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25 September 2012

John Hall
Chief Executive Officer
Queensland Competition Authority
GPO Box 2257
Brisbane Q 4001

Dear Mr. Hall,

Sustainable Electric Traction Pricing – Draft Amending Access Undertaking (DAAU)

Toshiba Corporation welcomes the opportunity of providing this submission to the QCA in response to the draft decision regarding QR Network's Draft Amending Access Undertaking (DAAU) for sustainable electric traction.

Electric locomotive technology

Development of electric locomotive propulsion systems

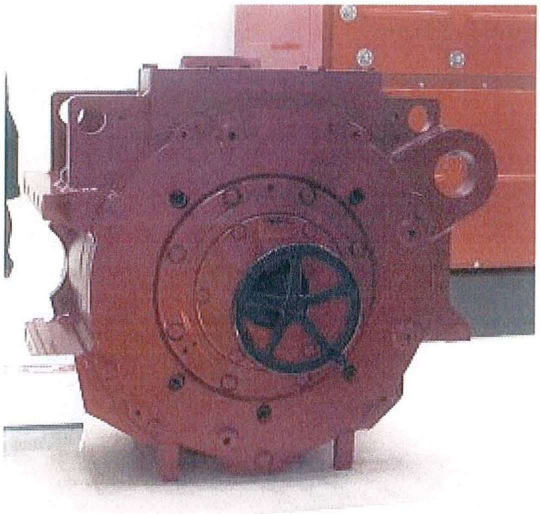
Toshiba developed the first Insulated Gate Bipolar Transistor (IGBT) based propulsion system for the Type EH500 dual voltage electric locomotive for the JR Freight narrow gauge system in 1997. Toshiba applied a forced air cooling system.

In order to meet customer's requirement for a High Power locomotive in the limited dimensions of the Chinese standard gauge, Toshiba developed the IGBT based propulsion system which applied a water circulation cooling system in 2006.

Based on the technologies Toshiba have developed, Toshiba introduced the new IGBT based electric locomotive propulsion system applying water circulation cooling for South African narrow gauge. (The South African loading gauge is similar to that of QR Network in Queensland; Toshiba is able to introduce our South Africa electric locomotive propulsion system with small modification to meet the QR Network requirements.)

In addition, Toshiba have been developing a new propulsion system which utilises a Permanent Magnet Synchronous Motor (PMSM) for the next generation locomotive. PMSM is a more efficient traction motor than conventional traction motors as the rotor of the traction motor is embedded with permanent magnets in lieu of a traditional winding thus reducing the traction motor's copper losses with savings on electrical usage and maintenance costs over the life of the locomotive.

The narrow gauge PMSM traction motor that Toshiba had developed was displayed at InnoTrans 2012 which is the largest exhibition in railway industry in the world as per photograph 1.



Photograph 1: Displayed PMSM for narrow gauge electric locomotive

Latest electric locomotive development (evidence of continuous improvement)

Our supply reference of electric locomotives (EL) is attached for your information. (Appendix-1) Toshiba have been continuously improving efficiency, maintainability and eco-friendliness which are major concerns of our customers.

Next generation electric locomotives for heavy haul freight

Toshiba has under development several items for new generation locomotives which are unfortunately in the confidential domain at the present.

However, Toshiba would also mention that PMSM driving propulsion systems are one of the key items being developed for electric locomotives.

International market for electric traction

Market size and growth

It is mentioned in the report of SCI Verkehr, an independent consultancy company for the transportation sector with activities around world as follows:

		Electric Locomotive (EL)	Diesel Electric Locomotive (DE)L
Market: (Global basis)	Size	5044 locos / year (2010 – 2015)	5520 locos / year (2010 – 2015)
	Growth Rate	1.037	1.342
Market: Asia (except for India & China), Africa & South-America	Size	150 locos / year (2010 – 2015)	555 locos / year (2010 – 2015)
	Growth Rate	1.625	1.108

<Global Market>

Both the Electric Locomotive (EL) market and the Diesel Electric Locomotive (DE)L markets are almost same size, but growth rate for DEL market is more expanding due to strong demand in USA where electric locomotives are no longer produced.

<Asia (except for India & China), Africa & South American Markets>

The market is where narrow or meter gauge are broadly applied. The EL market is smaller, but is expanding compared to the DEL market.

Market participants

Please refer to the below table showing major supplier for each locomotive market:

	EL	DEL
Major Supplier	Toshiba, Bombardier, Siemens, Alstom, CNR, CSR, Skoda, etc.	GE, EMD

- The DEL market is substantially a dominant market of GE and EMD since the major component, the Diesel Engine package, is provided under license by GE or EMD in many cases.
- On the other hand, the EL market is a relatively open market where many suppliers are competing with each other without constraint.
- Toshiba, not only produces complete locomotives, but also supports locomotive manufacturers (UCW, Dloco, Datung, and Rotem) as a propulsion supplier at the same time.
- The same position is taken by Bombardier, Siemens, Alstom and Skoda who are also major suppliers for complete locomotives, implying that the EL market can be under severe competition for electric locomotives as well as major components.

Barriers to entry and other considerations for the Australian market

Toshiba does not see particular barriers to enter the Australian market at the moment. But specific requirements which are based on an existing locomotive can create a barrier.

Summary of relevant case studies (see appendix for details)

In October 2007 the Japan International Cooperation Agency (JICA) submitted a feasibility study on the development of dedicated freight corridor for lines in India. According to this report, Electric Traction is more cost effective than Diesel Traction. (Please refer to "Appendix-2".)

