

Pressurised CNG Alternative for Heavy Duty Transportation

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The iGas prototype with 4-cylinder fuel-pack in vertical arrangement.

“Potential to reduce imports by over \$2 billion per year at current oil prices” – Paul Whiteman, iGas CEO

Australian company iGas Energy has been toiling over a new solution to fuelling heavy duty long-distance transportation in Australia, using compressed natural gas (CNG) fuel storage instead of LNG. The company has purchased two Western Star prime movers which are fitted with proven Westport high pressure direct injection (HPDI) gas engines as part of a collaborative agreement with Westport Innovations. The iGas system has been successfully fuelling a prototype vehicle towing loaded single and B-Double trailers at highway speeds. The system has been patented in Australia, Canada and the European Union with other international patents applied for.



The CNG is stored in carbon fibre composite cylinders at 350 bar, and as the gas is used to fuel the engine the iGas process maintains high pressure in the cylinder by displacing CNG with a liquid, one CNG cylinder at a time, allowing gas to be injected into the HPDI engine.

A fuel pack comprising four Australian-approved cylinders will give a truck the same range as a 450 litre tank of diesel using a conventional engine, according to a [Gas Today](#) report.

By way of an interview with Paul Whiteman, iGas Energy Holdings founder and Chief Executive Officer, the article describes the components and advantages of the system, including the iGas vision to transform interstate transportation on the Australian continent while reducing fuel costs, GHG emissions and particulate matter.

Whiteman told GAS Today, “From our research we believe vehicles in the initial target market for iGas burn around 4 billion litres of diesel fuel annually: almost all of this is either imported as refined product or produced from imported crude oil. Replacement of this imported fuel with local natural gas has the potential to reduce imports by over \$2 billion per year at current oil prices.”

Operational prototype

Bruce Hodgins, Vice President, Market Development for Westport Innovations Inc. has confirmed his company has an agreement to supply a limited number of GX engines for use in prototype iGas trucks in Australia. He added,

“Westport is working closely with iGas to integrate the Westport GX engine with the iGas system to optimise overall performance, range, and cost with the objective of developing a CNG fuel storage system to complement the Westport technologies.”



The Westport GX engine was certified to Australian Design Rules (ADR) 80/02 standards in 2007 and has approximately 50 per cent less particulate matter emissions and 25–29 per cent less greenhouse gas (GHG) emissions relative to an equivalent diesel engine. Westport has recently certified the GX 15 L engine to ADR 80/03 standards, which comes into force in January 2011.

iGas: break-through application for gas to fuel large highway trucks

By Paul Whiteman, iGas Energy Holdings founder and Chief Executive Officer

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The science

How does the system work?

The key to the iGas process is to maintain pressure in the CNG cylinder as the gas is consumed by the engine. This is achieved by displacing the gas with a liquid in one CNG cylinder at a time; this keeps the CNG at a pressure that allows gas to be directly injected into the engine.

Once all of the gas in a cylinder has been used the liquid injection stops, the valves are shut and the liquid is returned to a low pressure tank. The process is then repeated for the subsequent CNG storage cylinders.

There are four subsystems: the hydraulic pack, the fuel pack, the liquid tanks and the gas drying assembly.

- The hydraulic pack is fitted inside a second battery box on the prototype truck and it comprises a high pressure metering pump which is used to pump liquid into the CNG cylinders. It is powered by a hydraulic motor which in turn is powered by a hydraulic pump fitted in tandem with the truck's power steering pump.

- The fuel pack comprises four CNG cylinders, three air actuated valves per cylinder plus two header valves and a number of manual isolation and re-filling valves. The fuel pack gives a truck the same range as a 450 L tank of diesel in a conventional engine.
- The liquid tanks holds approximately 350 L of a water-based solution that is pumped into the CNG tanks at high pressure to maintain the gas at the required pressure for direct injection into the engine.
- The gas drying assembly contains two filters that remove water vapour from the gas stream and a collection arrangement to return any condensed liquids back to the tank.

Paul Whiteman, former Chief Executive Officer and Managing Director of EDL, is now founder and Chief Executive Officer of iGas Energy Holdings Limited, a new company developing a patented compressed natural gas (CNG) fuel storage and delivery system to enable large high pressure direct injection (HPDI) engined trucks to run on CNG.

He has been joined in the enterprise by Jim McDonald, former Chief Executive Officer and Managing Director of the Australian Pipeline Trust (now APA Group), and Derek Fekete, previously a senior engineer with EDL. The iGas team has been working with Westport to enable CNG to be used as fuel for the Westport GX engine that uses HPDI technology.

The new, patented iGas system could drive a new generation of CNG-fuelled interstate highway trucks, says Chief Executive Officer Paul Whiteman.

In addition, we have developed the concept of a changeover fuel pack; that is where a truck pulls into the refuelling terminal and the empty fuel pack is removed and replaced with a full one. This could reduce the time it takes to refuel a truck to less than five minutes.

Is the prototype running on the road?

The prototype is now registered for road use, and has successfully towed loaded trailers at highway speeds.

Will the iGas system work in this application?

Firstly, the Westport engine is proven using LNG as a fuel. In this configuration, the LNG is pumped up to high pressure by a pump submerged in the LNG and then piped to an evaporator where it becomes CNG. It is then pumped to the engine, so the Westport engine is really a CNG engine, as it already runs on CNG in LNG trucks.

Secondly, we have already proven that the injection of liquid into the CNG storage cylinder to maintain gas pressure works. We initially undertook small-scale testing to

confirm the concept, and in addition identified examples overseas where the principle has been used in gas compression going back several decades.

We are now focused on working through the components and the process to refine everything for absolute reliability and commercial application.

Finally, it has in the past been a challenge to get sufficient CNG storage on a truck because of its relatively low energy density. The iGas system operates at 350 barg (5,076 pounds-force per square inch gauge) which increases the energy density over previous systems by around 40 per cent. We intend that iGas trucks will carry sufficient fuel onboard to travel 1,000 km, and this prototype demonstrates that capability.

Westport's involvement

As the engine supplier for the truck, Westport has modified its control system to allow the iGas system to operate without the LNG tanks, pumps and vaporiser.

Import replacement

From our research we believe vehicles in the initial target market for iGas burn around 4 billion L of diesel fuel annually: almost all of this is either imported refined or produced from imported crude oil. Replacement of this imported fuel with local natural gas has the potential to reduce imports by over \$2 billion per year at current oil prices.

Cost and availability

We aim to lower the cost of interstate transport.

Environmental benefits

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