Shinkansen- Japanese High Speed Railway Network
Shinkansen- Japoński System Kolei Dużych Prędkości

Hitachi Rail Europe

Nick Watson – Head of Commercial and Business Planning

Contents

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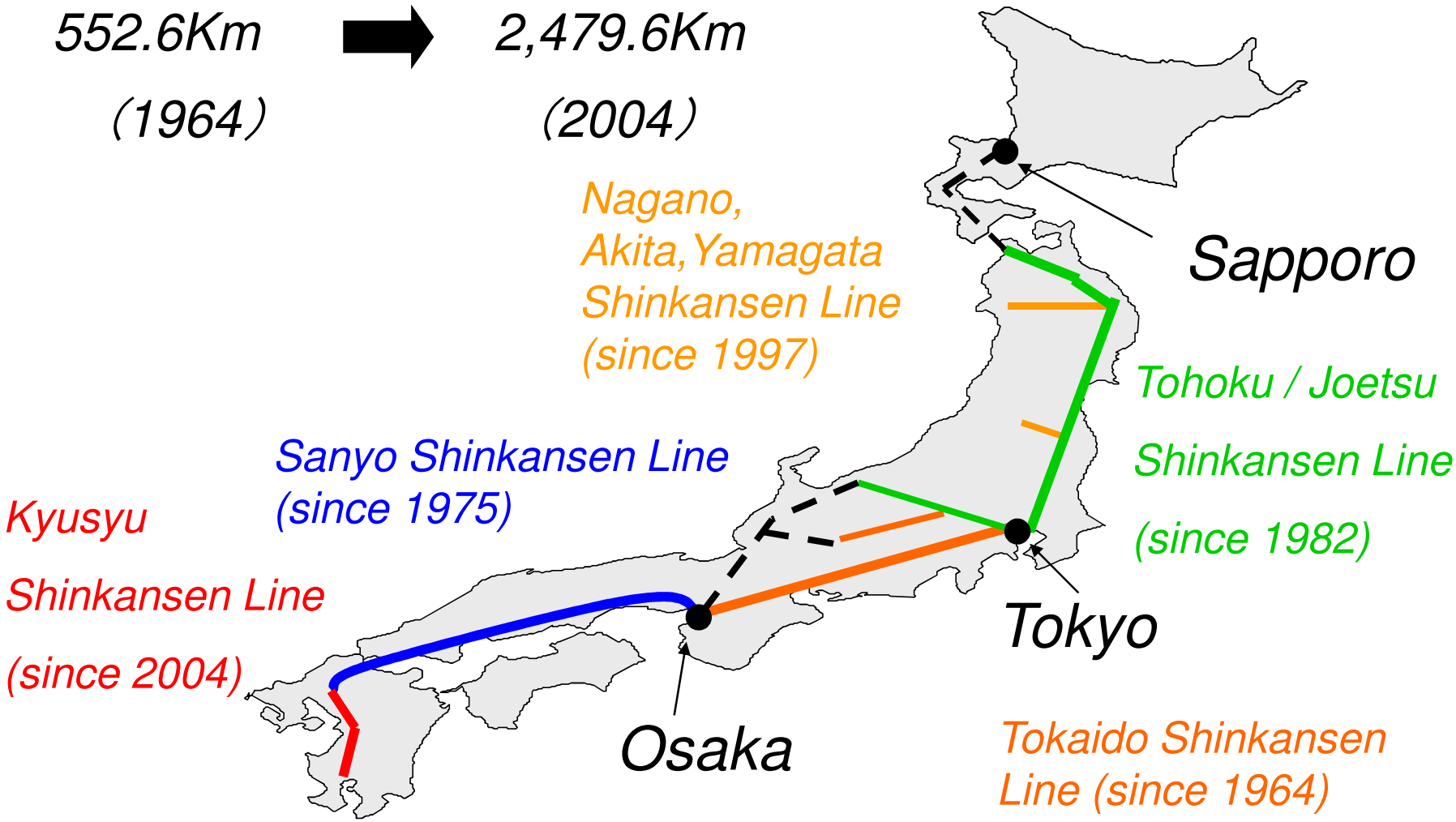
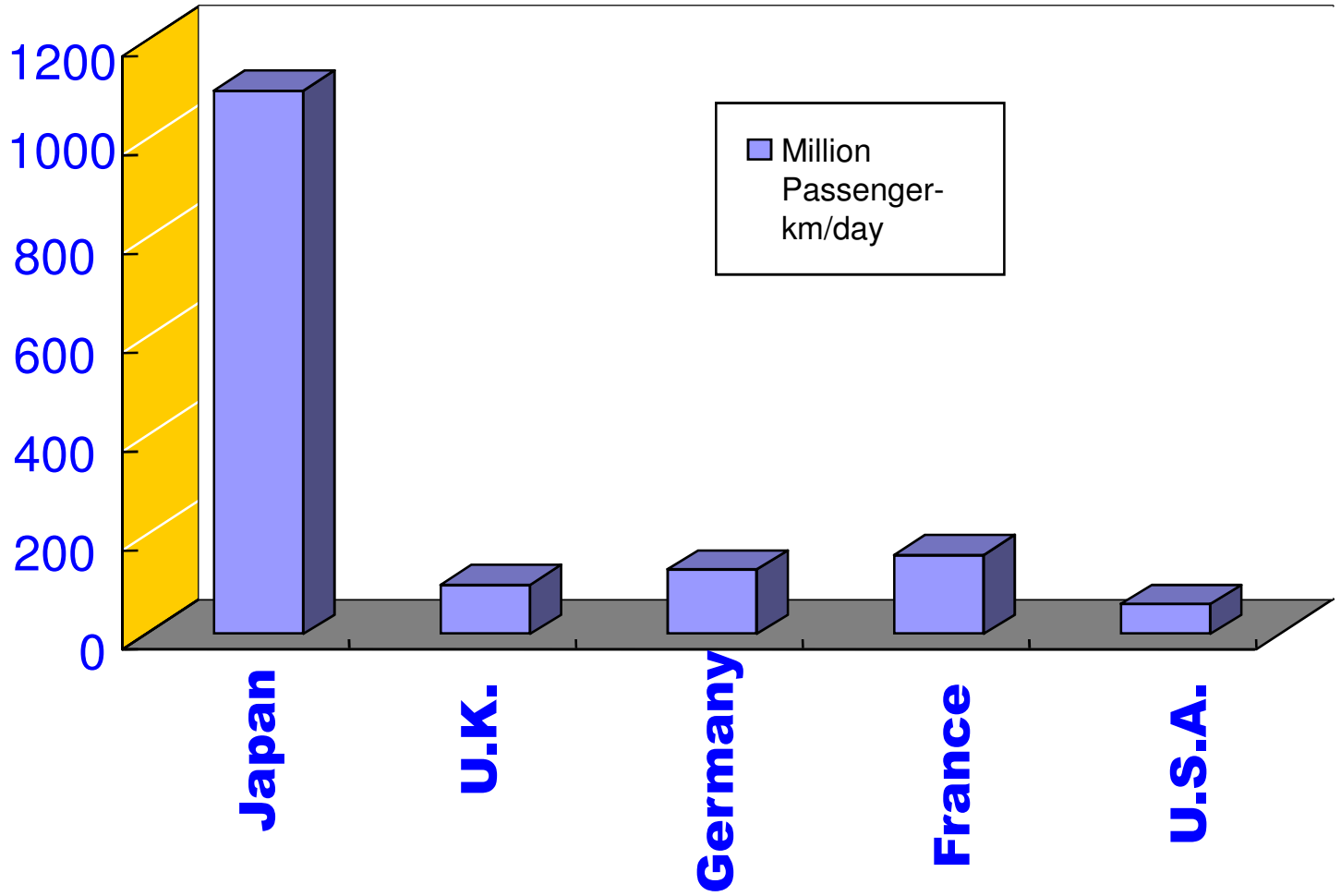
- **The Shinkansen**
- **Transferability to a European context**