Comparison of electric and diesel traction

General considerations

According to Toshiba's analysis, "Total Cost of Ownership of EL vs. DEL (Ref. No.: SSD-DA-D-0252)", electric traction system has an advantage from the point of view of total cost. Initial cost, maintenance cost and operation cost for both locomotive types and ground facilities are estimated in this analysis, the operation cost was found to be dominant to the total cost. One of the reasons is the effect of regenerative braking of electric locomotive. Regenerative braking contributes to the reduction of the total energy consumption and it is shown a distinctive advantage in an electric system.

Comparative analysis of electric and diesel locomotives

As mentioned above, the Toshiba comparative analysis for the cost of electric locomotives and diesel locomotives shows the cost of an electric locomotive is lower than that of a diesel locomotive.

In general, the purchasing cost for an electric locomotive is higher than that of a diesel locomotive. But in the case of electric locomotive, higher power is achieved. This means that fewer locomotives are required to be purchased. (Refer to Section 4 of this document.)

Considering maintenance, electric locomotive maintenance requirements are less than those required for diesel locomotives. This is due to the diesel engine, which requires a large volume of maintenance works in comparison to that required by the static equipment on-board an electric locomotive.

In addition, electric locomotives operation cost (= electricity cost) is lower than diesel locomotive operation cost (fuel cost) due to the effect of regenerative braking of the electric locomotives.

Environmental impacts of electric and diesel technologies

In general, the diesel engine operation is a source of generation of NOx, which may be a cause of air pollution and acid rain. NOx is emitted and distributed along the railway line where a diesel system is utilised; therefore the electric system is more efficient than a diesel system from an environmental point of view where emissions can be better controlled at the source.

Operational efficiency (energy, cost, lifespan, maintenance, performance

Operation cost (electricity cost for electric system, fuel cost for diesel system) is drastically different. The cost of electric system is much lower that that of diesel system.

Refer to Toshiba's analysis "Total Cost of Ownership of EL vs. DEL (Ref. No.: SSD-DA-D-0252)".

Locomotive hauling performance in comparison

In general, a higher power is achieved when using an electric locomotive. This is due to the restriction of the on-board engine size for diesel locomotive.
Essentially an electric traction system contributes as follows:

- Additional freight can be hauled with the same number of locomotives or;
- Fewer locomotives are required to haul the same amount of freight.

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Summary

It is evident that the choice of traction is primarily a question of overall system optimisation, taking all aspects of the railway system into account. Equally important is the perception of competitive market forces and future technological developments, given the long-term nature of rollingstock and infrastructure investments. Therefore, a view of the total cost of operation is as equally important as achieving energy and environmental policy objectives. As AC locomotive propulsion technology is now well established in Australia, there is an opportunity to continue to leverage the opportunities presented by the higher performance characteristics of electric traction through continued investment and utilisation of dedicated heavy rail haulage corridors such as in the Blackwater and Goonyella systems of the QR Network.

Toshiba Corporation appreciates the opportunity of providing this information to the QCA and we look forward to working with other supply chain participants to further their understanding of the issues presented

Yours faithfully,

[redacted]

Remy Reinker
General Manager, Finance & Administration
Company Secretary
Toshiba International Corporation

Appendices

Appendix-1: RAILWAY SYSTEMS Business Overview

Appendix-2: The Feasibility Study on the Development of Dedicated Freight Corridor for Delhi – Mumbai and Ludhiana-Sonnagar in India

Appendix-3: Total Cost of Ownership of EL vs. DEL (Doc. No. SSD-DA-D-0252 Rev.1)

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RAILWAY SYSTEMS
Business Overview

Sep., 2012

Railway Systems Division
Social Infrastructure Systems Company

Toshiba Corporation

Table of Contents

☐ Introduction of Toshiba Corporation

☐ Toshiba's Railway Business

☐ Particular Experience of Locomotives

Company Profile

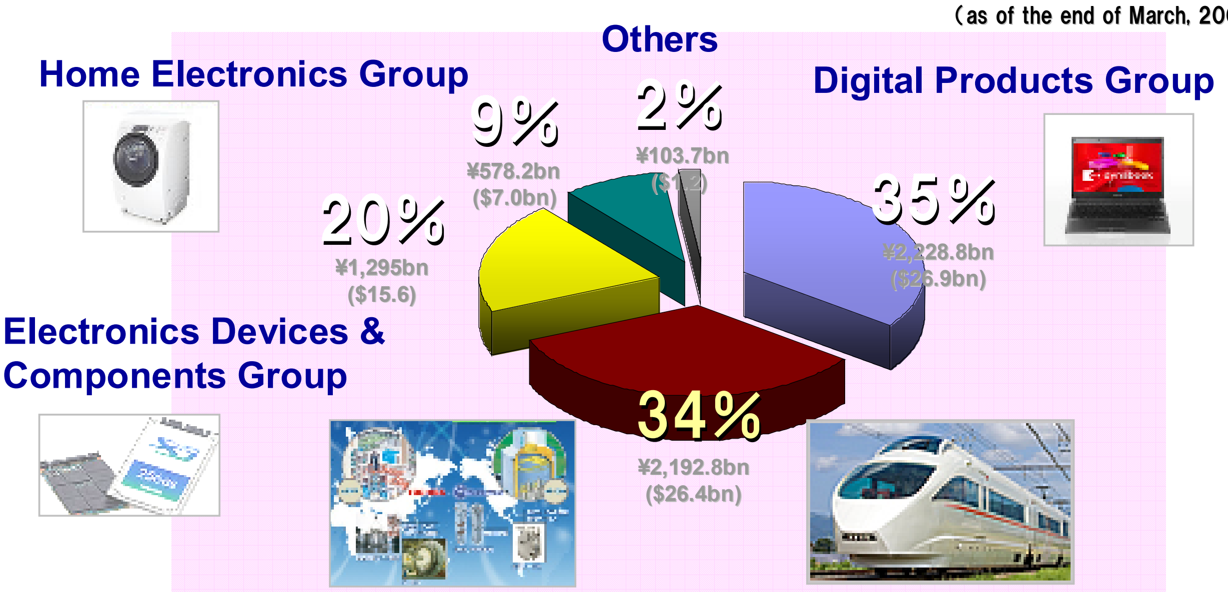
Establishments: 2nd of July, 1875
Location: 1-1-1 Shibaura, Minato-ku, Tokyo
Capital: ¥440bn ($5.3bn)
Total Assets: ¥5,379bn ($64.8bn)
Net Sales: Consolidated - ¥6,399bn ($77.1bn)
Non-Consolidated - ¥3,591bn ($43.3bn)
Employees: Consolidated - 202,638
Non-Consolidated – 34,686

