



# The HSR technology and experience of JR East

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Source: NASA World Wind (<http://worldwind.arc.nasa.gov/index.html>)

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# **1. Overview of JR East**

# Overview of JR East

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***JR EAST, a passenger railroad company, is the largest railroad company in JAPAN***

**Network: 4,700 miles**

**No. of Passengers: 17 million / day  
(the largest in the world)**

**No. of Trains: 13,000 / day**

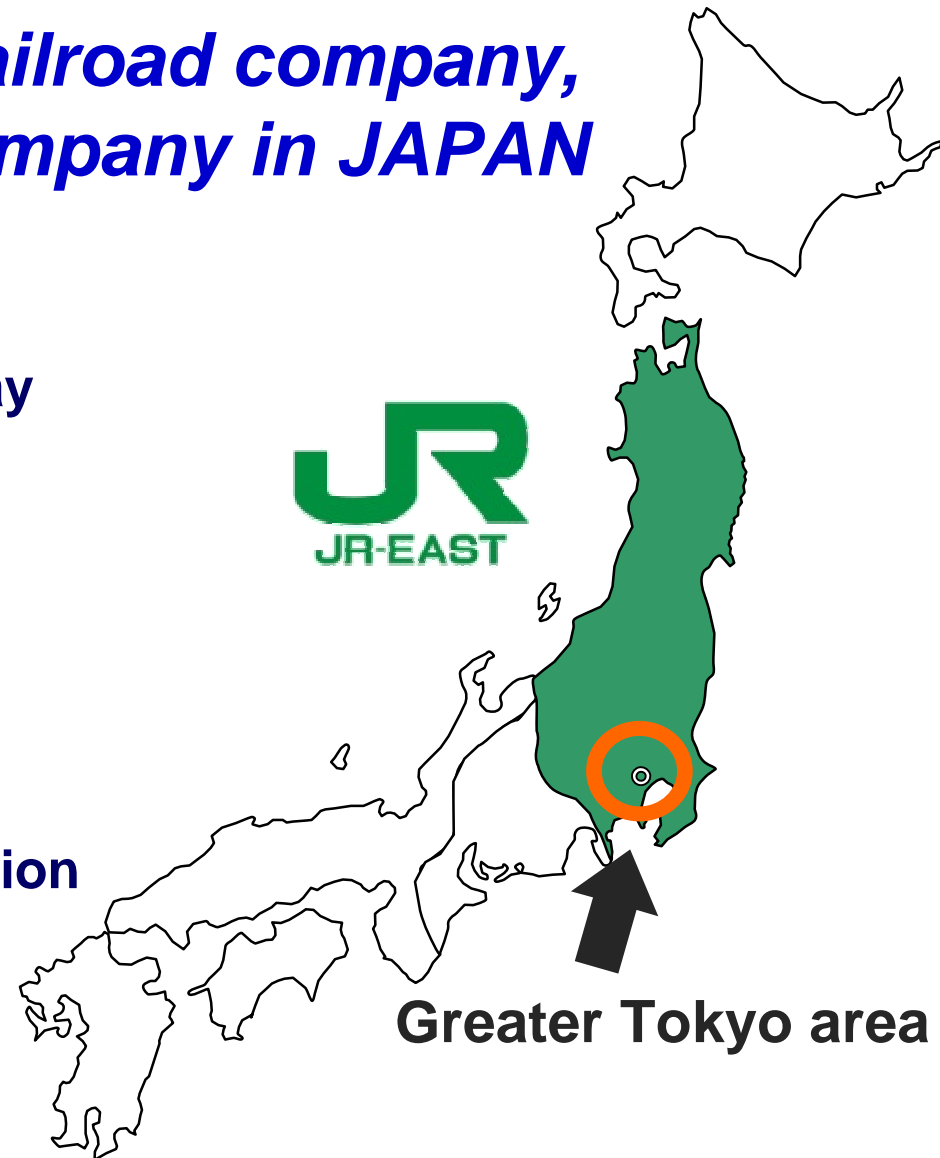
**Operating Revenue: \$32 billion**

**Net Income: \$1 billion**

**No. of Employees: 70,000**

**Total Stock Market Value: \$22 billion**

- No subsidies from the government
- The figures above are of FY from April 1, 2010 to March 31, 2011, including the loss of the earthquake of March 11, 2011.

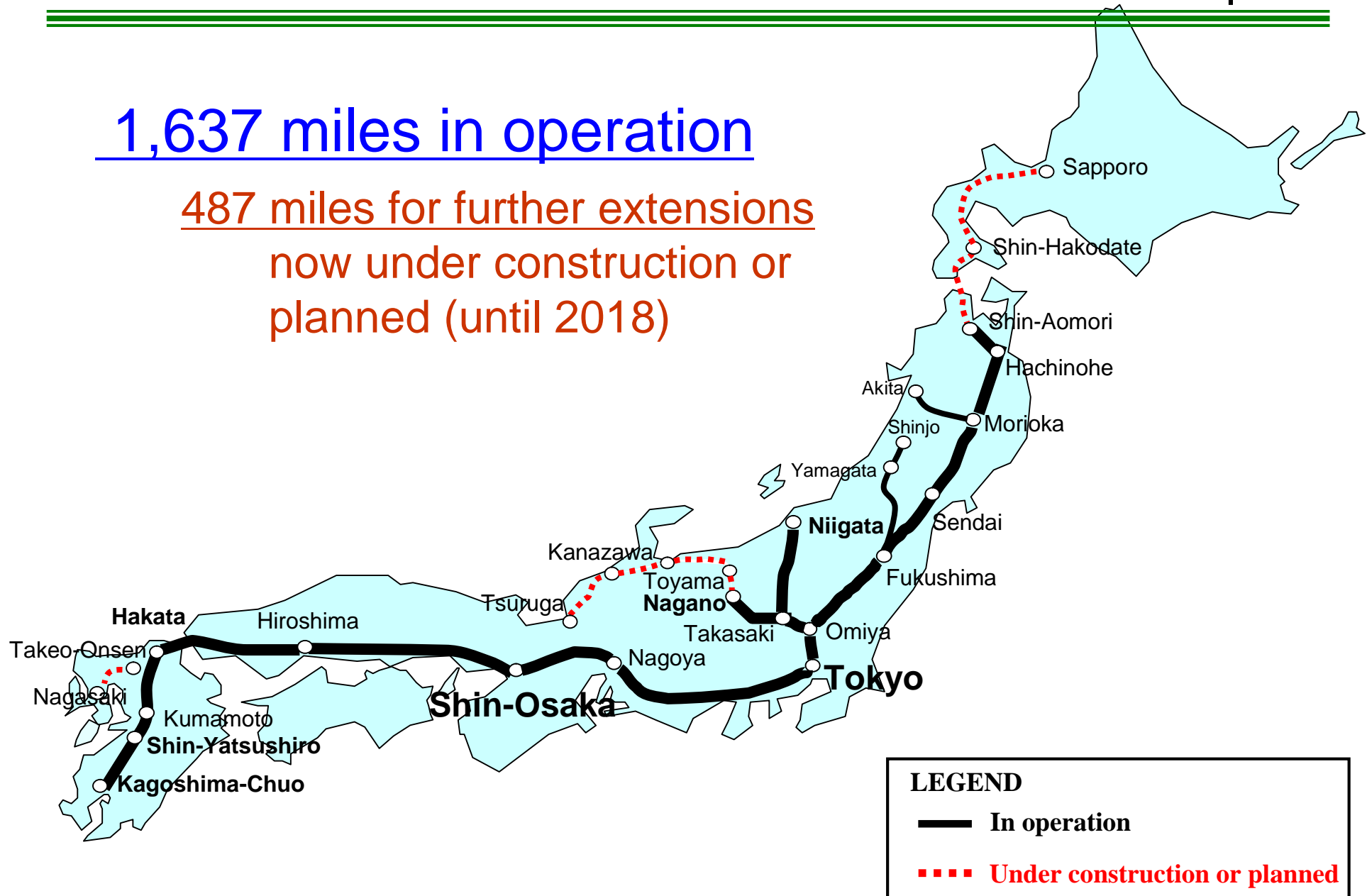


## **2. Features of Shinkansen (HSR)**

# Current status of the Entire Shinkansen network of Japan

1,637 miles in operation

487 miles for further extensions  
now under construction or  
planned (until 2018)