Shinkansen Network

552.6Km (1964) ➡ 2,479.6Km (2004)



Passenger Volumes By Rail



Shinkansen Key Attributes & Achievements

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1. Safety & Reliability

- Zero Accidents to date (6.9 billion passengers in total)
- Annual Average Delay : 0.6 minutes / train
- (In 2003 Average Delay : 0.1 minutes / train)

2. Large Capacity Transportation

- 783 Trains per day (All Lines)
- 1,300 passengers/train
- Minimum Operation Interval : 3 Minutes

3. High Speed Transportation

- Tokyo～Osaka - 515km - 2hr30min
- N700 Sanyo Shinkansen Line -300km/h

4. Harmony with the Environment

- Low Noise & Vibration
- Low Energy Consumption – Power Regeneration
- Low CO2 Emissions

Series 0

- Inauguration: October 1964
- Maximum speed: 220km/h
- Weight (tons/ train set): 972

1st-generation Rolling Stock

Series 100

- Inauguration: October 1985
- Maximum speed: 220km/h
- Weight (tons/ train set): 925

1st-generation Rolling Stock

Series 300

2nd-generation Rolling Stock

- Inauguration: March 1992
- Maximum speed: 270km/h
- Weight (tons/ train set): 711

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Series 500

- Inauguration: March 1997
- Maximum speed: 300km/h
- Weight (tons/ train set): 700

2nd-generation Rolling Stock

- Inauguration: July 1999
- Maximum speed:

  285km/h (Sanyo area)

  270km/h (Tokaido area)
- Weight (tons/trainset): 708

Series 700

2nd-generation Rolling Stock

New Shinkansen Rolling Stock

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Series N700

- Inauguration: July 2007
- Maximum speed: 270km/h
  (300km/h in the Sanyo area)
- Weight (tons/ train set): 700

- Increase in maximum speed on curves by introducing the Body Inclining System (250km/h→270km/h)
- Improvement in acceleration performance

2nd-generation Rolling Stock

New Shinkansen Rolling Stock

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- Inauguration: March 2011
- Maximum speed: 300km/h (320km/h planed from 2013)
- Weight (tons/ train set): 450

Series E5

The Evolution of Shinkansen Trains

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1964 1985 1992 1999 2007

1st-generation Rolling Stock

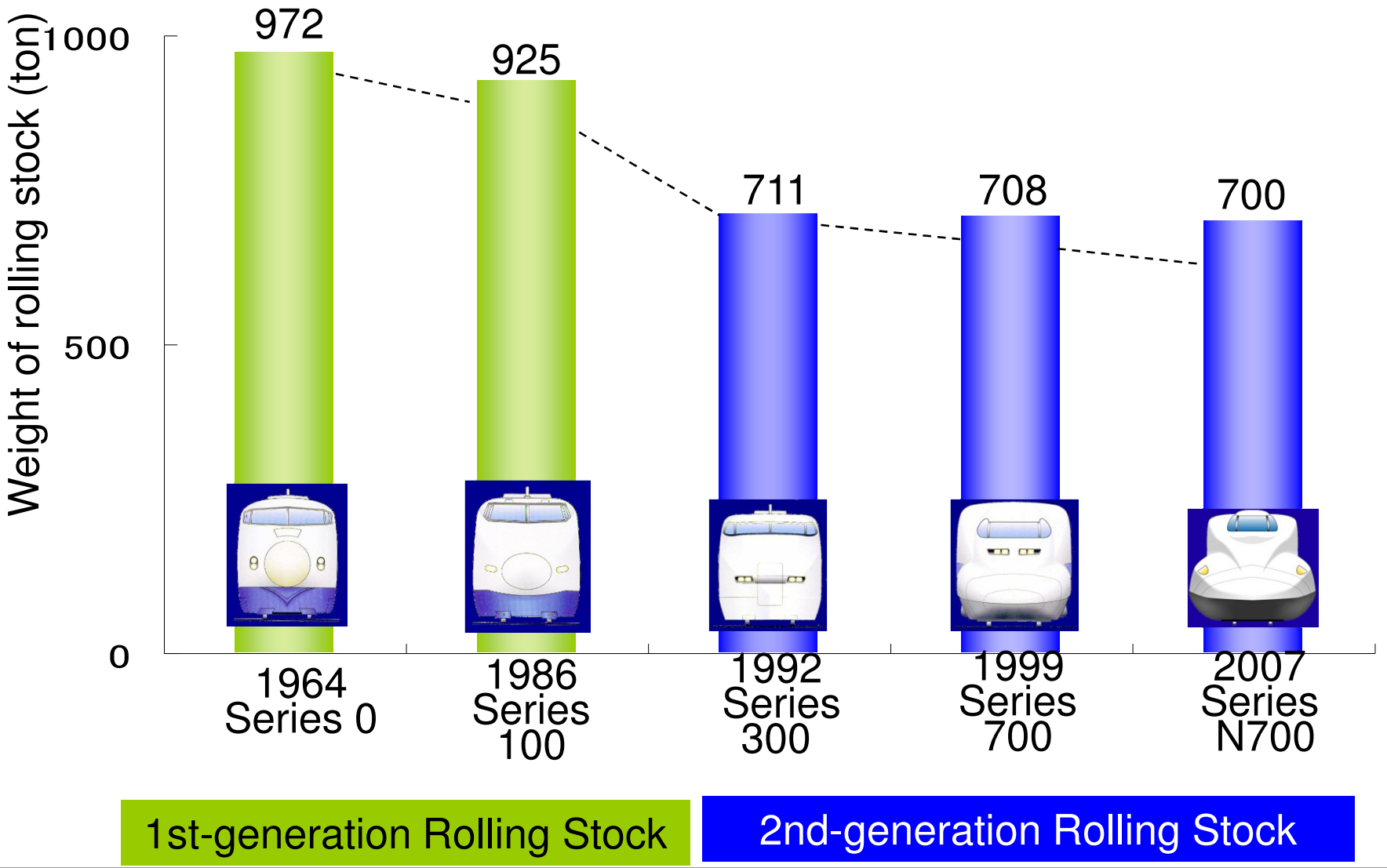
2nd-generation Rolling Stock

- Steel body
- Original Bogie
- DC traction motor

- Aluminum alloy body
- Bolsterless Bogie
- Asynchronous motor (VVVF Control)
  Regenerative brake

