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ISUZU TRUCKS No.1

YEARS

ISUZU

NEW CNG MODELS

Colin White

Manager, Product Planning &
Engineering Support



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CNG as TRANSPORT FUEL

- Australian pipeline natural gas is available in every capital city, and many larger regional centres
- Pipeline gas quality is very good by international standards, and compatible with design criteria for Isuzu CNG vehicles
- Sydney and Melbourne composition shown on next slide



Typical Australian NG Composition

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Table 1. Natural gas compositions

Hydrocarbon gas component	Australian natural gas	Japanese natural gas
Methane	87.4-91.1% (by volume)	84.4 – 100% (by volume)
Ethane	4.7 – 5.4%	0 – 5.5%
Propane	1.0 – 2.3%	0.2 – 2.3%
Butanes	0.3-0.8%	0.1 – 1.0%
C₅+	0.1 – 0.5%	0 – 0.4%

Source: May2004 Report to Australian Greenhouse Office

*percentage of natural gas by volume



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Isuzu's NGV Credentials

- Isuzu first built CNG light duty trucks in 1991, with mass production commencing 1998
- Isuzu has been a strong supporter of CNGVs in the Japanese market
- Isuzu CNGVs command around 70% commercial vehicle market share in Japan
- Cumulative sales to date exceed 10,000 units

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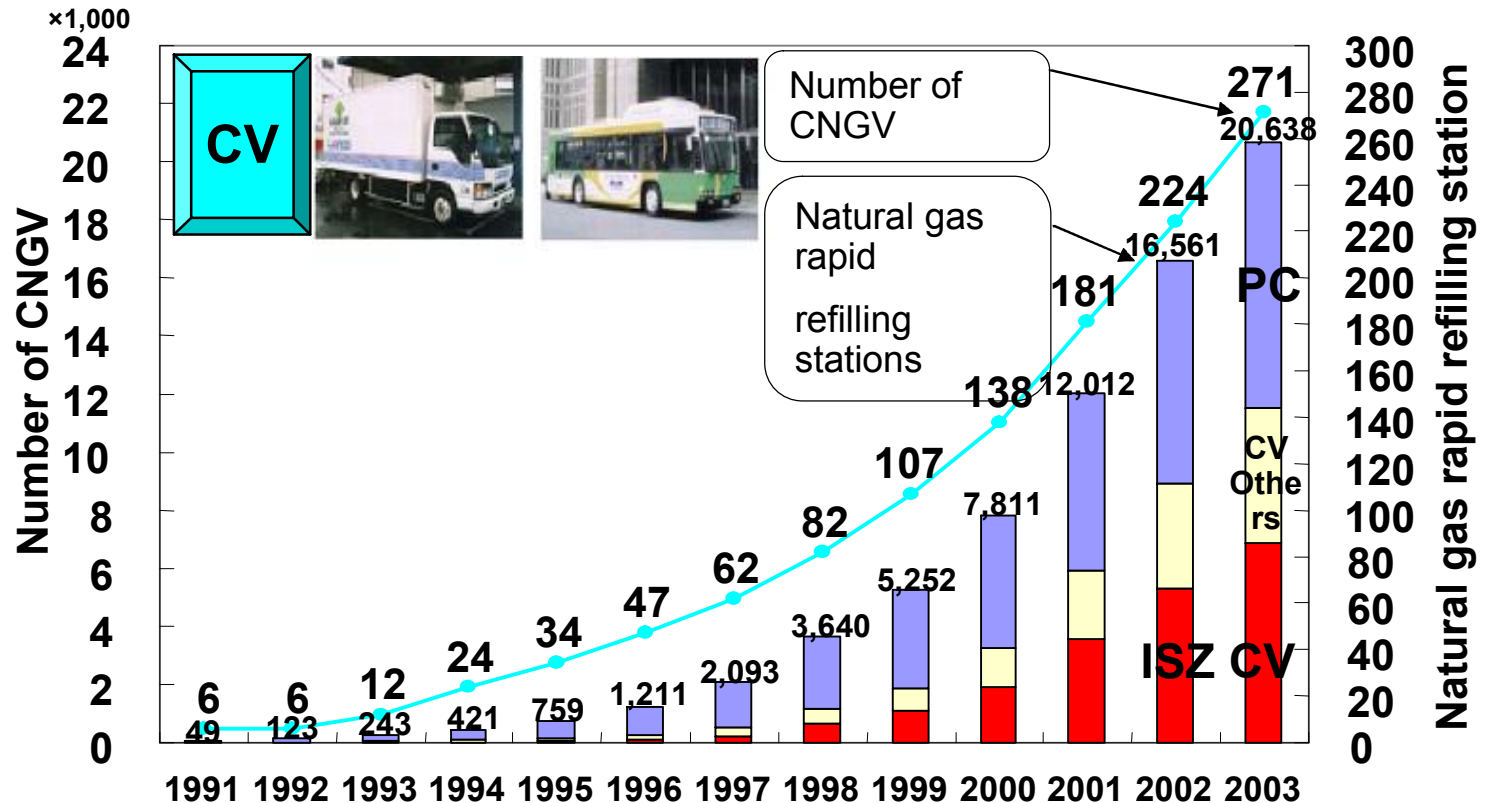
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Popularity of CNG Vehicles in Japan

Many types of vehicle from a low displacement car to a large-sized transit bus are manufactured and sold.



Reference ; Japan Gas Association internet home page
(May. '04)

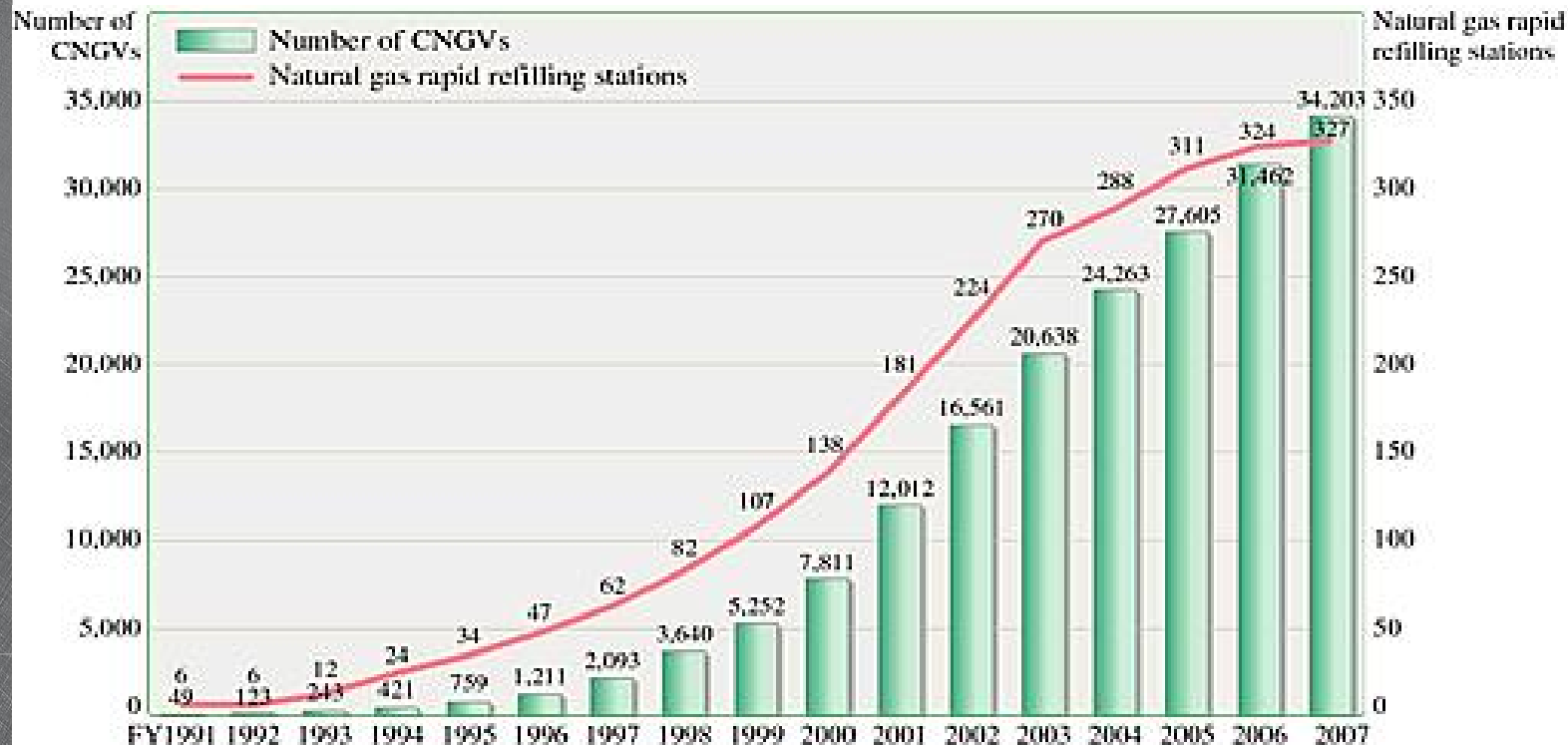
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Popularity of CNG Vehicles in Japan





