

Shinkansen's Technological Innovation and Chuo Shinkansen (SCMAGLEV)

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**Koei Tsuge,
Counsel and Director,
Central Japan Railway Company**

History of Japanese Railways

②

1872 Launch of first railway

1949 Japan National Railways(JNR)

1964 Tokaido Shinkansen opened

(Joined JNR in 1977)



1987 JNR breakup and privatization

(JR Central established in 1987)

(Became the President in 2014)

2023 Today



- “People” represent the biggest management resource
- Are employees happy to be part of this company?
 - Not just because of “wages”
 - “Sense of achievement” “Growth”
 - “Health of employees and their families”
- **“Everything” works well when “employees are satisfied”.**

Management Vision

4

Japan's Main Transportation Artery

(Development of Chuo Shinkansen)

Constant Reforms

Revenue Expansion

Railroad Business
Group Business

Cost Reduction

“Safety”

Investment
Education

“People”

Discipline
Teamwork
Employee Satisfaction

“Technology”

Research Center
Councils

Employee Turnover Rate

⑤

	JR Central	Japanese average
Male	1.0%	6.9%
Female	3.6%	10.0%
Total	1.3%	8.0%

Company Profile

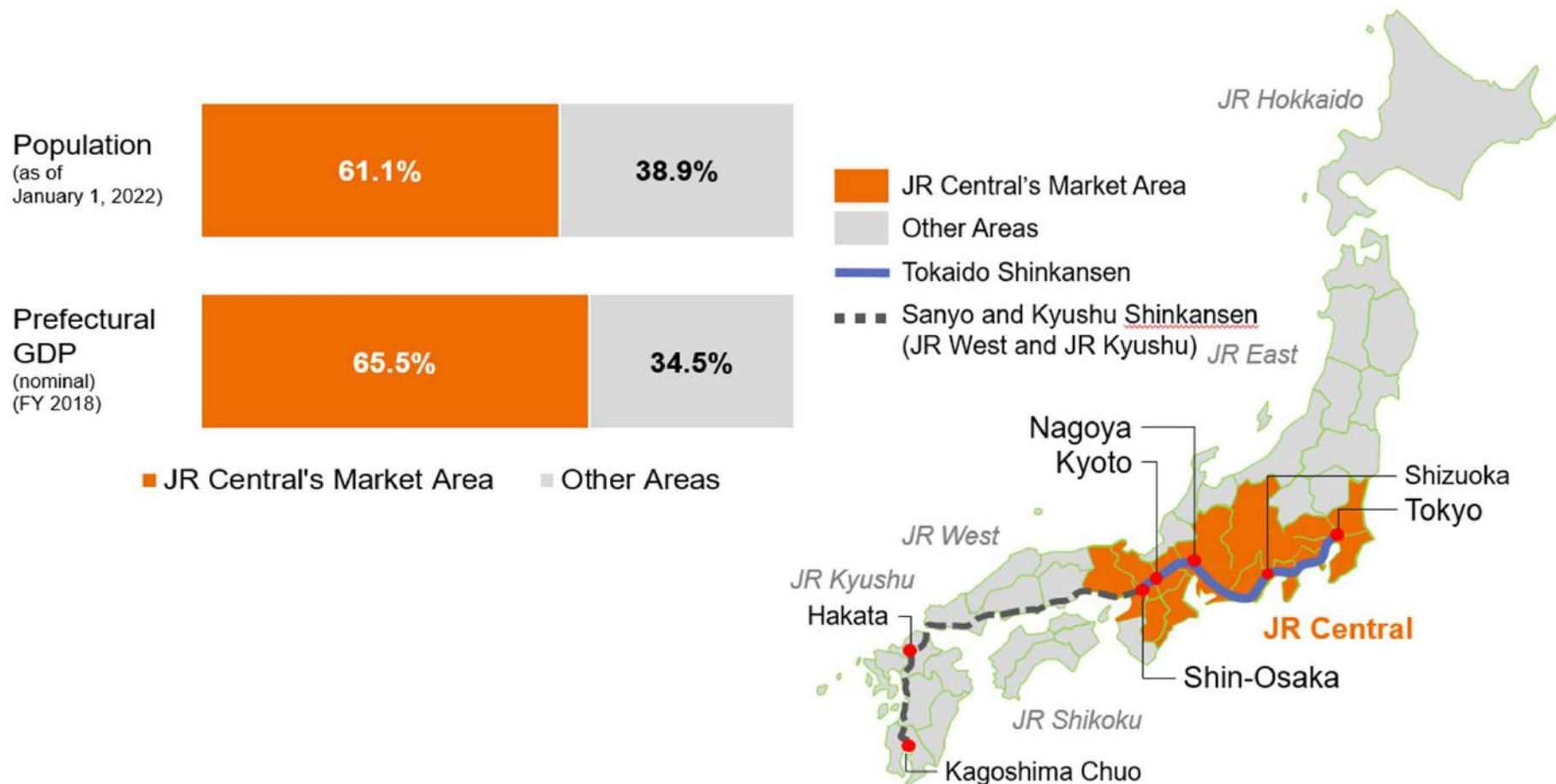
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Tokaido Shinkansen:

Main transportation artery connecting Tokyo, Nagoya and Osaka

Twelve Conventional Lines:

Intercity and local transportation covering the Nagoya and Shizuoka areas



Shinkansen's Technological Innovation



Shinkansen's Key Features

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1 Safety

No fatality of on-board passengers in any railway accident since service launch in 1964.

2 Punctuality

Average delay per service 0.9 minute

3 High speed

285km/h Tokyo – Shin-Osaka 2 hours 21 minutes



Shinkansen's Key Features

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④ High-frequency/ Mass transportation

Number of services :

FY2019

378 services / day Approx. 1,300 passengers per service

Transportation volume :