# Features of JR-East Shinkansen network



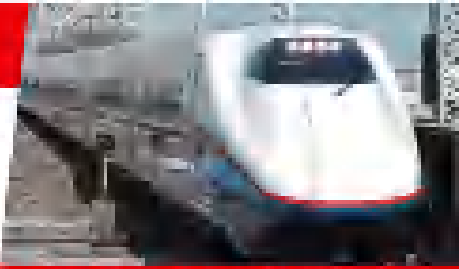
1. 5 directions
2. 3 types of rolling stock
  - Full body (for dedicated line)  
High-Speed type  
Large-Capacity type  
(Double-decker for commuting)
  - **Narrow body: Hybrid type**  
(for through operation with conventional lines)
3. Through operation with conventional lines by hybrid type
4. Coupling and uncoupling technology for through operation at the intermediate stations
5. Quick turn-back at terminal stations (12 minutes at Tokyo Station)
6. 4-minute headway



# Three types of JR East Shinkansen trains

**High speed**

**For longer trips**



Series E2 170mph \*



Series E5 200mph\*

**Hybrid type**

**For through service with coupling/uncoupling functions**



Series E3 170mph \*



Series E6 200mph \*

**Large capacity**

**For commuting**



Series E1 150mph



Series E4 150mph \*

# State-of-the-art Series E5 & E6



## *High Speed*

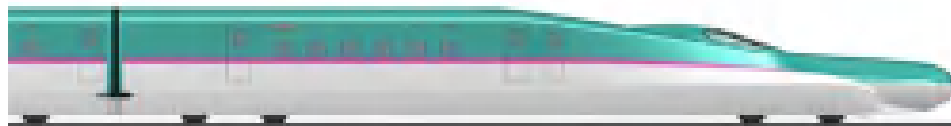
- Maximum commercial speed of Series E5 is planned to reach 200mph by 2013.



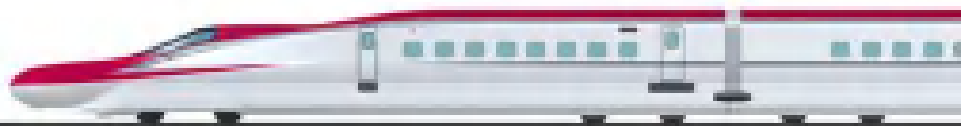
## *Through Service*

- Maximum commercial speed of Series E6 is planned to reach 200mph by 2014.
- Series E6 will run on improved conventional lines at 82 mph by the end of March, 2013.
- Series E5 & E6 can be coupled and uncoupled automatically.

## Series E5



## Series E6



# E5 Series “Hayabusa”

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# **3. The technology and experience of HSR in Japan**

# Characteristics of Shinkansen

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**High-speed**

Max. test speed : 225 mph  
Max. commercial speed : 200 mph

**High-density  
Large-capacity**

15 trains per hour  
1,634 (maximum)  
passengers per train

**Safe**

No. of passenger fatalities: 0 since opening in 1964  
Emergency countermeasures (earthquake, snow, heavy rainfalls, etc)

**Reliable**

Average delay:  
Less than 1 min.