Series 0	Series 100	Series300	Series700	SeriesN700
				
210km/h	**220km/h**	**270km/h**	**285km/h** (Sanyo Line)	**300km/h** (Sanyo Line)

Lightweight Technology



Lightweight Technology

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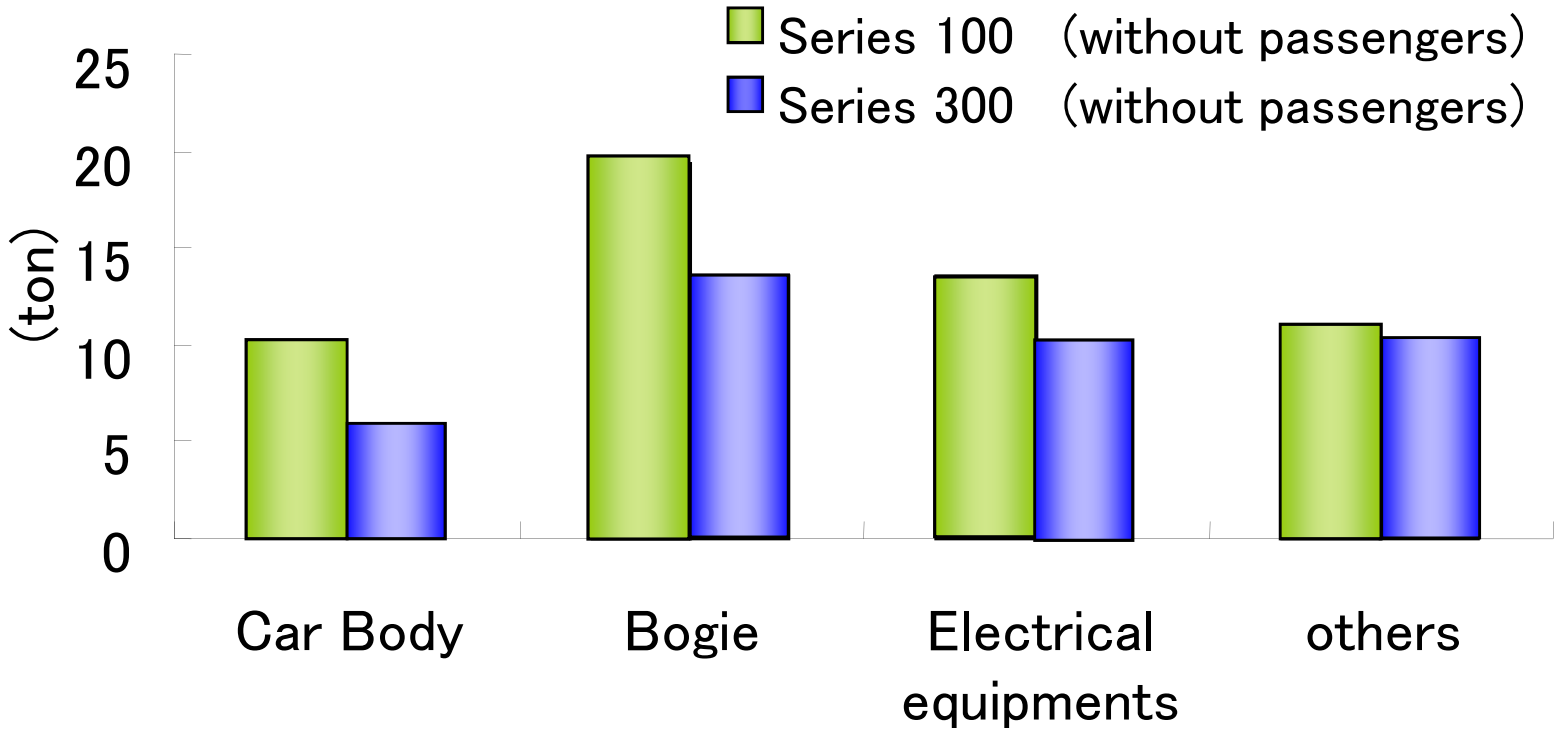
23% Weight Reduction



Car-body Structure

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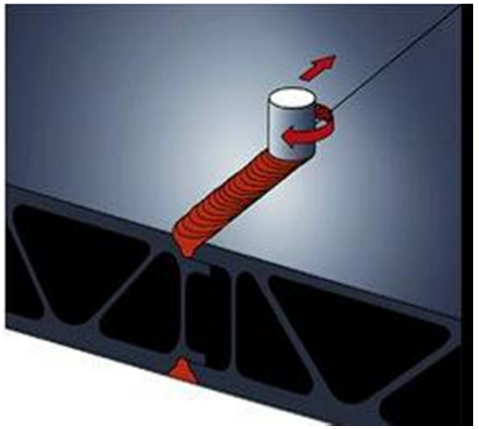
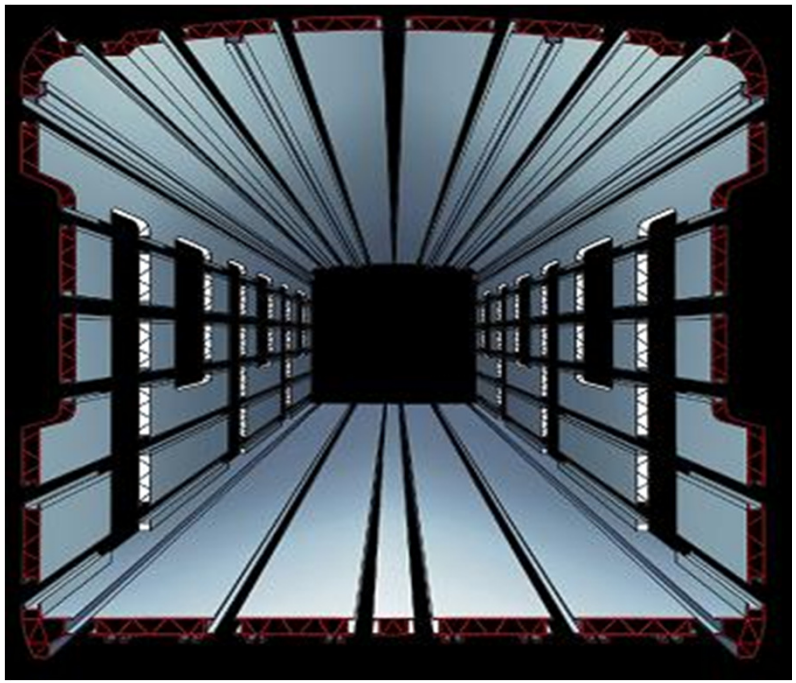
- Hollow Aluminium Alloy Extrusions
- Strong but Lightweight Structure
- Good Soundproofing Performance
- Large Cross Sectional Area (2 + 3 Seats per row)
- The Structure is Manufactured via Friction Stir Welding





Impact Value of Friction Stir Welded Joint is 1.7 times larger than that of Parent metal and 2.4 times larger than that of MIG welded Joint.