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NGV's in Australia

- Alas, Australian government support for alternative fuels has been minimal
 - Up to 50% of incremental cost subsidy from 2000-2008, but with tough conditions
 - No successful support program to provide NG re-fuelling infrastructure
 - No preferential access or tax concessions to operators of alternative fuel vehicles
- Overseas governments have been far more proactive:
 - e.g. Sweden, Germany, Italy, Argentina, India, Japan

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ISUZU
NPR 400 CNG



ISUZU
RELIABILITY IS EVERYTHING

AT A GLANCE	
GVM	8,000 kg
GCM	11,000 kg
Engine Type	Isuzu 4HF1-CNG
Displacement	4.3 L
Power	88 kW @ 3,400 rpm
Torque	323 Nm @ 1,500 rpm
Wheelbase	3,345 mm

2004 NPR400-CNG

- Isuzu Australia responded to customer demand, with a plan to initially import up to 30 units of domestic “ELF CNG” trucks
- Customers to be primarily local government
- Assistance from federal government of 50% of incremental cost over diesel model
 - Confirmed after GHG savings of 18% verified
- Local modification to satisfy market demand and Australian Standards for CNG tanks

Local ADR testing for brake system & noise regulation

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NPR400-CNG SALES

- Customers:
 - Waverley Council (inner Sydney): 2 units
 - Gosford City Council (NSW): 6 units
 - Warrnambool TAFE College: 1 unit
 - Salisbury City Council (Adelaide northern suburbs): 6 units
 - Demonstration in WA, then Private customer, TOLL IPEC: 1 unit
- Gosford Council units have been in operation for longest, with good data

Gosford City Council



- GCC fleet initially ordered 5 units with a depot refuelling site
- Project managed well, involving training, unions, all levels of management
- Positive results, even in early days
- Additional unit purchased in 2006



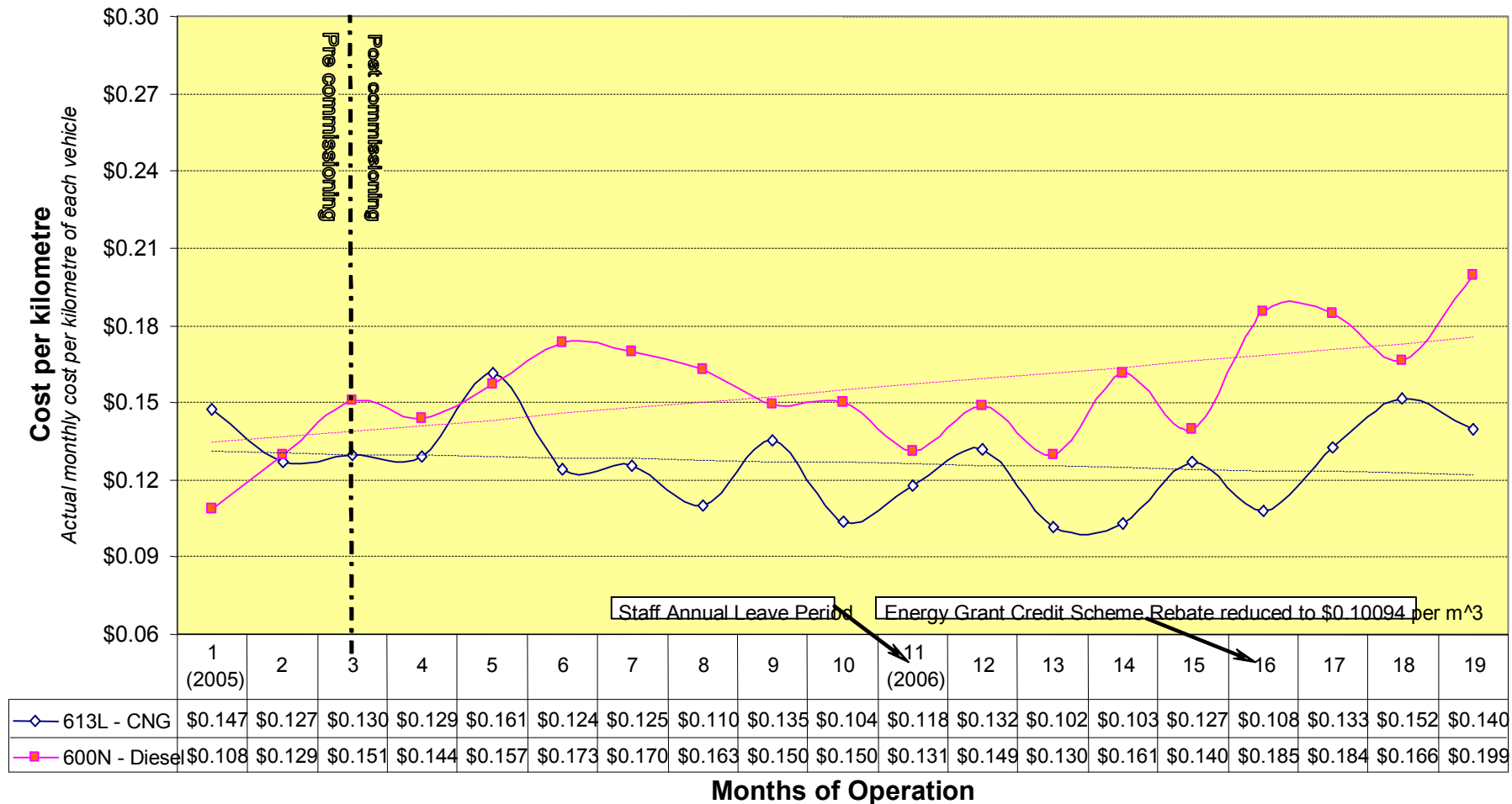
Gosford City Council Results

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- In Service since March 2005
- No engine failures: “just as reliable as the diesel models”
- Demonstrated fuel cost saving
- CNGV Fleet has supported GCC’s low emissions policy of improving air quality
- Project Manager is a keen supporter, and is now Acting Fleet Manager

Operating Data

(613L - Best Performing CNG vs 600N - Best Performing Diesel)



- Cost of operation vs diesel trucks lower, even in 2006



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GCC Latest Running Cost Comparison

- Gosford's recent 40 month project review
 - Started March, 2005
 - **Net Diesel price**, ex-GST and Fuel Tax Credit:
\$0.727 / Litre
 - **Net CNG price** at GCC's own depot:
\$0.491 / m³
 - Latest: June, 2008
 - **Net Diesel price**, ex-GST and Fuel Tax Credit:
\$1.405 / Litre (**increase of 93%**)
 - **Net CNG price** at GCC's own depot:
\$0.462 / m³ (**decrease of 6%, due to new contract with gas supplier**)

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GCC Latest Running Cost Comparison

- Cost savings have improved dramatically over 40 month period
- June 2005: 30% cost saving vs diesel
 - CNG truck average: 11.8 c/km
 - Diesel truck average: 16.9 c/km
- June 2008: 67% cost saving vs diesel
 - CNG truck average: 10.5 c/km
 - Diesel truck average: 31.9 c/km



