the earthquake this time, only bending failures

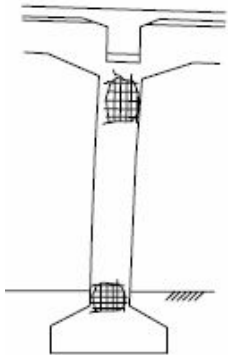


Countermeasures against earthquakes ①

Shear failure & Bending failure



Shear failure:
Pillars which do not have enough toughness against fracture and are subject to abrupt breakages



Bending failure:
Pillars which incorporate toughness against fracture but may be subject to destruction in the case of major earthquake

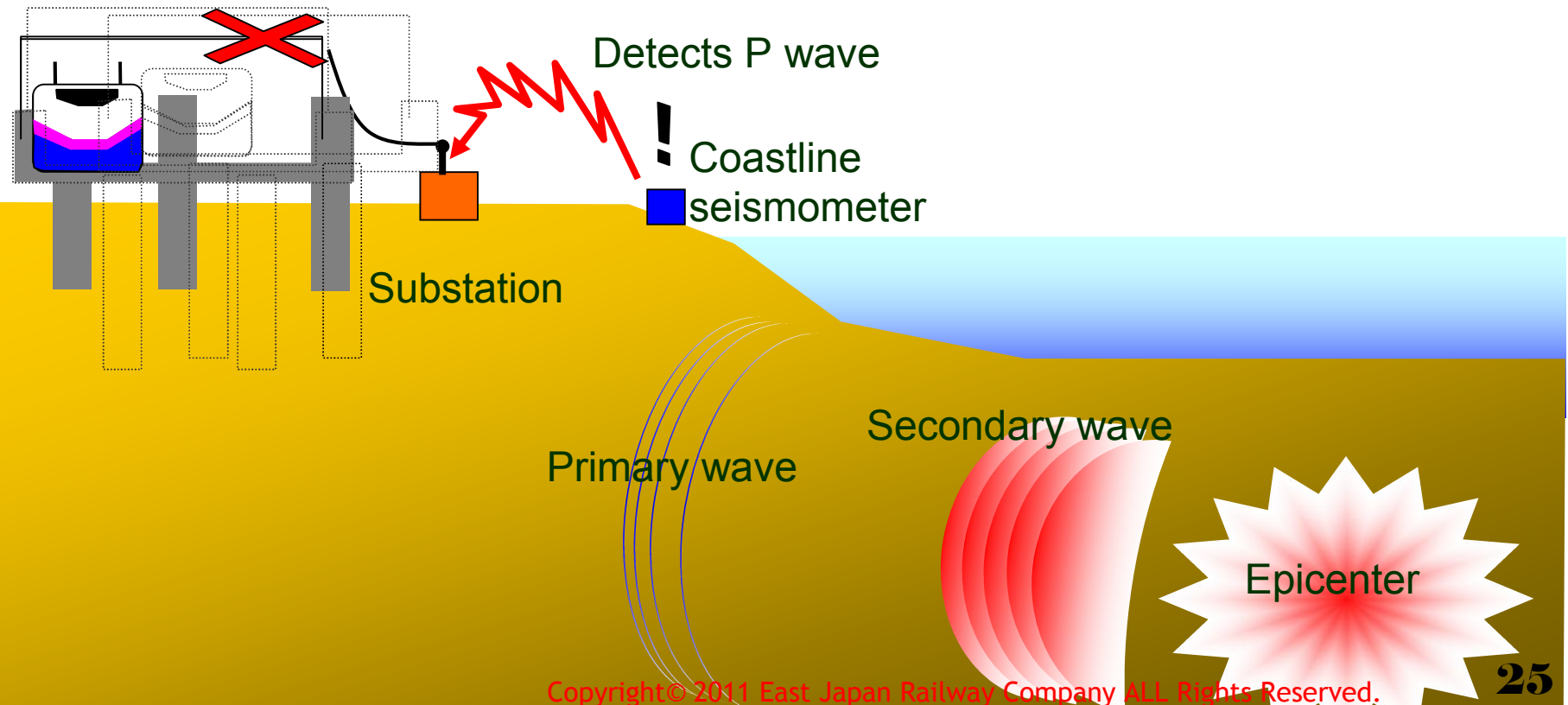
Countermeasures against earthquakes ②

“Early Earthquake Detection System”