**Eco-friendly**

Less CO<sup>2</sup> emissions

# Characteristics of Shinkansen

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**Comfortable**

**“Gran Class”**

**No ticket checking on board**

**Reduced**

**ticket purchasing time**

**Mobile phone Suica**

**(Contactless IC chip installed)**

**Profitable**

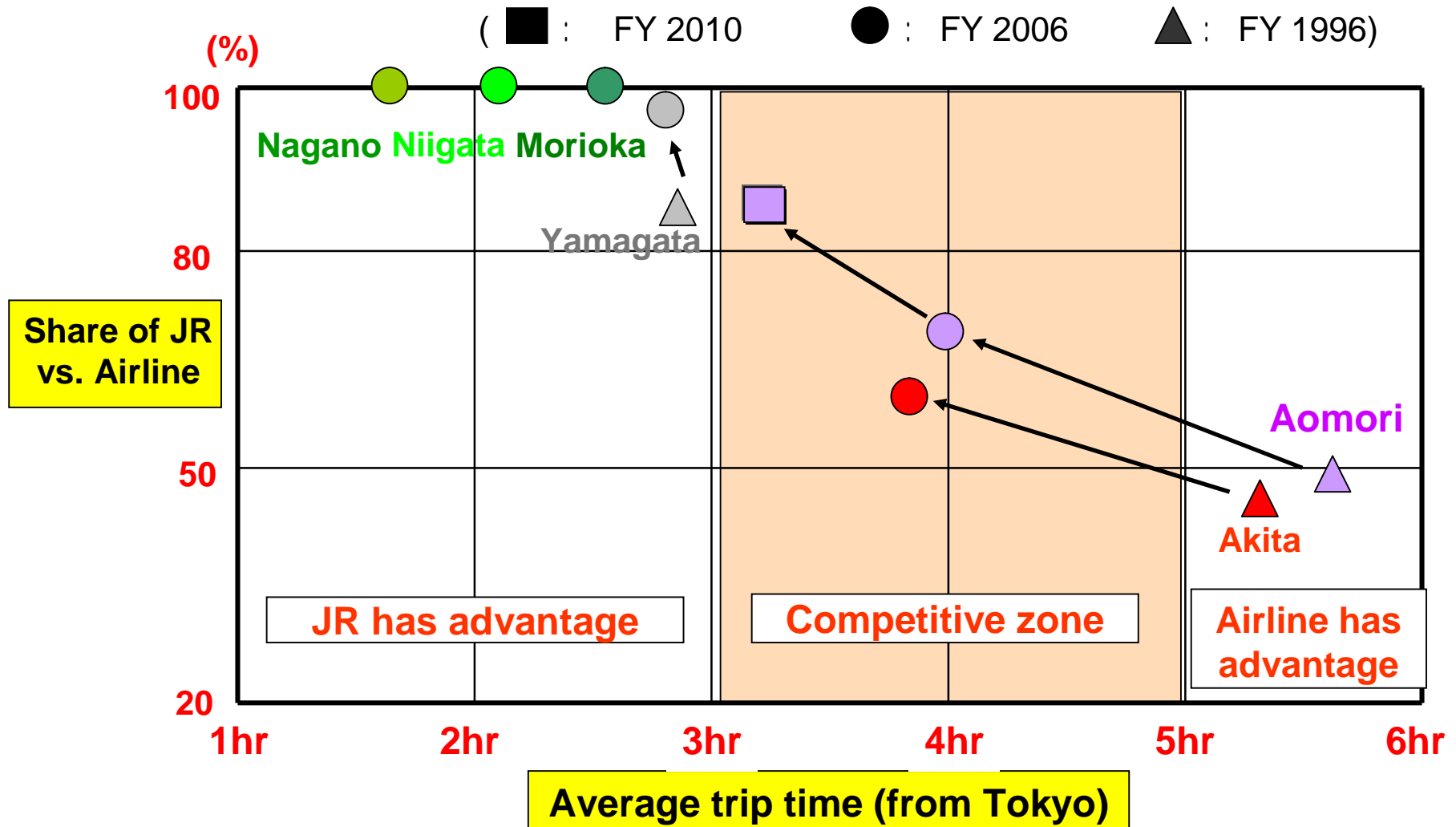
**Shinkansen Revenue**

**\$5.4 billion (Apr.2010 - Mar.2011)**

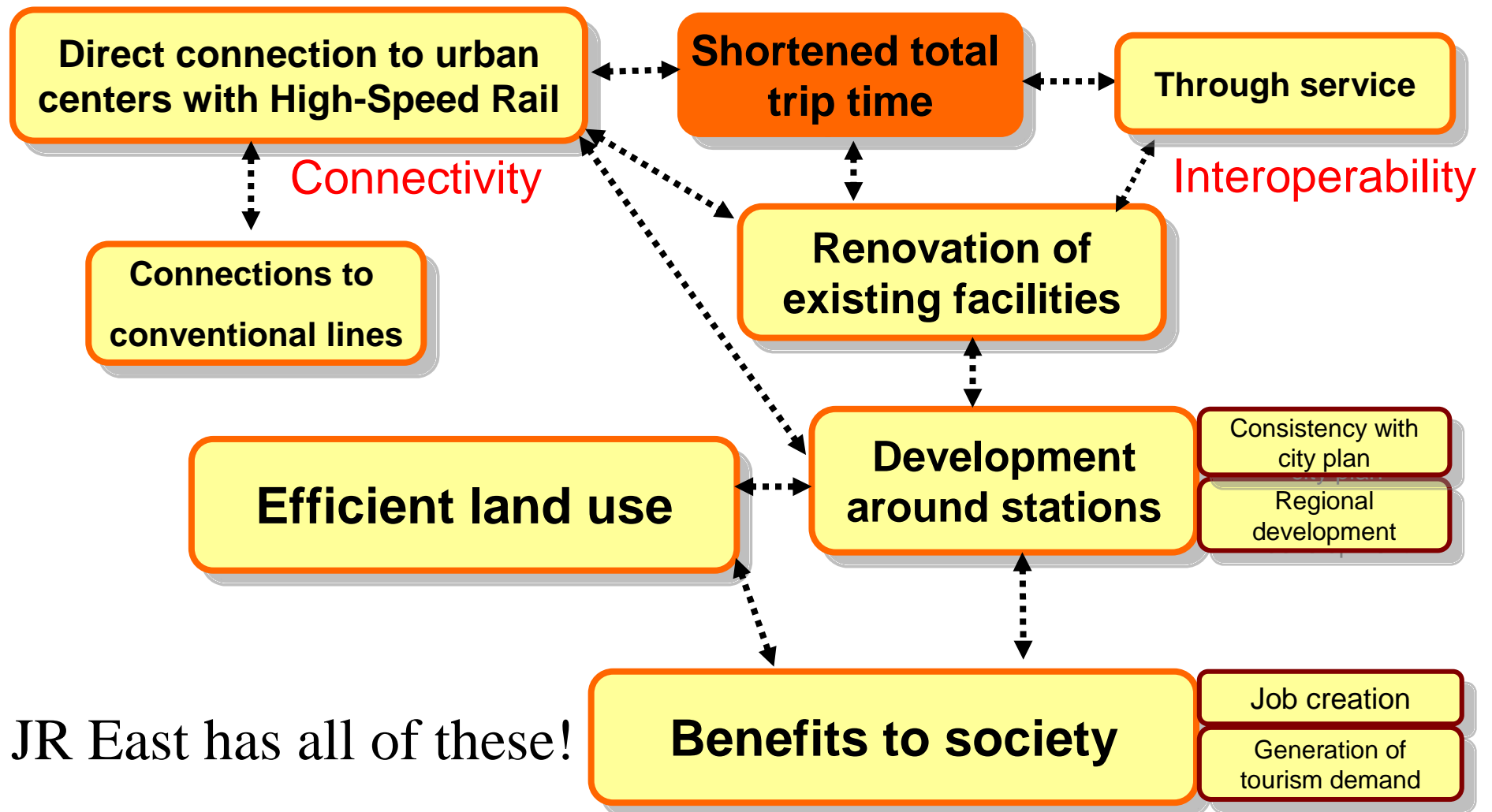
**Not subsidized**

# High speed increases ridership

## Comparison of JR and Airline Shares between Tokyo and Major Cities



# Correlation among High Speed Rail components





# Efficient land use and social benefits provided by HSR

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In Japan, Shinkansen trains carry

- 800 thousand passengers / day

**If there were no High Speed Rail,  
we would need:**

- 1) more cars: 500 thousand cars  
more highways: approximately 20 additional lanes needed
- 2) more airplanes: 1,800 jumbo jet flights per day  
more airports: 6 airports needed, each as large as Tokyo Int'l Airport



1,634 passengers per train (E4 series)



More land required



High Speed Rail provides an optimal solution, thus  
providing benefits for the whole society

# Why has HSR been successful in Japan?

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- First, of course, high-speed trains in Japan, provide passengers with **attractively shorter trip time and thus gain good ridership.**
- In addition, **features of HSR in Japan** such as safety, punctuality, ride comfort, and large-capacity **increase the ridership more.**
- Owing to these merits, the Shinkansen has won ridership by **constructing lines connecting major population centers with better connectivity to final destinations (the last mile).**
- We have built HSR from first phases to later phases step by step, so that profits obtained from the early phases can be invested in the next or future phases.