458,000 passengers / day 167 million passengers / year

⑤ Energy saving

Compared to airplanes

1/8 in energy consumption 1/12 in CO2 emission



Strengthen R&D

Structural testing field



Research building



Testing Building A



Track & structural dynamics simulator



Tri-axial loading system for structures



Testing truss bridge



Testing Building B



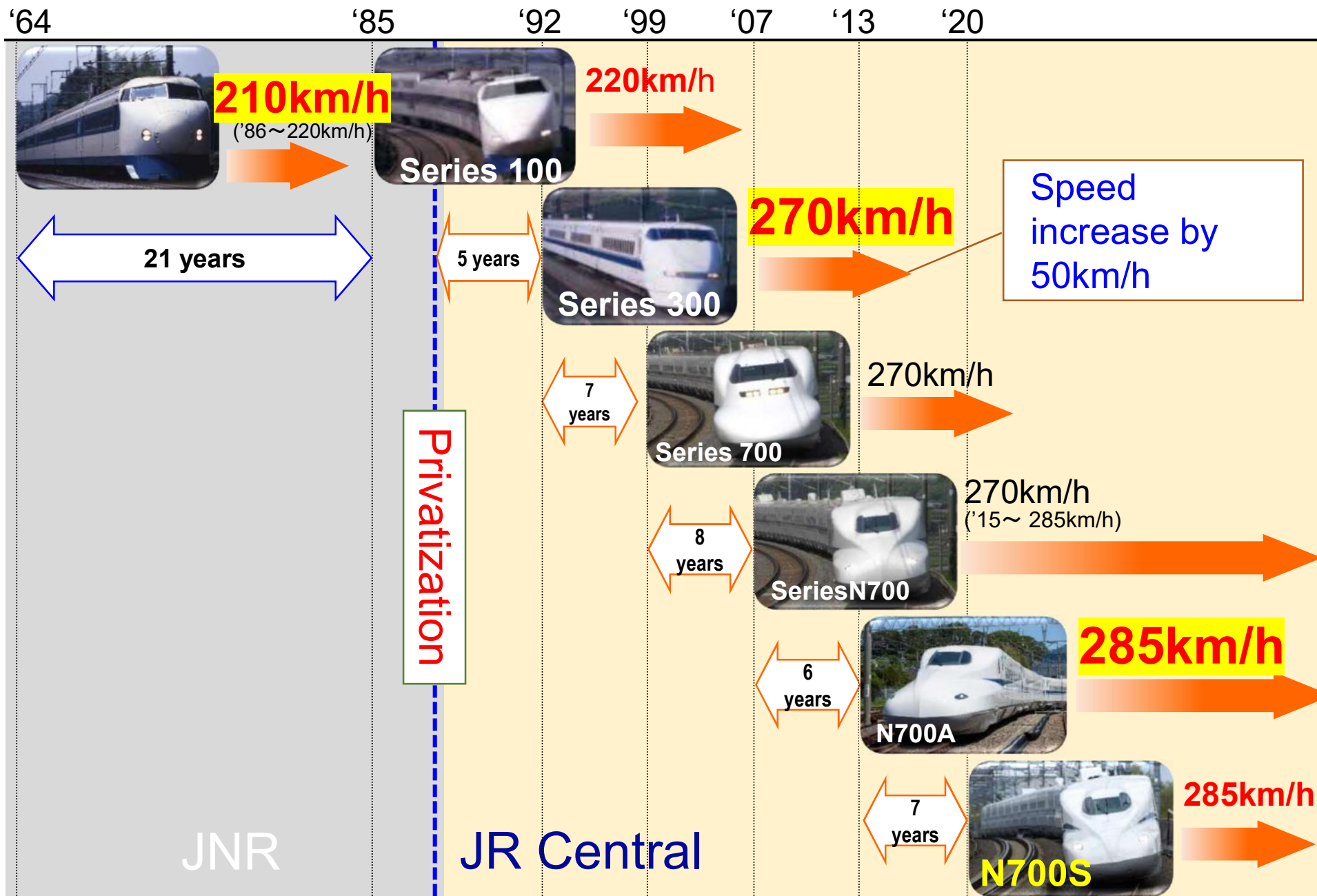
Testing Building C



Site area

Land area Approx. 73ha
Area in use Approx. 20ha

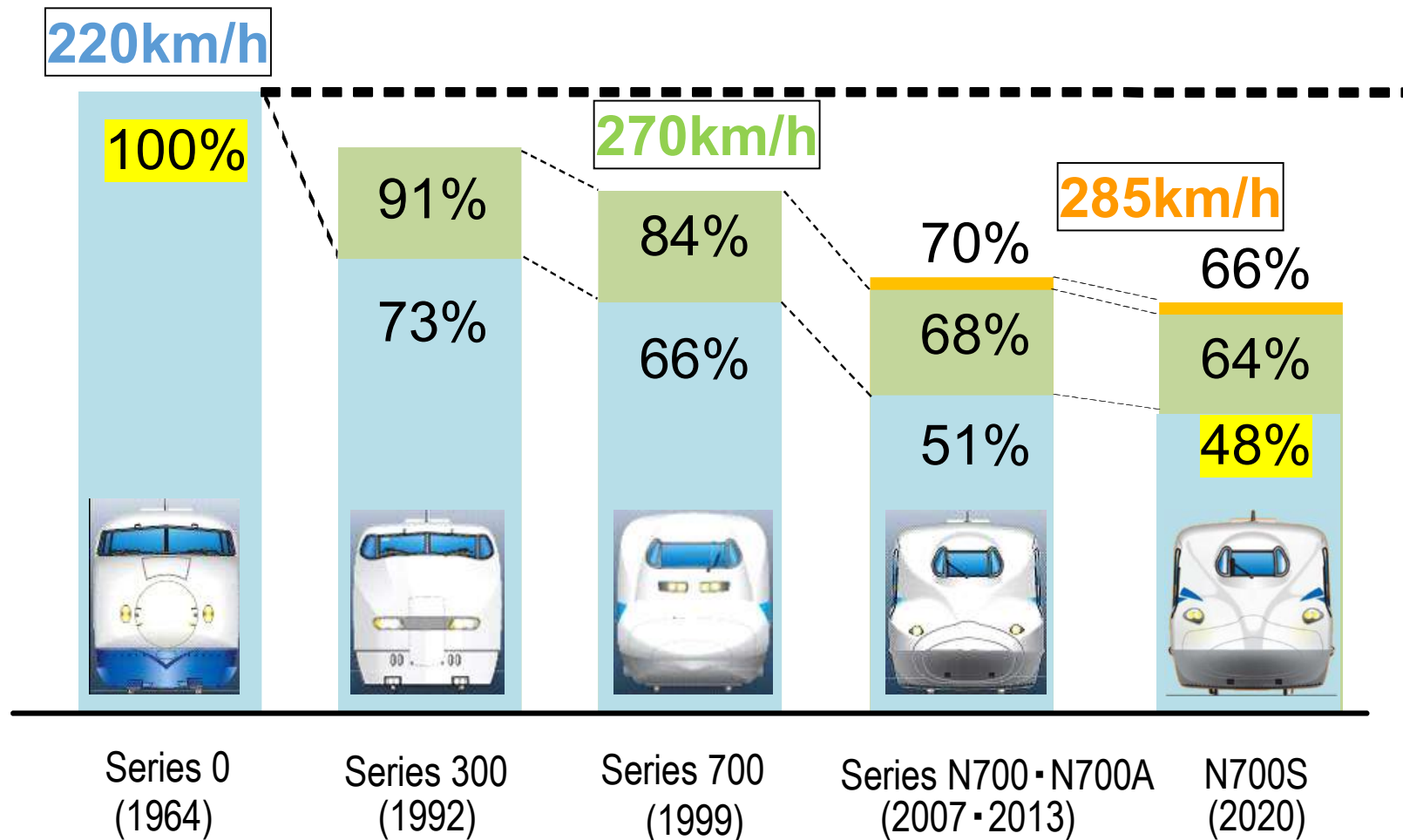
Evolving Rolling Stock



Energy Efficiency

1/8 of Airplanes' Energy Consumption

- (1) **Lightweight** (2) **Reduced air resistance** (3) **Regenerative brakes**



EX : Shinkansen Online Reservation Service

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Ticketless booking and boarding / No in-car ticket inspection

Online booking

Smartphone reservation
and booking change



Ticketless boarding



Passing the gate with an IC card

Since fall 2023~

EX-MaaS



Shinkansen



HOTEL

TAXI



Car rental

Special experiences
and priority entry plans



Over 10 million EX members

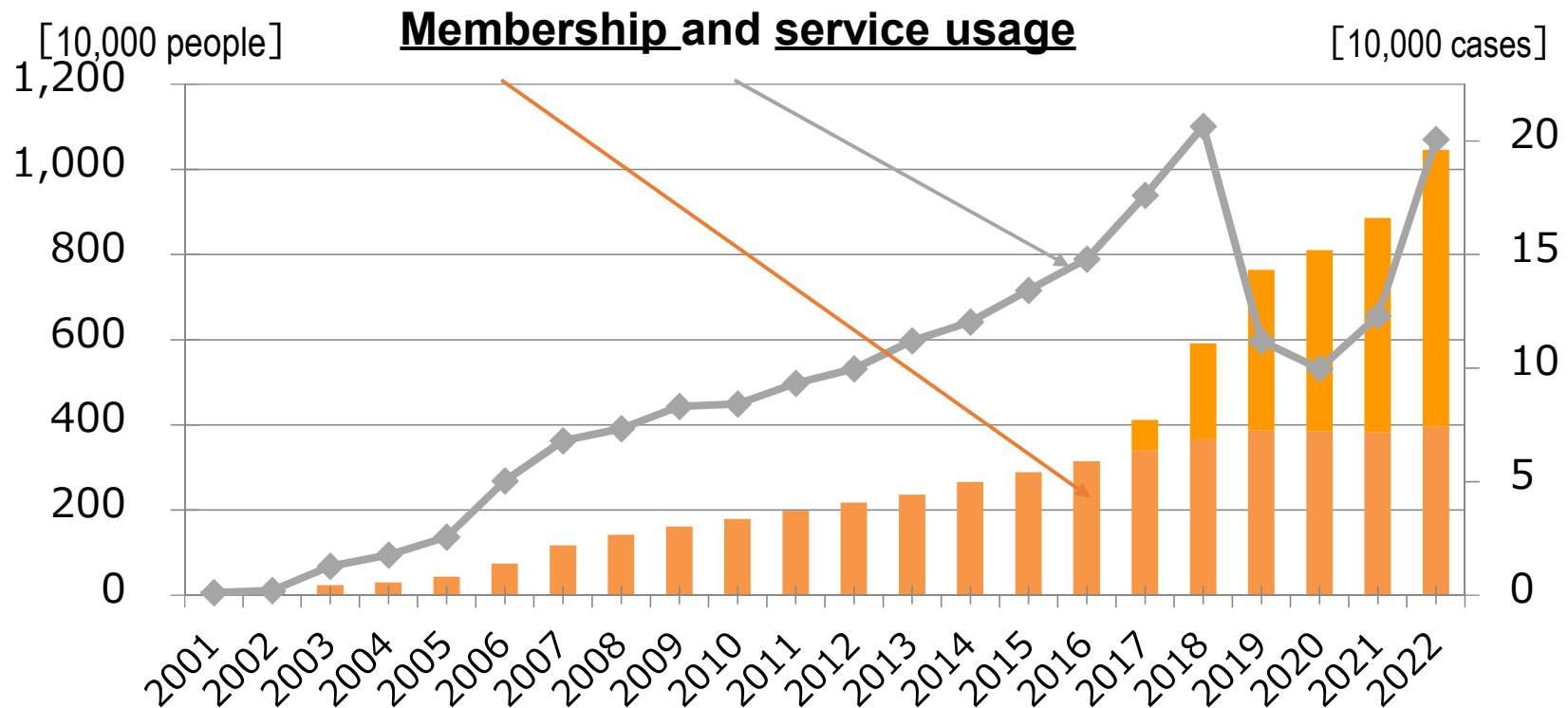
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Number of EX members

10.46 million

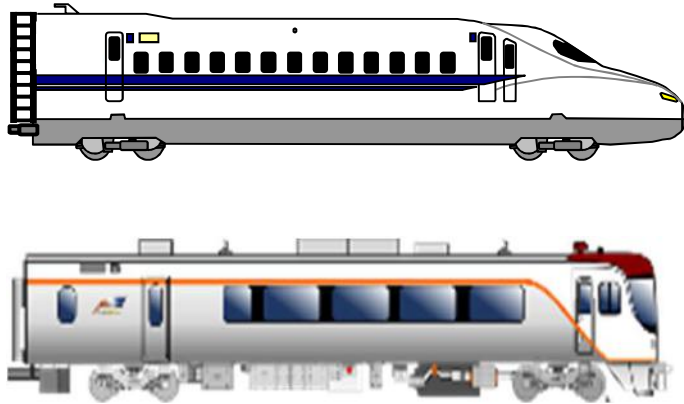
Online booking ratio

49%



Derailment prevention guards





On-board data recording

*Air conditioning, brakes, engines etc.