When the coastline seismometer detects a primary wave

Power shutdown

Emergency brakes





Countermeasures against earthquakes ②

New Measures after the Chuetsu Earthquake

1. 28 more seismometers installed along Shinkansen lines

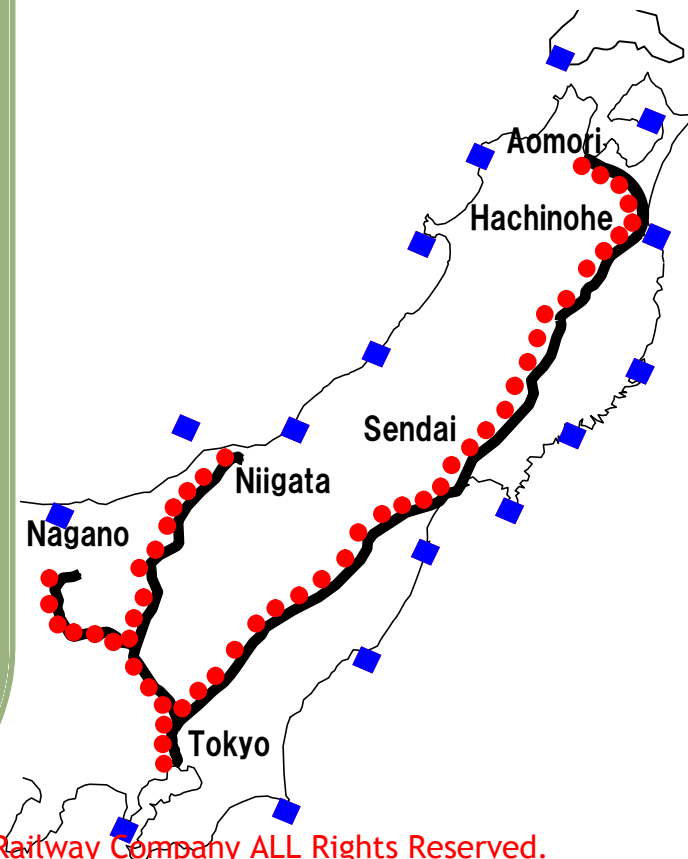
2. Shortening the total time from the earthquake detection to the emergency brake working

- Shortening of the logical judgment time after detection by seismometers along the coast (3 seconds to 2 seconds)
- Shortening the on-board interval between detection of power supply stop and the emergency brake working (4 seconds to 3 seconds)