(As of July 6, 2011)

Committed to People, Committed to the Future. TOSHIBA

Business Segments（All Toshiba Group）

（as of the end of March, 2009）



Infrastructure Systems Group

Social Infrastructure Systems Company — Railway Systems Division

Power Systems Company

☐ Introduction of Toshiba Corporation

☐ **Toshiba's Railway Business**

☐ Particular Experience of Locomotives

Toshiba Railway Systems

1) History:

- Start of railway business in **1899**
- First export of electric trains in **1954** (for Argentina)

2) Core Competency:

Development, design, integration and services for

- **Vehicle Systems**

(Propulsion Systems, Train Information Systems/Train Safety Systems, Auxiliary Power Supply Systems, Air Conditioning Systems, Locomotives)

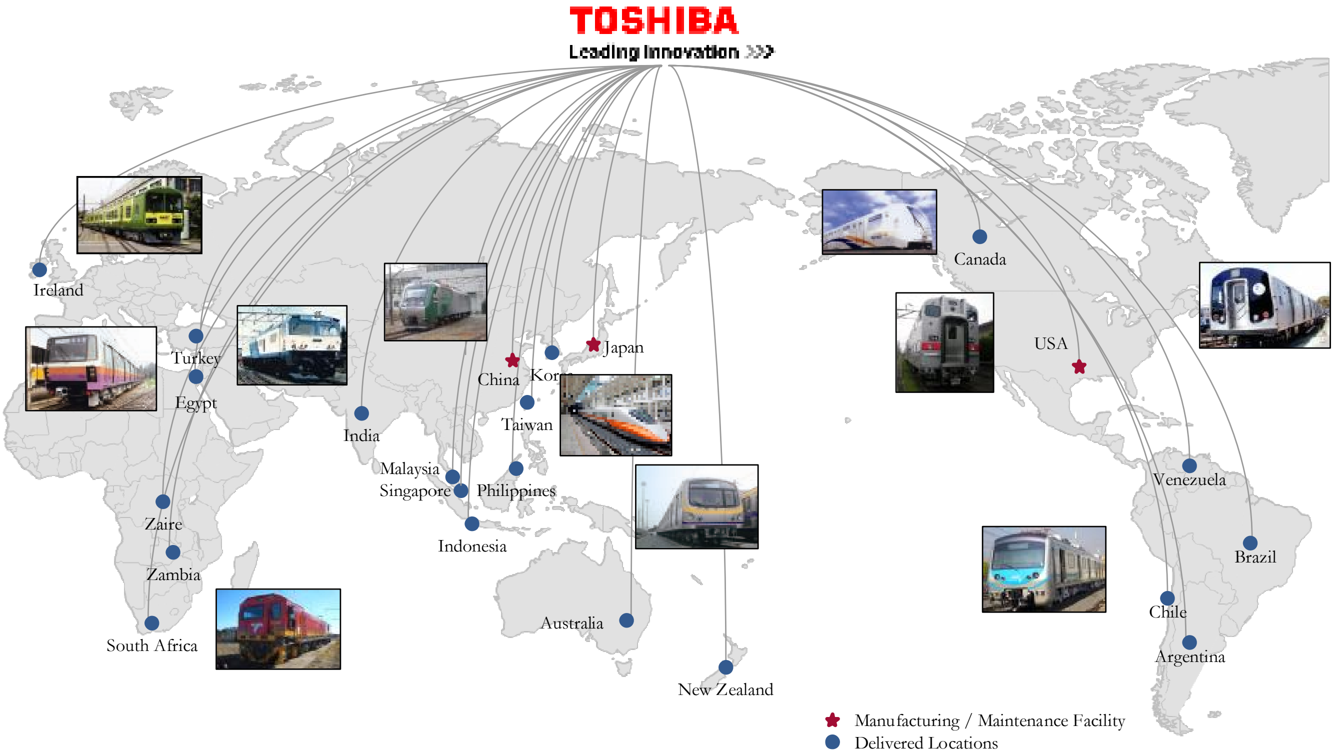
- **Power Supply Systems**
- **Information Systems**

3) Major Customers:

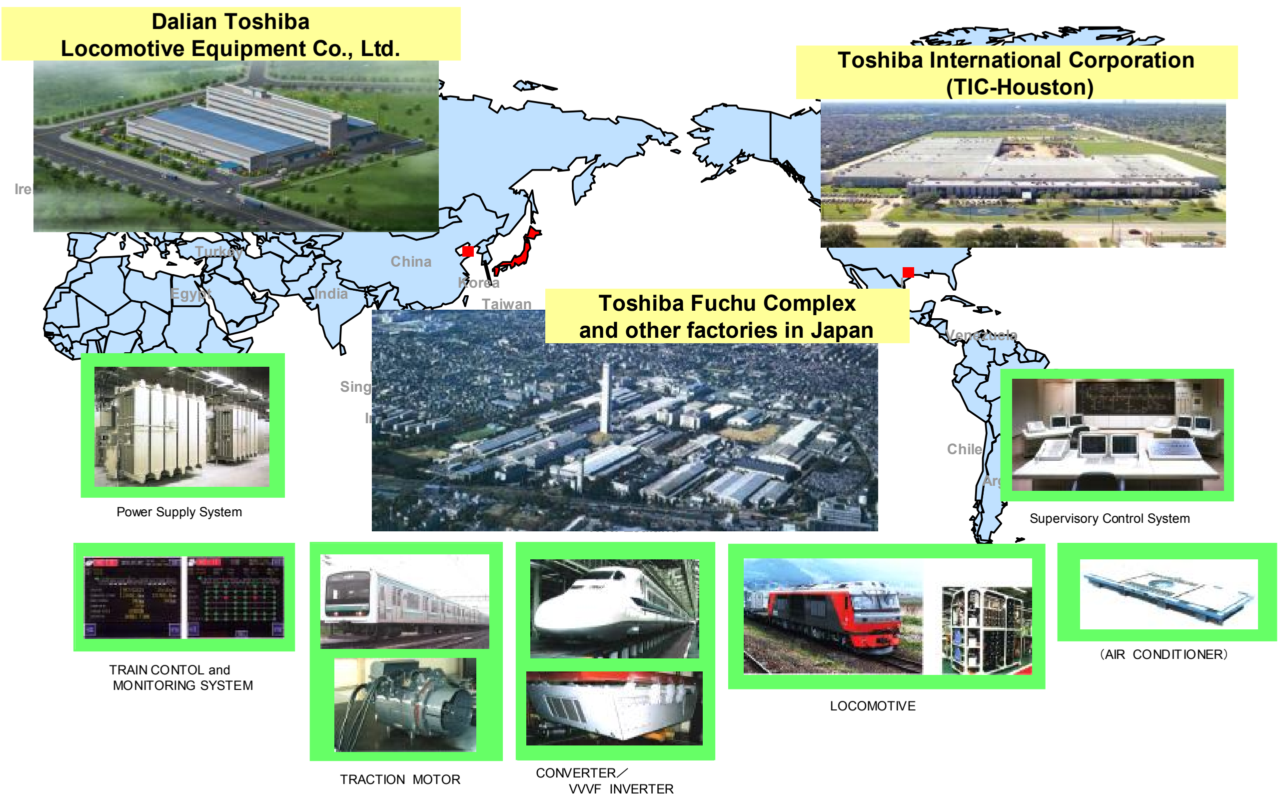
- Japanese Market: Japan Railways, major municipal railways, major private railways
- Overseas Market: Korea, China, Taiwan, Hong Kong, Philippine, Malaysia, Singapore, Indonesia, Turkey, Egypt, South Africa, EU, Ireland, Canada, USA, Mexico, Venezuela, Brazil, Argentina, etc.

World Wide Experiences

Toshiba's railway system technology is widely-applied to all over the world



World Wide Production Network



World Wide Experiences - Propulsion System for Rolling Stock

Electric Multiple Unit

China

Wuhan Metro Line 1 (China)
750V DC

Brazil

CENTRAL
3000V DC

Philippine

Metro Manila Light Transit Authority (Philippine)
1500VDC

Taiwan

Taiwan Railway Administration
25kV AC

High Speed Train

Taiwan

Taiwan High Speed Rail Corp.
Max. 300km/h
25kV AC

Japan

for JR Central
Max. 300km/h
25kV AC

- ☐ Introduction of Toshiba Corporation
- ☐ Toshiba's Railway Business
- ☐ **Particular Experience of Locomotives**

Electric Locomotive Type EH500 JR Freight

◆AC/DC Dual voltage electric locomotive with IGBT technology

Own design & work
In Japan

- JR Freight Co. (Japan)
- Type: EH500
- Electric locomotive
- No. of locomotives: 78
- Catenary Voltage: 20 kV AC (50/60Hz) and 1500 VDC
- Power: 4000 kW
- VVVF Inverter
- Axle Arrangement: (Bo-Bo)-(Bo-Bo)
- Weight: 134.4 tons
- Max. Speed: 110 km/h

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Electric Locomotive Type EH200 JR Freight

◆DC voltage electric locomotive with IGBT technology

Own design & work
In Japan

- JR Freight Co. (Japan)
- Type: EH200
- Electric locomotive
- No. of locomotives: 24
- Line Voltage: 1500 VDC
- Power: 4520 kW
- VVVF Inverter
- Axle Arrangement: (Bo-Bo)-(Bo-Bo)
- Weight: 134.4 tons
- Max. Speed: 110 km/h

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Electric Locomotive 10E/10E2 for South Africa

◆DC3000V Locomotive

Collaboration work with Local Manufacturer

- South African Transport Services (SATS)
- Year Supplied : 1985-92
- Type & No. of locomotives: 50 (10E) + 25 (10E2) sets
- Catenary Voltage: 3000 Vdc
- Power: 3090 kW
- Motor Rating: 515 kW-870 V-640 A-762 rpm
- Axle Arrangement: Co-Co
- Weight: 120 tons
- Max. Speed: 90 km/h