Rolling stock depot



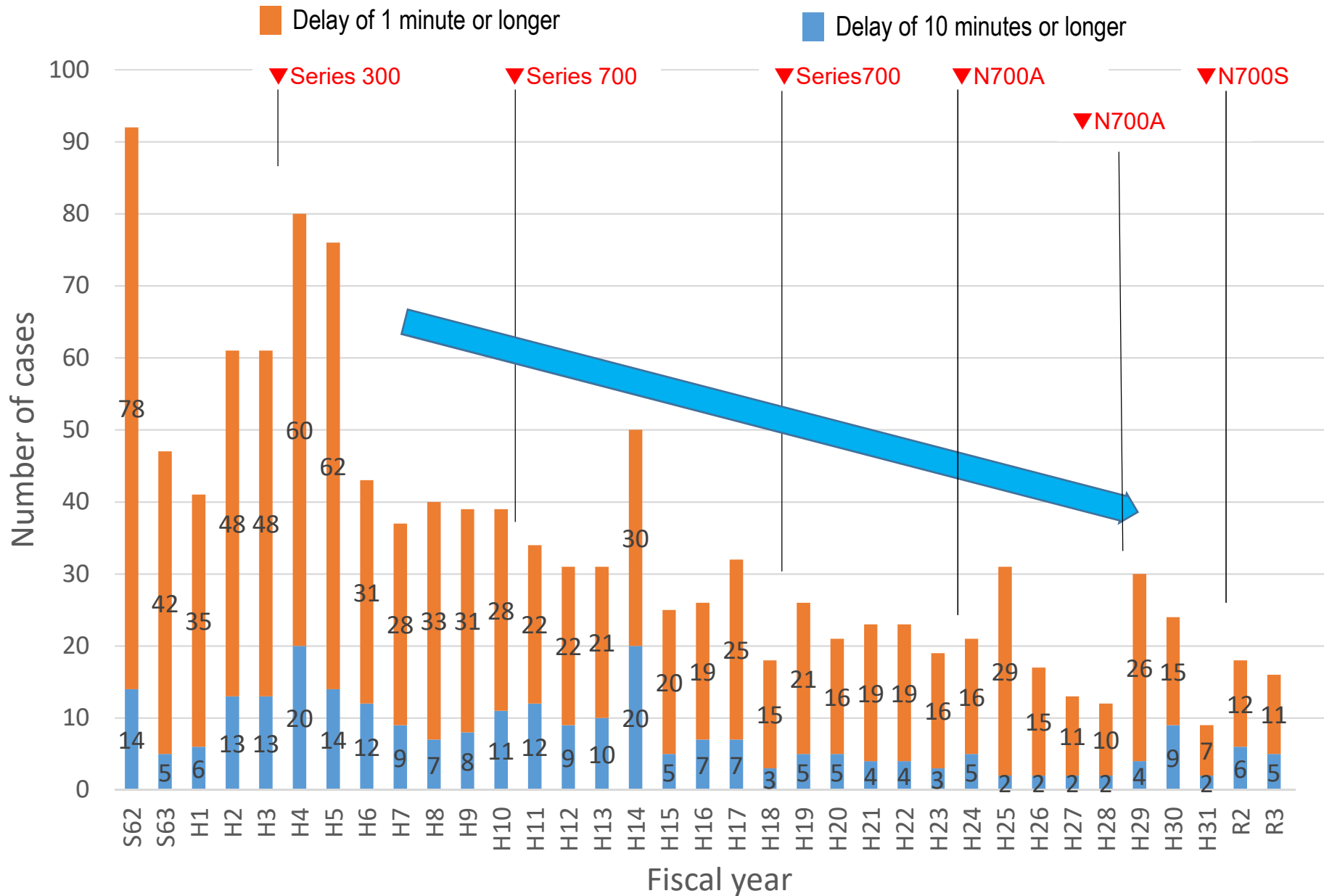
Analysis

Automatic fault detection

Before a fault leads to failure

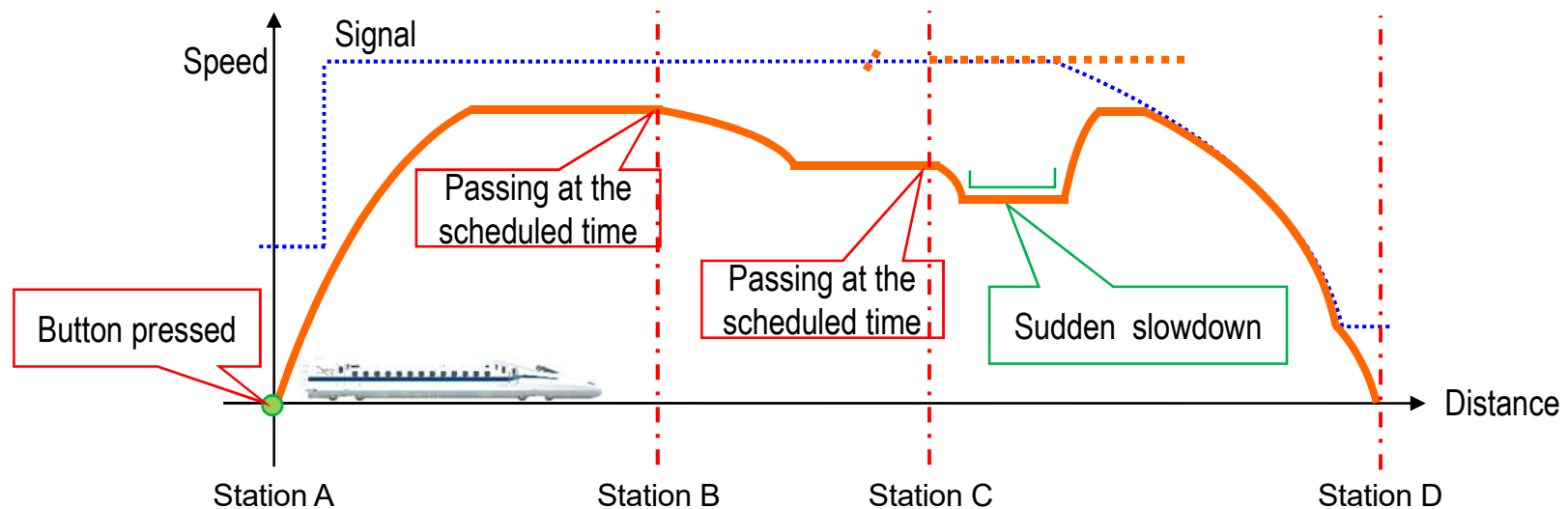
**Detect signs and apply repairs to prevent
service delay and disruption**

Number of Rolling Stock Faults



Trial self driving
between Hamamatsu Sta. and Shizuoka Sta.
(80km)

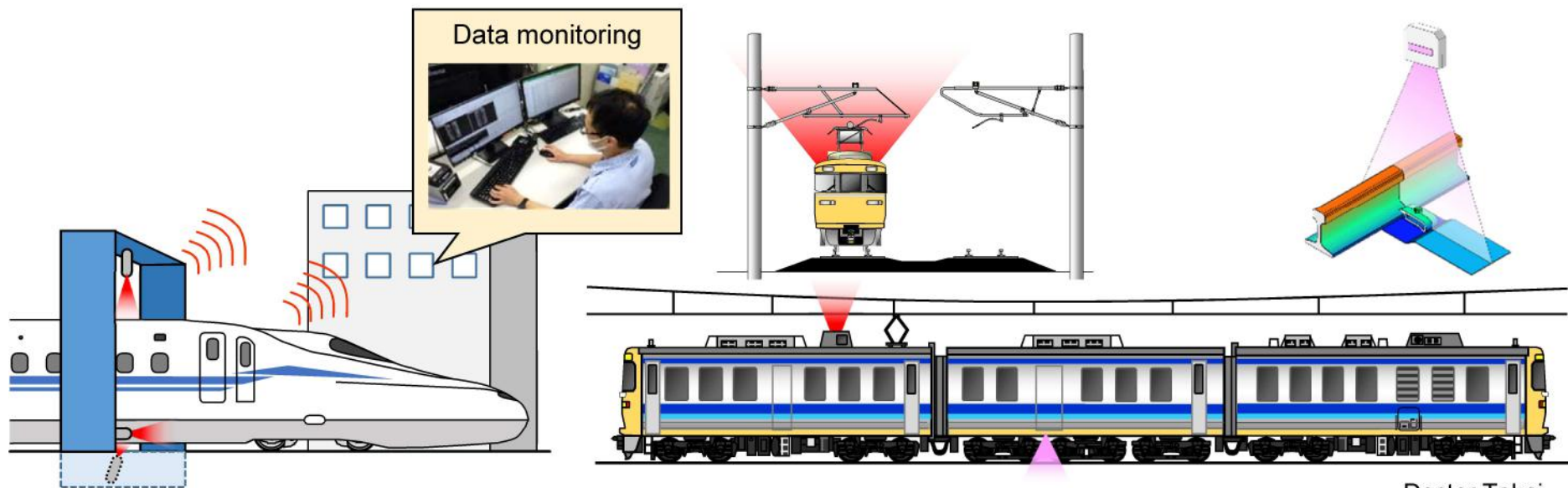
**Arriving at Shizuoka Sta. 2 seconds late
at the margin of 9mm**



⇒ Sending data on the status of rolling stock, track facilities, etc.

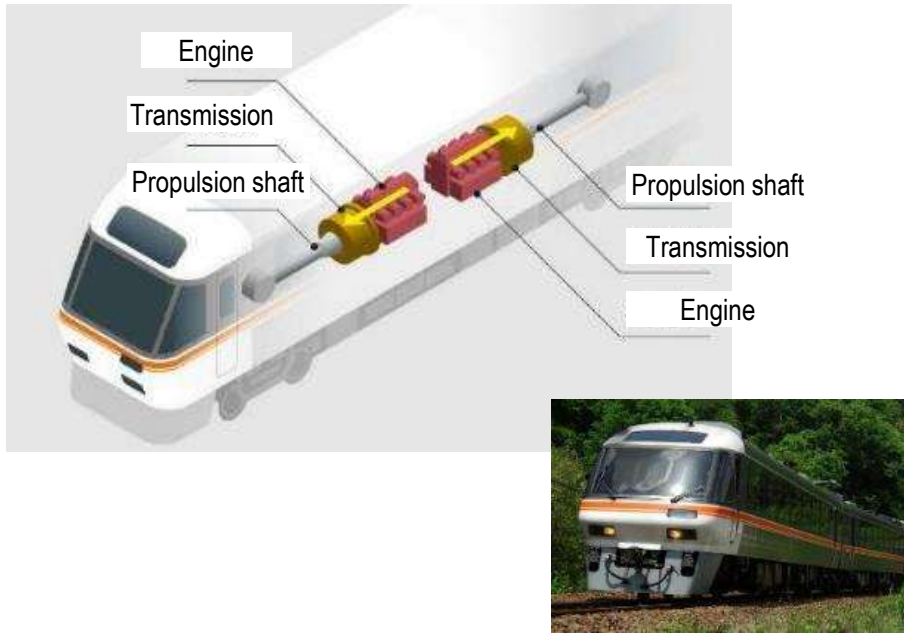
Constantly monitoring the data to apply repair work before failure

⇒ Reducing faults and service delays



Hybrid Limited Express

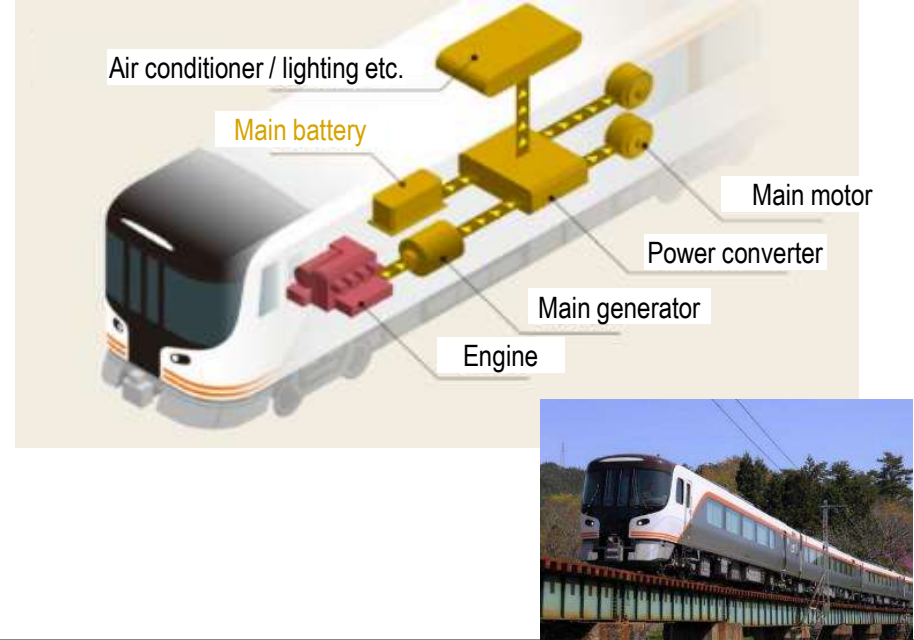
Previous models
(2 engines)



- Driving wheels with two engines

Series HC85

(One engine + Main battery)



- Driving wheels with electricity generated with the engine and with battery power

Reducing CO2 by 30% and NOx by 40%

Series HC85 Popular among Foreign Tourists (21)

◆ Green Car



Passengers' car



Deck

◆ Regular car



◆ Deck

Decorated with traditional art craft





Chuo Shinkansen (SCMAGLEV)



Movie ① (Approx.1min.)

SC Maglev Movie

Integrally Manages Two High-Speed Rail Lines 23



	Operating speed	Time required (fastest) / Distance	
		Tokyo - Nagoya	Tokyo - Osaka
Chuo Shinkansen (SCMAGLEV)	500 km/h	40 minutes 286 km	1 hour 7 minutes 438 km
Tokaido Shinkansen	285 km/h	1 hour 26 minutes 342 km	2 hours 21 minutes 515 km

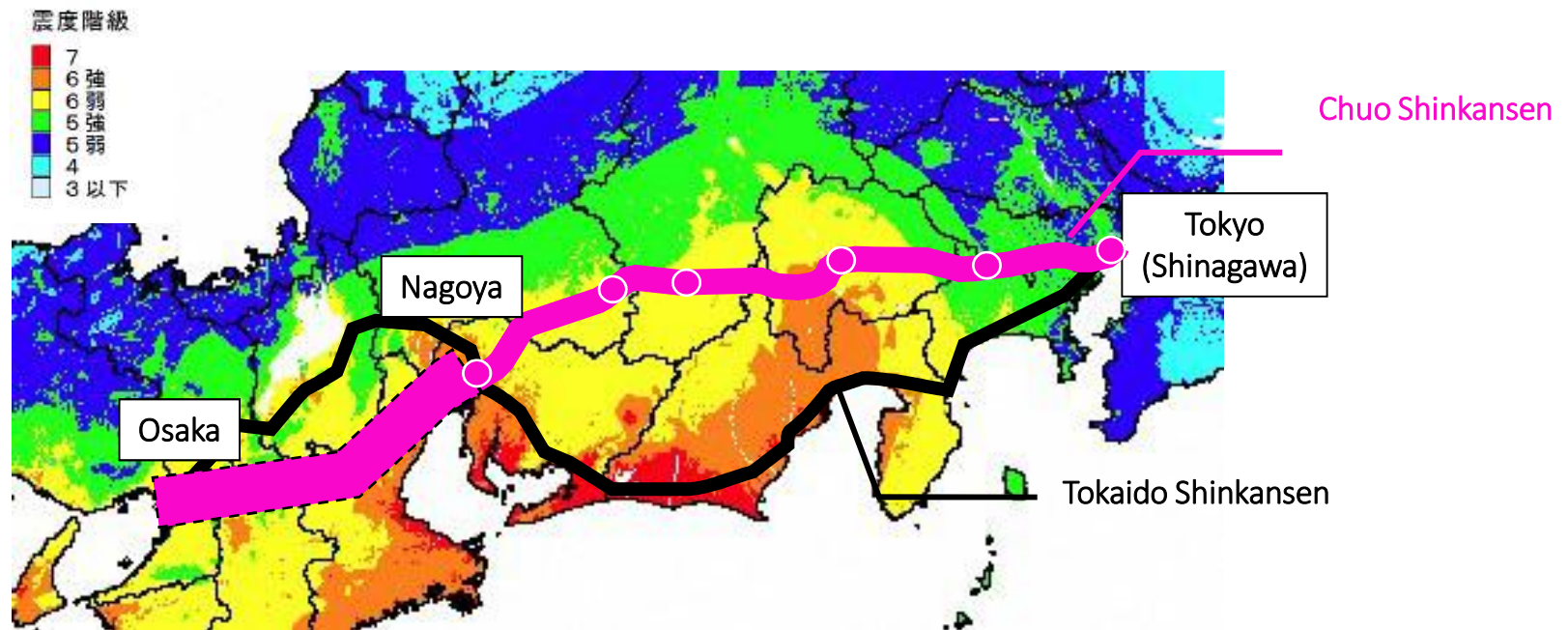
- Construction of Chuo Shinkansen (SCMAGLEV) began in 2014.
- Cost of construction (Tokyo – Nagoya) will total approx. 7 trillion yen(\$5.4bn), all to be paid by JRC.
- JR Central integrally manages the two Shinkansen lines connecting Tokyo, Nagoya and Osaka