# Why has HSR been successful in Japan?

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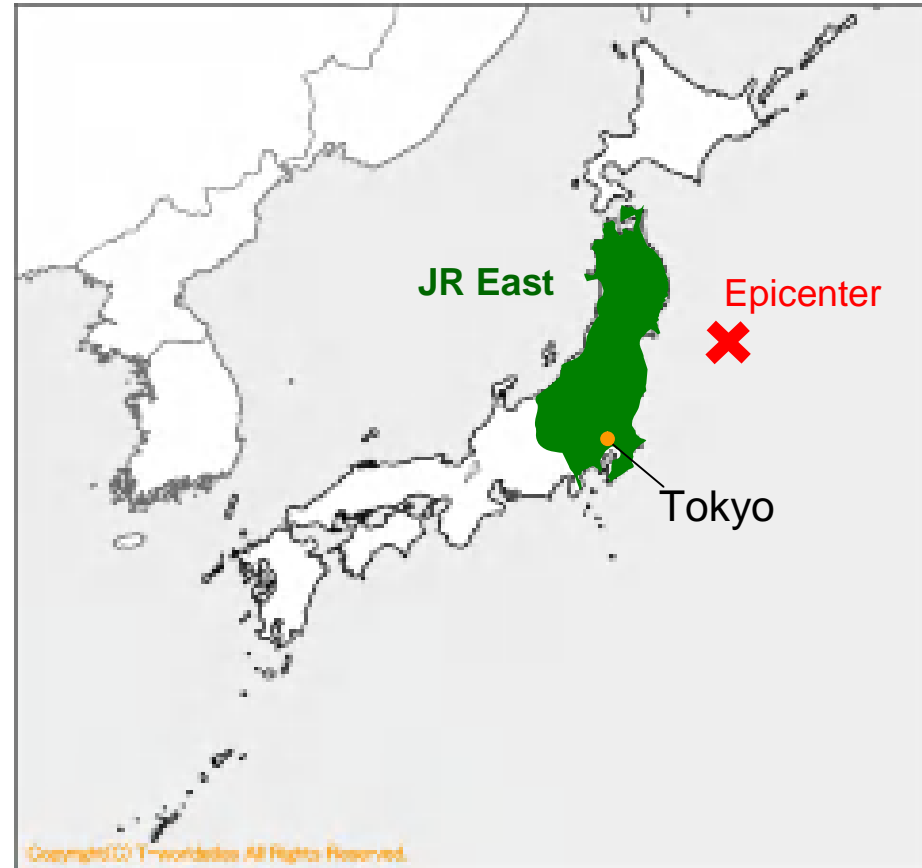
- Society has accepted the Shinkansen because of **its continuous evolution in environmental technology and in emergency countermeasures**, especially for earthquakes and other natural disasters.
- Shinkansen has been in **harmony with the planning of cities and communities, and grown together with them** (contribution and benefits to society).
- We are happy to share our experiences with the United States and contribute to the advance of railroad technology throughout the world.

# **4. The March 2011 Earthquake and our challenges**

# The March 2011 Earthquake

## Outline of East Japan Earthquake

- **Date and time of occurrence:**  
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:**  
19,553 (As of Oct. 28, 2011)  
(Resulting from earthquake,  
tsunami and fire)



# Countermeasures against earthquakes

## *Reinforced pillars*

Great Hanshin - Awaji Earthquake  
(Jan, 1995)



Highway Viaduct

Lesson



Viaducts:

Aseismic reinforcement to prevent failure

No critical destruction to major structures besides bending failure by this earthquake

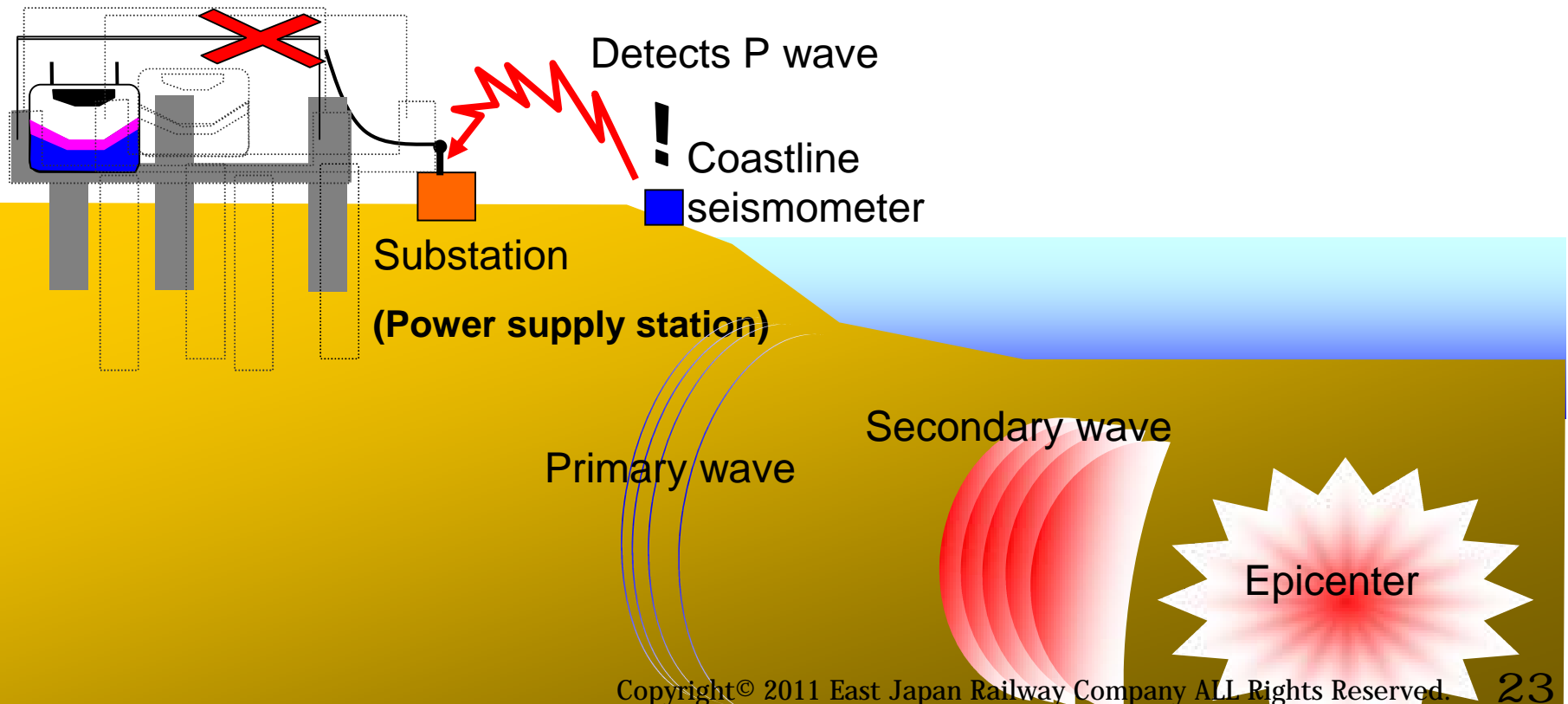
# Countermeasures against earthquakes

## ***“Early Earthquake Detection System”***

When the coastline seismometer detects a primary wave:

**Power shutdown automatically**

Emergency brakes

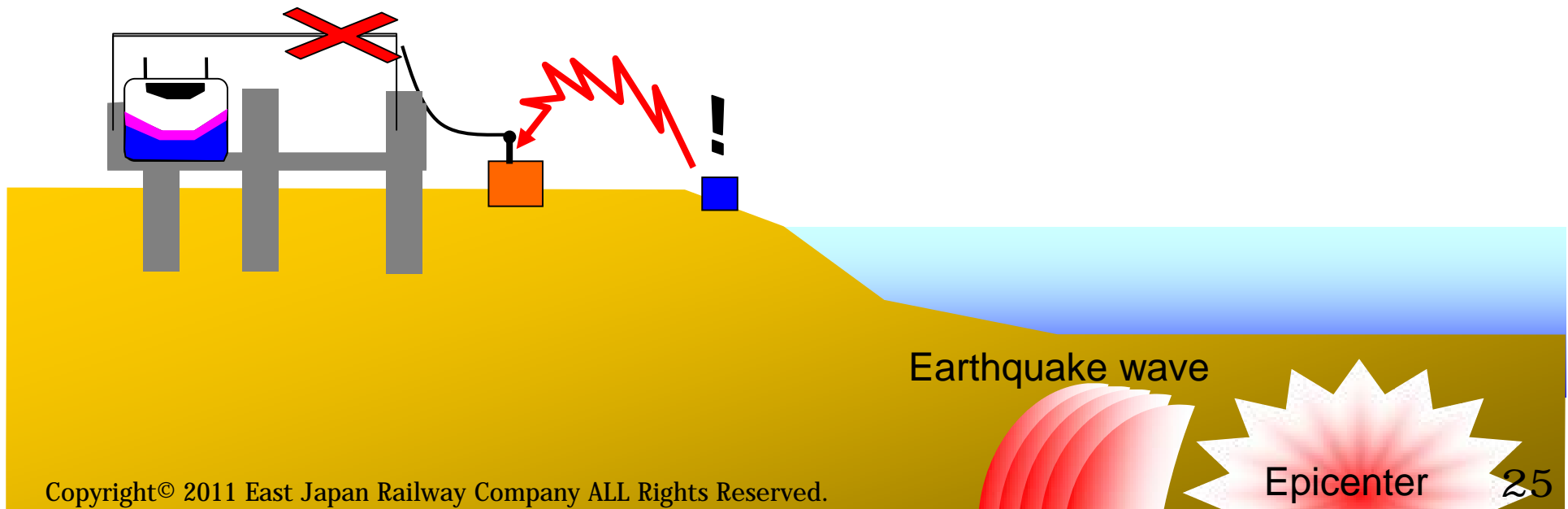






# Countermeasures against earthquakes

- Two trains running at approx. 168 mph (270 km/h) 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. By then, it is likely that the trains had slowed down to a speed of about 63 mph (100 km/h).



# Consequences of the earthquake & tsunami

- Passenger fatalities : 0
- Passenger injuries : 0

- Shinkansen (HSR)

- Aseismic reinforcement
- Early earthquake detection system

**No derailment  
of commercial trains**

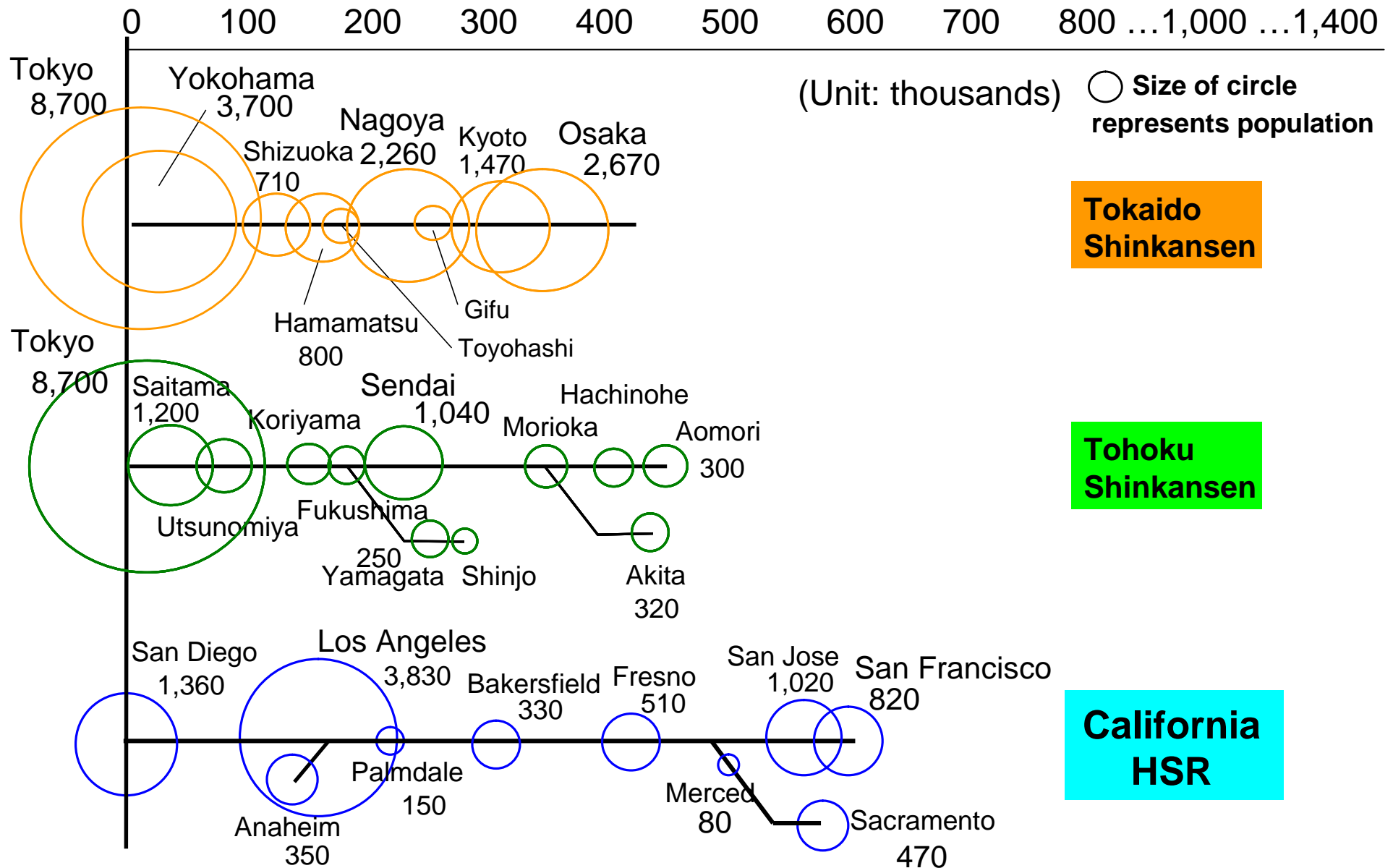
- Conventional lines

Station staff and train crews successfully led passengers to emergency evacuation areas before the tsunami hit.

## **5. Prospect for WHSRA project**

# Population distribution along HSR lines

distance (miles)



