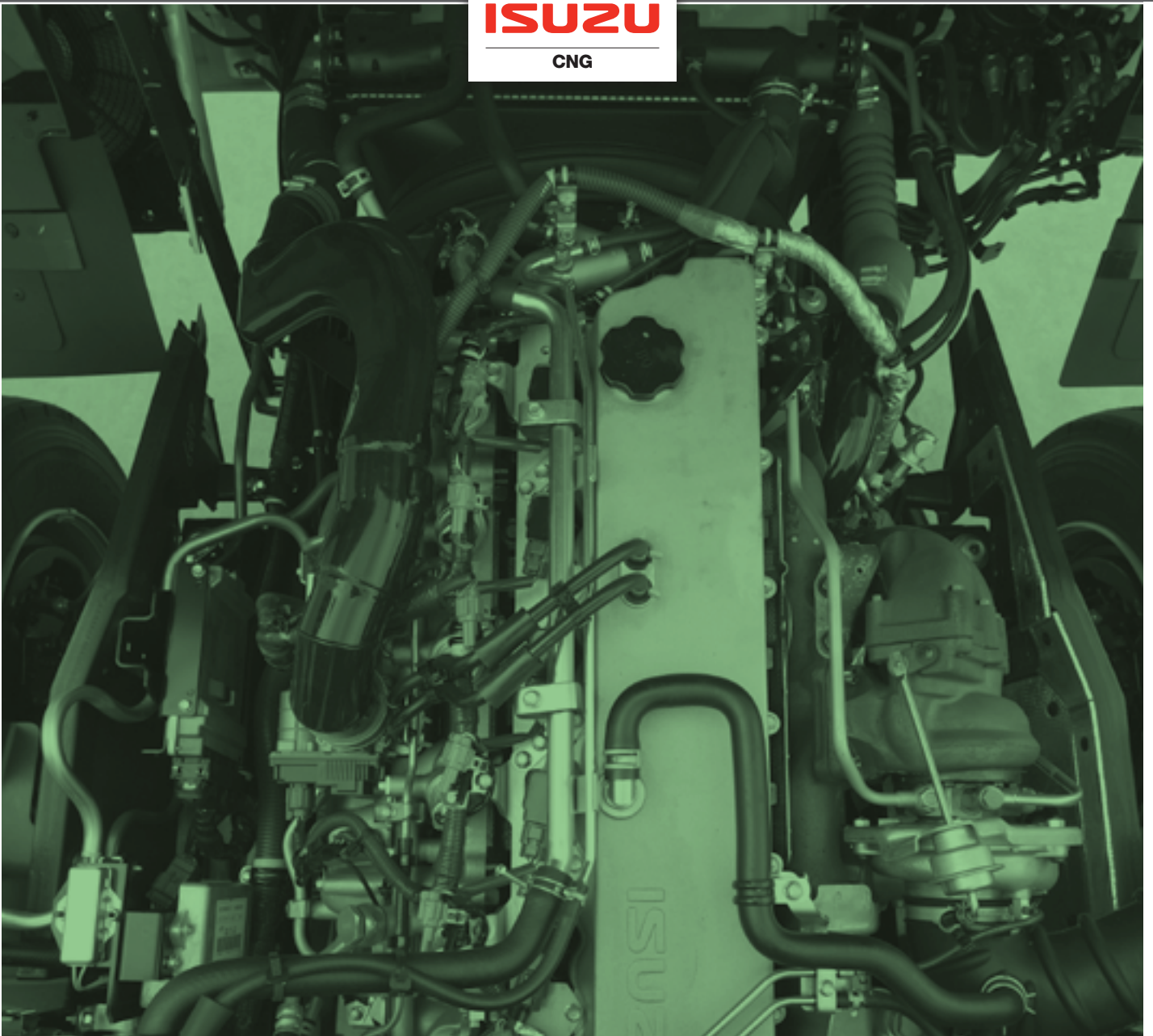


**ISUZU**

CNG



# Explanatory Guide



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## INTRODUCTION

CNG is a vastly more popular fuel than indicated through current use in Australia. Other countries such as Japan (ranked 23rd in global usage) have been making the most of its many advantages from its wide ranging environmental properties to low cost and availability.

Isuzu Motors, Japan, has several truck models available in CNG configuration; sales-to-date exceed 10,000 units. Isuzu CNG trucks command around 70 per cent of the CNG commercial vehicle market share in Japan.