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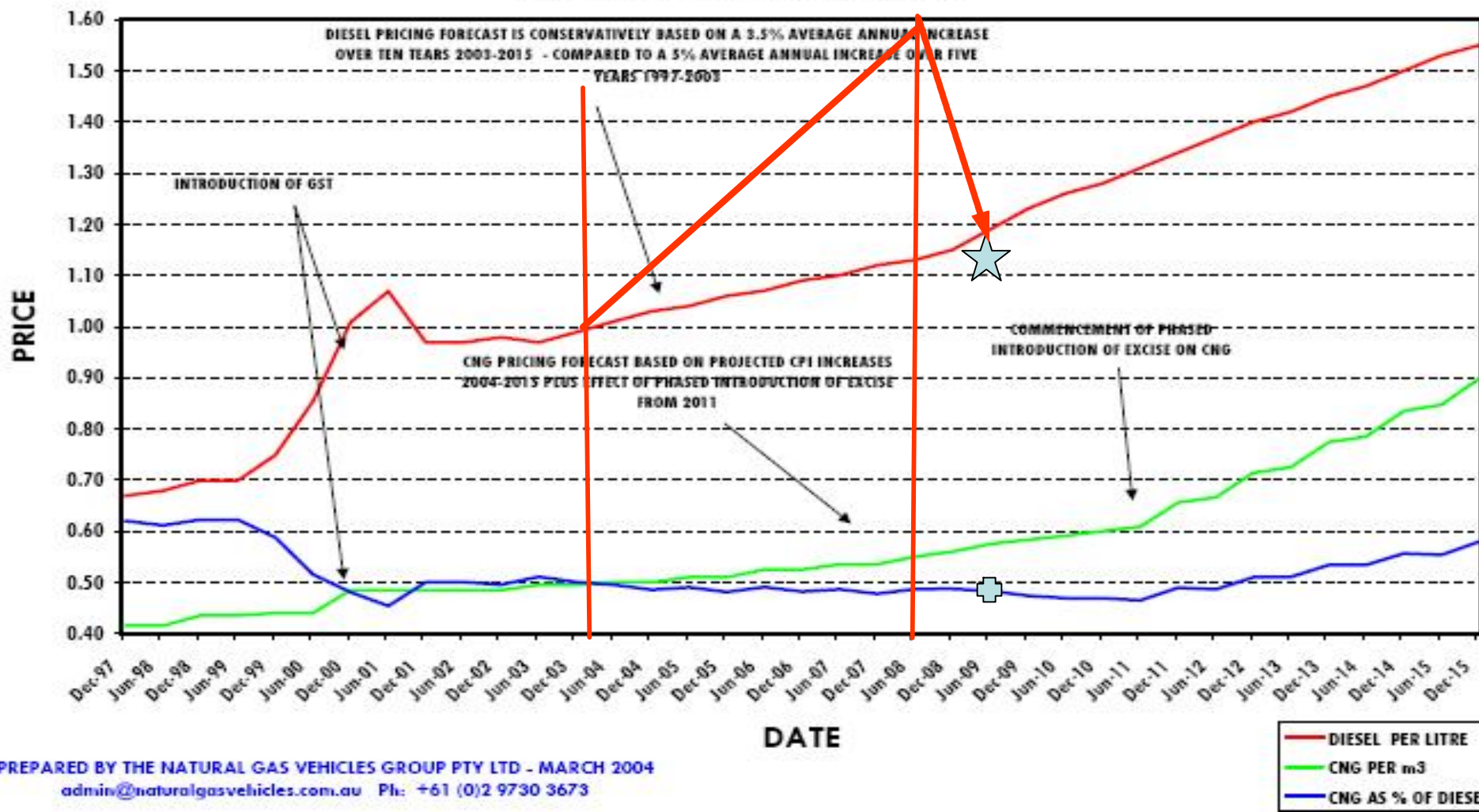
What has changed since 2004?

- Diesel price increased way beyond projections!
- Pump price of diesel:
 - March 2004: approx A\$1.00 / Litre
 - June 2008: A\$1.60 / Litre (and higher), or +60%!
 - May 2009: A\$1.15 / litre
 - Previous (conservative) chart predicted just a 13% rise in same period
- Customer price for CNG is same as projection, or lower in many cases

Projections of Fuel Prices in 2004

COMPARATIVE RETAIL PRICING -DIESEL/CNG

LIKELY PRICE MOVEMENTS INCLUDING POTENTIAL EFFECT OF STAGED INTRODUCTION OF 19 CENTS PER CUBIC METRE EXCISE DUTY ON CNG FROM 2011





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What has Changed since 2004?

- Actual customer data shows CNGV operating cost is now 50% less than diesel models
- Air Quality AND CO₂ reductions are both higher profile concerns than ever before
- Federal Government has announced a Carbon trading scheme for medium and large businesses from 2010 ???????
- Fleets are studying ALL options to reduce carbon footprint ***and*** operating costs, and have become ***very serious*** about alternative fuels.
- Gas suppliers have renewed focus on NGVs

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New Model Release

- **Compressed Natural Gas Range**

NLR200 Medium CNG 4.5 t GVM

NPR300 Medium CNG 7.0t GVM

FSR700 / 850 Medium CNG 12.0 t GVM, & 14.0 t GVM



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Outstanding Low Emission Performance

- Adoption of MPI (Multi Point Injection)

Fuel injection systems

2004 CNG

Gas mixer system
= carburetor equivalent

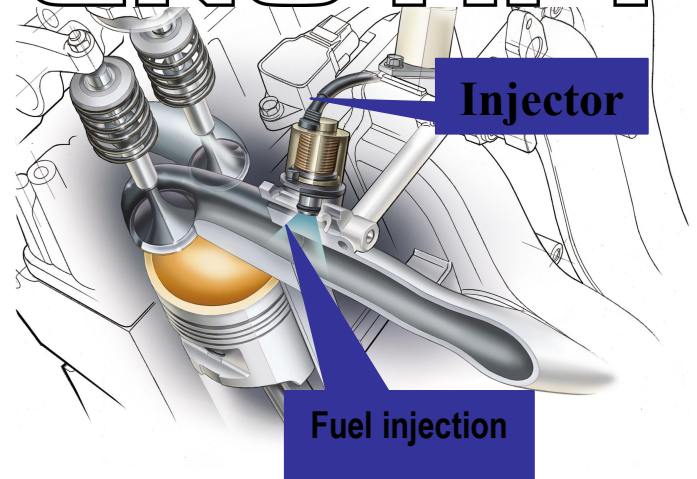
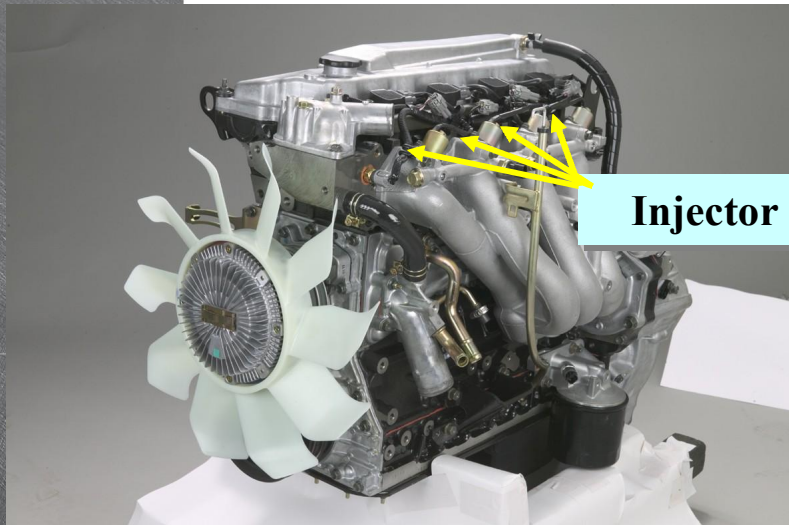
2009 + CNG-MPI