Objectives of Chuo Shinkansen

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Redundancy for major transportation artery

- 1 Aging Tokaido Shinkansen
 - 2 Preparedness for Nankai Trough Earthquake
- } Redundancy (bypass)



Anticipated hypo central region of Nankai Trough Megaquake and distribution of maximum seismic intensities

Chuo Shinkansen Route

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1. Terminal stations

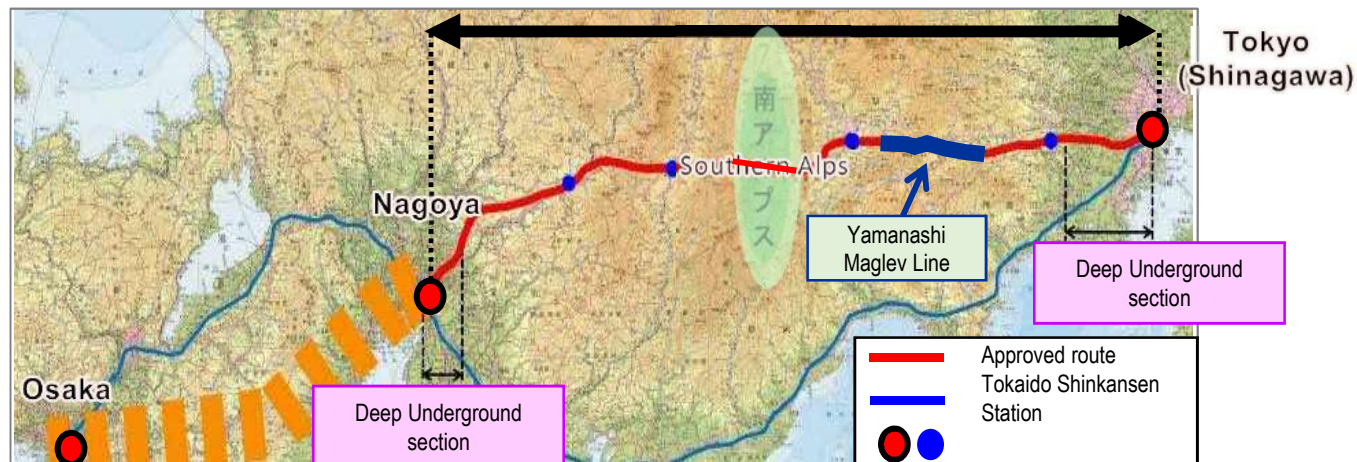
- Shinagawa Station and Nagoya Station

2. Route

- The Yamanashi Maglev Line will be used to extends
- Minimum curve radius 8,000m / Maximum Grade 4%

3. Intermediate stations

- Station each in Four Prefectures along the route



2011

- Minister of Land, Infrastructure, Transport and Tourism (MLIT) issues instructions to construct the Chuo Shinkansen
- Process initiated for Environmental Impact Statement (EIS)

2014

- Final EIS issued
- MLIT approves Civil Engineering Work Implementation Plan
- Construction begins

2018

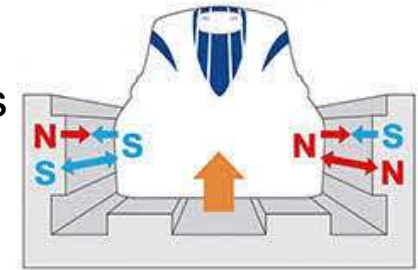
- MLIT approves Electrical Work Implementation Plan



The World's First Superconducting Maglev System ②7

Superconducting Maglev

- Using magnetic force acting between superconducting magnets on vehicle and coils on ground facilities
- Levitate by around **10cm** to achieve ultra high-speed train operations (**500km/h**)



History

- 1962 JNR commencing research on SCMAGLEV technology
- 1964 Tokaido Shinkansen launched
-
- 1987 JR Central established,
commencing SCMAGLEV development for commercial
implementation
- 1997 Running tests on the Yamanashi Maglev Line commenced
- 2009 Technologies required for commercial service established**
- 2015 Record speed of 603km/h achieved in manned operation
(The Guinness World Records)

Movie ② (Approx.5min.)

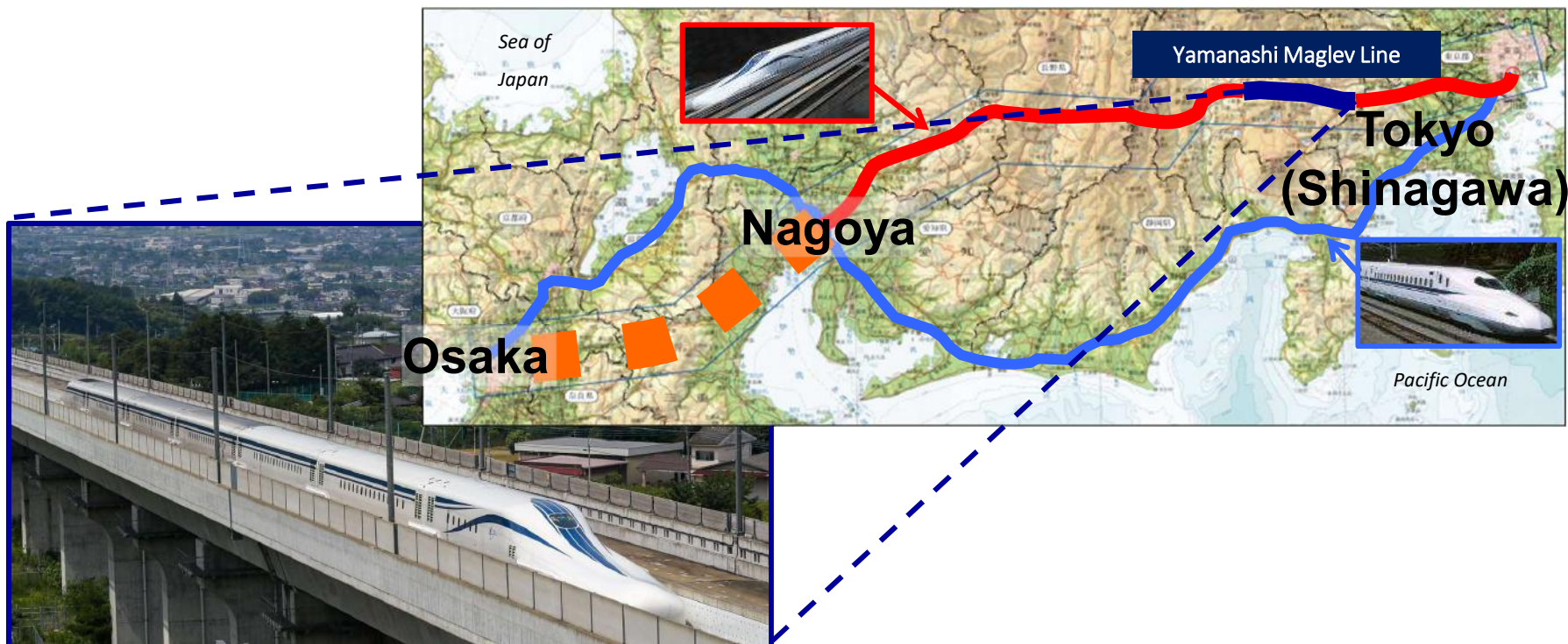
SCMAGLEV Technology

Yamanashi Maglev Line

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- Total length: 42.8 km
1/7th of the distance between Tokyo and Nagoya.
- Cumulative distance travelled and passengers carried since 1997
approx. 4,260,000 km (equivalent to 106 laps around the earth)
approx. 320,000 people

(As of January 31, 2023)



Movie ③ (1min. 27sec.)

Yamanashi Test Line

History of Vehicles and Public Rides 29

- Running along Yamanashi Maglev Line continue as the maglev vehicles are improved.
- Rides are offered to the public on the latest maglev vehicles to build expectations for the Chuo Shinkansen



History of Yamanashi Maglev Line Vehicles



MLX01-1



MLX01-1-901



Series L0



Improved version
of Series L0

Rides Offered to U.S. VIPs

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- U.S. Secretaries of Transportation, Ambassadors to Japan, Governors, and College students enjoyed rides.

Jul 2005 Ambassador Thomas Schieffer

May 2010 Secretary of Transportation Ray LaHood

Sep 2010 Ambassador John Roos

Sep 2013 Deputy Secretary of Transportation John Porcari

Apr 2014 Ambassador Caroline Kennedy

Jun 2015 Governor of Maryland Larry Hogan

Nov 2015 Secretary of Transportation Anthony Foxx

Jan 2018 Ambassador William Hagerty



Governor of Maryland Larry Hogan



Ambassador William Hagerty and his family

Movie ④ (2min. 30sec.)

Voice

SCMAGLEV Features

- SCMAGLEV high-speed and capacity may prompt travelers to switch away from aircraft, opening slots at busy airports for international flights.
- SCMAGLEV CO2 emissions per seat are **approx. 1/3rd** those of aircraft.