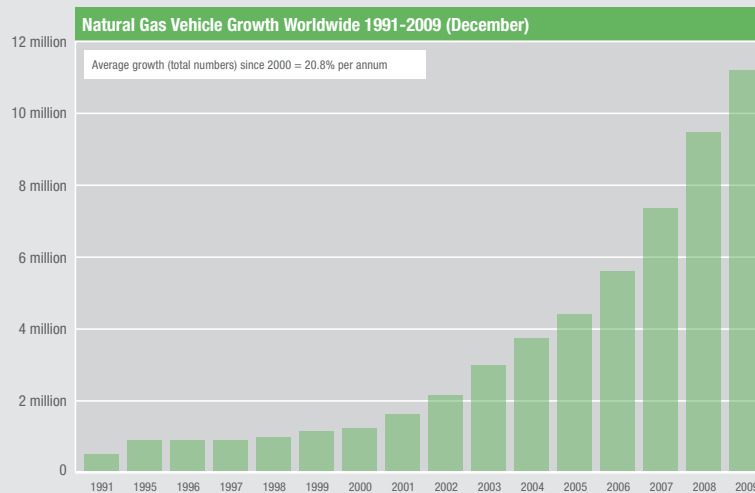
### Countries by CNG vehicle population – top 10 plus Australia

1	Pakistan	2.3 million
2	Argentina	1.8 million
3	Brazil	1.6 million
4	Iran	1.6 million
5	India	900,000
6	Italy	630,000
7	China	450,000
8	Colombia	300,000
9	Ukraine	200,000
10	Bangladesh	177,000
41	<b>Australia</b>	<b>2,750</b>

Natural gas Statistics from the International Association for Natural Gas Vehicles [www.iangv.org](http://www.iangv.org)

Australia is fortunate in having abundant natural gas reserves, which many experts predict can sustain CNG use in motor vehicles for more than 100 years - Australia is the fifth largest producer of natural gas in the world.

The graph below demonstrates the recent growth in the global CNG vehicle population. The increase is most noticeable during the last five to seven years, in line with advancements in CNG technology and increases in crude oil prices.



## WHAT IS CNG?



CNG is made by compressing natural gas to less than one per cent of its volume at standard atmospheric pressure; it consists of a mix of hydrocarbons, mainly methane, and is formed from the decomposition of organic marine growth. CNG is odourless, colourless and tasteless.

In Australia the vast majority of natural gas is sourced from three main basins: the Cooper/Eromanga in central Australia, the Gippsland Basin in Bass Strait and the Carnarvon Basin off the North West Shelf.

Australian pipeline natural gas is available in every capital city however, the vast distances of the Australian continent mean that outside of the capital cities, availability is presently limited to large regional centres.

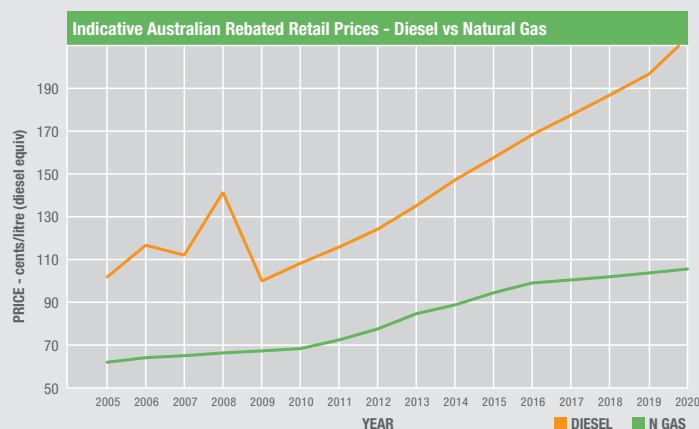
## COST BENEFITS

Cost benefits of using CNG have improved dramatically as the price of diesel has risen. In June 2005 the cost advantage was 30 per cent as against diesel; by June 2008 this had increased to a cost saving of around 67 per cent.

Since natural gas is not tied to international parity pricing, unlike oil and LPG, the CNG price is generally between 30 and 50 per cent less than the equivalent price of diesel.

As a further benefit, there is also the opportunity of securing a fixed long term CNG price contract with the supplier for better balance sheet control and lower overall cost.

The chart to the right indicates natural gas versus diesel historical pricing, as well as forecast likely future price differences\*.



\*Diesel pricing data has taken into account likely future decreases in the diesel fuel rebate.

## ENVIRONMENTAL

CNG burns cleaner and more efficiently than diesel and contributes far less to air pollution, especially in particulate matter (PM) emissions.

A study conducted by the CSIRO and the Australian Greenhouse Office titled *Comparison of Transport Fuels, Life-Cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles* tested alternative fuels including CNG. The study concluded that CNG and Liquefied Natural Gas (LNG) produced the least emissions across all categories.

LNG is the liquefied form of CNG, which is also used in vehicles, but unlike CNG it must be kept at temperatures below -161°C and so requires specialised cryogenic storage tanks.