Location of Seismometers

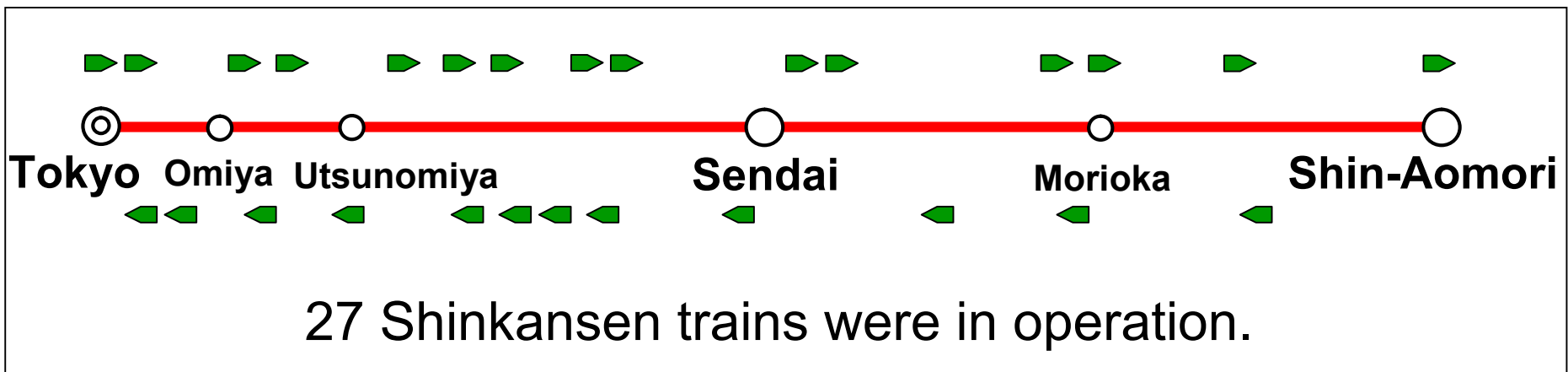
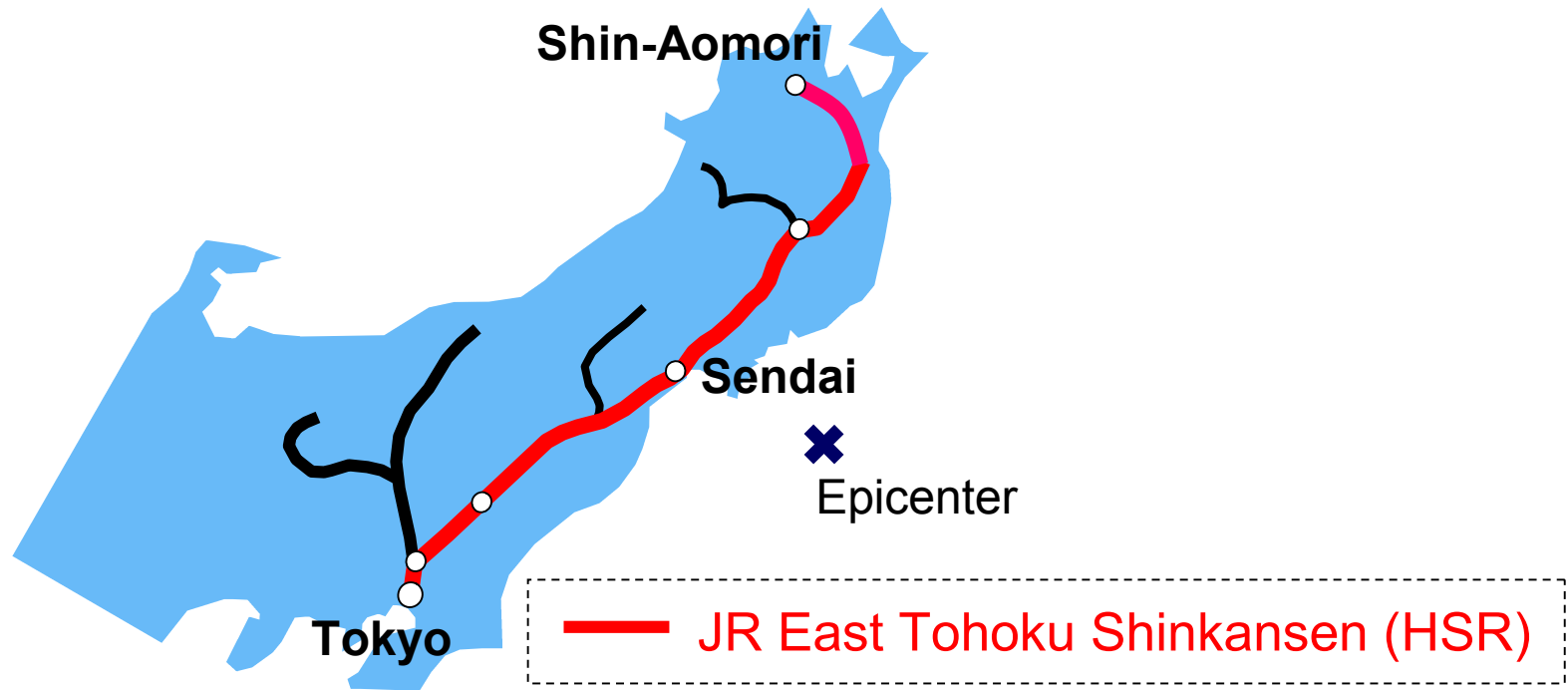
● : Seismometers along the Shinkansen lines (81 locations)

