



DUAL FUEL LIMITED

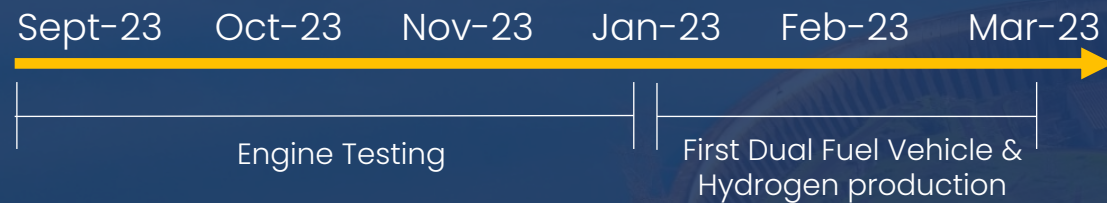
A Green House Capital Company

Powered by  atome

EXECUTIVE SUMMARY

COMPANY OVERVIEW & TIMELINE

Starting in the first part of 2024, DFL will retrofit existing diesel heavy goods trucks and barges to run on a mixture of diesel & hydrogen in order to provide a transitional solution to the decarbonisation of heavy goods transportation.



PARAGUAY

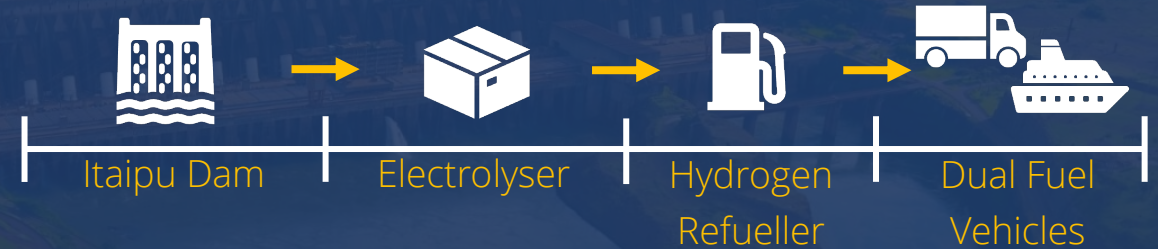
DFL is a UK based company which will be operational worldwide. Paraguay is a perfect location for DFL's first operations. The country has low cost, 24/7 baseload green power from the grid. It is a land-locked country with no active railways; therefore, all goods are transported by road, or by the country's fleet of barges which is the 3rd largest in the world.

LOCAL KNOWLEDGE

DFL is a Green House Capital company, which has the support of both its parent company (Molecular Energies PLC) and its sister company (ATOME Energy PLC), which are listed on the London Stock Exchange and have established businesses in Paraguay including a 120 MW green fertiliser project and oil & gas exploration. Dual Fuel Limited will sell carbon credits through a forward purchase agreement with another Green House Capital company, Aton 6.

LOW-COST, ONE-STOP-SHOP SOLUTION

DFL will offer a complete solution to users in Paraguay. DFL will facilitate the use of green hydrogen as a fuel in heavy goods trucks & barges, whilst also providing the production and refueling infrastructure.



DFL will engineer an affordable vehicle retrofit and, using Paraguay's low-cost electricity from the national grid, supply low-cost green hydrogen to heavy goods road and barge transportation, differing significantly from the European model.

ENGINEERING EXPERTISE

DFL has developed its dual fuel engineering with its partner, G-volution which is a leading dual fuel engineering company in the UK. DFL also has engineering support from its Owner's Engineer, AECOM, a Fortune-500 engineering consultancy with US\$13.1 billion of revenue in 2022.

DUAL FUEL TECHNOLOGY IN TRUCKS

A Transitional Decarbonisation Solution

Hydrogen Refueling Infrastructure

The vehicle can run on diesel only if it runs out of hydrogen, therefore it is not reliant on an extensive hydrogen refuelling network

Power Output

The power output of the engine is unchanged and the operation is undetectable by the driver.