Approximately 40 per cent of air pollution comes from motor vehicles in the form of oxides of nitrogen (NOx), volatile organic compounds (VOC), PM as well as other contaminants.

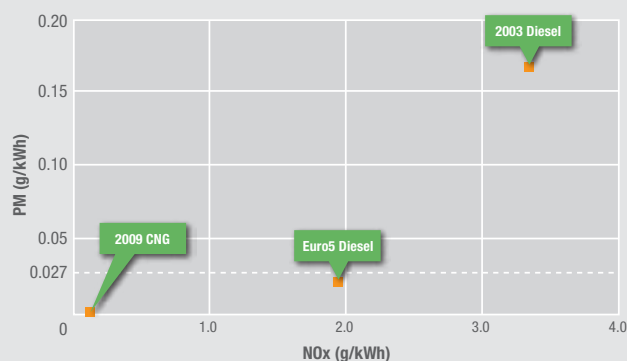
Vehicles using CNG show reductions of around 50 per cent of NOx, 98 per cent of VOCs and 60 per cent of PM (Isuzu CNG engines emit zero PM) over comparable diesel vehicles.

During the actual refuelling process the method for refilling with CNG produces no emission pollution. With diesel and petrol vehicles, where the fuels come into contact with the environment, this accounts for around 50 per cent of the total hydrocarbon emission.

As mentioned earlier, both CNG and LNG provide similar benefits particularly in reducing exhaust emissions. For light and medium duty freight applications

up to 16 tonne GVM, Isuzu considers CNG to be more suitable as the CNG set-up provides adequate range with only small increases in tare weights. LNG requires much more expensive and complex cryogenic tanks to maintain the gas at the correct temperature and is therefore better suited to heavy duty trucks requiring a longer operating range.

Isuzu Trucks' CNG model range easily exceeds the stringent EURO 5 (ADR80/03) emissions standard introduced in 2011, and even meets a number of performance criteria under proposed EURO 6 standards – see below.



IAL (Isuzu Australia Limited) on road comparison testing using the FSR 700 CNG and the diesel-powered FSR 700 loaded to 10 tonne GVM revealed that the CNG variant achieved a 26.3 per cent CO<sub>2</sub> reduction in urban driving conditions and a 35 per cent CO<sub>2</sub> reduction on the highway cycle\*\*.

### FSR CNG Exhaust Emissions & Fuel Consumption Comparison vs ADR80/02 Diesel

Isuzu FSR 700 Medium Duty 12000 kg GVM	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 (%)	CNG CO <sub>2</sub> Reduction	
				Km Travelled	CO <sub>2</sub> Saved (tonnes)
Urban Cycle					
Fuel Consumption (Av. Km/L) Aust Expected value	4.03		CO <sub>2</sub> Reduction 26.3%	50,000	8.54
Fuel Consumption (Av. Km/m³) Aust Expected value		4.34			
CO <sub>2</sub> “Equivalent” Emissions (g/km)	650	479			
Highway Cycle					
Fuel Consumption (Av. Km/L) Aust Expected value	3.48		CO <sub>2</sub> Reduction 35.0%	50,000	13.17
Fuel Consumption (Av. Km/m³) Aust Expected value		4.25			
CO <sub>2</sub> “Equivalent” Emissions (g/km)	753	489			

## OPERATING USES



Australia has had limited take-up of CNG as a transport fuel in the past. Isuzu made a limited number of its earlier generation CNG trucks available in 2005, the majority of which were acquired by forward thinking councils such as Gosford City Council in New South Wales and South Australia's Salisbury Council.

Aside from Isuzu's factory delivered product, a number of aftermarket CNG conversion companies have also added to the numbers.

CNG is particularly well suited to urban use, it is ideal for return-to-base operations such as urban courier fleets, large fleets operating from fixed depots, as well as state and local government fleets.

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\*\* Testing undertaken using IAL vehicles and drivers; fleet operators may experience variances in performance.