◆ : Seismometers along the coast (16 locations)



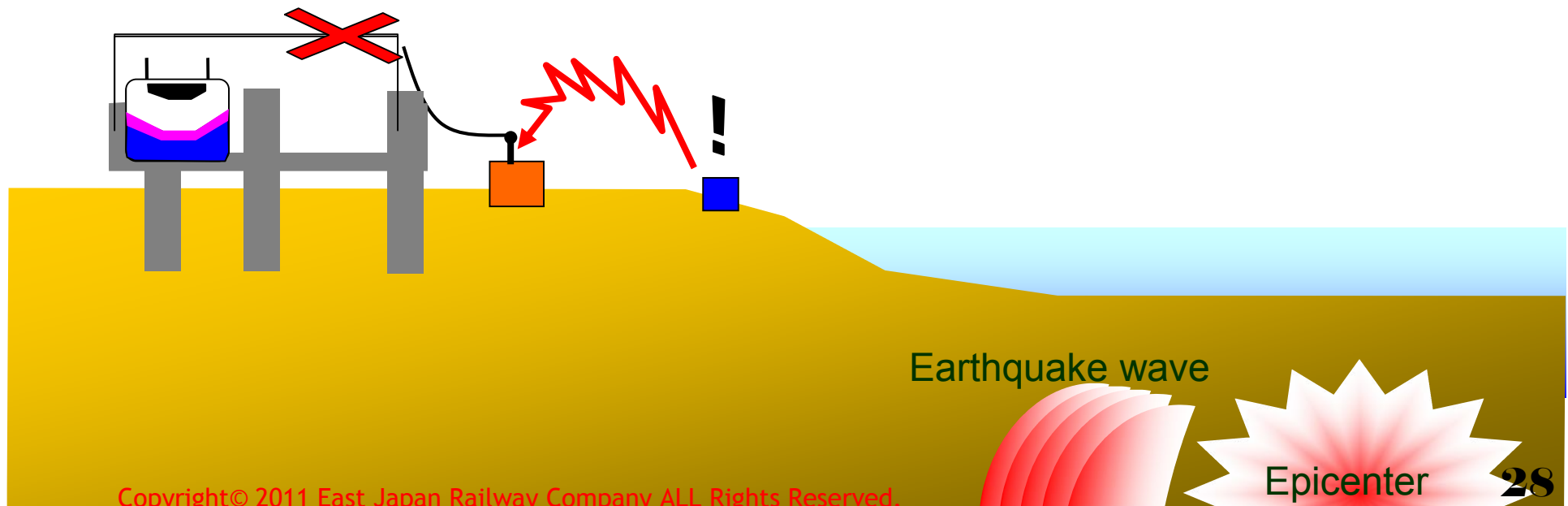


Location of Shinkansen trains when the earthquake occurred.



