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Towards Sustainable Technology in Transport Sector
- Developing Trains with lower CO2 Emissions -

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1. Introduction
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1-1 Hitachi Rail Systems

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Rolling Stock

Depot

Maintenance supervisory system

Control Center

Railway System Integrator
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Substation

Signaling

Station

1-2 Class 395 Javelin for UK

-Contract in 2005: Programme on time
-Service will begin in Dec 2009
-2012 Olympic Shuttle service
-225km/ hour
-29 Six-car trains

1-3 Ashford Maintenance Centre

-Main depot for Class 395
-Open on 2nd Oct 2007 by Secretary for State
-Size: 110,000 m2
-Staff: Upto 100

2-1 Railway in Japan

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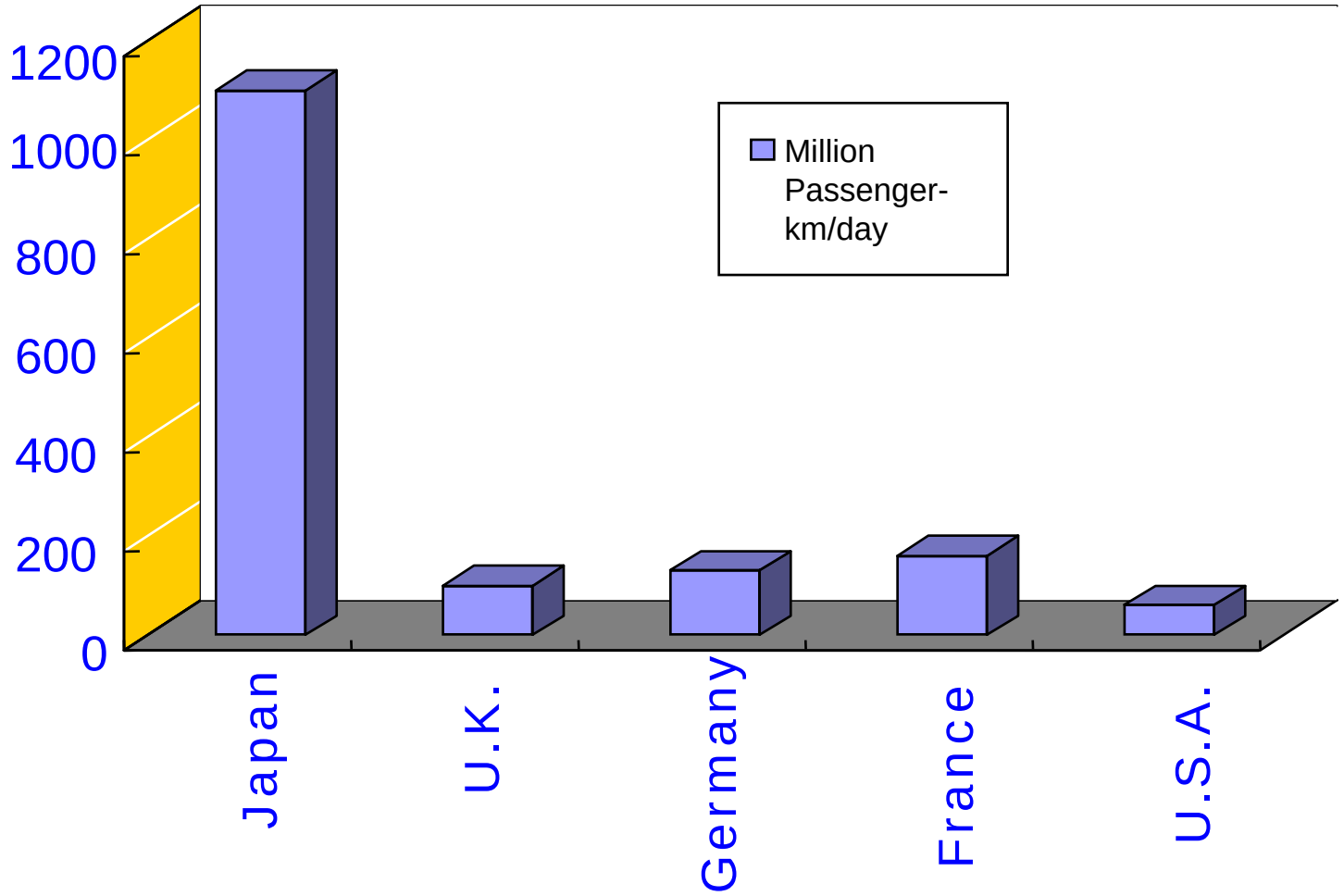
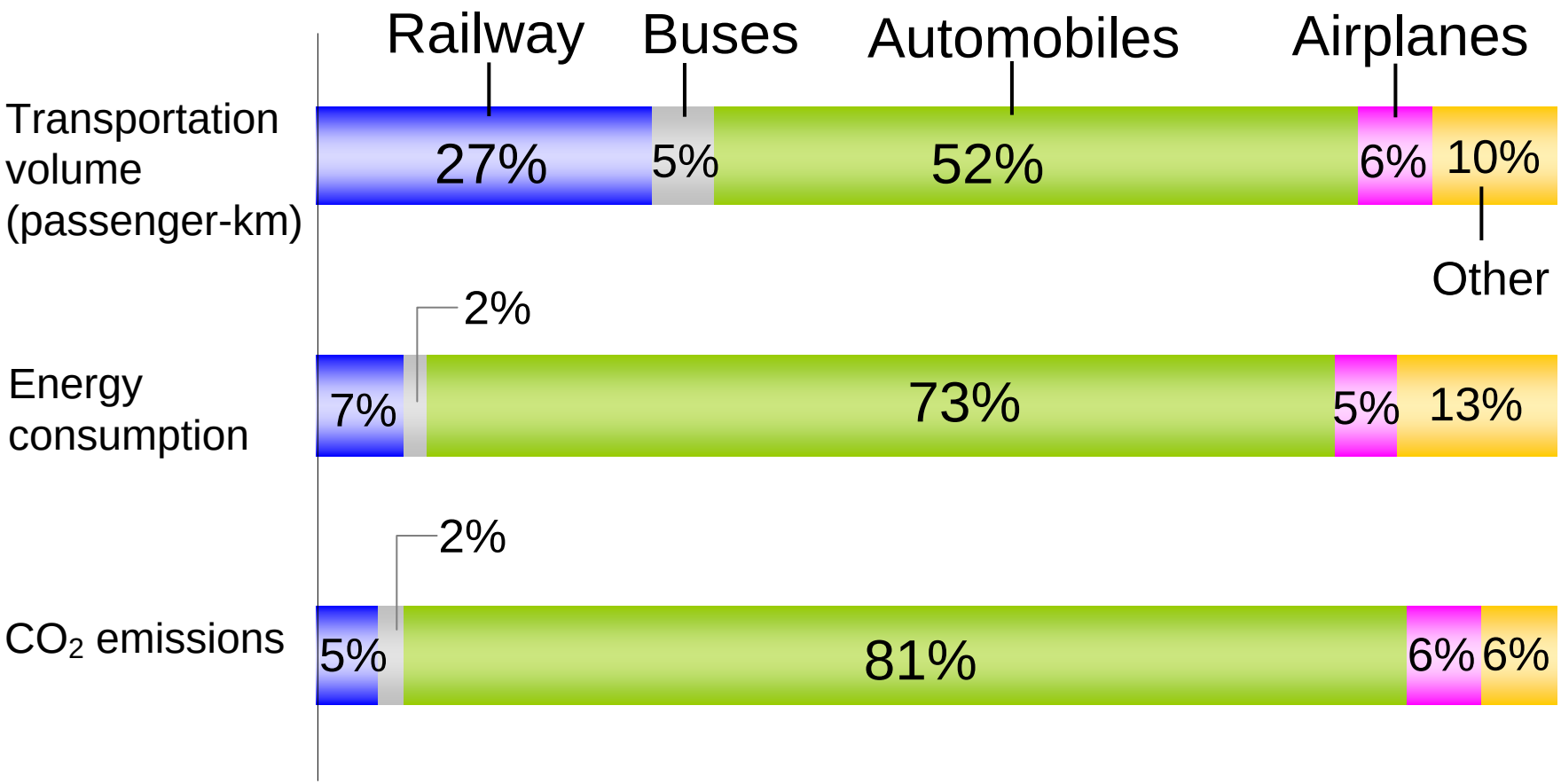
2-2 Passenger Volumes By Rail



2-3 Energy Consumption and CO2 emissions in Japan



Source: Ministry of Land, Infrastructure and Transport-Survey on Transport Energy (2006) (FY2004) Greenhouse Gas Inventory

3-1 Lessons from Japan

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- Railway is greener than other transportation methods
- There are still to do for environment.