Electronic control injector systems

CNG-MPI

Injector

Fuel injection



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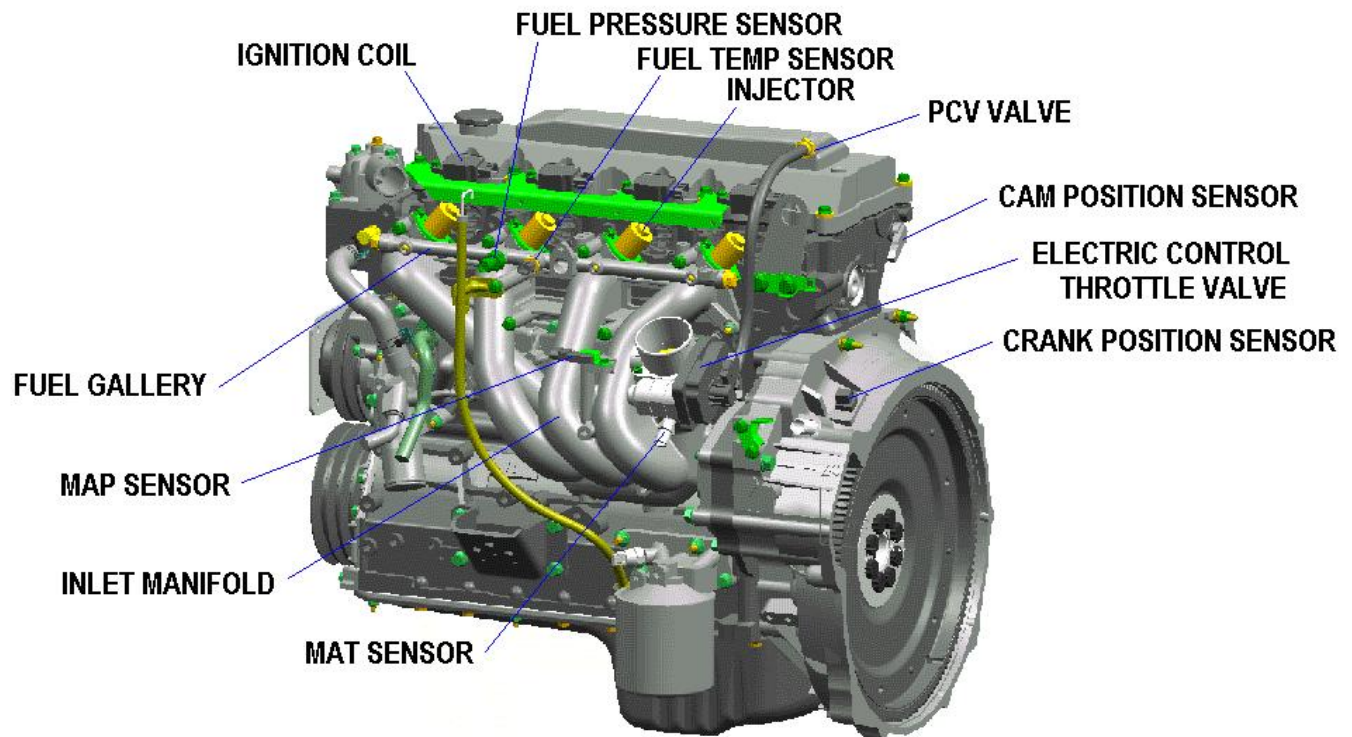
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Isuzu CNG MPI Engine

Isuzu CNG MPI engine achieves 2005 year New Long Term emission standard and Ultra Low Emission Vehicle standard in Japan.



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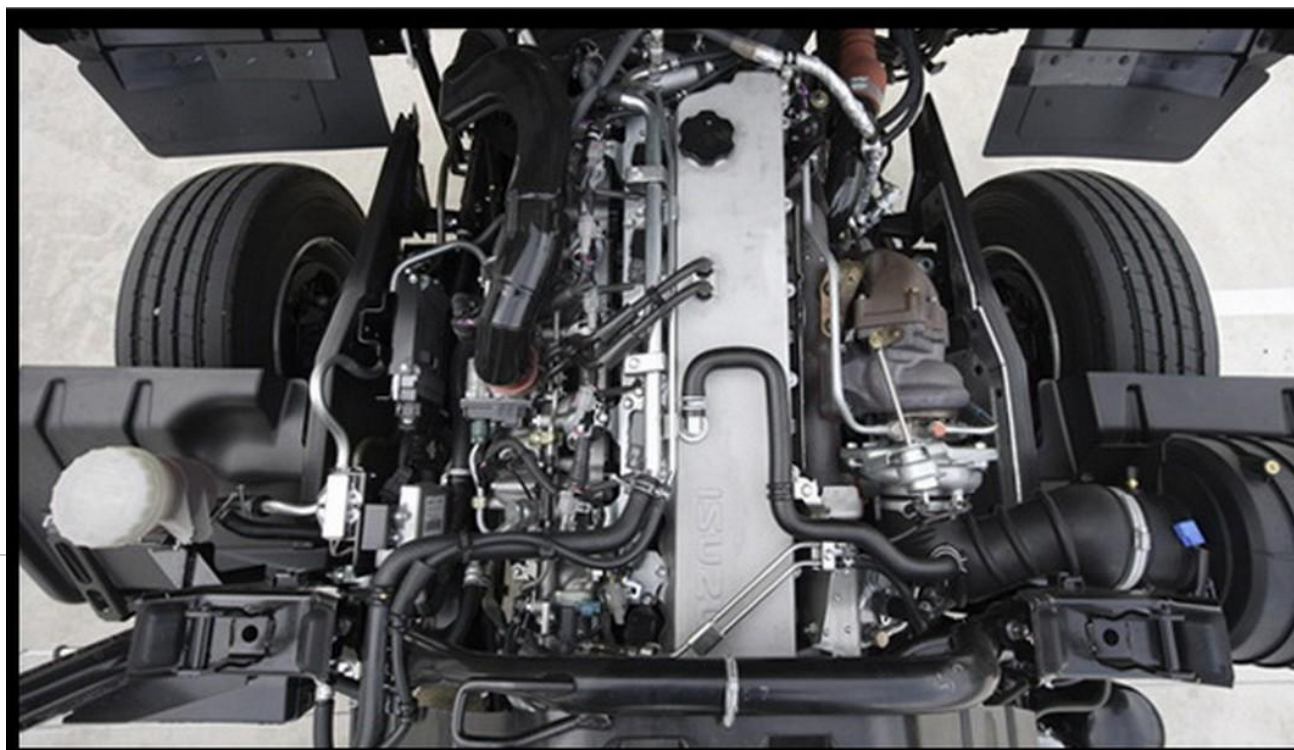
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Outstanding Low Emission Performance

- **Adoption of MPI (Multi Point Injection)**

2009 + CNG-MPI

CNG-MPI



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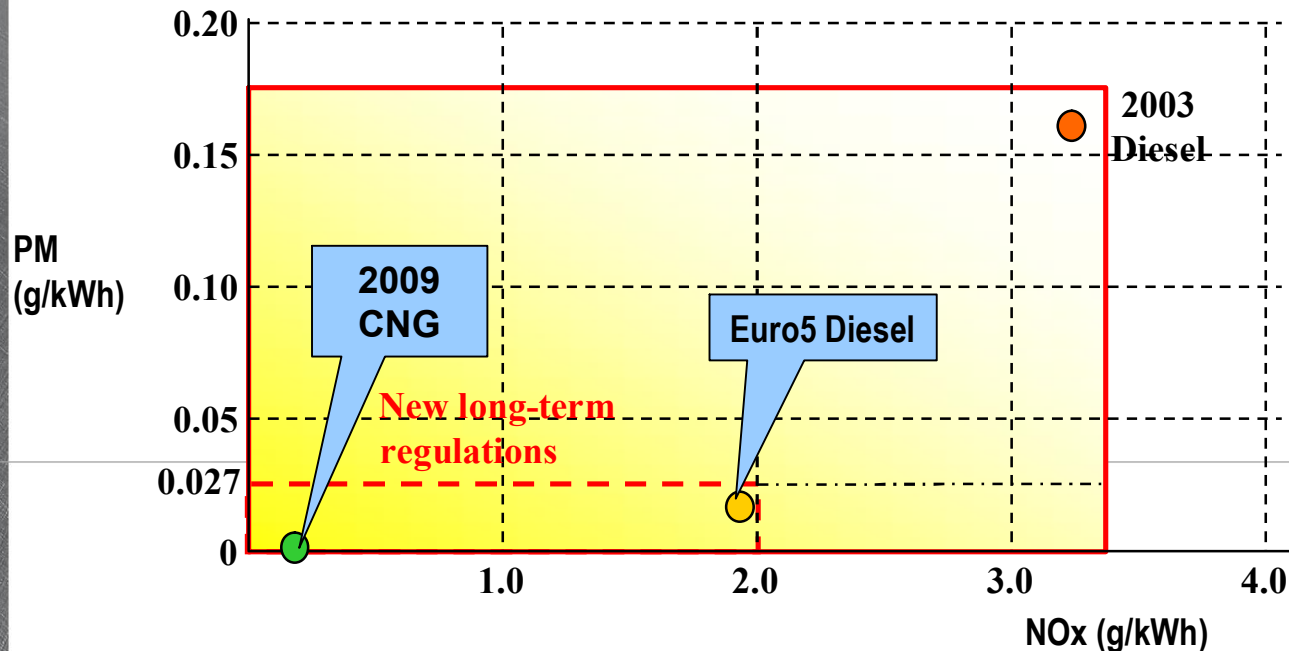
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Outstanding Low Emission Performance