	Number of seats	Trains per hour Average per day	Passenger capacity (Seats × average trains per day)
Completion to Osaka	Approx. 1,000 seats (16 cars/trainset)	8 trains per hour 260 trains per day	Approx. 260,000 seats per day (Equivalent to approx. 700 aircraft flights)

*Source: Investigative Report on Chuo-Shinkansen (Tokyo-Osaka) (24/12/2009)
Conversion of transportation capacity to aircraft is based on B777(382 seats)



Construction Status



Progress of Main Construction Projects (Tokyo - Shizuoka)

(Guide) ■ : Full-scale construction commenced ■ : Contract signed

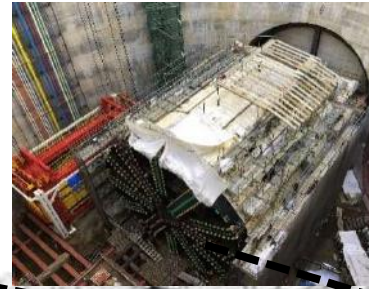
Southern Alps Tunnel (Yamanashi)



Kanagawa Prefecture Station (tentative name)



Metropolitan Area Tunnel No.1 (Kajigaya)



Shinagawa Station



North construction area: (JRE side)



Viaduct in Yamanashi



Metropolitan Area Tunnel No.1 (Kita-Shinagawa)

■ Construction contracts signed: **approx. 90% ※** ■ Land acquisition rate: **approx. 60%**

*Ratio against the total length between Shinagawa and Nagoya (286km)

Progress of Main Construction Projects (Nagano - Aichi)

(Guide)

■ : Full-scale construction commenced

■ : Contract signed



■ Construction contracts signed: **approx. 90%** ✖ ■ Land acquisition rate: **approx. 60%**

*Ratio against the total length between Shinagawa and Nagoya (286km)

Station Construction

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Tunnel Construction

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Changing Future of Japan

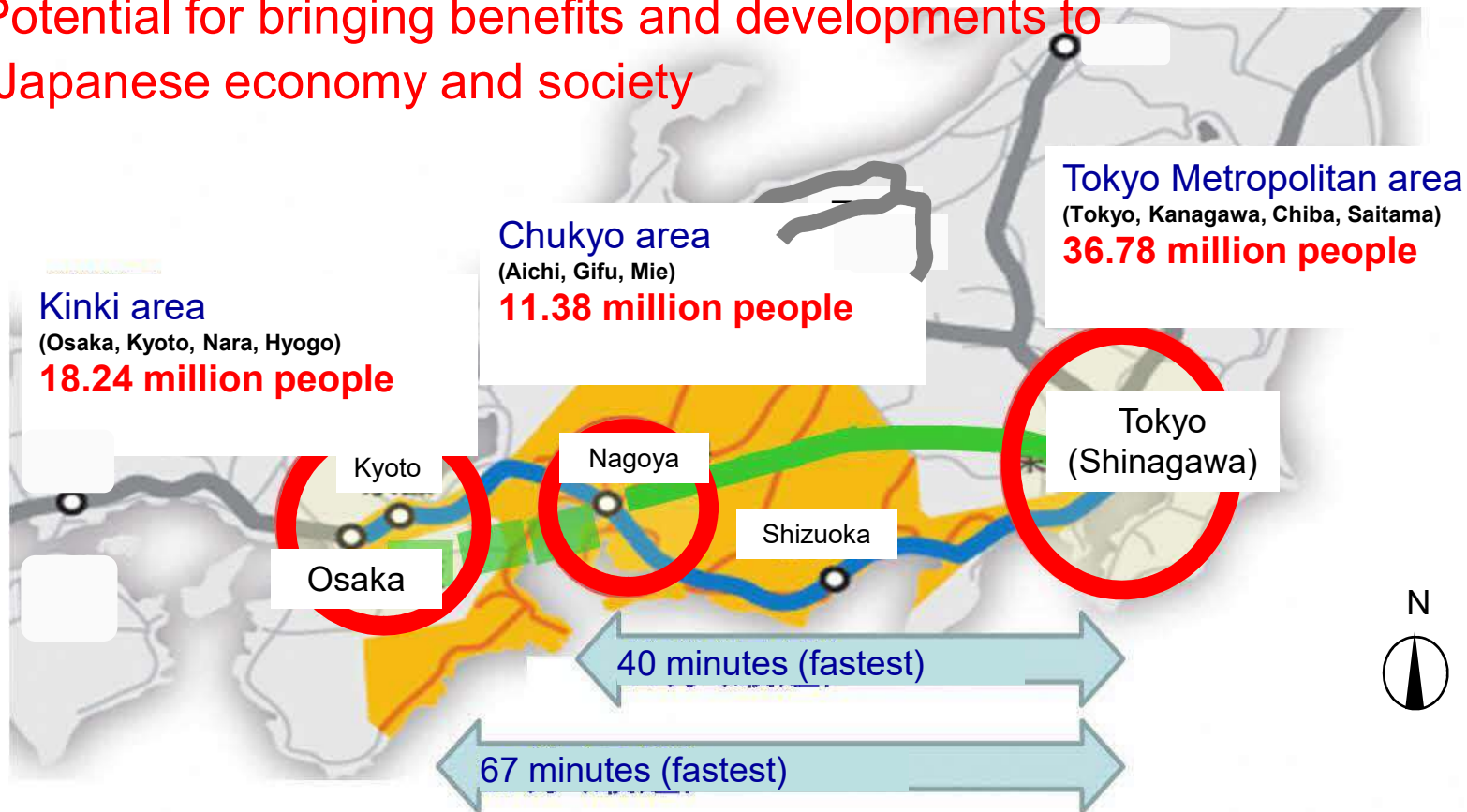


Effect of Chuo Shinkansen

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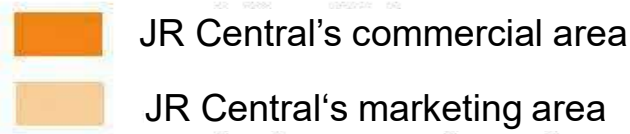
Linking Tokyo – Nagoya – Osaka in one hour
to create the world's largest Mega Regions home to 66 million people,
more than half of Japan's total population

⇒ **Potential for bringing benefits and developments to
Japanese economy and society**



*The population figures are based on the Basic Resident Register of the Ministry of Internal Affairs and Communications in 2021

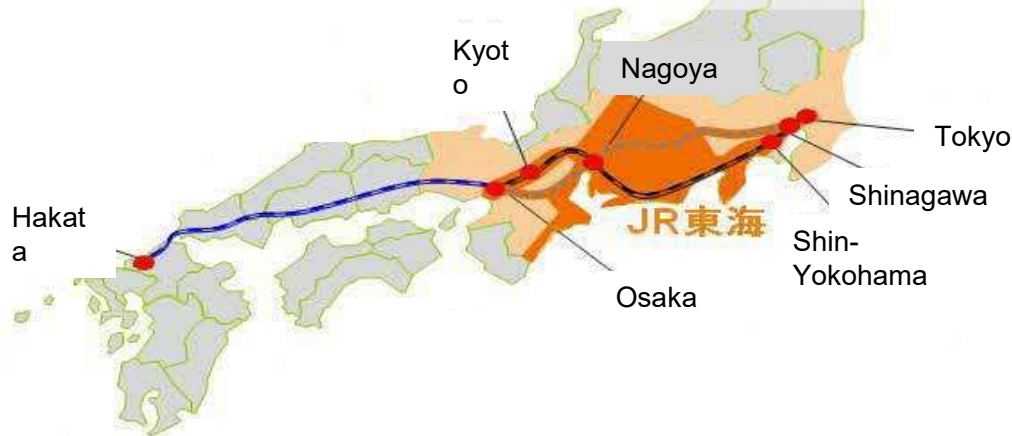
Power of the Mega Region



Area approx. 24%
Population approx. 60%
GDP approx. 66%
 (JR Central Fact Sheet 2022)

GDP: ¥187 trillion (Tokyo Metropolitan) + ¥76 trillion(Kansai)
 + ¥57 trillion (Chubu)
 = **approx. ¥320 trillion**

> France's GDP (approx. ¥299 trillion)

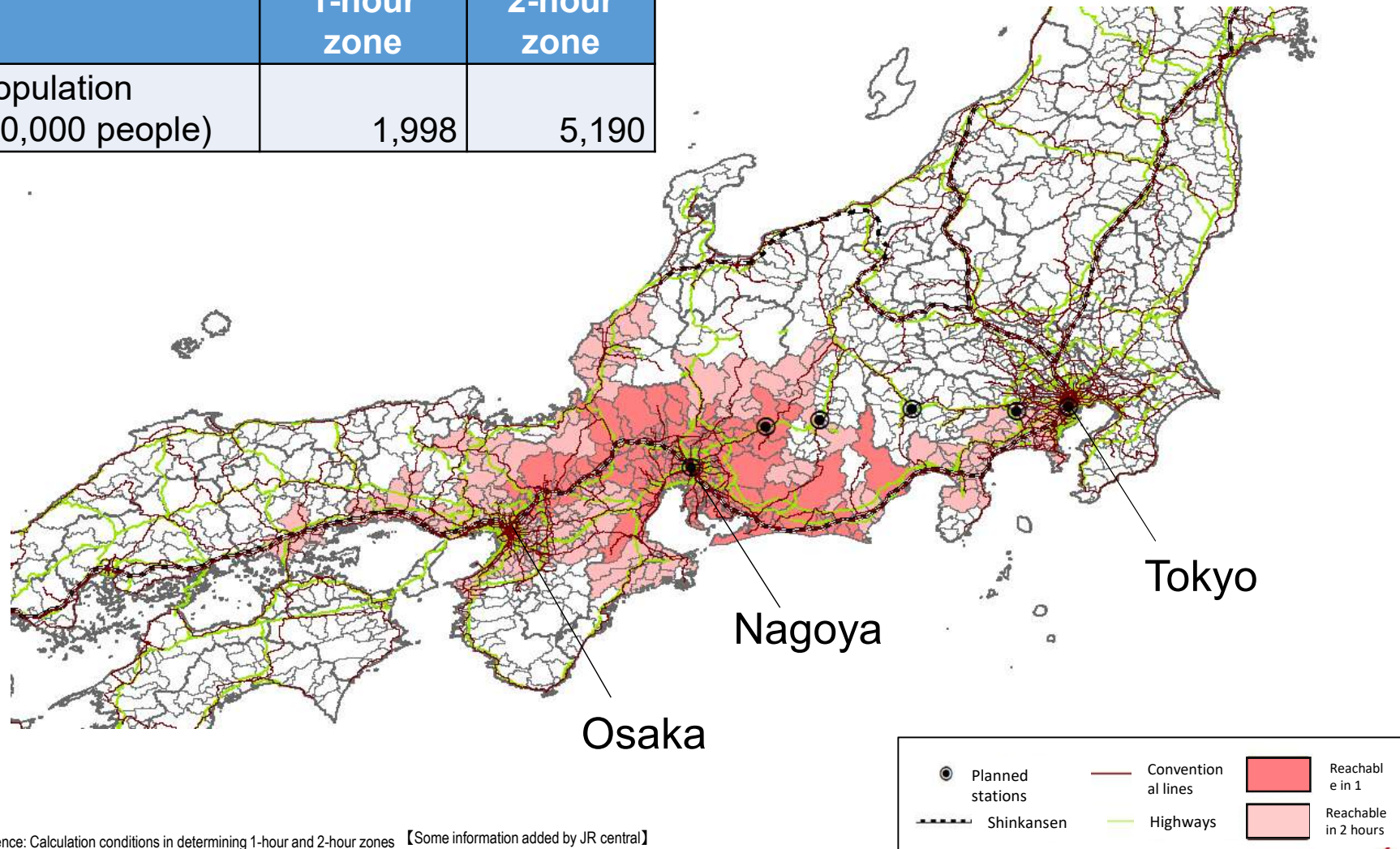


Japan's total area : Approx. 380,000km² Population : 127 million people (as of January 1, 2021)
 Note: JR Central's marketing territory covers: Tokyo, Kanagawa, Chiba, Saitama, Ibaraki, Shizuoka, Yamanashi, Nagano, Aichi, Mie, Gifu, Shiga, Osaka, Kyoto, Hyogo and Nara Prefectures
 [Sources]
 National land area : "Areas of Prefectures and Municipalities in Japan" by the Geospatial Information Authority of Japan
 Population: "Population, Demographics and Households based on the Basic Resident Register" by the Ministry of Internal Affairs and Communications (January 1, 2020)
 Gross Prefectural Product: "Prefectural Economic Accounts" by the Cabinet Office (March 2018)
 French GDP in 2021 : United Nations database 2302.86 (1 billion Euro) = 299 trillion yen *Calculated as 1 Euro = 129.83 yen (IMF data in 2021)

Distance Reachable in 1 & 2 hours from Nagoya ④0

Nagoya before service launch

	1-hour zone	2-hour zone
Population (10,000 people)	1,998	5,190



*Reference: Calculation conditions in determining 1-hour and 2-hour zones 【Some information added by JR central】