3-2 Improvement of bullet train's Energy Consumption

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Year	Type	Energy Consumption 1964=100	
		220km/h	270km/h
1964	Series 0	100	-
1986	Series 100	75	-
1992	Series 300	73	91
1999	Series 700	66	84
2007	Series N700	51	68

*Comparison of Electric Power Consumption between Tokyo and Osaka operated by Central Japan Railway Company

3-3 Challenges for reducing energy consumption

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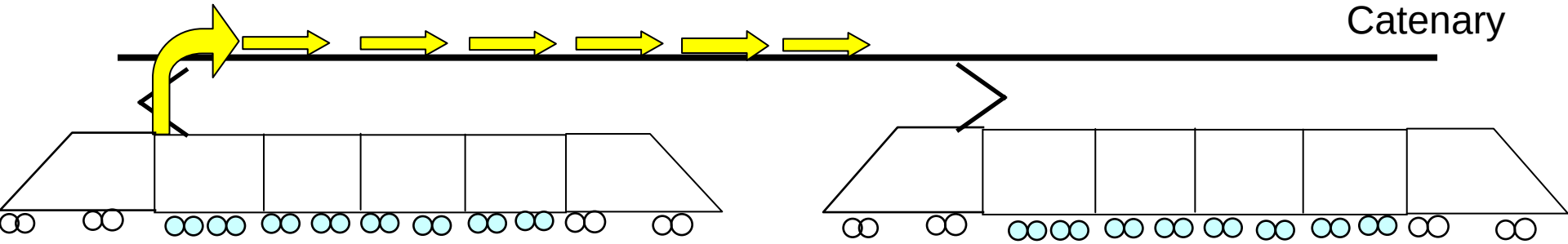
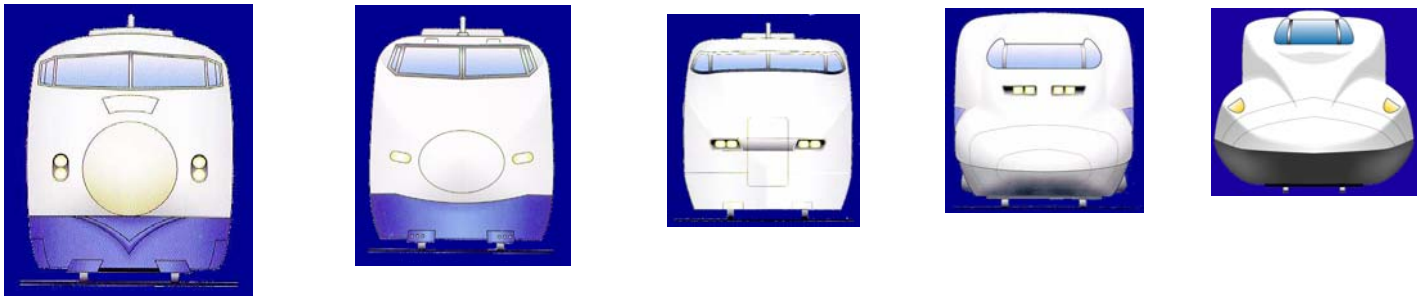
1. Regenerative brakes



2. Light weight



-28%

1964
Series 0

1986
Series 100

1992
Series 300

1999
Series 700

2007
Series N700

3-4 Market Share of Bullet trains vs airplane

Section	Distance	Passenger (day)	Share of Rail
Tokyo-Nagoya	342km	63,000	100%
Tokyo-Osaka	515km	117,000	80%
Tokyo-Hiroshima	821km	13,000	51%
Tokyo-Fukuoka	1069km	26,000	9%

- Current CO_2 emission (Tokyo-Osaka)
  Rail: 280kt Air: 510kt
- If bullet trains carry all passenger Tokyo-Osaka, it is estimated that 440kt of CO_2 (per year) will be reduced.

4-1 Using Regenerative Power for Diesel Trains

- On Electrified Lines, power generated by regenerated braking can be consumed by other trains
- What is the solution for non-electrified lines?