Key features – Carbody

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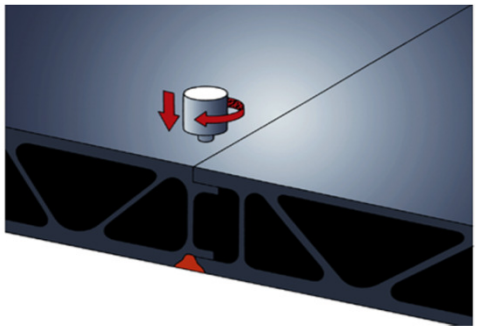
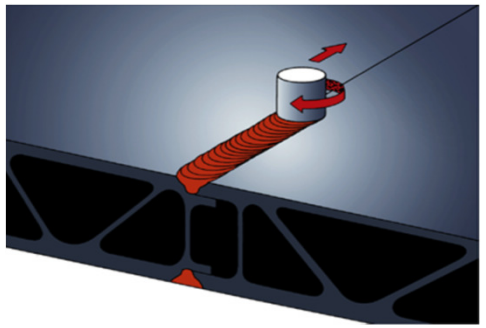
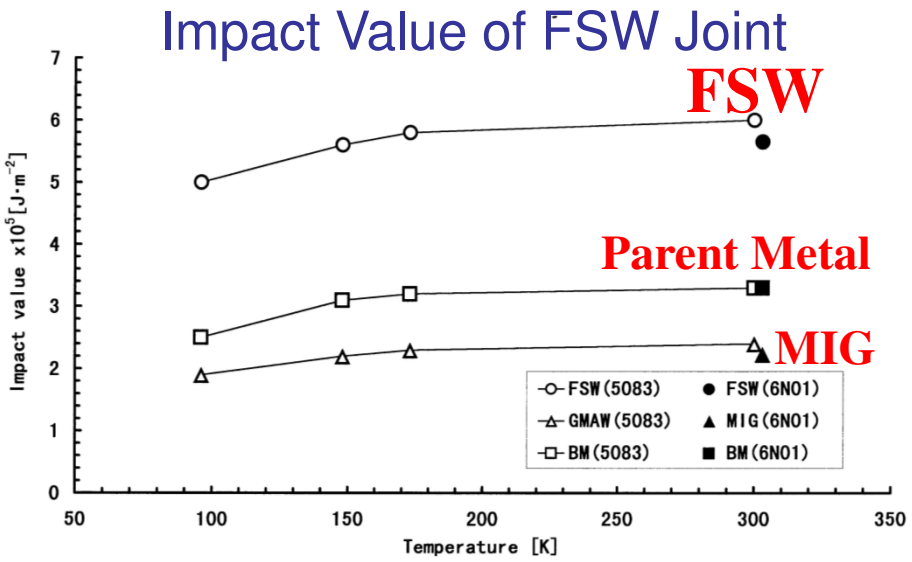
Friction Stir Welding (FSW)

- Minimised Distortion
- Smoother Surface Finish
- Higher Strength
- Best Fit for Modular Design







Bogie Development and Ride Comfort

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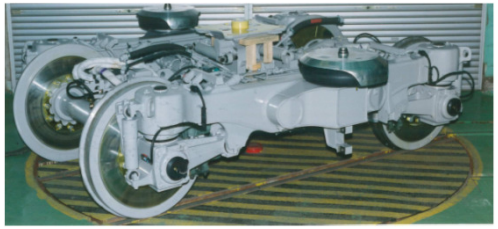
- High Stability
- High Speed Technology
- Good Ride comfort

Series 700



Series 500

Series 300

- Bolsterless Bogie
- Air Suspension
- Yaw Dampers Between Cars

Key features – Bogie

300km/h, Series 500

285km/h, Series 700

High-Speed technology

Good Ride performance

Running Stability

Less damage to track

270km/h, Series 300

275km/h, Series E2

Nose End Aerodynamics

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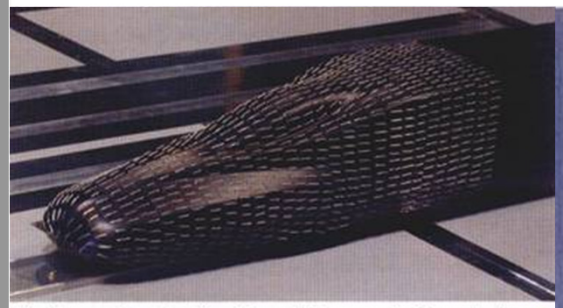
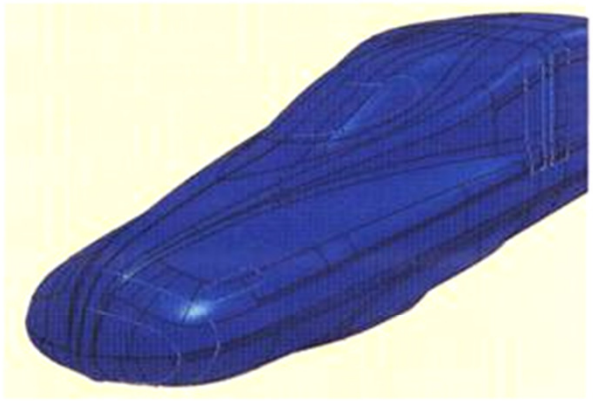
Nose Shape（Aero Double-Wing）

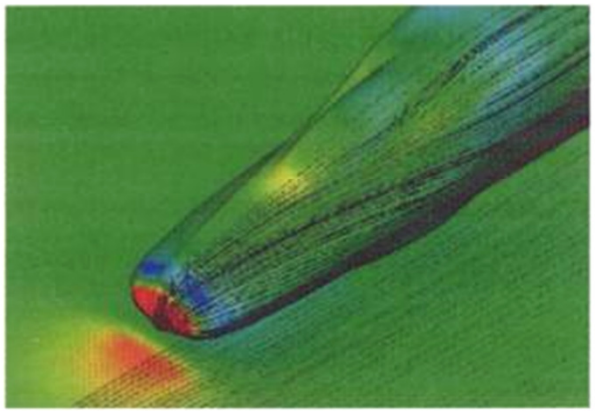


Wind tunnel test (at the Komaki Research Complex)