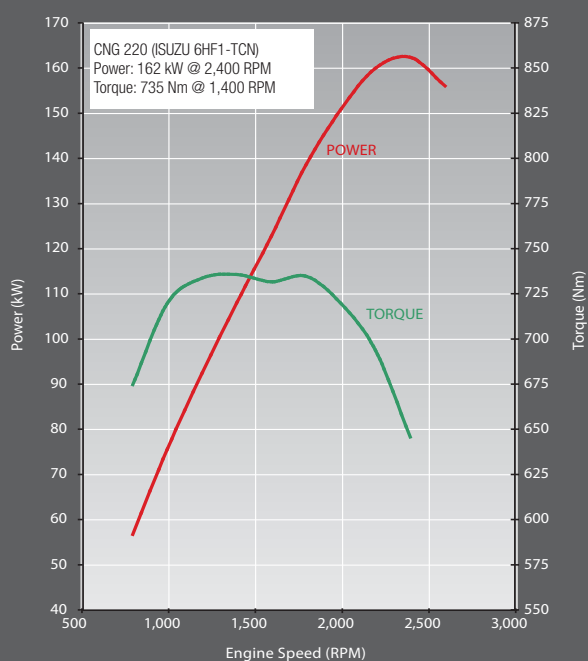
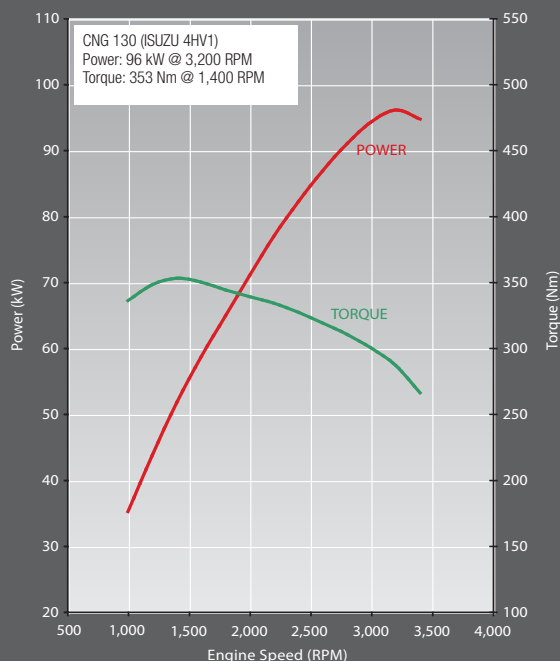
## ISUZU CNG MODELS

Isuzu has new models available: the NLR 200 CNG suitable for local government operators and express couriers, NPR 300 CNG for parcel delivery and local government fleets, and the FSR 700 and 850 CNG for medium duty parcel delivery fleets. Additional models are under consideration for future release.

A typical driving range for one of these CNG models is around 300 kilometres for N Series models and about 400 kilometres for F Series models.

The power and torque of modern CNG engines is comparable to equivalent diesel engines. Below is a table detailing the performance of Isuzu's CNG engines. Please note the CNG engine's peak torque is achieved at lower RPM than in the diesels – this equates to excellent drivability.

NLR 200 CNG	NPR 300 CNG	FSR 700/850 CNG
CNG 130 Isuzu 4HV1	CNG 130 Isuzu 4HV1	CNG 220 Isuzu 6HF1-TCN
4 cylinder SOHC	4 cylinder SOHC	6 cylinder SOHC
4570cc	4570cc	7790cc
Max Power 96kW @ 3200rpm	Max Power 96kW @ 3200rpm	Max Power 162 kW @ 2400 rpm
Max Torque 353 Nm @ 1400 rpm	Max Torque 353 Nm @ 1400 rpm	Max Torque 735 Nm @ 1400 rpm



## SAFETY

Natural gas is only flammable at a very low and narrow range of concentrations, and even at the correct concentration for ignition, it requires a much higher temperature to ignite than petroleum products.

In some countries where CNG is more widely used, refuelling has been set up in private garages for convenience and is considered quite safe. Since CNG is lighter than air, any leaks will dissipate into the atmosphere and

this means the risk of the fuel forming a hazardous pool is eliminated, also natural gas is not poisonous.

The risk associated with the use of fuel tanks is less with CNG, as the tanks are highly engineered and tested to meet stringent standards including tests against rupture and high temperatures.

## REFUELLING

Currently there are just four public refuelling sites in Australia: two in New South Wales, one in the ACT and the third in Melbourne.

Further metropolitan sites are planned for 2011 providing full public access facilities where refuelling of CNG will take place side-by-side with existing liquid fuels. Several regional refuelling sites are also under consideration.

Many fleet customers will choose to install their own depot refuelling equipment which may be an advantage if the facility already uses natural gas for heating or forklifts.

Refuelling is simple and fast, in fact the process is very similar to filling an LPG vehicle.

Natural gas suppliers are well on the way to expanding the number of public sites available.

The information in this brochure was correct at time of printing, but all measurements, specifications and equipment are subject to change without notice. Some equipment may have been changed and/or is available at extra cost. IAL may make changes at any time without notice, in prices, colours, materials, equipment and models. IAL makes all reasonable steps to ensure the availability of all vehicles and equipment. The information in this brochure is general in nature. Your Isuzu dealer can confirm all measurements, specifications and vehicle/equipment availability upon request.

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