4-2 Solution: Hybrid Diesel Train

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Non-electrified line: Hybrid with on-board storage

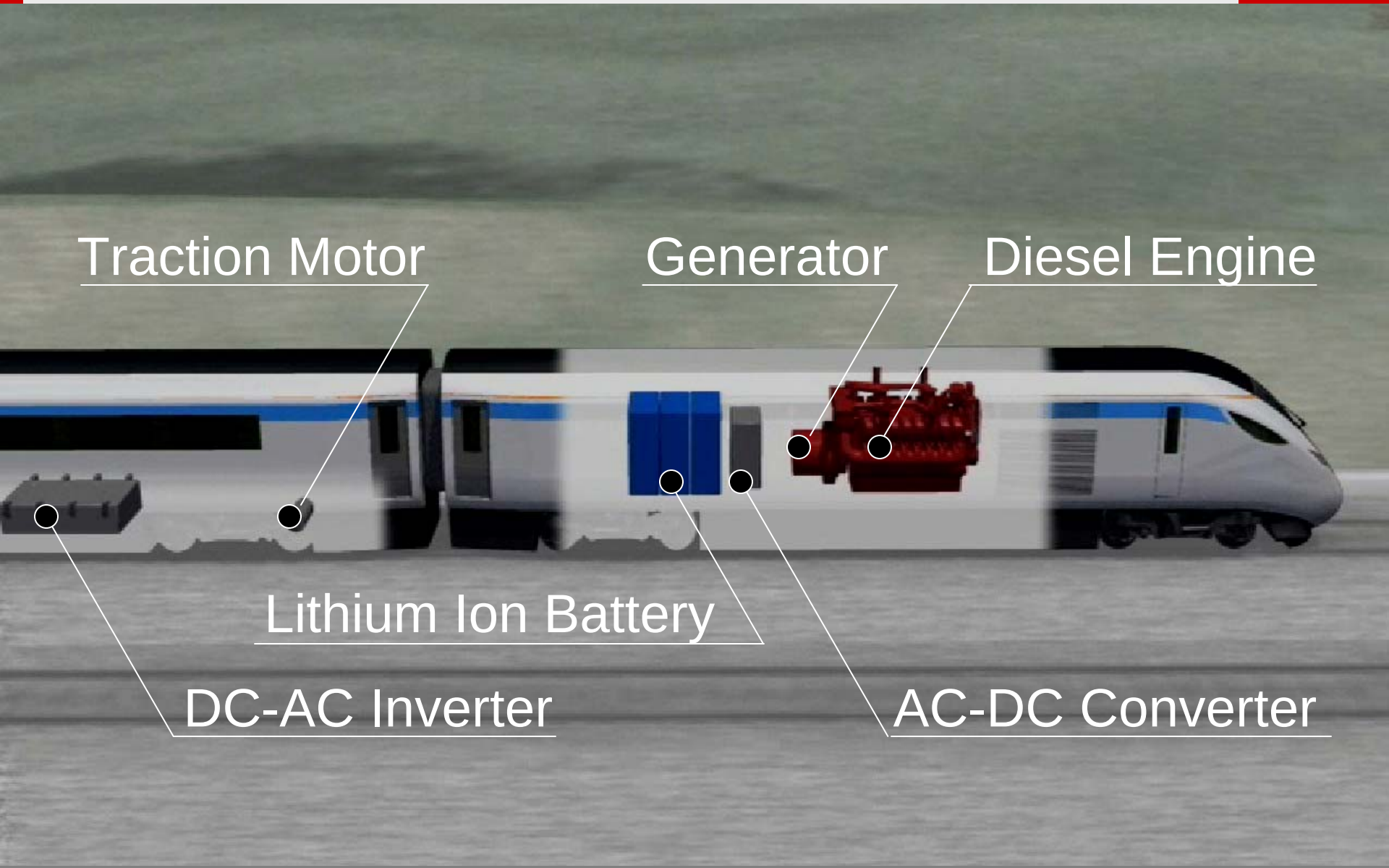
→Hybrid Diesel Trains

20% energy saving