Further reduction in running resistance

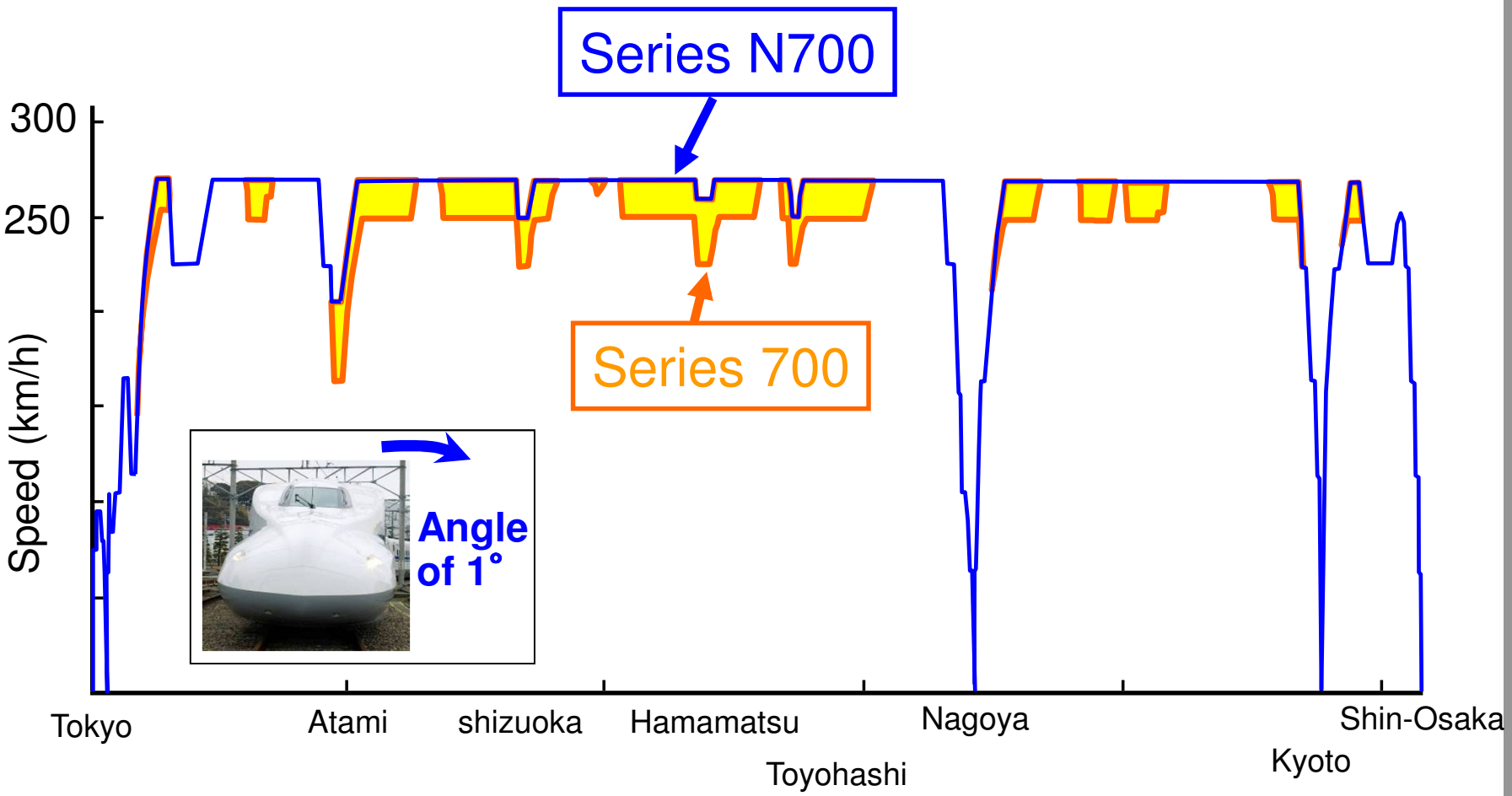


3D CFD model



Distribution of surface pressure,
and streamlines (300km/h)

Body-inclining system



Running at 270km/h over 2/3 distance for the Tokaido Shinkansen section (series 700 :about 1/3 distance)

Power Regeneration Technology

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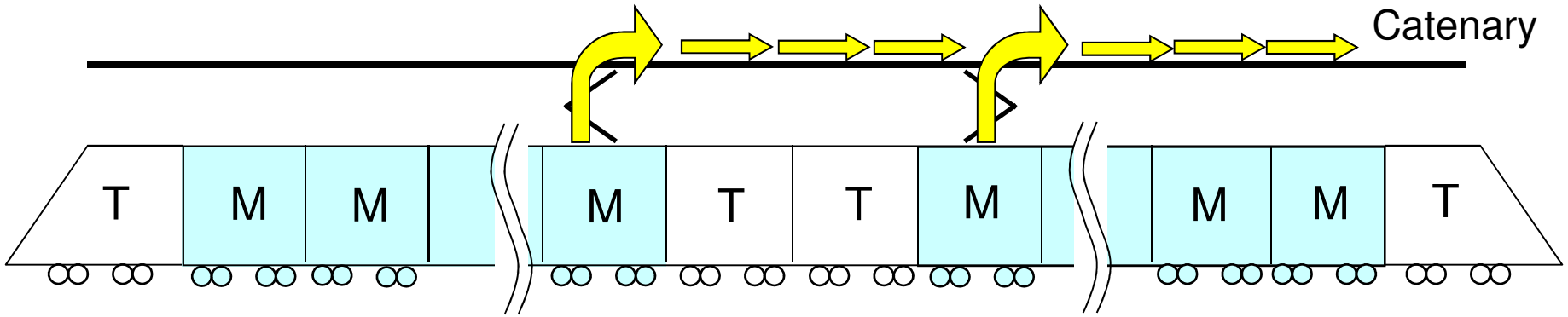
《Series 700》



Regenerates energy of 12 cars
No regeneration in 4 trailers

M : Motor car

T : Trailer

Power Regeneration Technology

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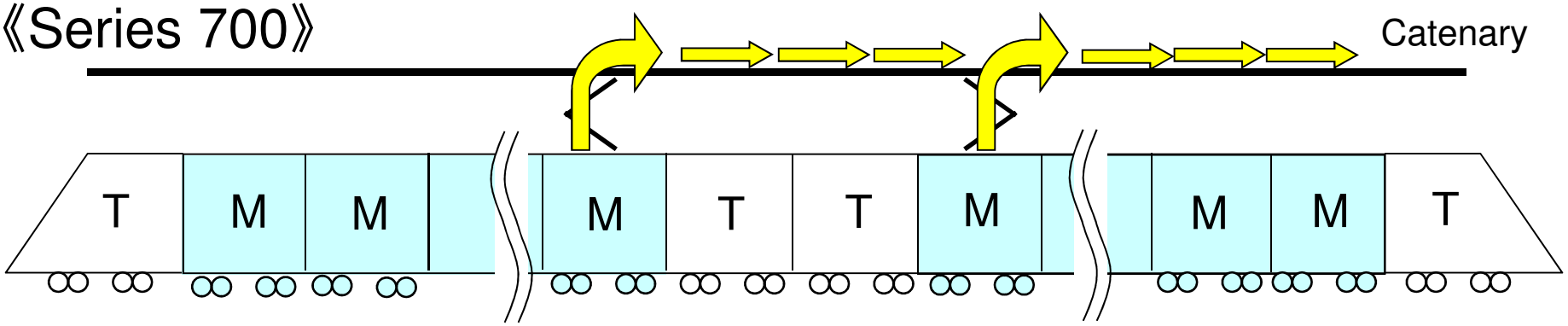
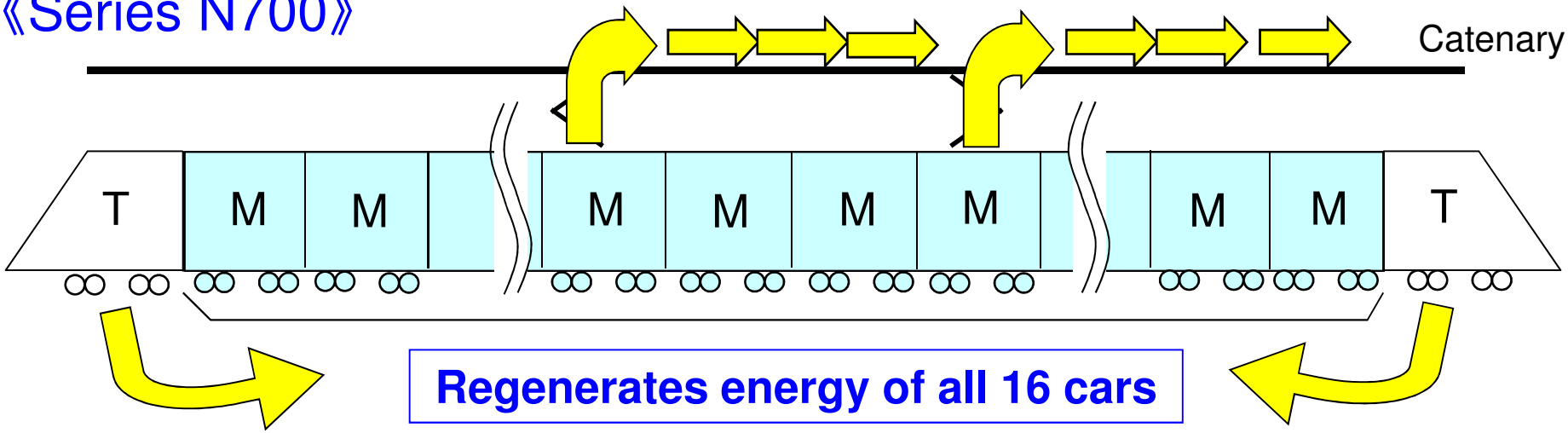
《Series 700》