Electric Locomotive HXD3 Loco for China

◆7200kW heavy haul locomotive for China

Collaboration work with Local Manufacturer

- Ministry of Railway (China)
- Type HXD3 electric locomotive
- Number of Locos: more than 1500
- Catenary Voltage: AC25kV-50Hz
- Rated Power 7200 kW
- Axle Arrangement: Co-Co
- Axle Load: 23 tons, 25 tons
- Weight: 138 tons, 150 tons
- Max. Speed: 120 km/h

Electric Locomotive South Africa

◆19E Locomotive for Transnet Freight Rail

Collaboration work with Local Manufacturer

- Transnet Freight Rail (South Africa)
- Application: To haul Wagons for Coal Link
- No. of locomotives: 110 sets
- Contract awarded: 2006
- To be delivered in: 2008-2011
- Catenary Voltage: 25000 V ac and 3000 Vdc
- Power: 3000kW
- Axle Arrangement: Bo-Bo
- Weight: 100 tons
- Max. Speed: 120 km/h

Electric Locomotive South Africa

◆15E Locomotive for Transnet Freight Rail

Collaboration work with Local Manufacturer

- Transnet Freight Rail (South Africa)
- Contract awarded: 2006
- To be delivered in: 2009-2011
- Application: To haul wagons for Iron Ore Line
- No. of locomotives: 44 sets
- Catenary Voltage: 50000 Vac
- Power: 4500kW
- Axle Arrangement: Co-Co
- Weight: 180 tons
- Max. Speed: 90 km/h

Ongoing Contract Korea Railroad Corp.

◆8500 Locomotive for Korea Railroad

Collaboration work with Local Manufacturer

(Under mass production)

- Korea Railroad (Korea)
- Contract awarded: 2010
- To be delivered in: 2011
- Application: freight haulage
- No. of locomotives: 87 sets
- Catenary Voltage: 25000 Vac
- Power: 6600 kW
- Axle Arrangement: Co-Co
- Weight: 132 tons
- Max. Speed: 150 km/h

Diesel Electric Locomotive Type DF200 JR Freight

◆*DEL controlled by IGBT traction system*

Collaboration work with domestic Car Builder

- JR Freight Co. (Japan)
- Type: DF200
- Diesel electric locomotives
- No. of locomotives: 30
- Power: 1800 kW
- Engine: 1250kW-1800 rpm (x 2 engines)
- VVVF Inverter
- Axle Arrangement: (Bo)-(Bo)-(Bo)
- Weight: 96 tons
- Max. Speed: 110 km/h

Diesel Electric Locomotive Malaysia KTMB

◆*DEL controlled by IGBT traction system*

- KTMB (Malaysia)
- No. of locomotives: 20
- Diesel Output: 2580 kW
- Bogie Arrangement: Co-Co
- Max. Speed: 120 km/h
- Output Capacity: 2028 kW
- 6 axis individual control
- Forced Air Cooling

Collaboration work with Chinese Manufacturer

Diesel Electric Locomotive Type HD300 JR Freight

◆*Diesel Hybrid Locomotive featured with Li-ion Battery and PMSM*

- JR Freight Co. (Japan)
- Type: HD300
- Rated Output: 500 kW
- Motor Rating: 125 kW
- Controlled by: IGBT
- Axle Arrangement: Bo-Bo
- Weight: 60 tons
- Max. Speed: 45 km/h

- Engine-generator
  6 Cylinders 4Cycle Water Cooled
  160kW-1600 rpm
- Battery
  Li-ion 750V-60 kWh

Own design & work In Japan

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Total Cost of Ownership of EL vs DEL

2012-09-18

General

Estimated necessary cost

A) EL Operation

- A1) Initial Cost (Electrification cost)
- A2) Initial Cost (Electric Locomotive Cost)
- A3) Maintenance Cost (Electrified Facility Cost)
- A4) Maintenance Cost (Electric Locomotive)
- A5) Operation Cost (Electricity Cost)

B) DEL Operation

- B1) Initial Cost (Fuel Charge Facility Cost)
- B2) Initial Cost (Diesel Electric Locomotive Cost)
- B3) Maintenance Cost (Diesel Electric Locomotive)
- B4) Operation Cost (Fuel Cost)

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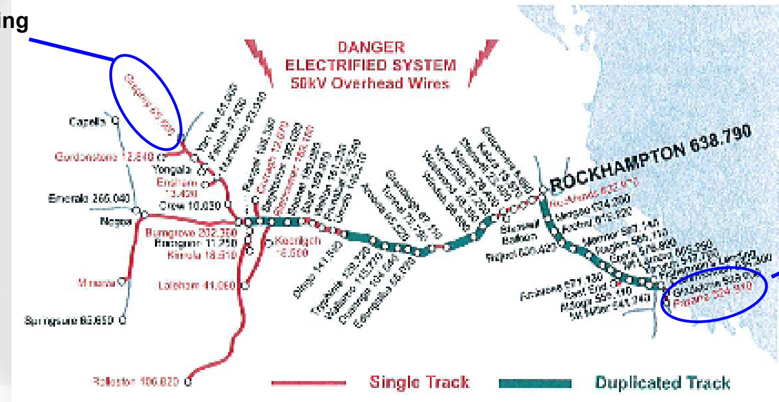
General

General Condition of the study

- Blackwater line (electrified or non-electrified)

Gregory Siding



Parana

Blackwater line

- **Total 837.2 km (supplied data)**
- **Running simulation for operation cost is done between Gregory Siding and Parana (369.88 km)**