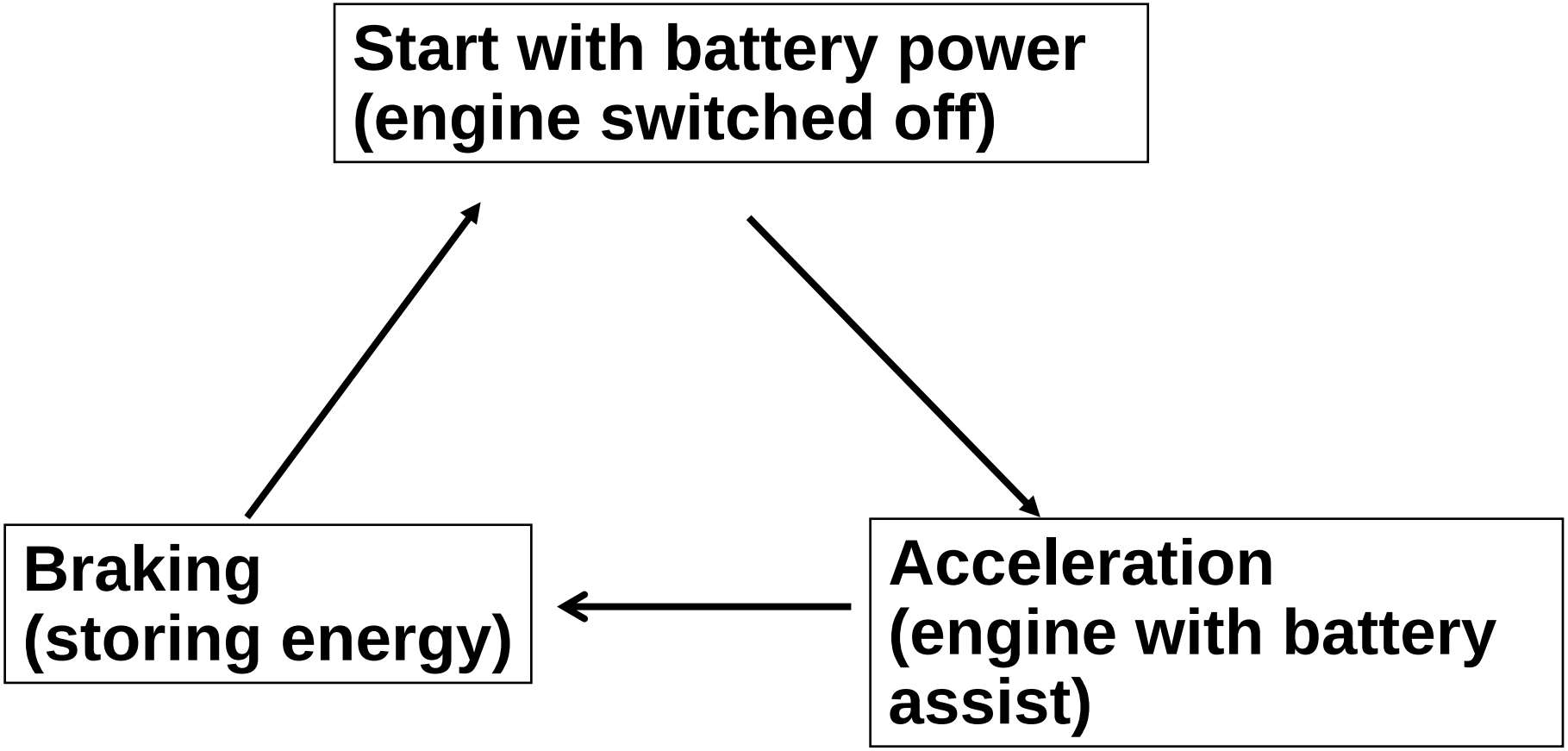
20% reduction of CO2 emission

50% reduction of Nox, PM and HC emission

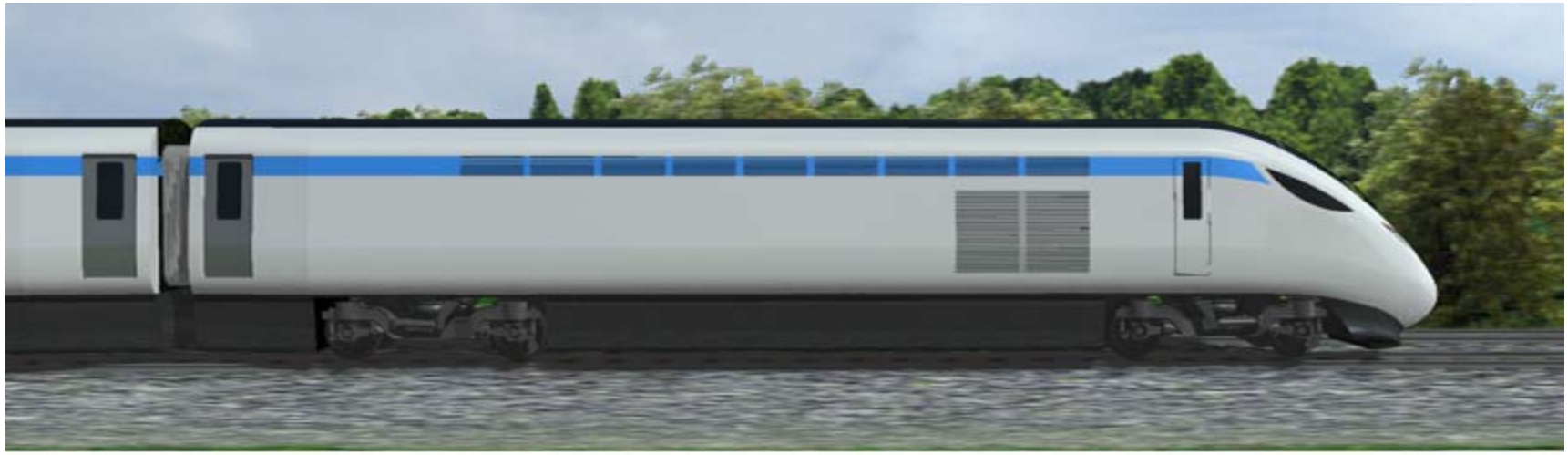
4-3 Hybrid Traction System

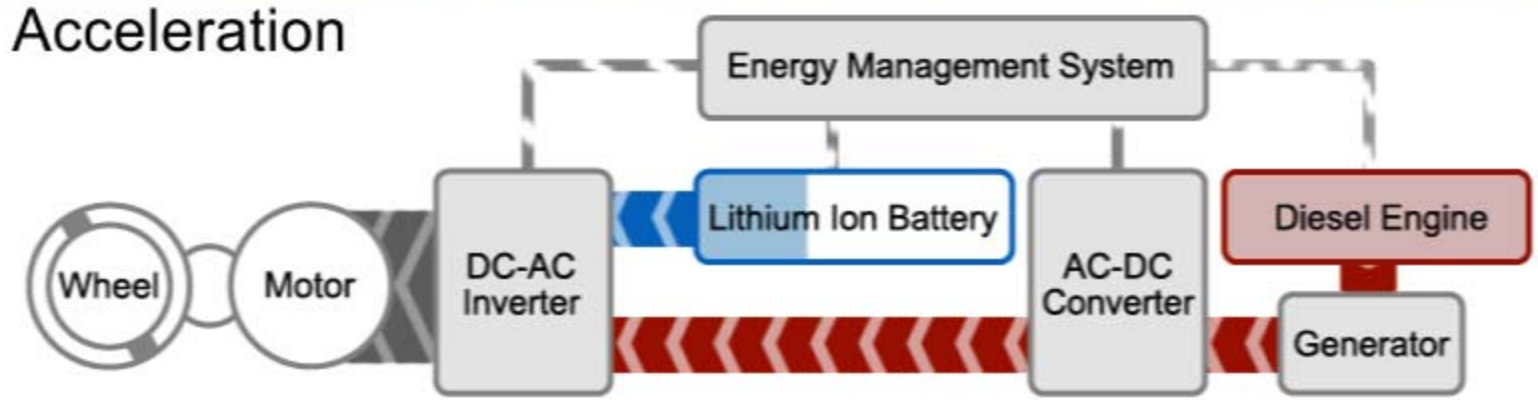


4-4 Hybrid Traction System



4-5 Hybrid Traction System





For further acceleration the Energy Management System will start the engine, and begins to blend the power to keep the engine operating efficiently.