Regenerates energy of 12 cars

No regeneration in 4 trailers

《Series N700》



Regenerates energy of all 16 cars

14 motored cars provide braking for the 2 trailers

Transition of Electric Power Consumption

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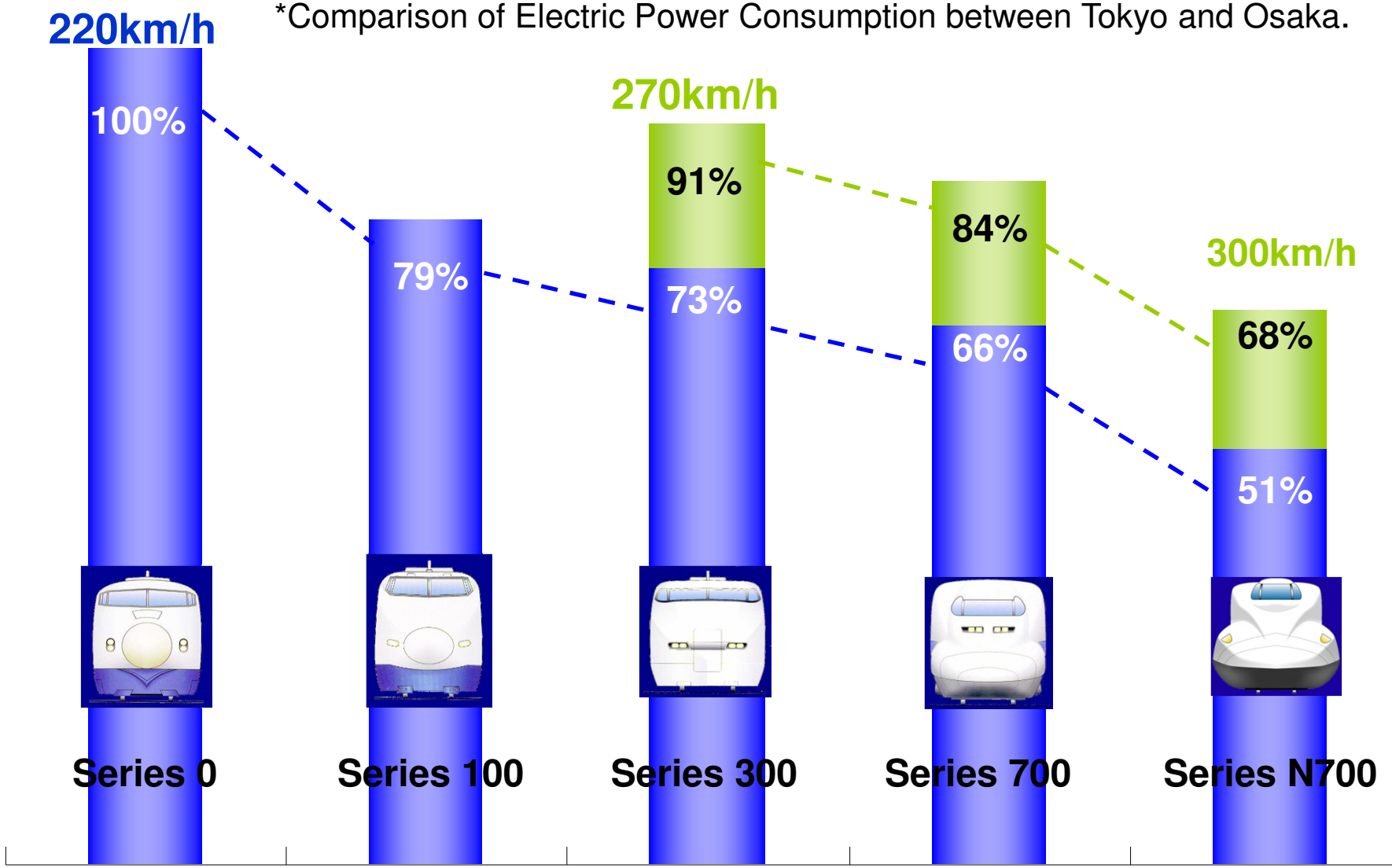
*Comparison of Electric Power Consumption between Tokyo and Osaka.



Shinkansen Reliability – How is it achieved?

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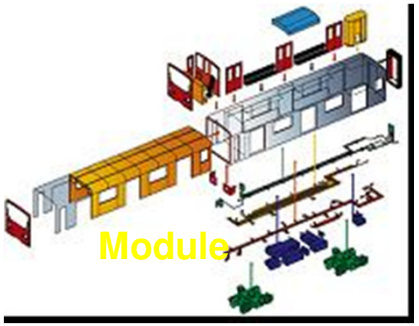
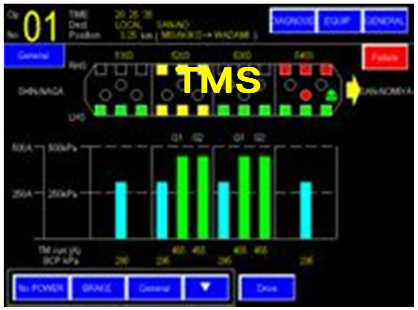
Applying established reliable technology





An Example – Passenger Doors

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- **Simple slide door for reliable & fast open/close operation**
  Air-tight seal achieved by door pressure device at 4 corners

Japanese Sliding Door

MTBF: 33×10^6

European Sliding plug Door

MTBF: 18×10^3

Continuous Testing

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Full Scale Pressure Pulse Testing