Countermeasures against earthquakes ②

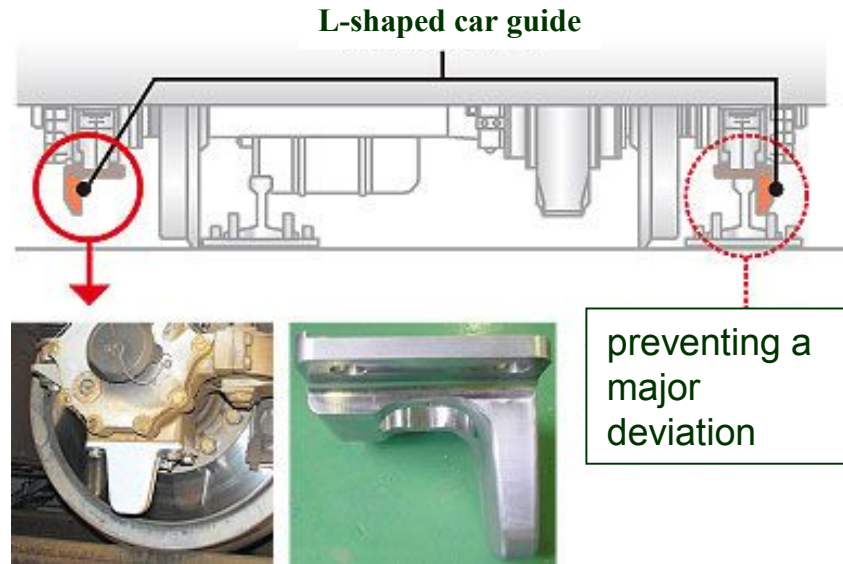
- Two trains running at approx. 270km/h (168mph) through the Sendai area were exposed to strong shaking from the earthquake.
- The power supply to these trains was cut 9 to 12 seconds before the first vibrations arrived, and their emergency brakes were applied.
- The largest vibration came to these trains approx. 70 seconds after their emergency brakes were applied.





Countermeasures against earthquakes ③

L-shaped car guides (on vehicle)



Develop glued-insulated rail joint (IJ)



Rail over-turn prevention device



Countermeasures against earthquakes (tsunamis) ④

Examples of countermeasures against tsunamis

1. Establish hazard maps for all the local segments of the line along the seacoast
2. Prepare a manual for train crews & station staffs
3. Carry out training for train crews, station staffs and operation staffs, and repeat this training regularly
4. OCC dispatchers commanding evacuation
 - If impossible, the crews voluntarily evacuate passengers to the safer places designated by local governments.