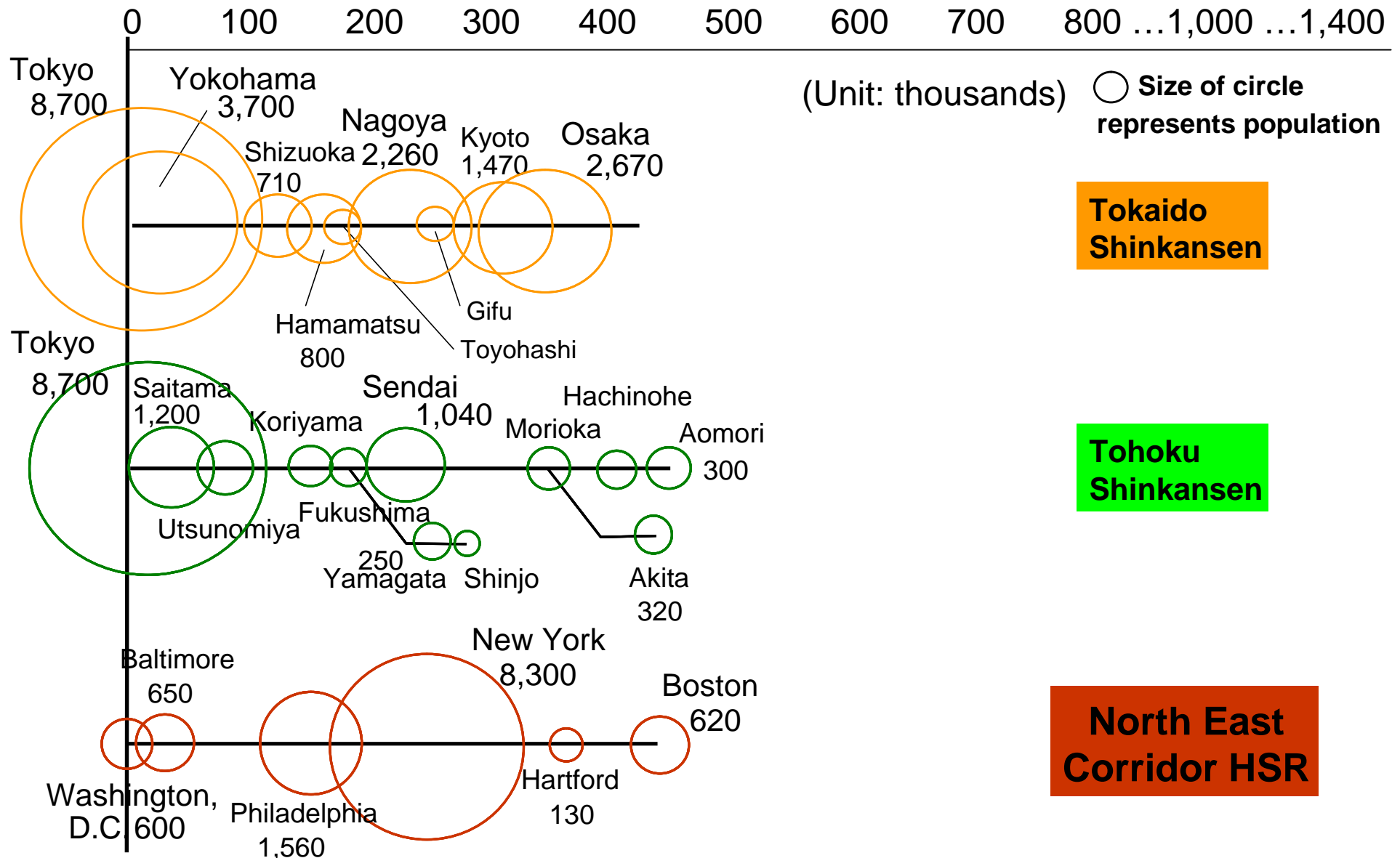
**Tokaido Shinkansen**

**Tohoku Shinkansen**

**California HSR**

# Population distribution along HSR lines

distance (miles)



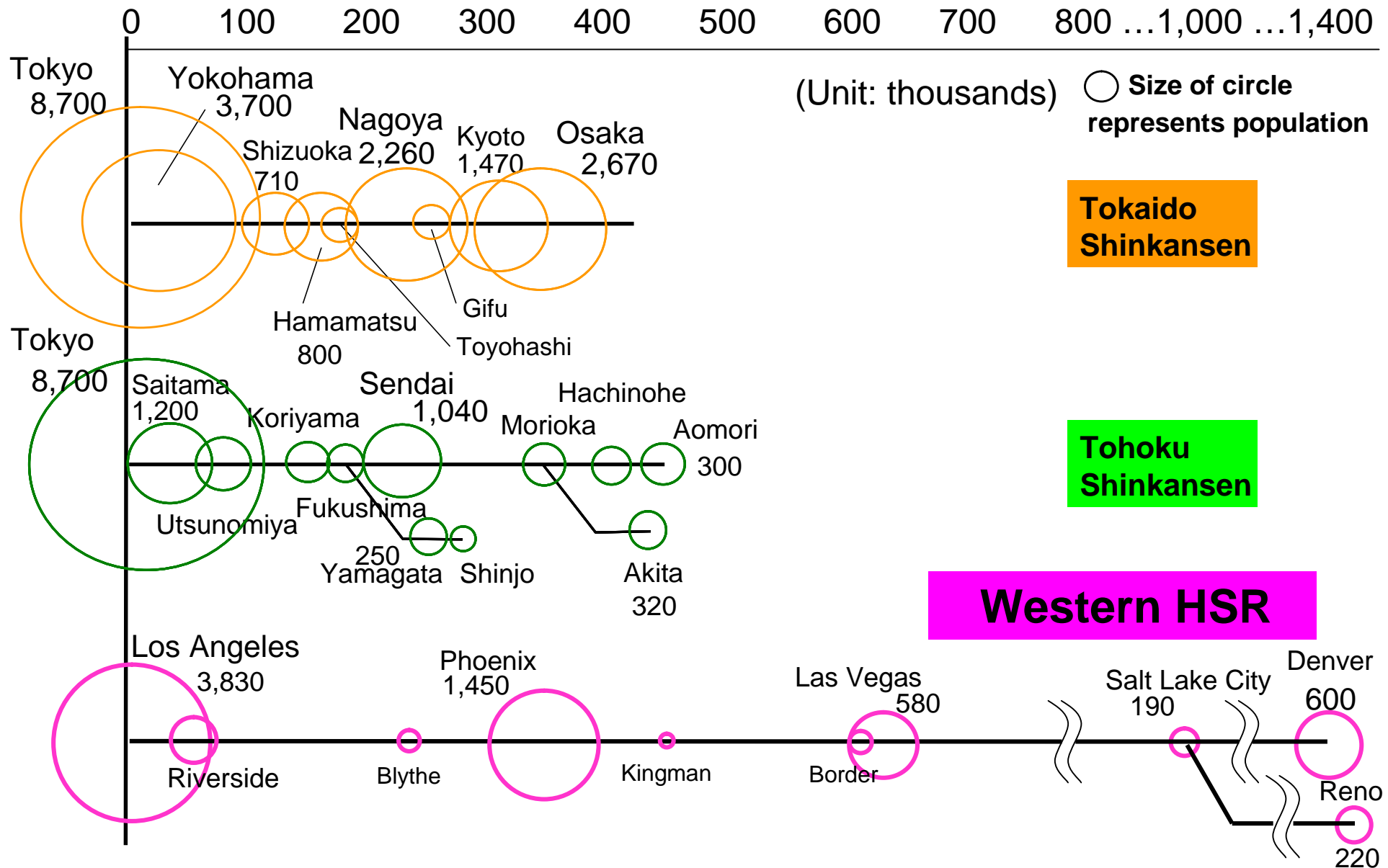
**Tokaido Shinkansen**

**Tohoku Shinkansen**

**North East Corridor HSR**

# Population distribution along HSR lines

distance (miles)



# Main points for HSR management

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In technology, the features of the Shinkansen are also feasible here in the Alliance region.