Shinkansen Technology – Tried & Tested

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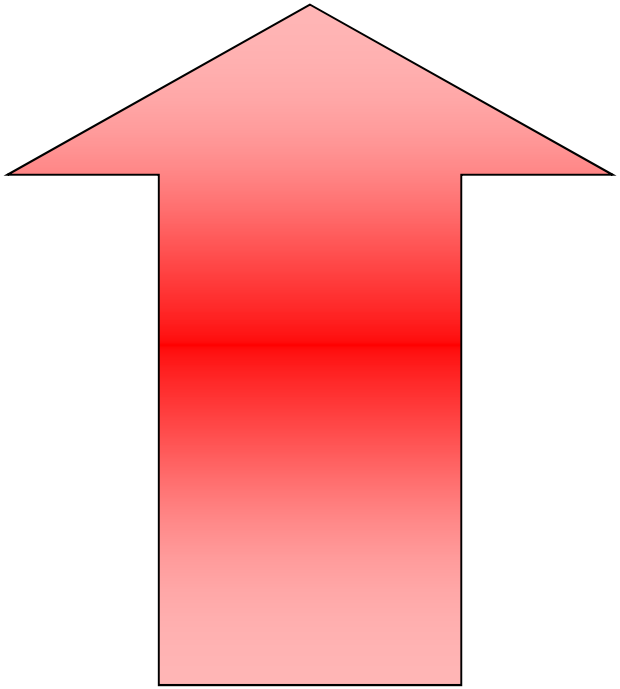
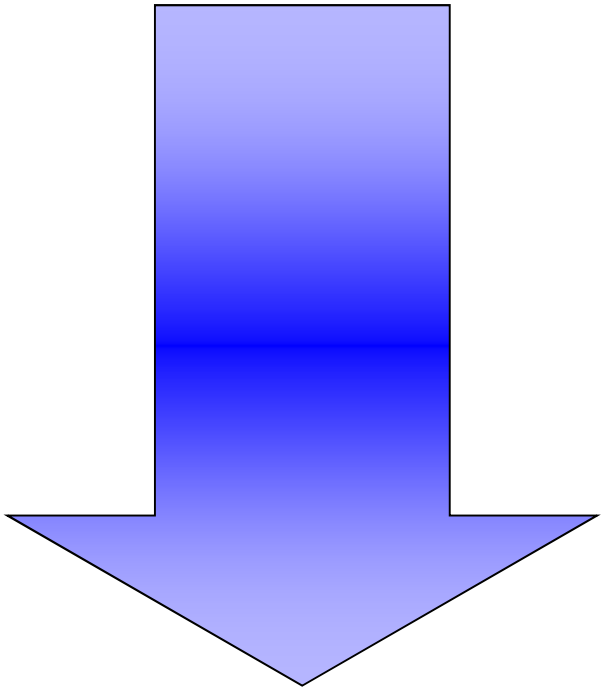
40 + Years of Continuous Improvement

Speed, Reliability, Punctuality & Safety





Electrical Power Consumption, Weight & Harmful Environmental Effects

Contents

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- **The Shinkansen**
- **Transferability to a European context**

Evolution from Shinkansen

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Modify to EU standards

Project management

Exceptional reliability

Integration of Japanese & European components

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Key features – Crashworthiness structure

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RGS&TSI compliant Crashworthiness

Crashworthiness structure

Key features – Crashworthiness structure

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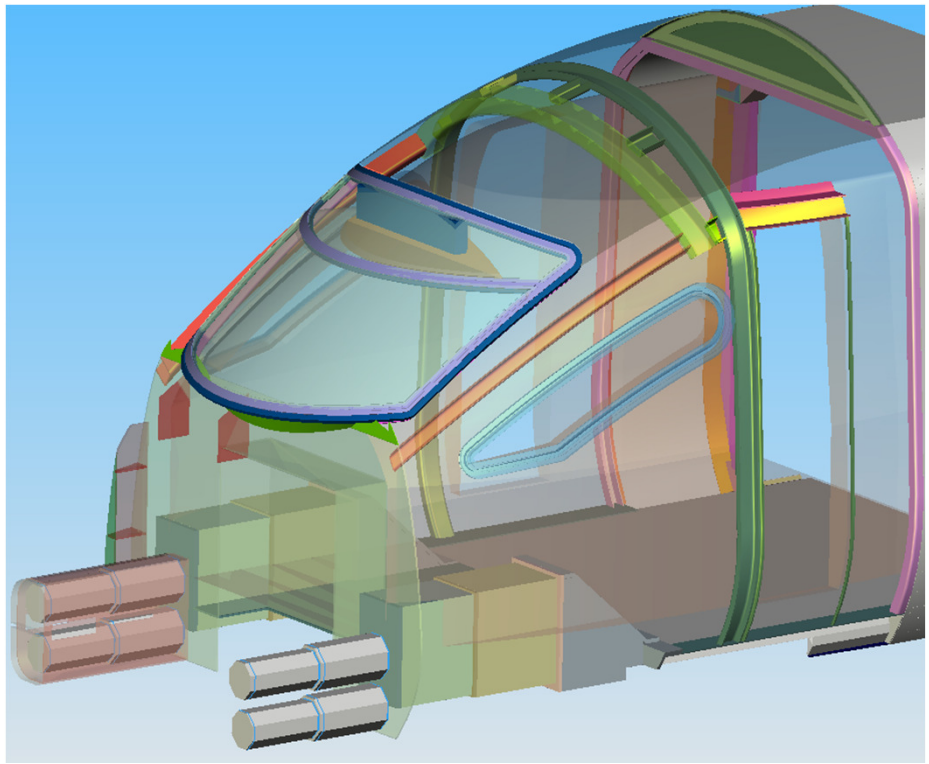
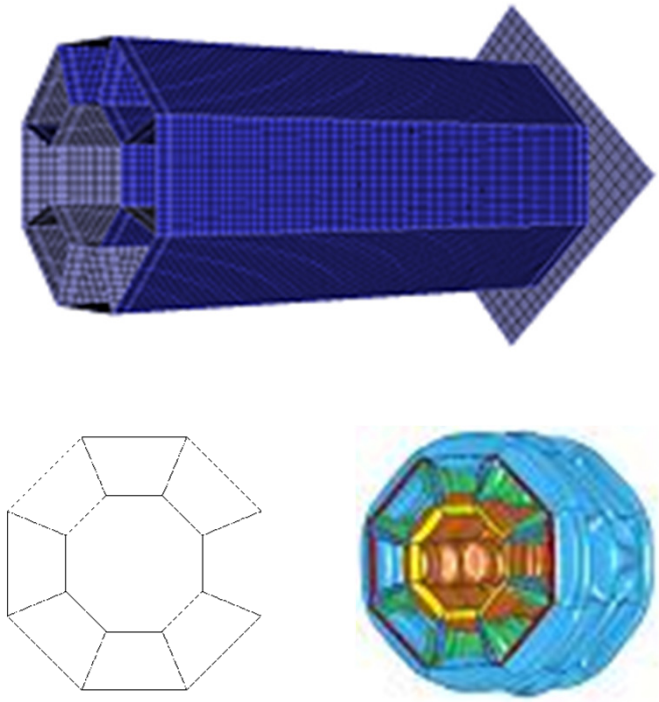
High Performance Structure Developed by Various Analysis and Testing