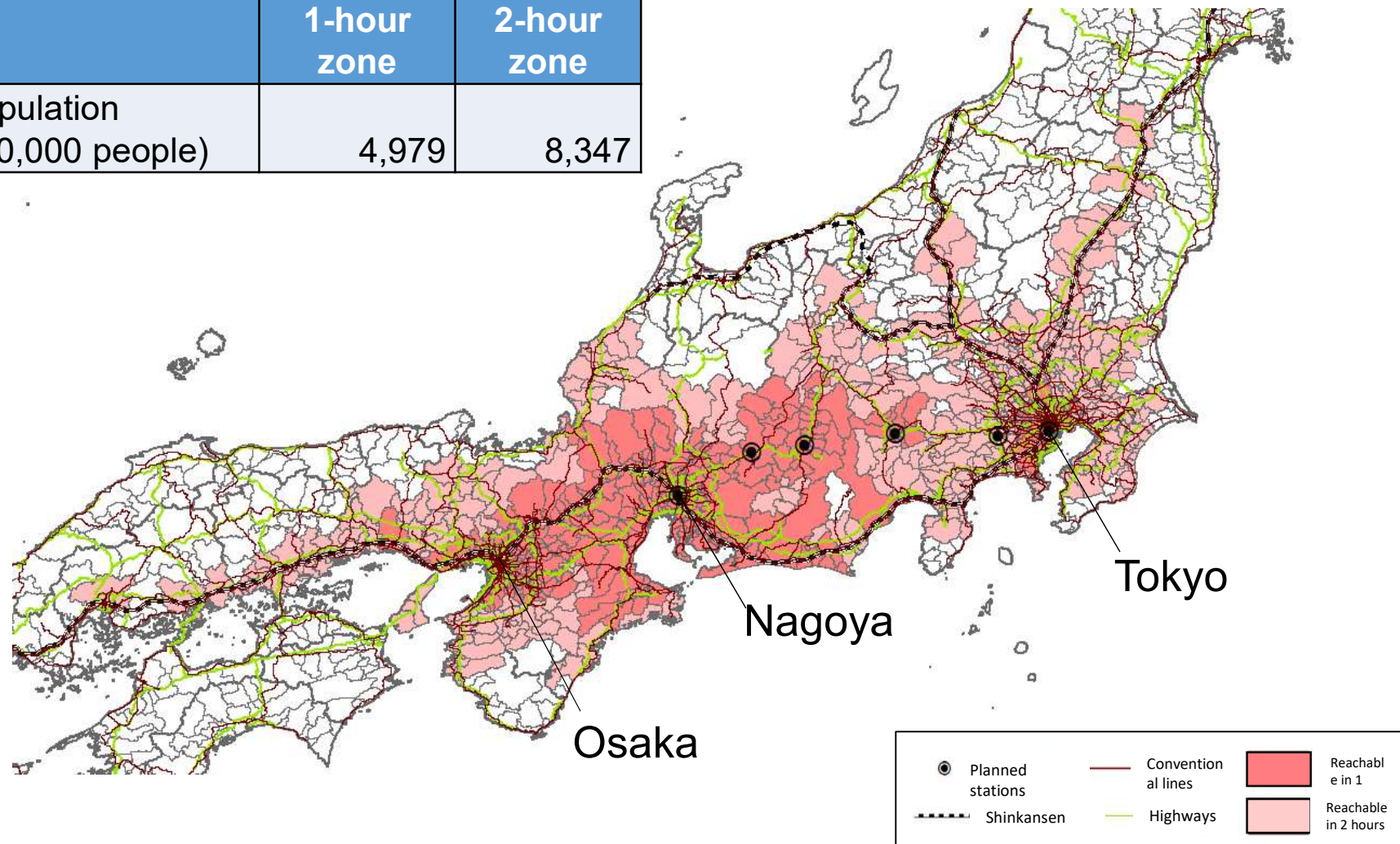
*Showing municipalities that have at least one railway station that can be reached in 1 hour / 2 hours from Nagoya Station by train; Tallying train travel time only, excluding transit / transfer time

*Source: Compiled by the National Land Policy Bureau, Ministry of Land, Infrastructure, Transport and Tourism, using NITAS(Version2.4) (as of March 2015)

Distance Reachable in 1 & 2 hours from Nagoya ④1

Nagoya after service launch

	1-hour zone	2-hour zone
Population (10,000 people)	4,979	8,347



*Reference: Calculation conditions in determining 1-hour and 2-hour zones 【Some information added by JR central】

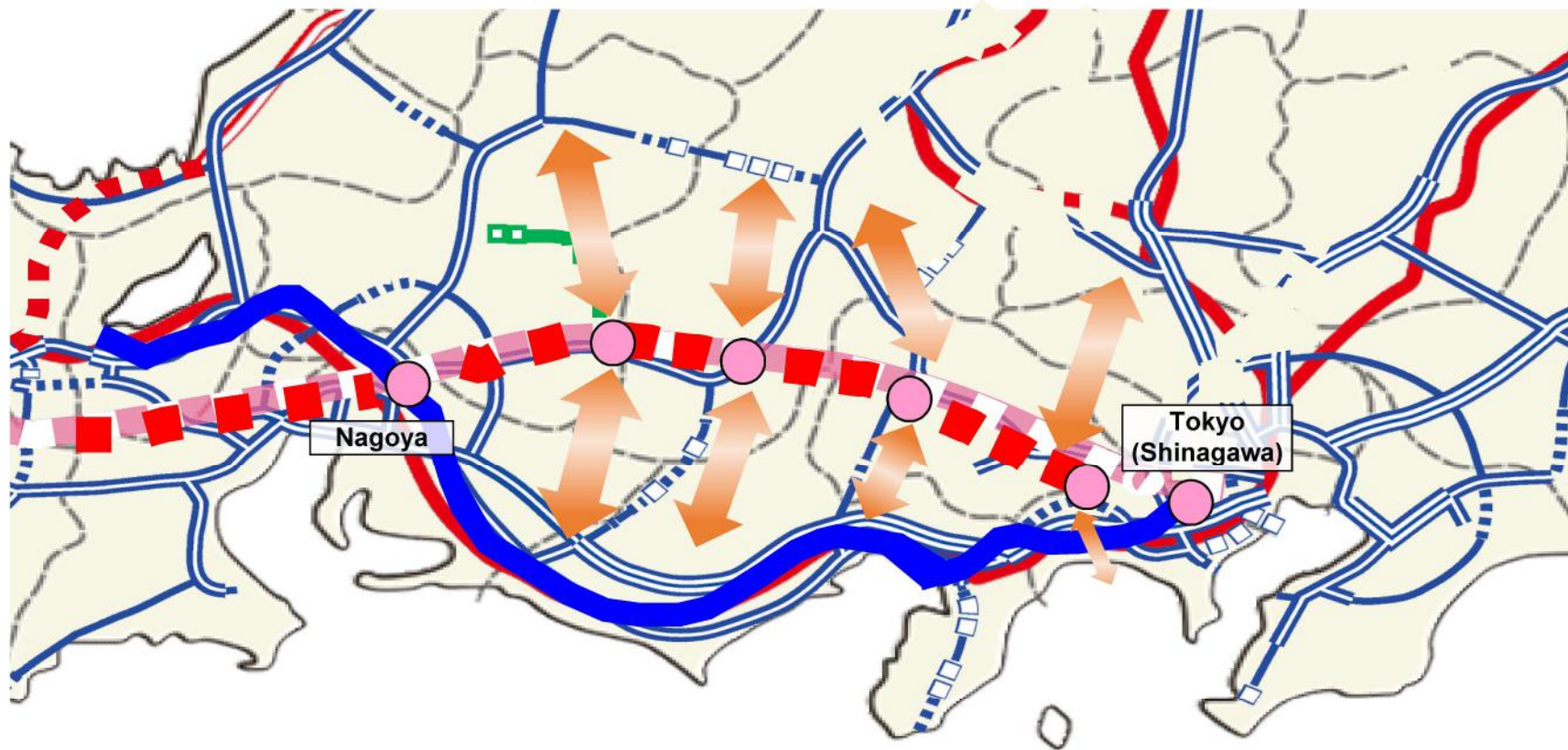
*Showing municipalities that have at least one railway station that can be reached in 1 hour / 2 hours from Nagoya Station by train; Tallying train travel time only, excluding transit / transfer time

*Source: Compiled by the National Land Policy Bureau, Ministry of Land, Infrastructure, Transport and Tourism, using NITAS (Version 2.4) (as of March 2015)

Intermediate Stations are to Develop Northwards and Southwards

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The Chuo Shinkansen will develop transportation in the east-west direction.
Motorways will expand in the north-south direction for wide-area development.



• Source: "New regional regeneration that begins from intermediate railway stations" by the Mega Region Vision Council

Innovation at Intermediate Stations

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Innovation through collaboration of industrial clusters

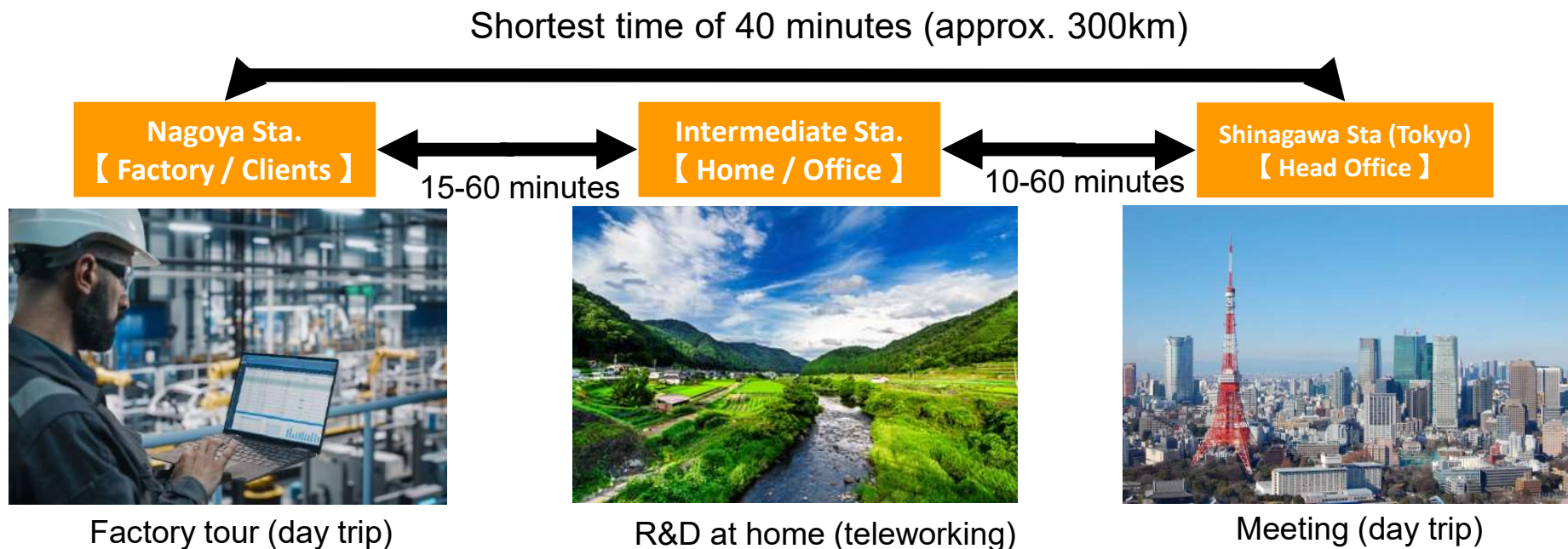


(Source) MLIT *Pictures used on regional industries are a guide only.