4-6 Hybrid Traction System

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Minimise

Fuel Consumption	**Regenerative power into the battery**
Emissions / Noise	**Keep engine at its most efficient operation point**
	No idling at stations
Route Capacity	**Better acceleration by battery power assist**
Train Performance	**Flexibility on performance improvement with extra battery module**

Maximise

4-7 Development of Hybrid Trains

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NE Train

Kiha E200

High speed

Hybrid traction system for JR-East “NE Train”

1st step:
- Diesel Hybrid system
- Test run started 2003

2nd step:
- Fuel Cell Hybrid system

KihaE200 in passenger service operation since July 2007 on JR-East network

World’s first hybrid HST

Hybrid traction system installed in the HST

To verify energy efficiency and reliability on the routes in UK 2007

4-8 Hayabusa – Hybrid HST in UK

Proving Hitachi's energy saving Hybrid Traction technology in the UK

<u>Partners:</u>

Hitachi Europe Ltd.

Network Rail

Porterbrook Leasing

Brush Traction

4-9 Hayabusa – Hybrid HST in UK

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Launched 3rd May 2007

- Great Central Railway & Midland Mainline Testing Completed

Entered service 30th September 2007

4-10 Hybrid - Implication for the Present

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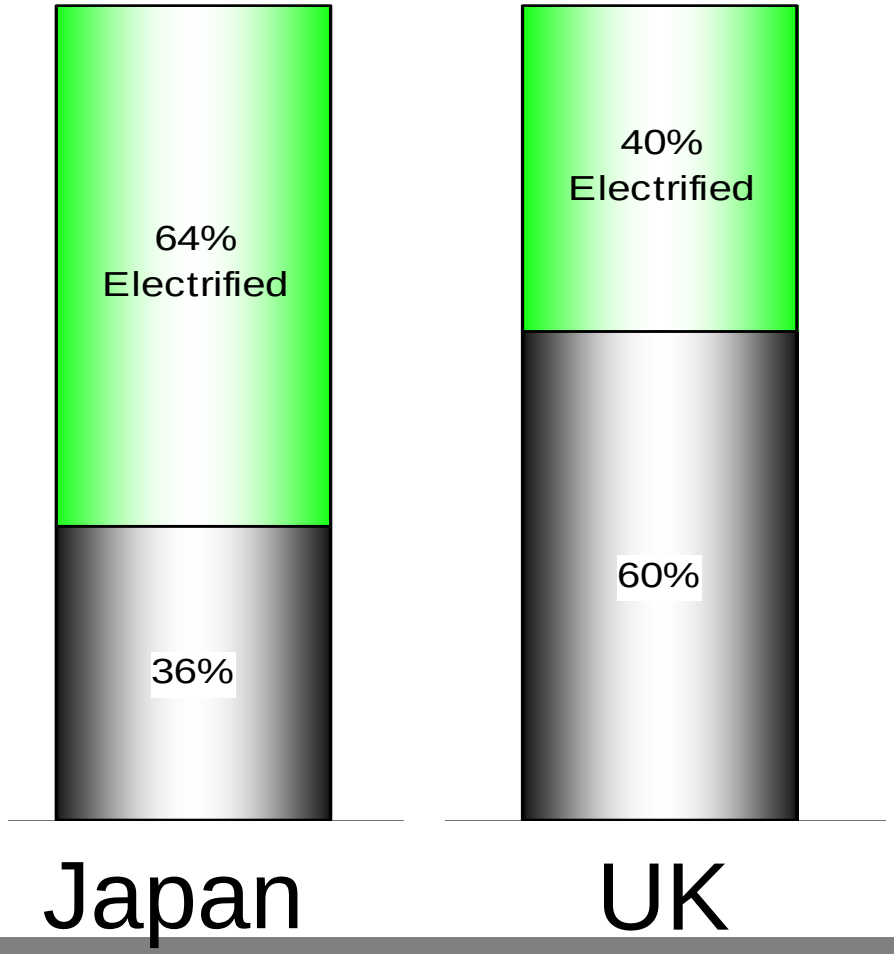
Electrification



60% of UK network could benefit from Hybrid Technology

5. Conclusions

- Railway is greener transportation.
- Electric trains achieved significant reduction of environmental impacts.
- Hybrid diesel reduces emissions and energy consumption.

Tomorrow's climate is today's challenge.

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Thank you for your attention