- Easily exceeds JNLT-05 standard
- Better than Euro6 for PM and NOx
- CO2 reductions of 10-20% (vs diesel)



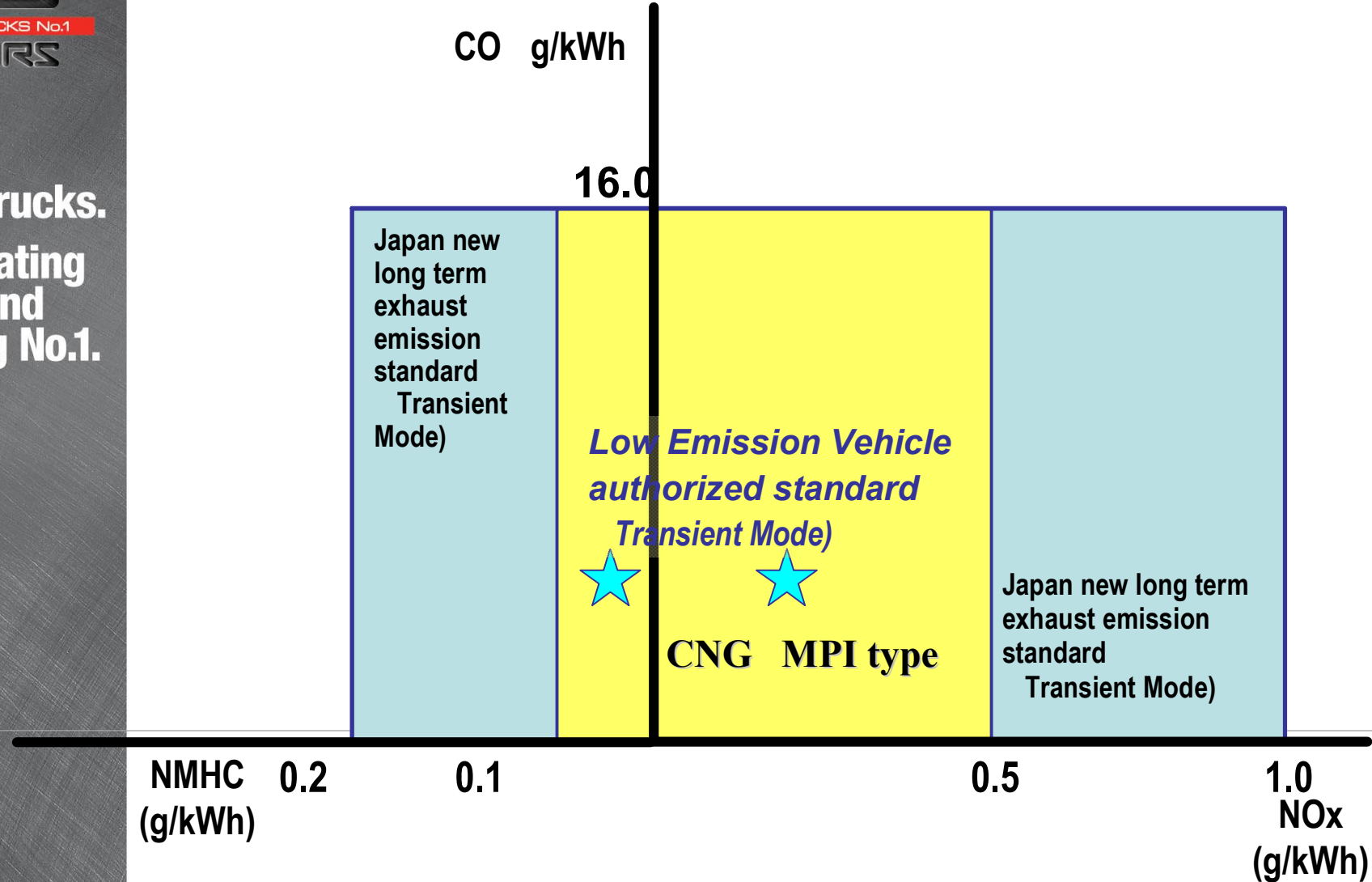
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The MPI engine achieves LEV standard even in the Transient Mode.





Outstanding Low Emission Performance

Exhaust Emissions & Fuel Consumption Comparison vs ADR80/02 Diesel

NPR300	(For Reference)	Isuzu 4HK1-TCN 5.2L ADR80/02 Diesel Engine	Isuzu 4HV1-CNG 4.6L ADR80/03 CNG Spark Ignition Engine	CNG Engine Advantage compared to diesel (%)
Fuel Consumption (Av. Km/L) Aust Expected value		5.88		
Fuel Consumption (Av. Km/m³) Aust Expected value			5.55	
CO₂ "Equivalent" Emissions (g/km)		446	375	18.9%
Official regulation exhaust gas limits comparison:	Euro 4 Standard	Euro 4 Actual	Japan NLT05 Actual	
Carbon Monoxide (CO) (g/kW.h)	4.00	0.01	0.37	90.8%
Non Methane Hydrocarbon (NMHC) (g/kW.h)	0.55	0.005	0.009	98.4%
Nitrogen Oxides (NOx) (g/kW.h)	3.50	2.86	0.19	94.6%
Particulate Matter (PM) (g/kW.h)	0.03	0.005	0.00	100.0%



Outstanding Low Emission Performance

Exhaust Emissions & Fuel Consumption Comparison vs ADR80/02 Diesel

FSR700	(For Reference)	Isuzu 6HK1-TCN 7.8L ADR80/02 Diesel Engine	Isuzu 6HF1-CNG 7.8L ADR80/03 CNG Spark Ignition Engine	CNG Engine Advantage compared to diesel (%)
Fuel Consumption (Av. Km/L) Aust Expected value		4.20		
Fuel Consumption (Av. Km/m ³) Aust Expected value			4.00	
CO₂ "Equivalent" Emissions (g/km)		624	520	20.0%
Official regulation exhaust gas limits comparison:	Euro 4 Standard	Euro 4 Actual	Japan NLT05 Actual	
Carbon Monoxide (CO) (g/kW.h)	4.00	0	0.37	90.8%
Non Methane Hydrocarbon (NMHC) (g/kW.h)	0.55	0.01	0.013	97.6%
Nitrogen Oxides (NOx) (g/kW.h)	3.50	2.69	0.01	99.7%
Particulate Matter (PM) (g/kW.h)	0.03	0.003	0.00	100.0%

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FSR700 / 850 Medium CNG 12.0 t GVM, & 14.0 t GVM

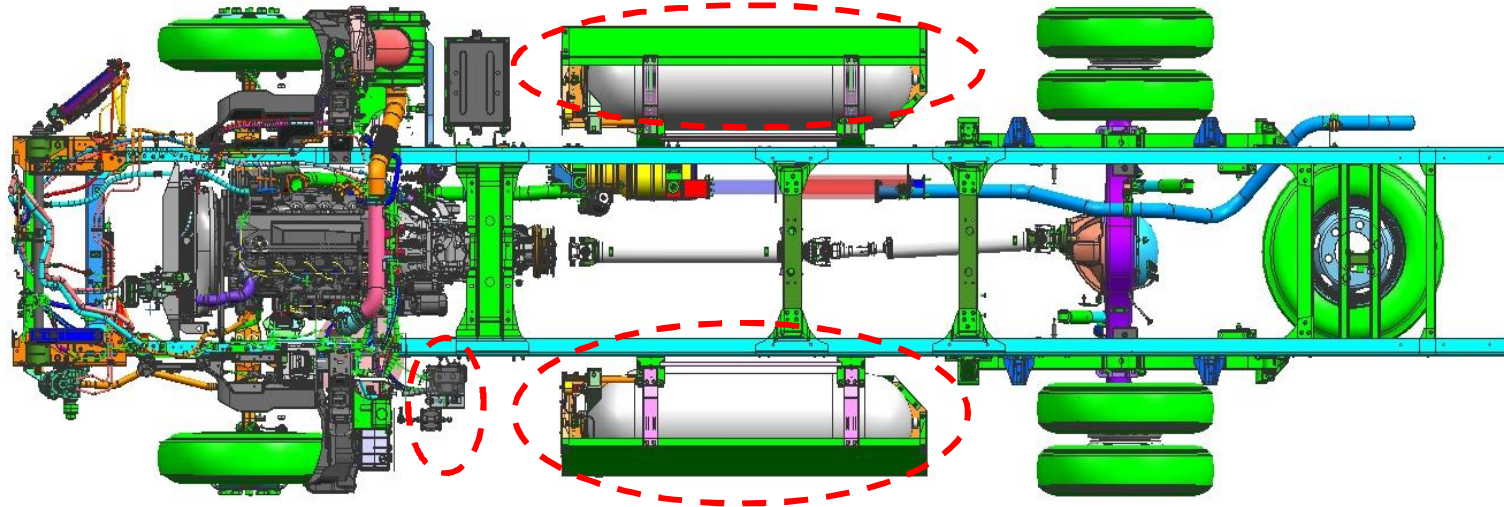


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CNG NPR LAYOUT



ENG/Drive line/Frame/Sus&Axle/Brake/Fuel line: will be applied same spec as domestic model