Hazard map

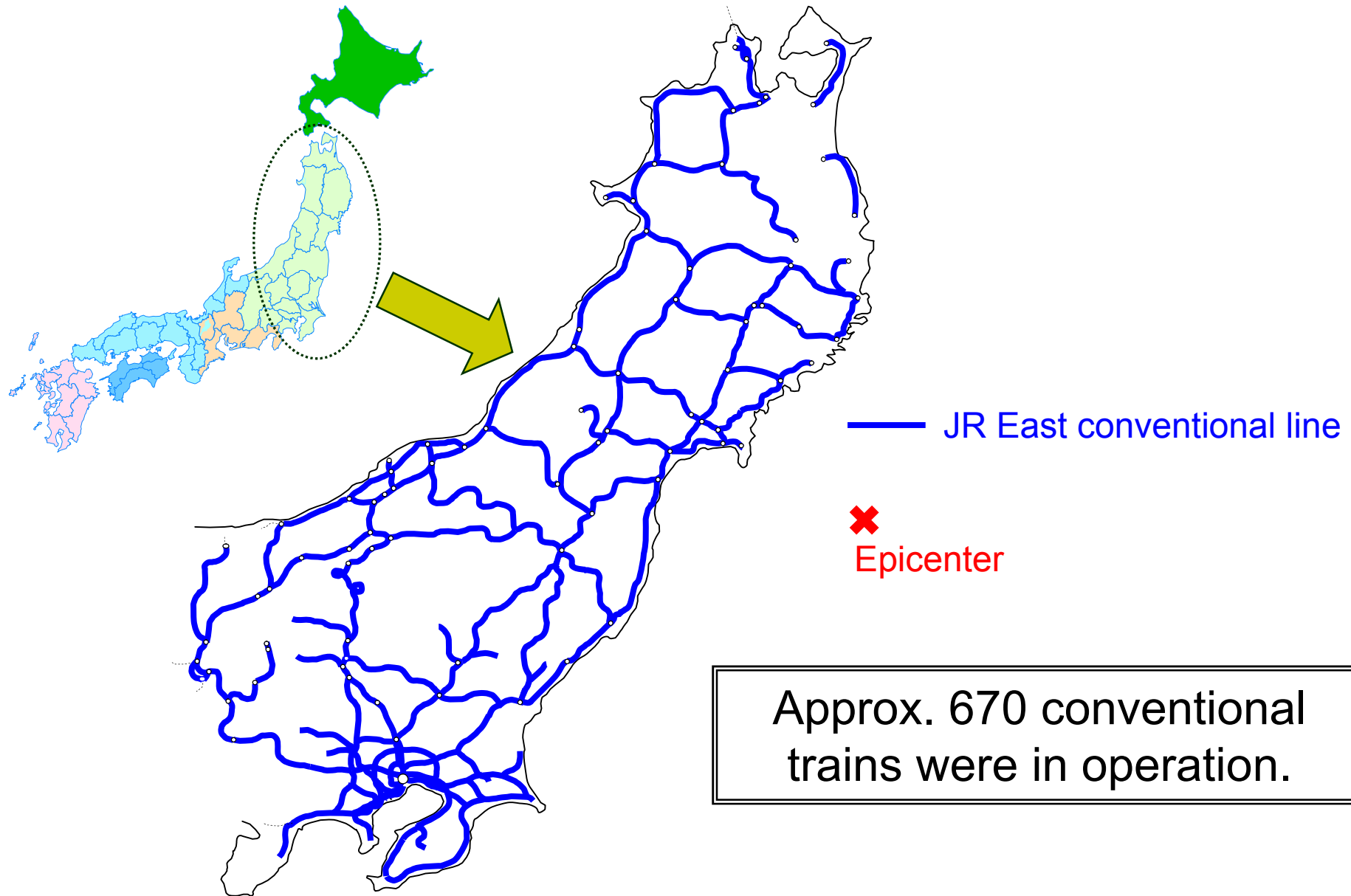


Training



Signs for evacuation area

Number of conventional trains when the earthquake occurred.





Consequences of the earthquake & tsunami

- Customer fatalities : 0

- Customer injuries : 0

- Shinkansen (HSR)

- Aseismic reinforcement
- Early earthquake detection system

⇒ **No derailment
of commercial trains**

- Conventional lines

Station staffs and train crews successfully led our customers to the emergency evacuation areas before the tsunami hit.



Damage caused by the earthquake

■ Tohoku Shinkansen

- No critical destruction to major structures by the earthquake this time, only bending failures

Number of damage sites	Approx. 1,200
------------------------	---------------

* Approx. 550 more damage sites due to the earthquake, aftershock, of April 7, 2011.

■ Conventional Lines (excluding 7 lines damaged by tsunami)

Number of damage sites	Approx. 4,400
------------------------	---------------

* Approx. 850 more damage sites due to the earthquake, aftershock, of April 7, 2011.

■ Conventional Lines (7 lines damaged by tsunami)