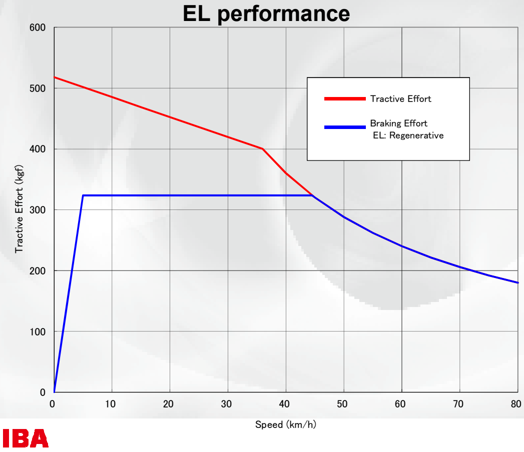
General

General Condition of the study

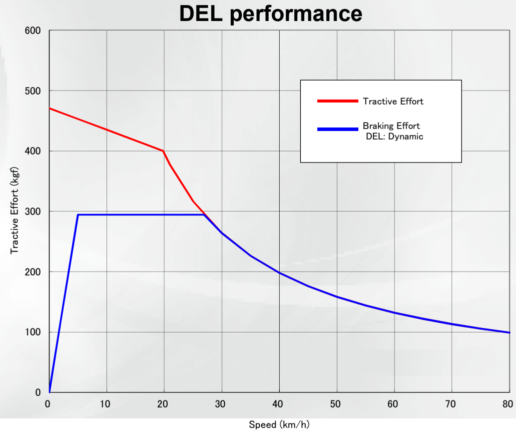
Feature of Locomotive

	EL	DEL
Power source	Electricity	Diesel Fuel
Maximum Power	4,000 kW	2,200 kW
Weight	132 tons	120 tons
Performance / loco	See below	See below
Trainset	3 locos + 98 wagons	4 locos + 98 wagons

EL performance



DEL performance



General

General Condition of the study

- 30 years revenue operation (2013 – 2042) for total cost analysis

Note : "supplied data" in this document means data from QR national received on 4th of Sep. 2012.

Summary of the Cost

Summary of the cost

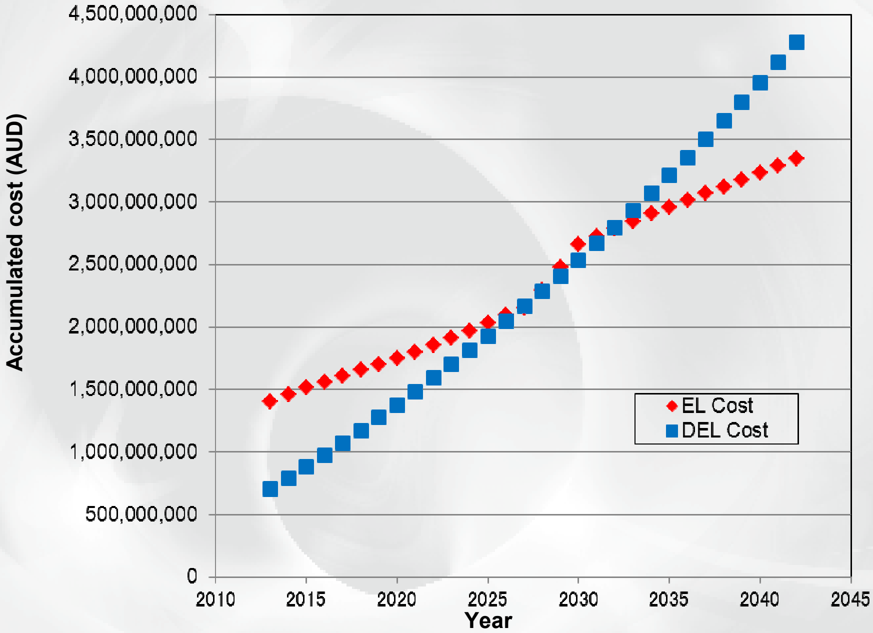
	EL (AUD)	DEL (AUD)	Remarks
Initial Cost (Electrification cost) …..A1)	1,001,040,000		P8
Initial Cost (Fuel Charge Facility Cost) …..B1)		250,000,000	P9
Initial Cost (Locomotive Cost) …..A2), B2)	340,836,300	371,947,264	P11
Maintenance Cost (Electrified Facility Cost)..A3)	1,126,349,616		P9, P10
Maintenance Cost (Locomotive) …..A4), B3)	389,639,862	791,331,341	P19, P20
Operation Cost …..A5), B4)	489,165,425	2,864,205,255	P12 – P18
Total Cost	3,347,031,203	4,277,483,859	

The operation cost is majority of the difference.

The total cost of EL system is lower than that of DEL system.

Summary of the cost

Summary of the cost



Break point of the accumulated cost is around 2027.

Accumulation of the cost (2013 – 2042)

Cost Analysis Relevant to Ground Facilities

A1) Initial Cost (Electrification cost)

Only for EL

Electrification Cost

837.2 km --- supplied data

700,000 AUD / km --- supplied data

Feeder Station

10 feeder stations --- assumption

41,500,000 AUD / substation --- supplied data

	Unit Price (AUD)	Quantity	Total (AUD)
Electrification Cost	700,000	837.2 km	586,040,000
Feeder Station	41,500,000	10 sets	415,000,000
Total			1,001,040,000

Cost of A1)

Cost Analysis Relevant to Ground Facilities

B1) Initial Cost (Fuel Charge Facility Cost)

Only for DEL

Fuel Charge Facility Cost

250,000,000 AUD --- data in the discussion on 4th Sep. 2012

Total (AUD)
250,000,000

Cost of B1)

A3) Maintenance Cost (Electrified Facility Cost)

Only for EL

i) Electric Traction Capital Maintenance

- Assumption : 30 years operation (2013-2042)
- Maintenance cost of each year is given in supplied data.
- Distance of supplied data is 837.2 km

Distance	Cost	Total (AUD)
837.2 km	(Supplied data)	735,481,284

Cost Analysis Relevant to Ground Facilities

ii) Maintenance capex - electrification group

- Defined annual data as “1,852 AUD/km” in supplied data.