Cab B.I.W. will be applied 700P IAL spec

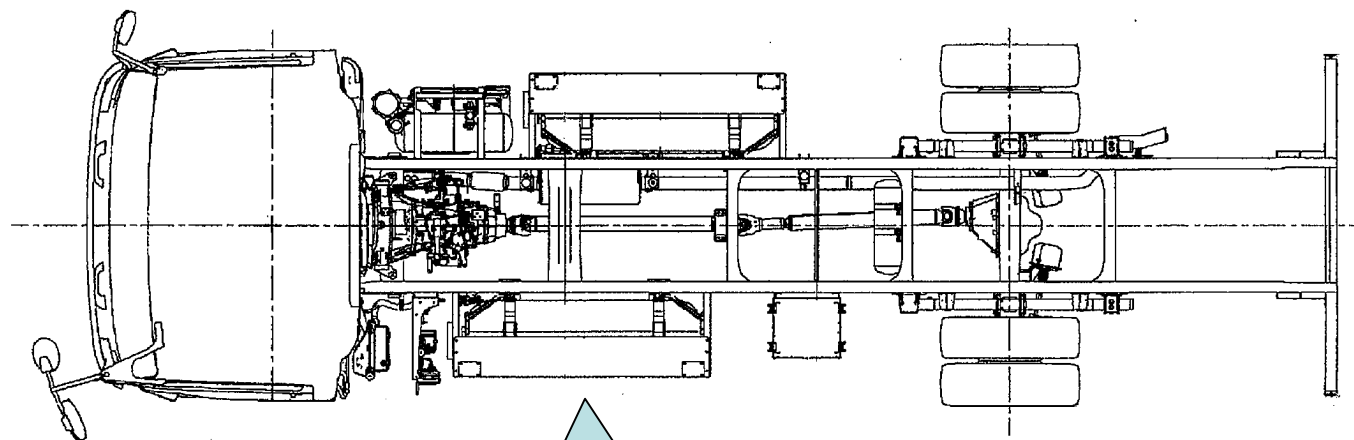
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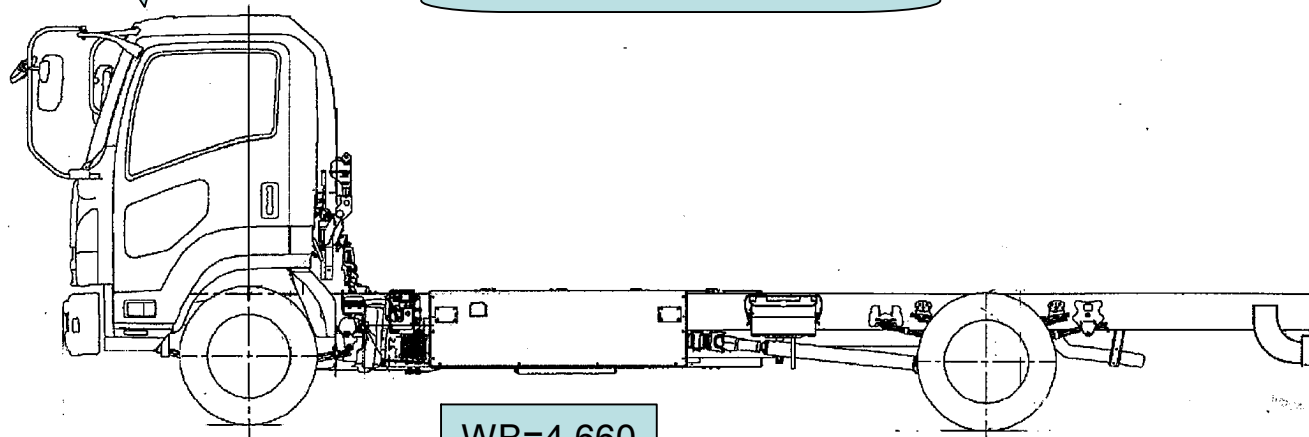
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CNG FSR LAYOUT



4X-Day

$150L \times 1 + 100L \times 2 + 75L \times 2$



WB=4,660

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CNG MODELS

- **NLR200 CNG**
- 4.5t GVM
- 96 kW & 353 Nm
- 300 WL tank capacity
- 300+ km driving range
- This model aimed at express courier fleet and local council operators
- Aimed at LCV courier vans
- Available towards the end of 2009

CNG MODELS

- **NPR300 CNG**
- 7.0t GVM
- 96 kW & 353 Nm
- 300 WL tank capacity
- 280-300 km usable driving range
- Aimed at parcel delivery and council fleets
- Higher GVM than equivalent diesel model at 6,500 kg, to compensate for higher tare mass, giving better payload



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CNG MODELS

- **FSR700 / 850 Medium CNG**
- 12.0 t GVM, or 14.0 t GVM
- 162 kW & 735 Nm
- 500 WL tank capacity
- 350+ km usable driving range
- Aimed at MD parcel delivery fleets
12.0 t GVM gives superior payload to current diesel powered vehicles



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CNG Models

Preliminary Tare Masses

MODEL	W/base (mm)	MASS			CNG MASS PENALTY
		Front	Rear	Total	
NPR 300 CNG	3365	1830	1004	2834	163
NPR 250/300 Medium Premium	3365	1759	912	2671	
FSR 700 CNG	4660	2500	1480	3980	76
FSR 700/850 Long	5560	2452	1452	3904	

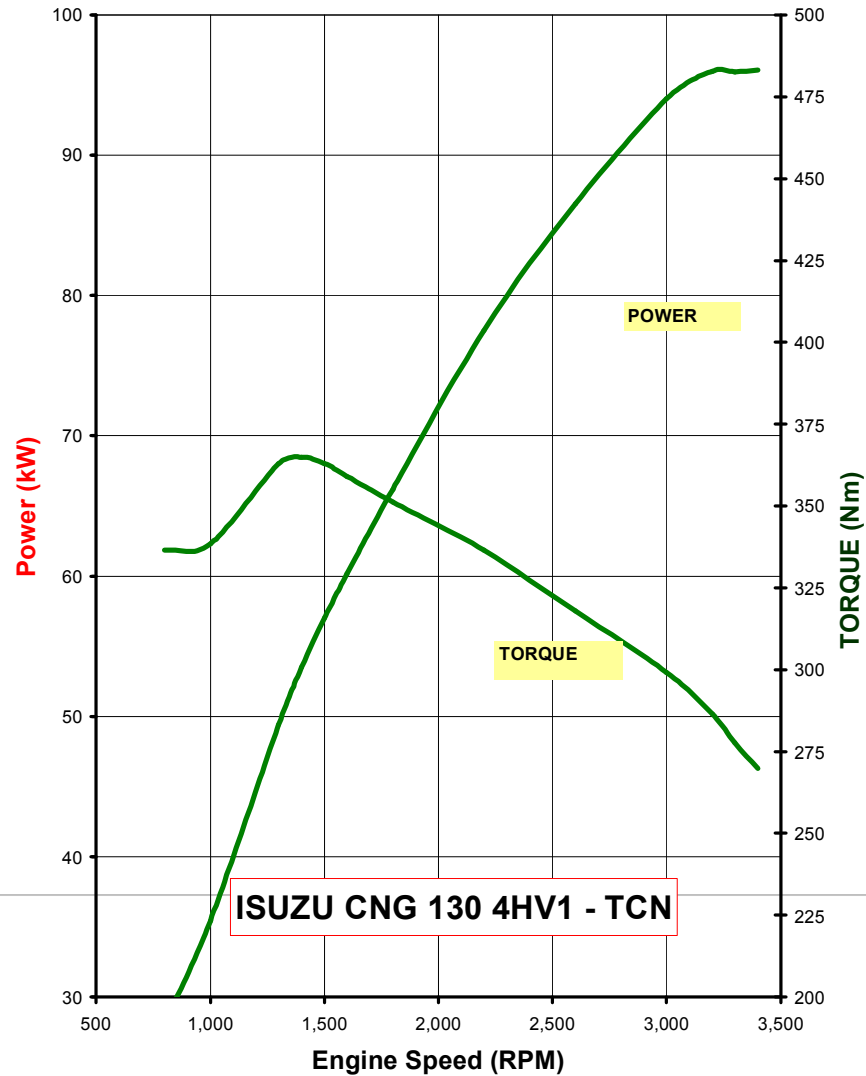
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CNG Engine - 4HV1 TCN