Number of damage sites	Approx. 1,730
------------------------	---------------

•As of May 1, 2011



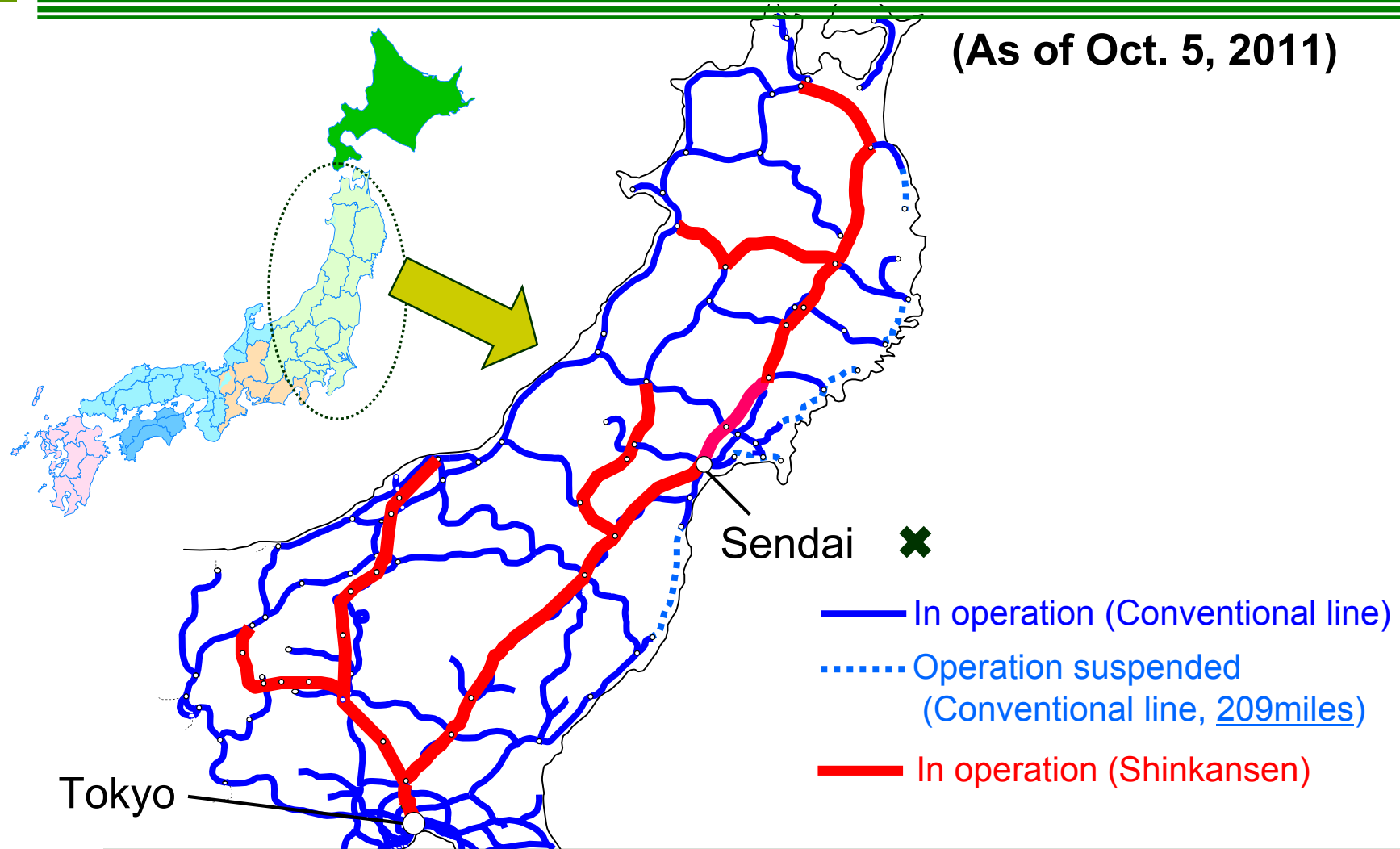
The situation immediately after the earthquake

(As of March 12, 2011)





The present status of our recovery work



- Shinkansen operations were completely restored by 49 days after the earthquake.
- Staffs and workers working on the restoration per day was about 8,500 at maximum.



Our gratitude to the United States!

Operation Tomodachi

20 U.S. naval ships, 140 aircraft, and 20,000 Marines and Sailors were involved in humanitarian assistance and disaster relief efforts

Operation Soul Train (April 21-29)

US Army cleared mud and rubble from Nobiru station and Rikuzen-Ono station.

We will never ever forget
what you have done for us !



The devastating earthquake & tsunami in Japan

- “Safety” is JR East’s top managerial priority.
- We have thoroughly implemented countermeasures for earthquakes, tsunamis, and other natural disasters as our policy of safety.
- Though the huge earthquake of magnitude 9 was the largest ever recorded in Japan, the consequences showed that our countermeasures were effective against the earthquake.



The devastating earthquake & tsunami in Japan

- We will examine the results, derive lessons from the earthquake & tsunami and further improve safety of our railroad continuously.
- We share our experience with the world and contribute to the advance of railroad technology throughout the world.

Thank you for your attention