Unit cost	Distance (km)	Year	Total (AUD)
1,852	837.2	30	46,514,832

iii) Maintenance capex – feeder stations

- Defined annual data as “1,147,845 AUD/FS” in supplied data

Unit cost	Set	Year	Total (AUD)
1,147,845	10	30	344,353,500

Total of i), ii) and iii)

i)	ii)	iii)	Total (AUD)
735,481,284	46,514,832	344,353,500	1,126,349,616

Cost of A3)

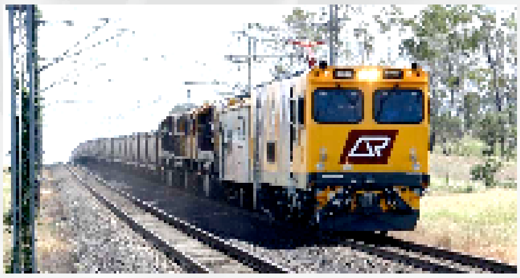
A2) Initial Cost (Electric Locomotive)
B2) Initial Cost (Diesel Electric Locomotive)

Initial Cost

	Unit Price (AUD)	Loco (sets)	Total Price (AUD)	
EL	7,574,140	45	340,836,300	Cost of A2)
DEL	5,811,676	64	371,947,264	Cost of B2)

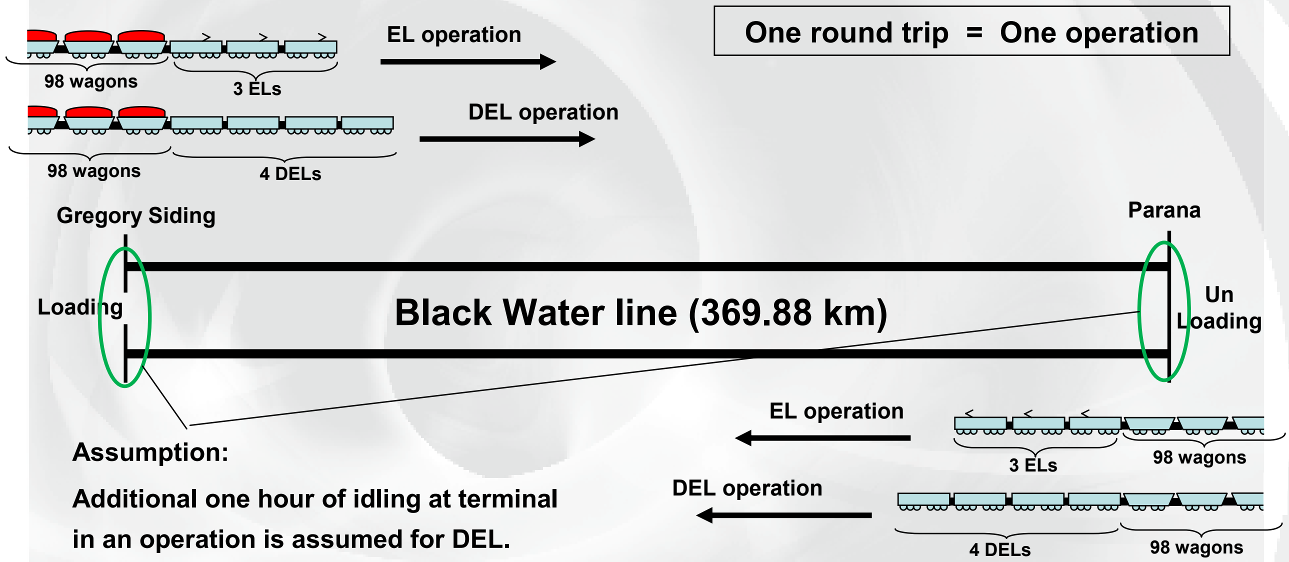
Note 1 : Unit price is given in supplied data.

Note 2 : Refer to Page x for "Loco sets".



A2) Operation Cost (Electric Locomotive)
B2) Operation Cost (Diesel Electric Locomotive)

Operation condition



Assumption:

Additional one hour of idling at terminal in an operation is assumed for DEL.

Cost Analysis Relevant to Locomotives

Operating condition

Operaiton days of each trainset per year = 330 days --- supplied data

Assumption:

Daily operation : 12 operation (12 trainsets x 1 operation per day)

⇨ 12 trainsetsa are under operation everyday.

Under maintenance and/or spare :

EL : 3 trainsets

DEL : 4 trainsets

Note : DEL needs longer period than EL, therefore it is assumed that one more trainset is required.

⇩

EL : 15 trainsets are required.
DE+ : 16 trainsets are required.