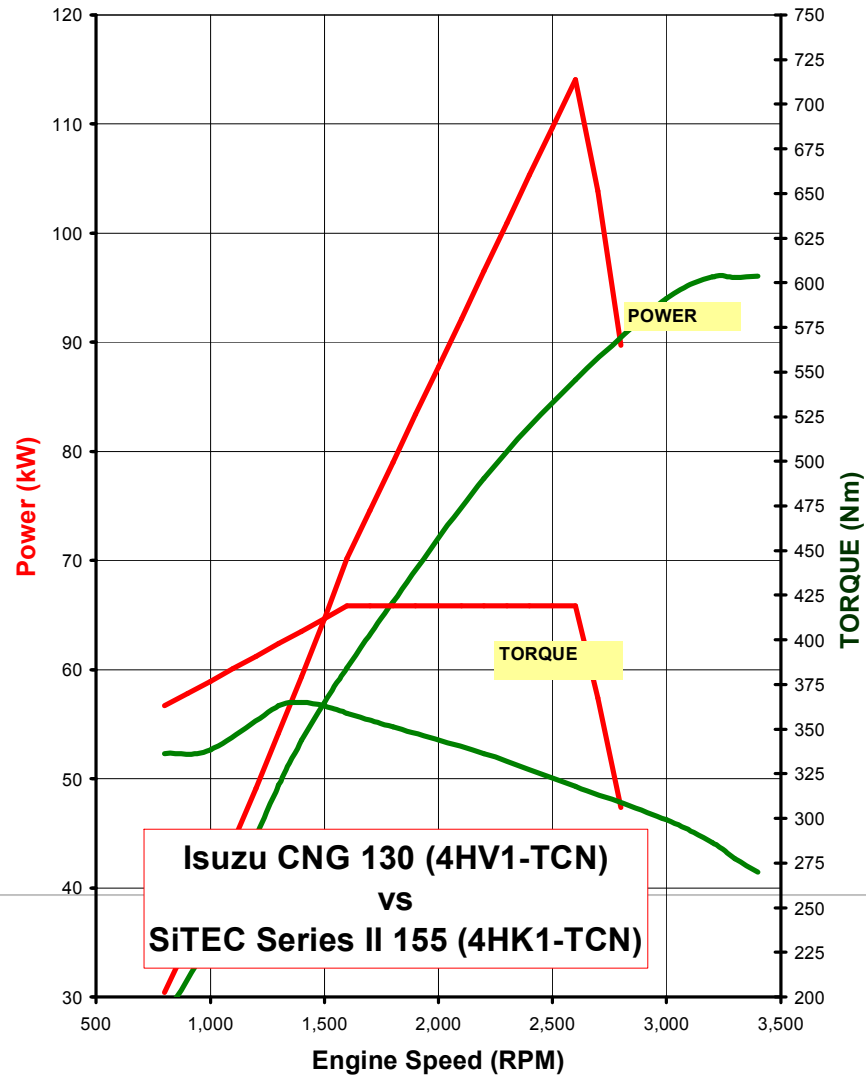
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CNG Engine - 4HV1 TCN



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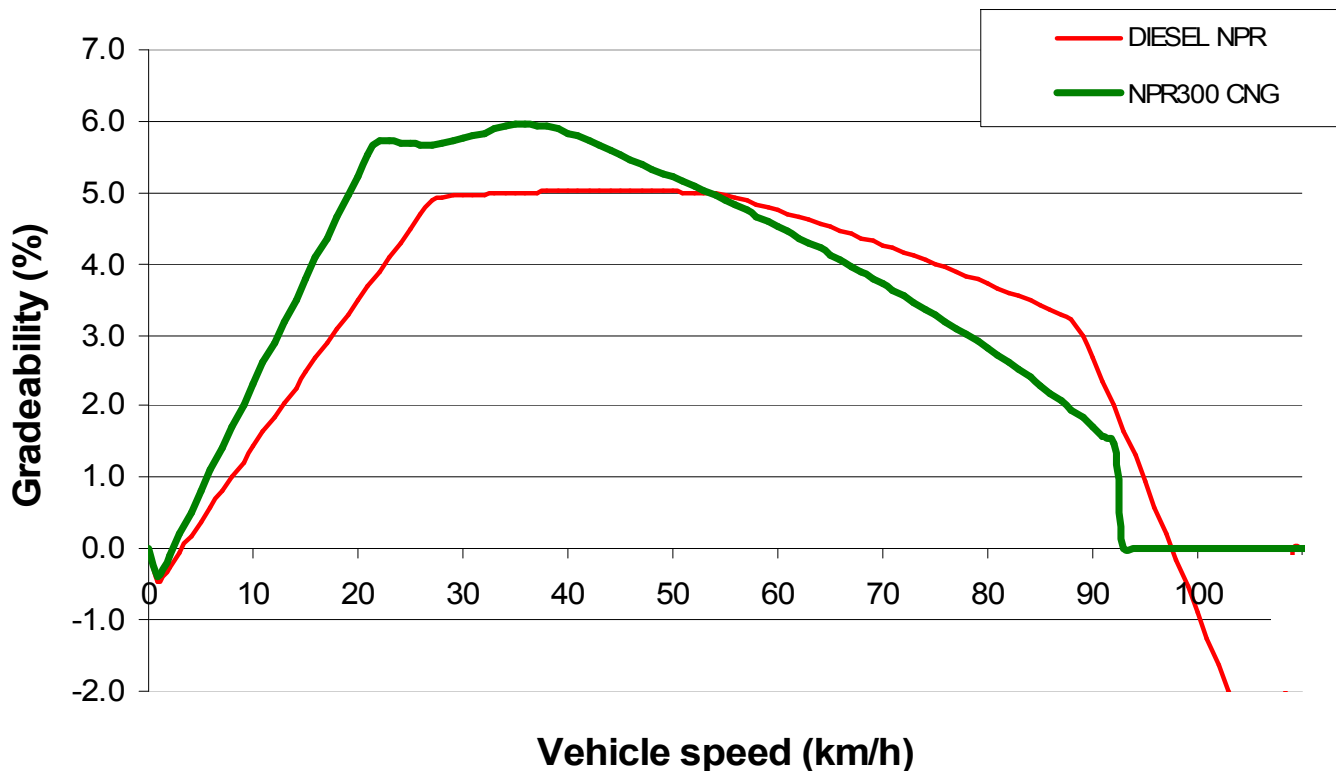
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CNG Performance on Road