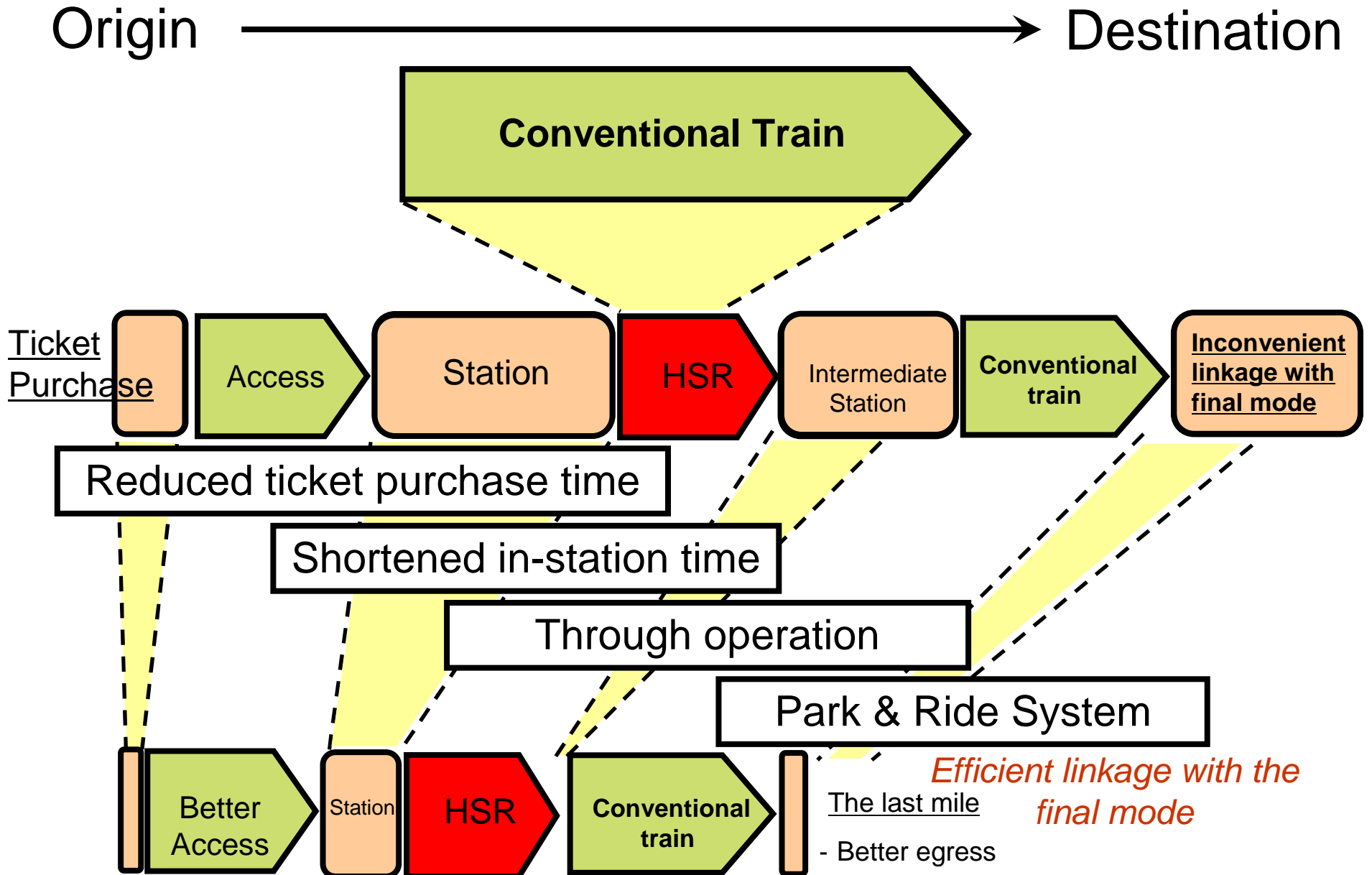
For satisfactory financial results, the following factors should be considered in both operation and maintenance.

**Shortened total trip time**

**Punctuality**

**Cost efficiency**

# Shortened total trip time





# Punctuality

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- **Safety is the top priority for HSR management**  
(JR East has kept it and will keep it)
- **Punctuality is the mother for everything**
  - 1) reliance by passengers and society
  - 2) competitiveness against other modes of transportation
  - 3) efficient operation requiring less infrastructure and rolling stock
  - 4) reduced operation cost
- In order to improve punctuality, an excellent operation plan, train schedule diagram, train control, maintenance, human resources, and so on are required.

# Cost efficiency

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Technology and experience of Shinkansen can minimize the facilities, rolling stock, personnel for operation

## OPEX: 1) Efficient Operation

Punctuality, Train schedule, Train control, Short Turn-around at station, and so on.

## 2) Efficient Maintenance

Rolling stock, Track, Overhead catenary, Signaling, and so on.