Crashworthy Structure



Energy Absorption Block

Key features – Crashworthiness structure

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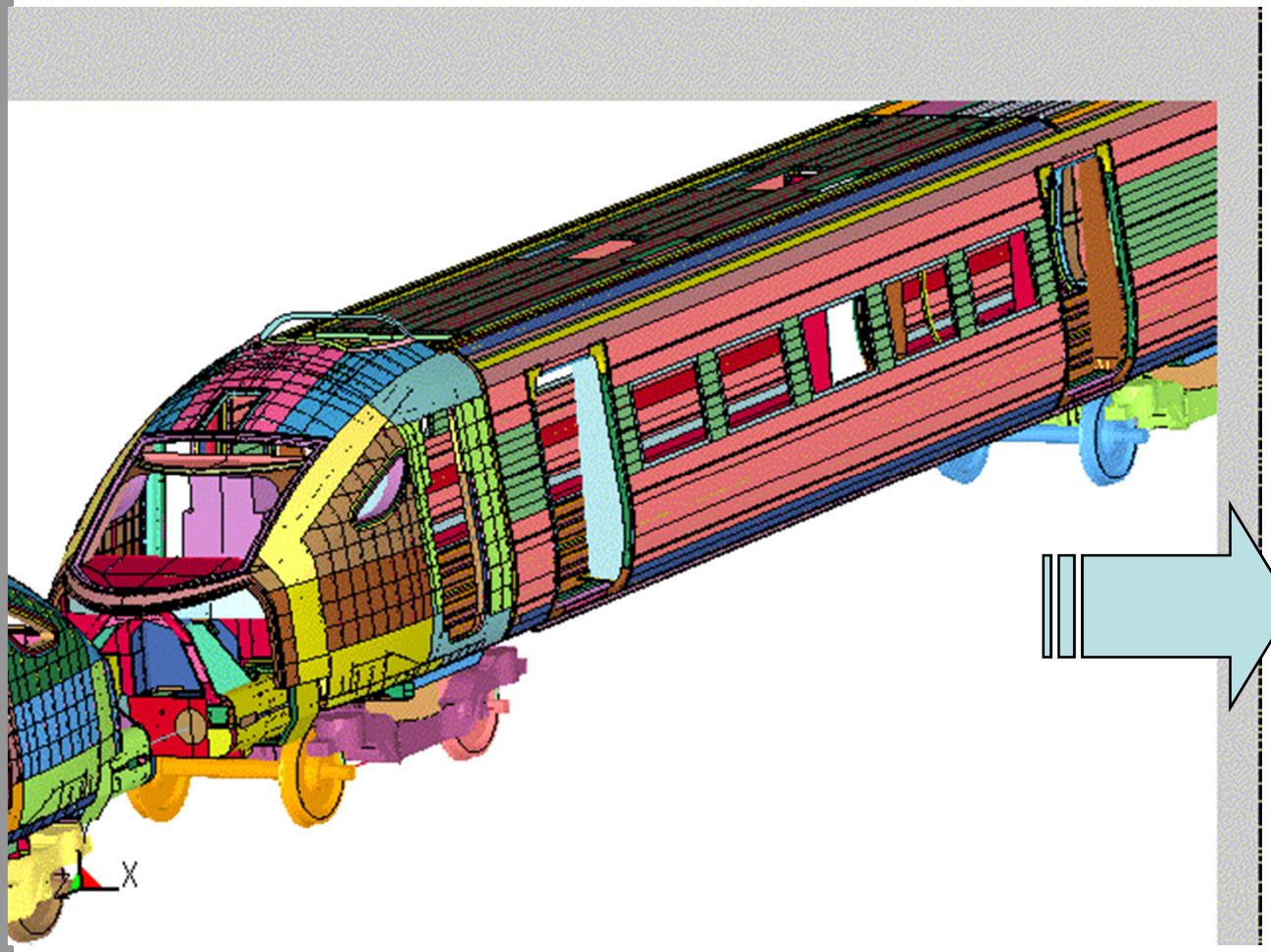
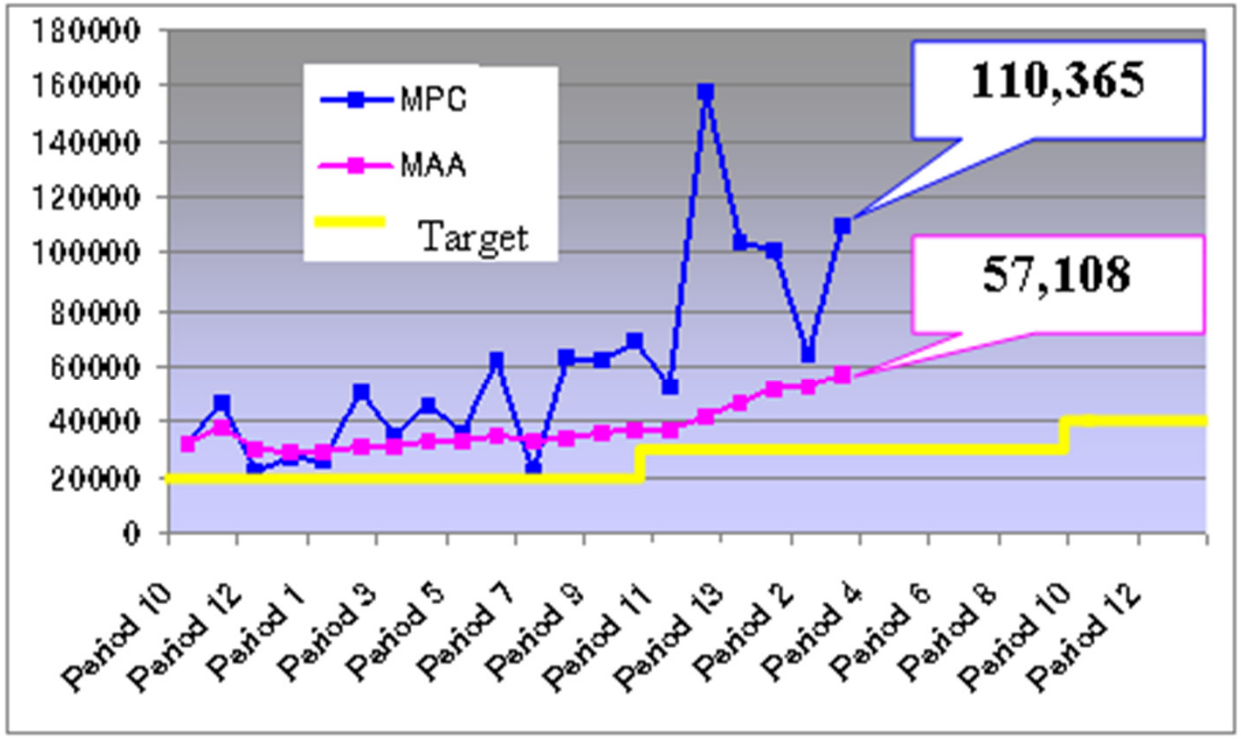
Crash Simulation to confirm the energy absorption performance



Crash Simulation – Train to Train

Performance & Target



Thank you for Listening

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