5th Gear Gradeability



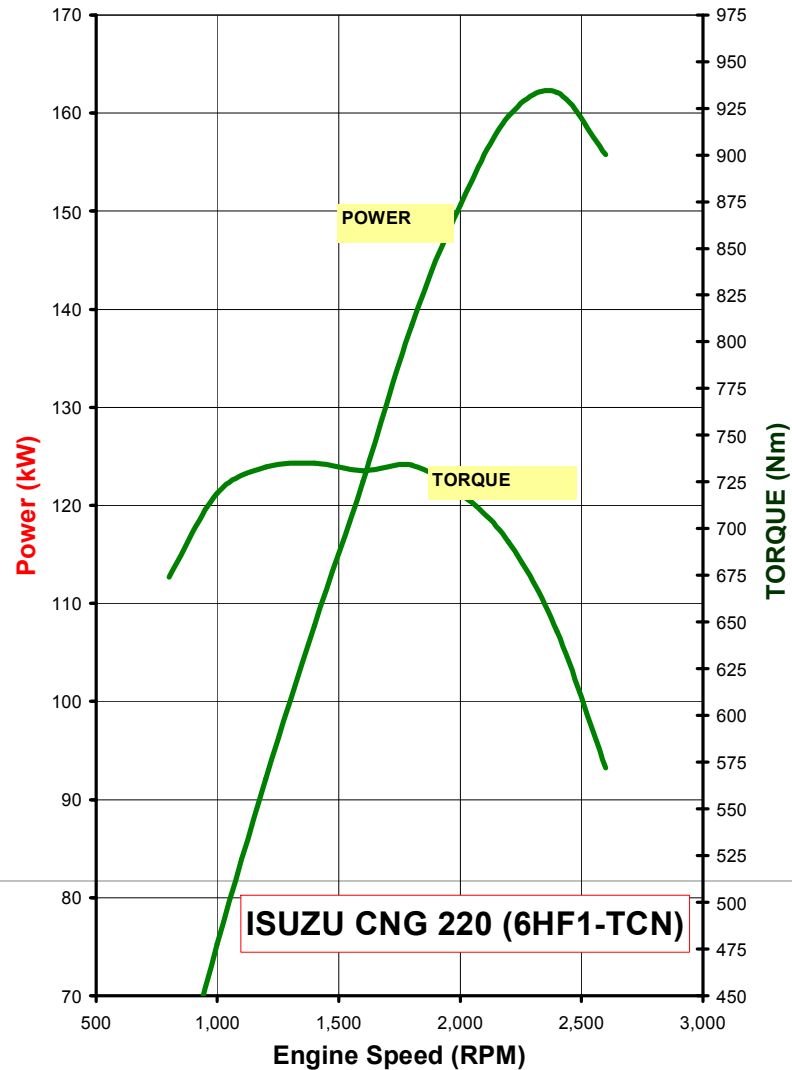
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CNG Engine - 6HF1 TCN



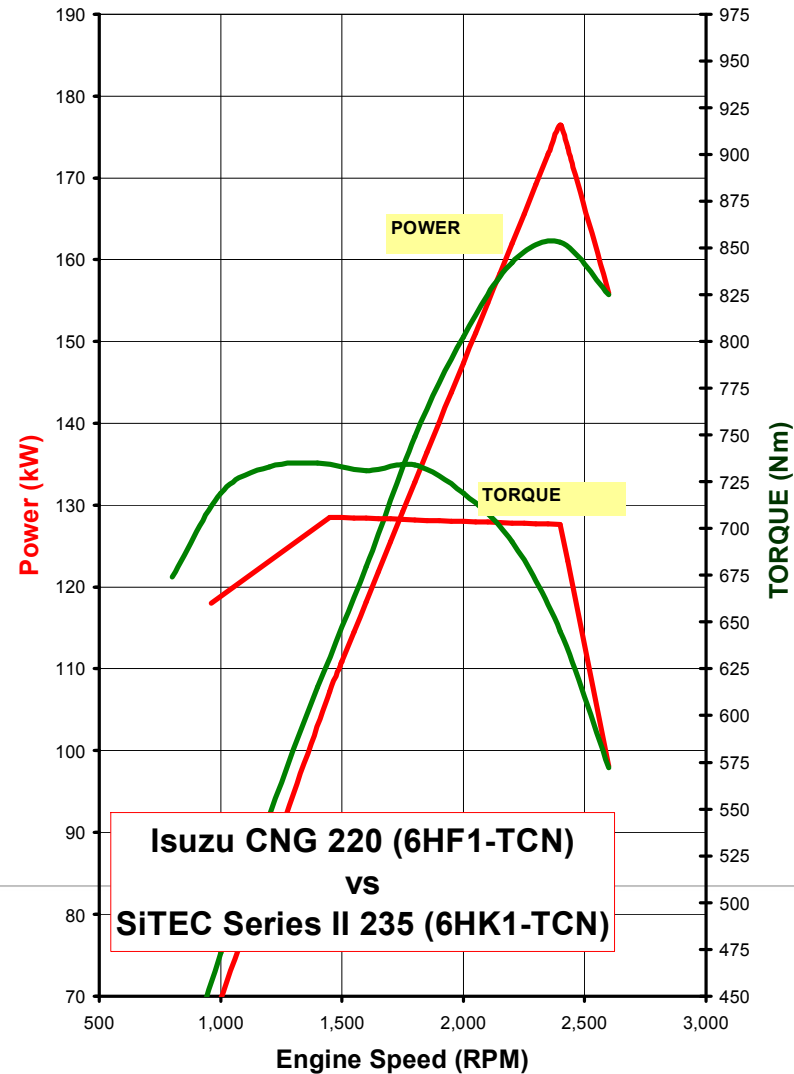
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CNG Engine - 6HF1 TCN



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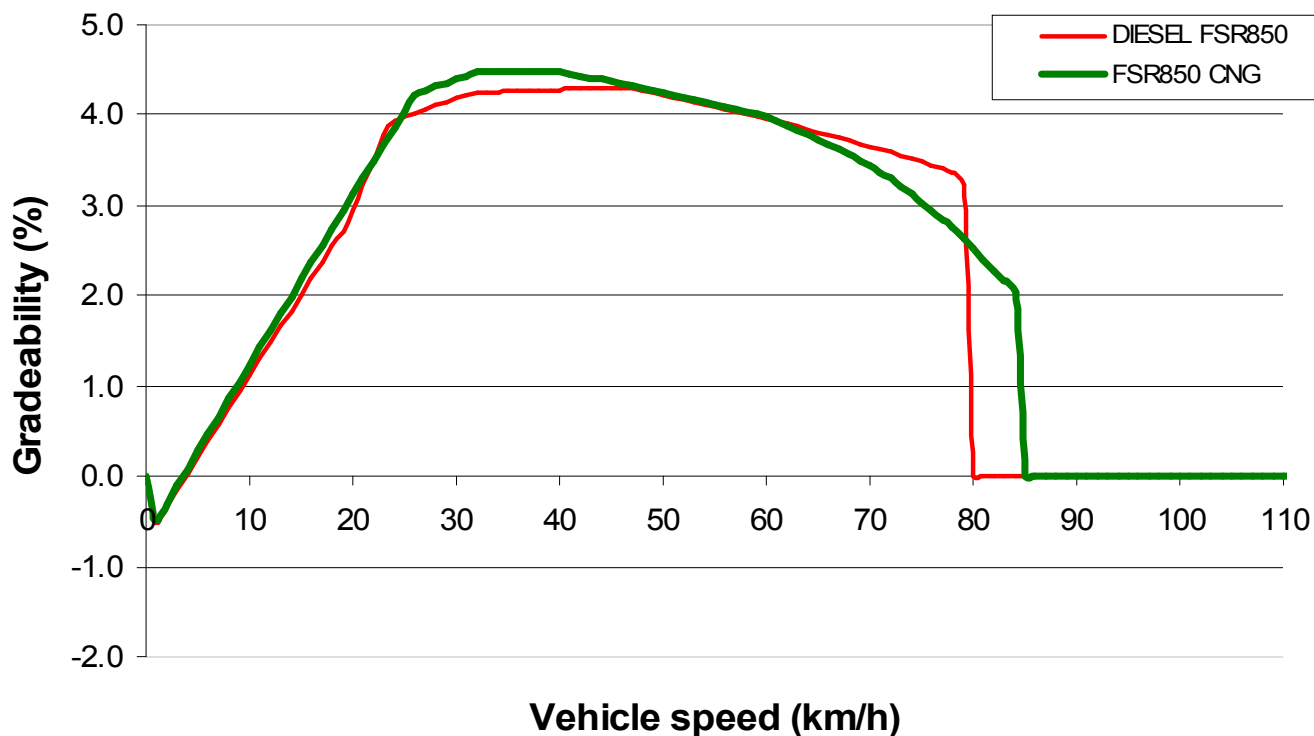
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CNG Performance on Road

5th Gear Gradeability





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Customers for Isuzu CNG Models

- History of aftermarket CNGV conversions is mixed: many failures and service problems, with a few successes
- Australian customers have a strong preference for OEM-produced NGVs
- Isuzu OEM Product is well placed to re-enter the CNGV market, taking advantage of past efforts and good results



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Customers for Isuzu CNG Models

- “Return to base” operation of <300 km/day
- Large Fleets operating from fixed Depots
- Large inner urban parcel / courier fleets
- State governments, esp. Tasmania
- Bakeries (already consuming large quantities of gas at low cost)
- Local government in various locations

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Thank You

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