⇨

45 ELs are required.
64 DELs are required.

Note : EL : 3 locos in a trainset DEL : 4 locos in a trainset

Cost Analysis Relevant to Locomotives

Running Result

EL

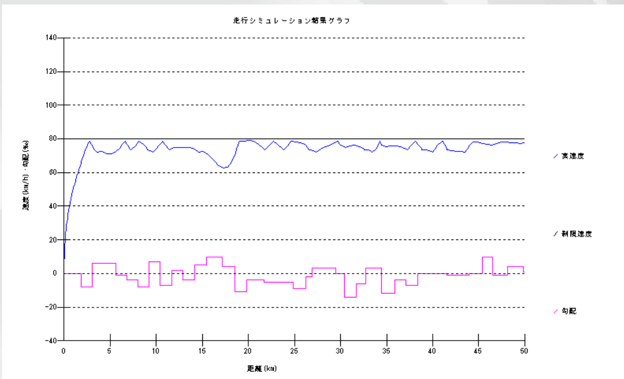
Electricity consumption is calculated with running simulation

Gregory Siding to Parana :

3 locos + 98 wagons with load

Parana to Gregory Siding :

3 locos + 98 wagons without load



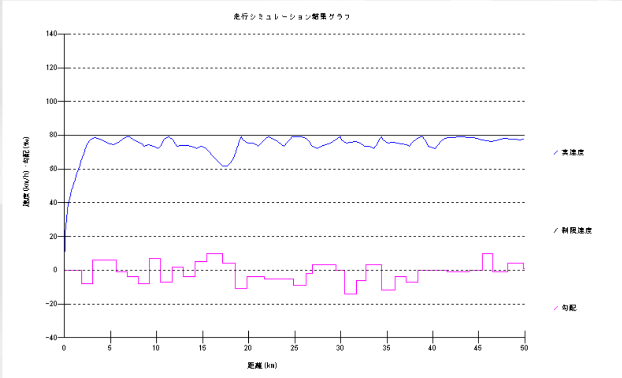
Type	Route	Electricity consumption (kWh)	Total (kWh)
EL	Gregory Siding to Parana	19,284	34,047
	Parana to Gregory Siding	14,763	

Cost Analysis Relevant to Locomotives

Running Result

DEL

Fuel consumption is calculated with running simulation



Gregory Siding to Parana :

4 locos + 98 wagons with load

Parana to Gregory Siding :

4 locos + 98 wagons without load

Type	Route	Fuel consumption	Total (Litre)
DEL	Gregory Siding to Parana	8,982	14,236
	Parana to Gregory Siding	5,104	
	(One hour idling)	150	

Cost Analysis Relevant to Locomotives

Running Result

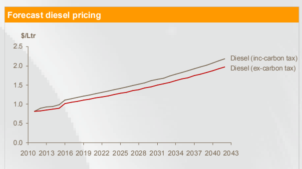
EL : Electricity consumption 34,047 kWh per operation

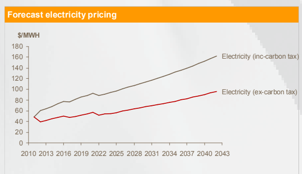
DEL : Fuel consumption 14,236 litre per operation

Electricity cost, Fuel cost :

supplied data is used

(considering annual cost variation)





Type	Consumption	Annual operation	Cost	Total (AUD)
EL	34,047 kWh	12 x 365	(Supplied data)	292,660,226
DEL	14,236 litre	12 x 365	(Supplied data)	2,602,989,263

Cost of A5)

Cost of B4)

Cost Analysis Relevant to Locomotives

Carbon Tax … Electricity/Fuel cost involves carbon tax.

EL : Electricity consumption 34,047 kWh per operation

DEL : Fuel consumption 14,086 litre per operation

EL : 1 ton CO2 generation by 1100 kWh electricity consumption --- supplied data

DEL : 1 ton CO2 generation by 346 litre fuel consumption --- supplied data

→ EL : 34,047 / 1100 = 30.95 ton CO2 generation per operation

DEL : 14,236 / 346 = 41.14 ton CO2 generation per operation

Carbon Tax: supplied data is used

(considering annual cost variation)

Cost Analysis Relevant to Locomotives

Carbon Tax

Type	CO2 generation	Annual operation	Carbon Tax	Total (AUD)
EL	30.95 tons	12 x 365	(Supplied data)	196,505,199
DEL	41.14 tons	12 x 365	(Supplied data)	261,215,992

Type	Electricity/Fuel Fee	Tax	Total (AUD)	
EL	292,660,226	196,505,199	489,165,425	Cost of A5)
DEL	2,575,562,430	258,463,645	2,864,205,255	Cost of B4)

Cost Analysis Relevant to Locomotives

A3) Maintenance Cost (Electric Locomotive)
B2) Maintenance Cost (Diesel Electric Locomotive)

i) Variable cost

- Variable cost of EL is given as 1.0 AUD/loco/km in supplied data.
- Variable cost of DEL is given as 1.3 AUD/loco/km in supplied data.
- Traveling distance per loco per day is as follows
  369.88 km x 2 = 739.76

Type	Unit cost	distance	Operating locos/day	day	Year	Total (AUD)
EL	1.0	739.36	3 x 12	365	30	291,455,712
DEL	1.3	739.36	4 x 12	365	30	505,189,901

Cost Analysis Relevant to Locomotives

ii) Fixed cost

- Fixed cost of EL is given as 72,729 AUD/loco/year in supplied data.
- Fixed of DEL is given as 149,032 AUD/loco/year in supplied data.

Type	Unit cost (AUD)	Loco	Year	Total (AUD)
EL	72,729	45	30	98,184,150
DEL	149,032	60	30	286,141,440

Total of i) and ii)

Type	i) Variable cost (AUD)	ii) Fixed cost (AUD)	Total (AUD)	
EL	291,445,712	98,184,150	389,639,862	Cost of A4)
DEL	505,189,901	286,141,440	791,331,341	Cost of B3)

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