New Work & Life Styles

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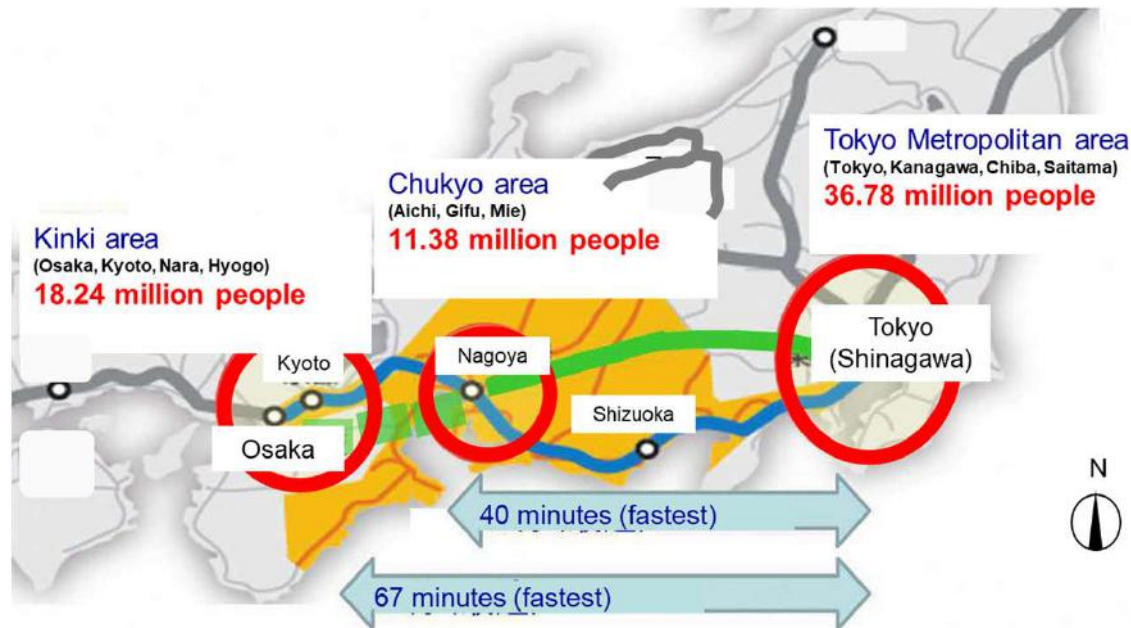
- High-speed transportation and digitalization free people from time and location constraints.
⇒ Quick travel between metropolitan and scenic areas improves work-life balance, enhancing productivity.
- Close proximity of home and workplace increases leisure time with family and interactions with local community.



Changing Japan

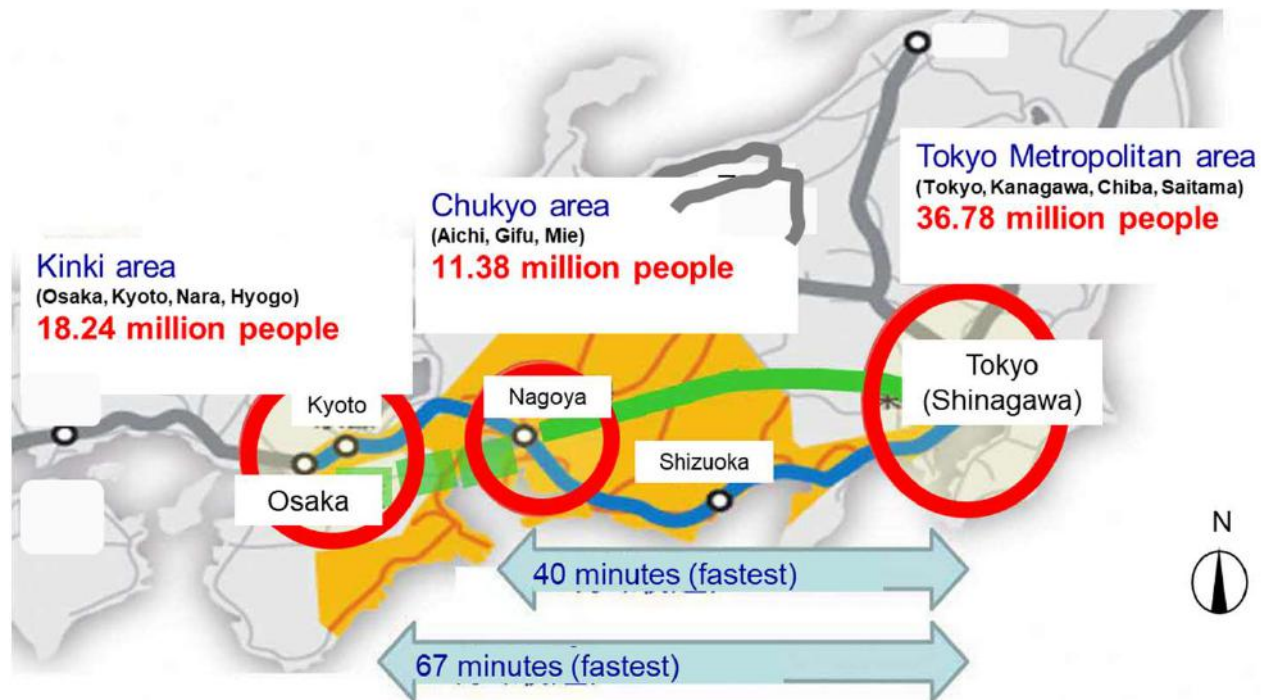
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- 1 Tokyo, Nagoya and Osaka to merge into a single city
 - ⇒ Travel within one hour
 - ⇒ Potential to become Asia's largest hub



*The population figures are based on the Basic Resident Register of the Ministry of Internal Affairs and Communications in 2021

② Transportation redundancy between Tokyo and Osaka Tokaido Shinkansen & Maglev

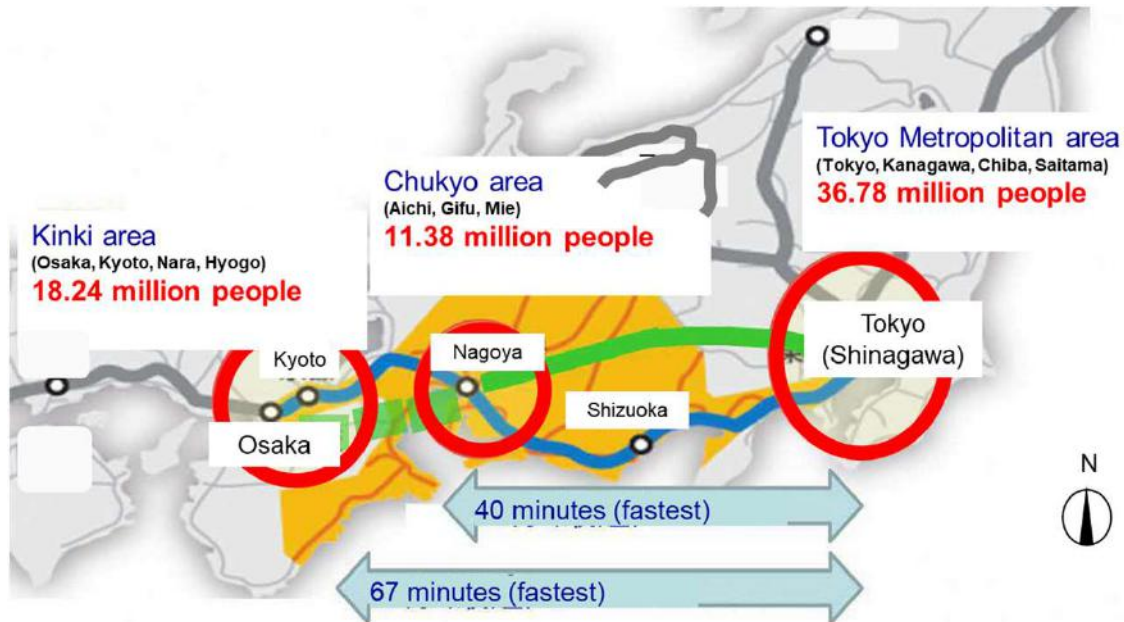


*The population figures are based on the Basic Resident Register of the Ministry of Internal Affairs and Communications in 2021

3 Alleviating centralization to Tokyo

⇒ Distributing functions

⇒ Creating available land in Tokyo

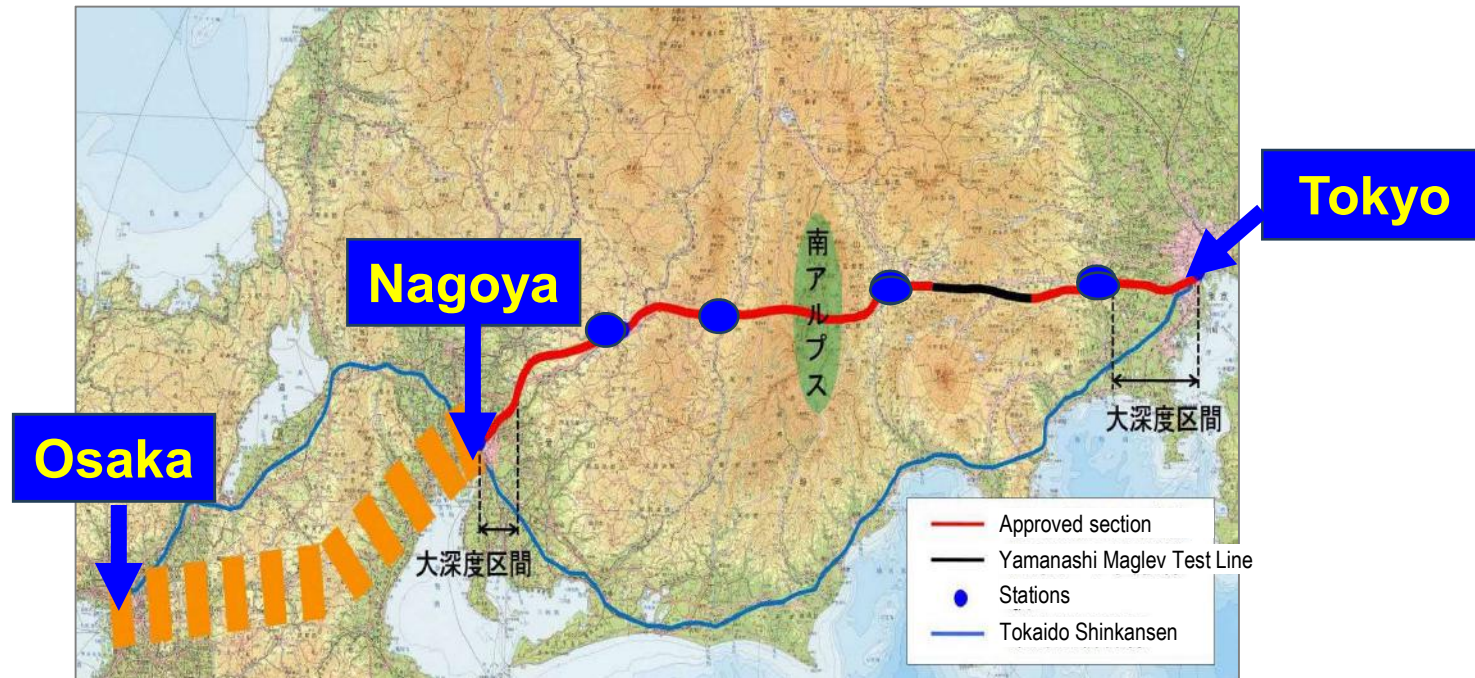


*The population figures are based on the Basic Resident Register of the Ministry of Internal Affairs and Communications in 2021