*Higher efficiency*

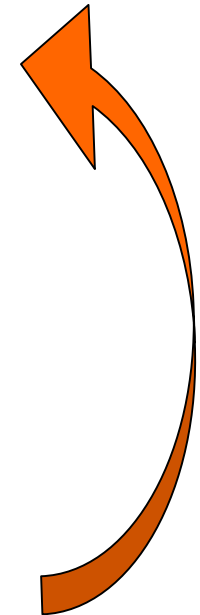


*needs only*

## CAPEX: 1) Minimum Infrastructure

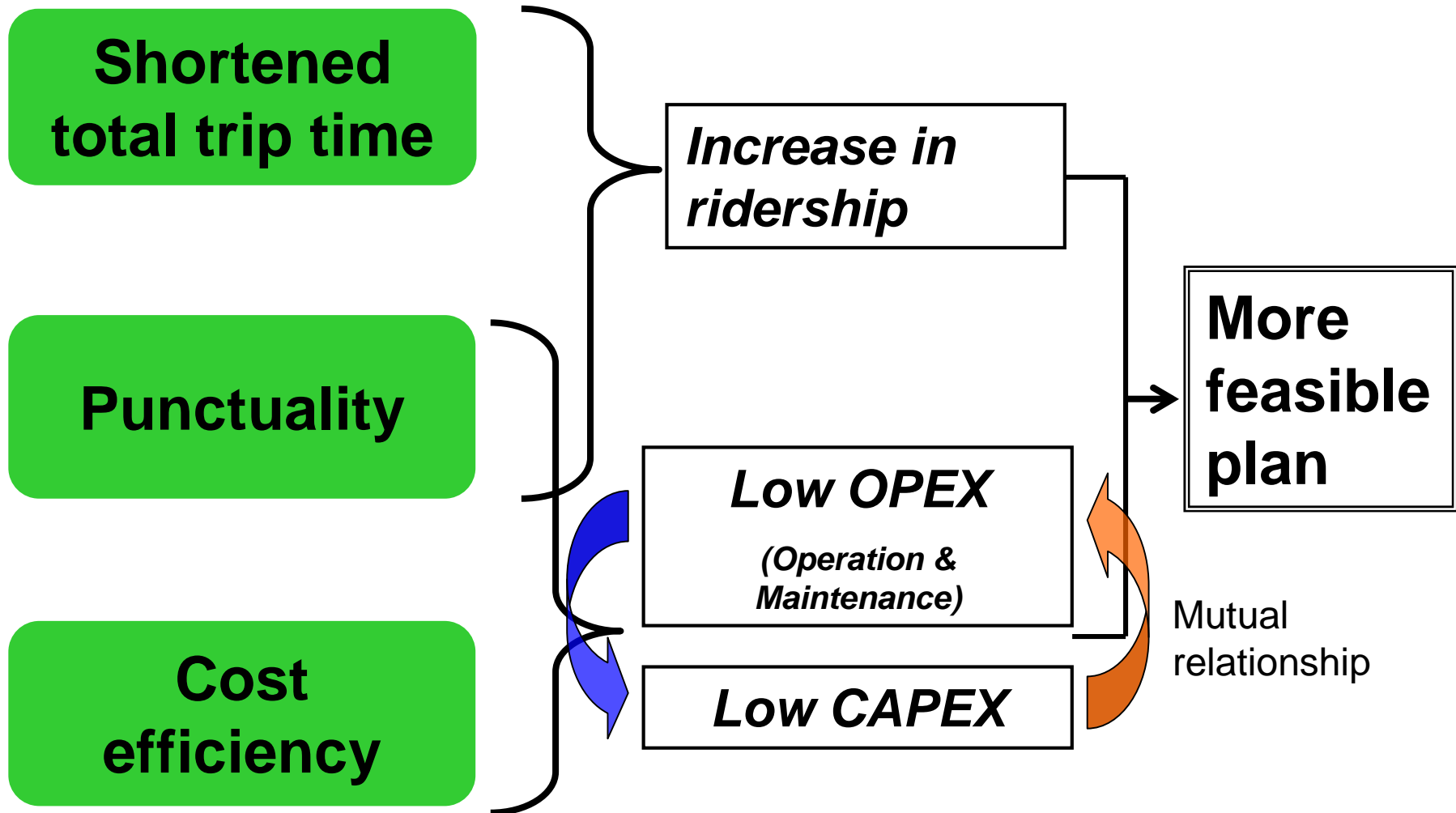
## 2) Minimum Rolling Stock

*CAPEX will be saved as well!*



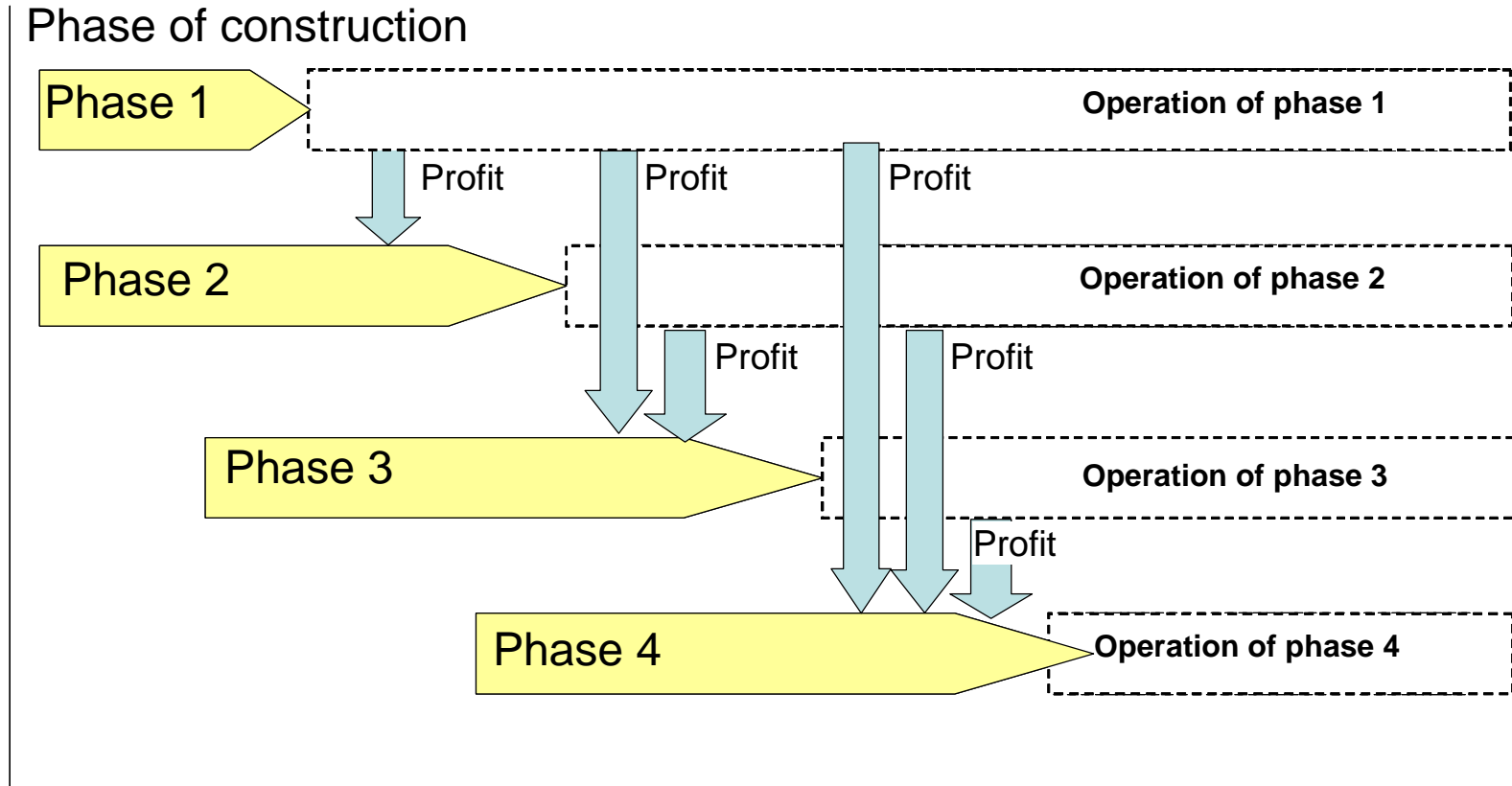
*Needs high efficiency of O&M*

# Main points for HSR management



# Phase plan

## *Construction based on an optimal phase plan*



Building HSR from first phase to another  
step by step

# 6. Conclusion

# Conclusion

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- High-speed trains in Japan provide passengers with **attractively shorter trip time, gaining financially sufficient ridership. Their features** such as safety, punctuality, comfort, large capacity and so on **increase the ridership more.**
- Society has accepted the Shinkansen because of **its continuous evolution in the environmental technology and in emergency countermeasures**, especially for earthquakes, and other natural disasters.

# Conclusion

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- The Shinkansen has been in **harmony with the planning of cities and communities, and grown together with them** (contribution and benefits to society).
- **“Shorten total trip time”**, **“Punctuality”** and **“Cost Efficiency”** are key factors for **increase in ridership and low OPEX & CAPEX**, and these can make HSR plans much more feasible.

# Conclusion

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Before the first Shinkansen plan in Japan, there were many critics against it, claiming that dedicated lines for HSR would be wasteful - even among people such as government officials and railroad professionals.

Such criticisms were;

- Railroads are a “has-been industry”, while airplanes and highways would now play major roles as transportation modes.
- Upgrading conventional lines for “higher speed railroads” would be sufficient to fit the increasing demands.
- Lack of funding and financing would be fatal.



# Conclusion

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However, if there were no Shinkansen, the first HSR in the world, the world railroad network might not be as it is today.

- Feasible plans and intelligent decisions, looking toward future operation and maintenance
- Sophisticated phase plan for construction and operation
- Reasonable funding and financing scheme
- Enthusiasm and passion for promoting the project

can lead to success of HSR

We believe that our technology and experience of HSR can contribute to HSR in the U.S.A. and WHSRA.

# Conclusion

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*You can make it happen!*

*Thank you for your attention*