④ Increasing urban value of Nagoya and Osaka



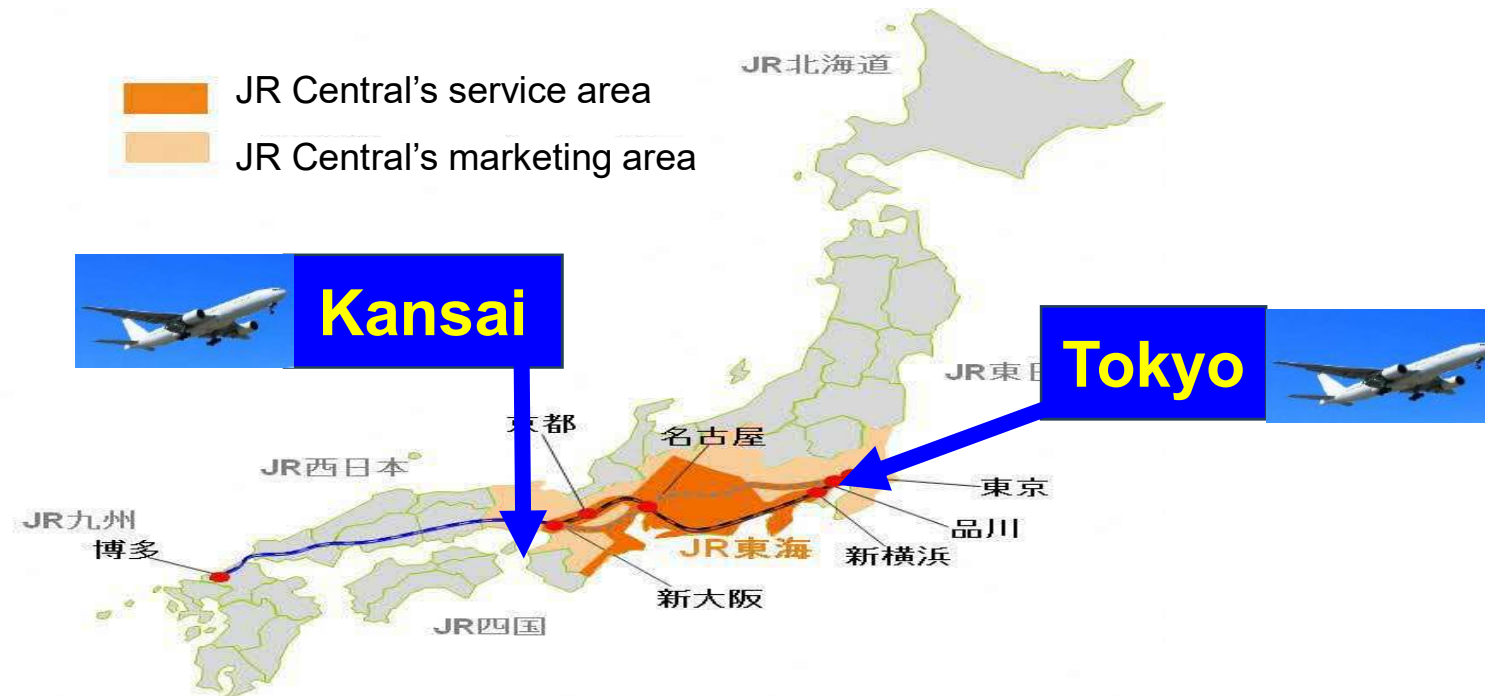
- ⑤ Revitalizing Maglev's intermediate stations
⇒ Inviting companies, revitalizing tourism



⑥ Effective use of airplane slots

⇒ Tokyo-Osaka flights to disappear

⇒ Haneda and KIX to only service international flights



⑦ Improved quality of life

- ⇒ Expanded scope of activities for researchers, doctors, lawyers and consultants
- ⇒ End to work-imposed family separation
 - ⇒ Increased family time

Overseas Deployment

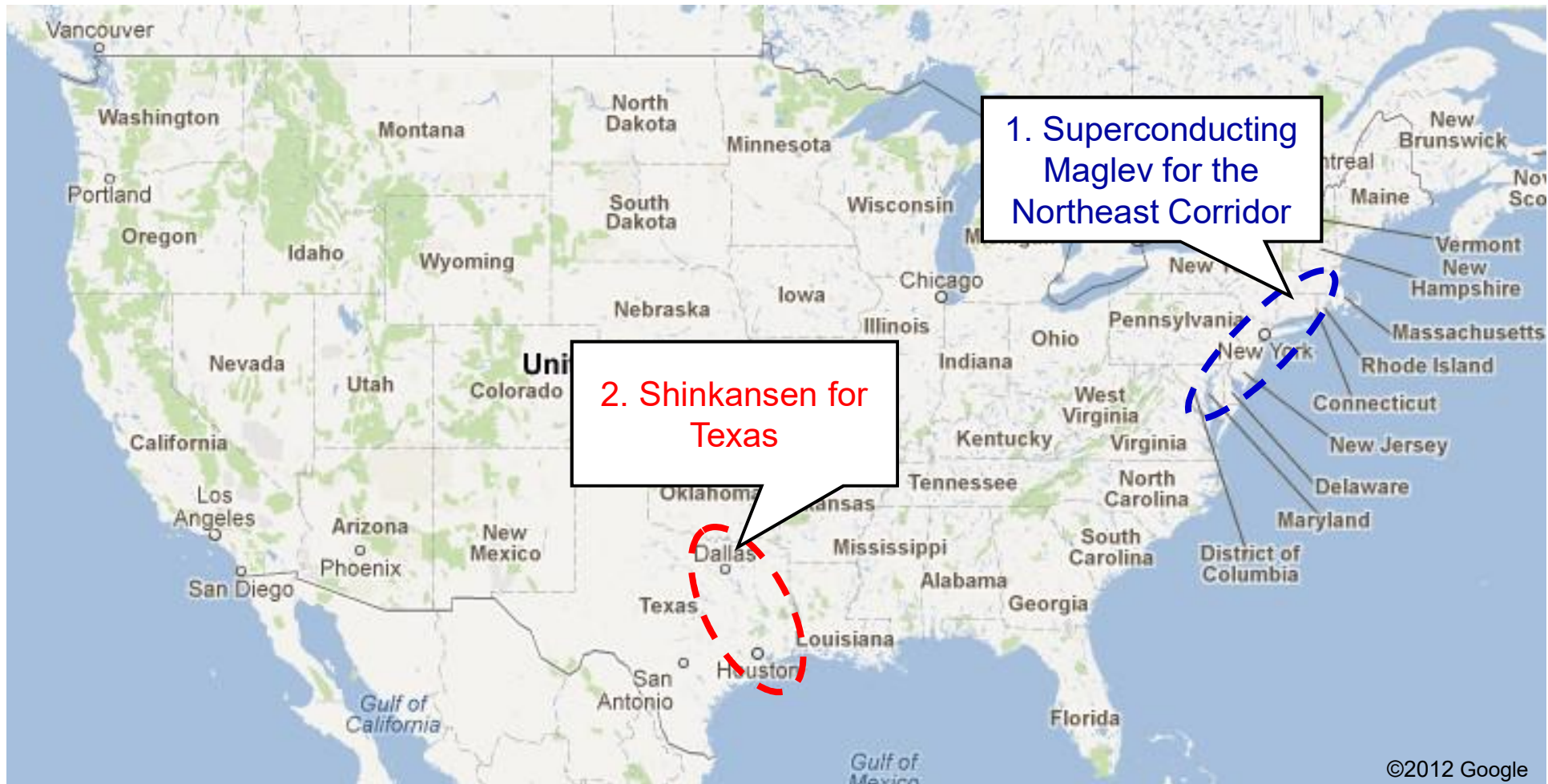
A photograph of a white and orange high-speed train (Shinkansen) stopped at a station platform. The train is sleek and aerodynamic, with a prominent orange stripe running along its side. The platform is modern, with a yellow tactile paving strip along the edge. The station has a large, modern glass and steel structure in the background.

Taiwan Shinkansen, the first case of overseas Shinkansen deployment

Targeting Two lines in the U.S.

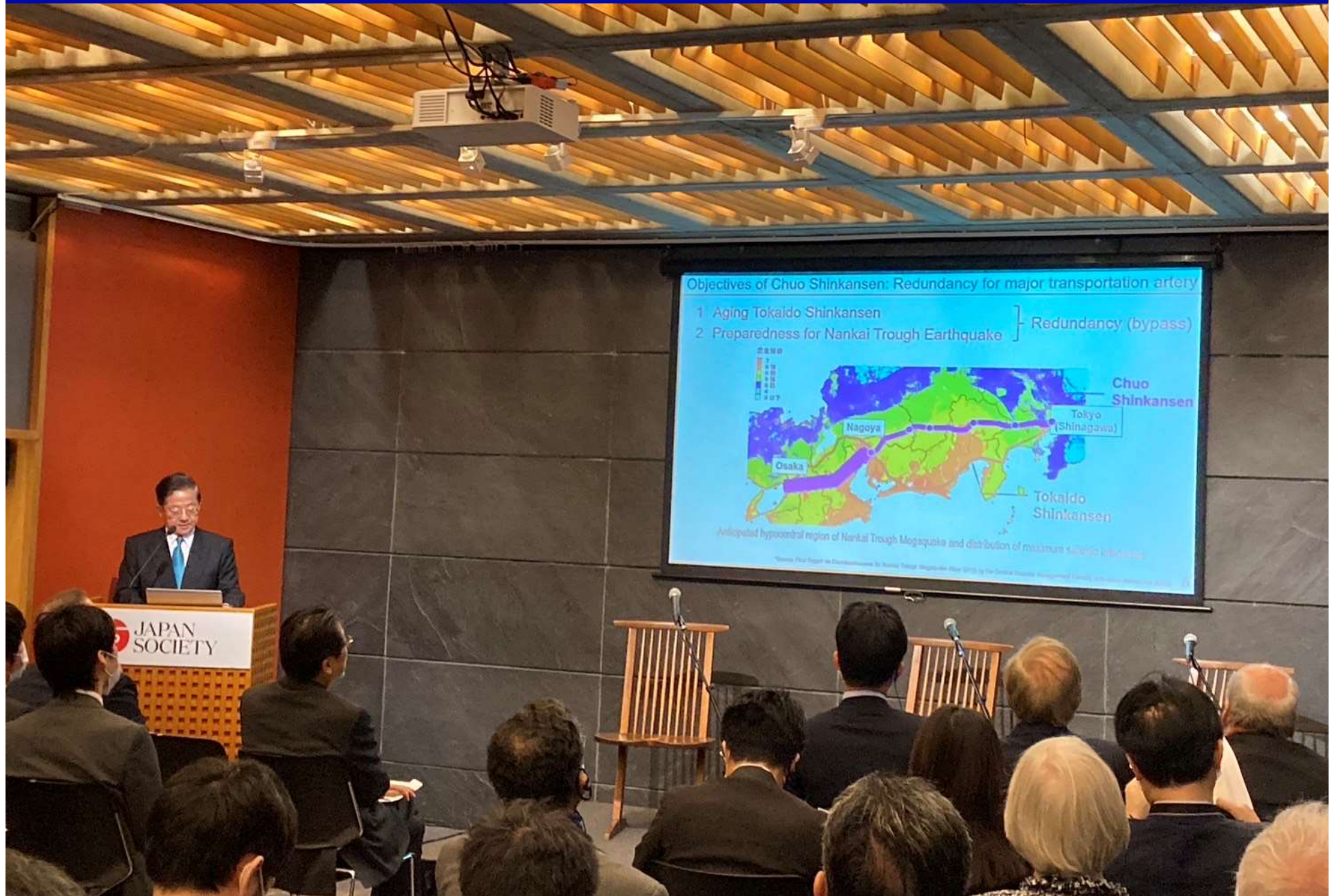
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1. Maglev: Washington D.C. – New York (approx. 360km) in 60 minutes
2. Shinkansen: Dallas – Houston (approx. 385km) in 90 minutes



Maglev Speech in New York

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Thank you