Drive Train

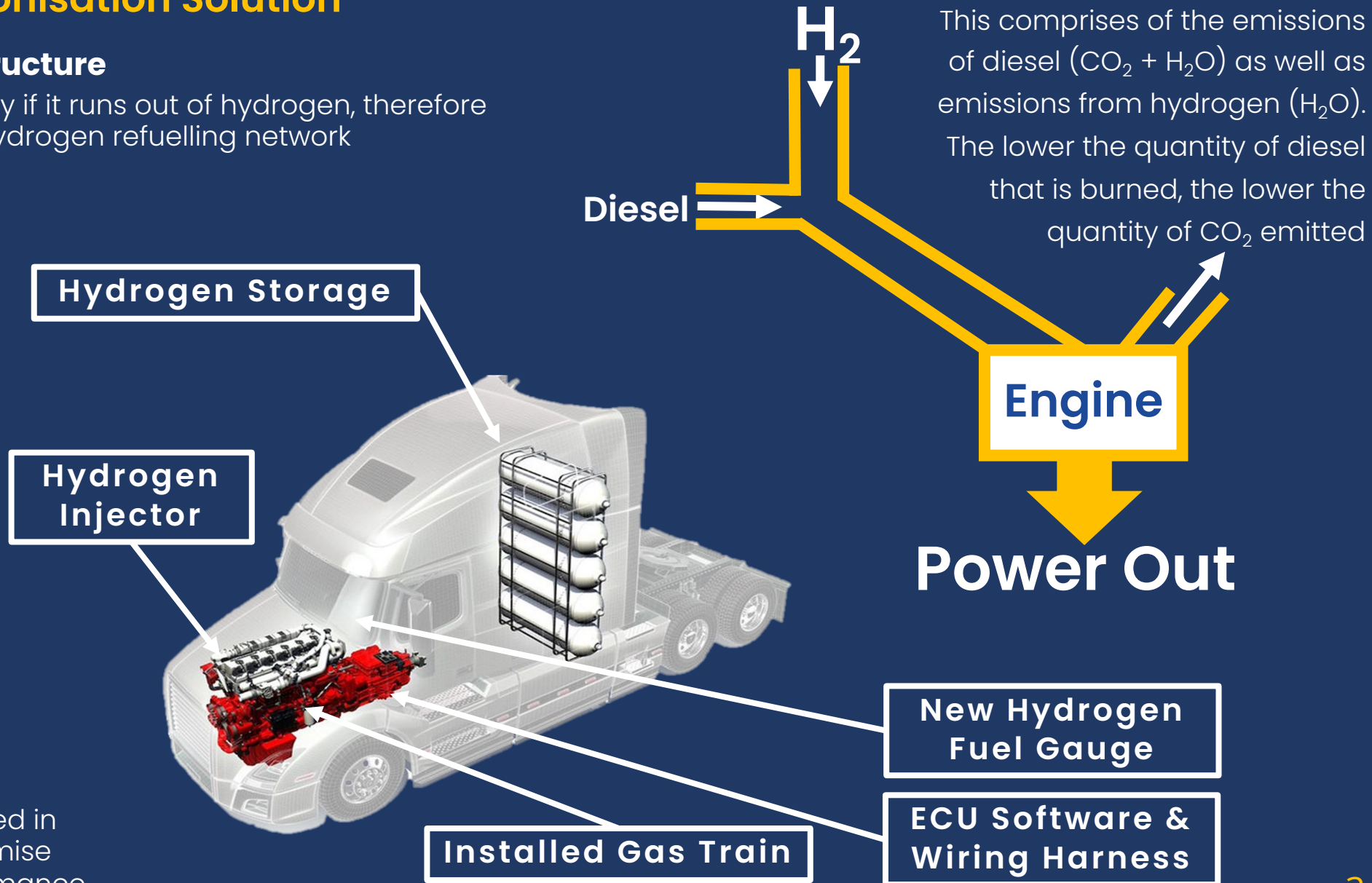
There is no additional power or torque which could give rise to drive train damage.

Electronic Systems

The original vehicle ECU continues to operate as it was intended by the OEM and on board diagnostic systems are not affected or compromised.

Patented Technology

Hydrogen and diesel are delivered in constantly varying ratios to optimise economic and emissions performance.

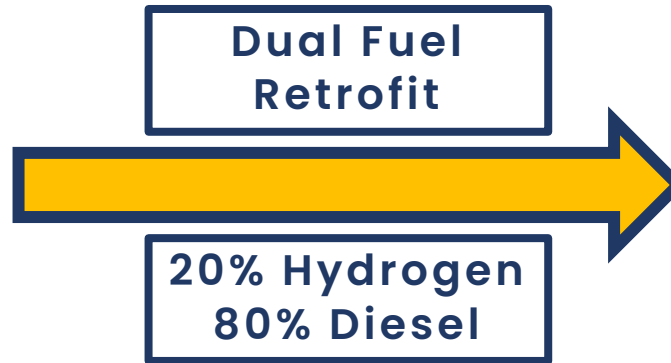


DUAL FUEL'S DECARBONISATION POTENTIAL

Dual Fuel Engines Commercial Solution can Significantly Reduce Emissions

- Dual Fuel's retrofit technology will reduce emissions & add vehicle range.
- For a fleet of 50 heavy goods land transportation vehicles, a minimum of 1.1 million liters of diesel can be avoided each year, which correlates to 2900 tonnes of CO₂.

For This Fleet...



Each Year...



PARAGUAY: COUNTRY PROFILE

Dual Fuel Limited's First Country of Entry

Molecular Energies PLC & ATOME Energy PLC (DFL's parent and sister companies) both have established projects, knowledge and presence in Paraguay, making it the perfect first location for DFL operations.



SIZE & POPULATION

Larger than Germany in size (with an area of 406,742 km²) and a population of 7 million



ECONOMY, TAX & TRADE

Has a stable, open economy with a BB+ Fitch rating, whilst maintaining low tax and trade barriers, enhanced by being the founding member of the Mercosur bloc



TRUCKS

With no active railways, Paraguay is heavily dependent on heavy goods road transport



BARGES

Imports and exports all goods such as soybeans, rice and other agricultural products through its network of inland waterways, using its barge fleet which is the 3rd largest in the world



AGRICULTURE

Is a large exporter of agricultural products including soybeans (world's 4th largest, \$2.1B exported in 2020)



GREEN ELECTRICITY

Has a 99% green national grid, primarily from Itaipu Dam, making the country the world largest energy exporter (\$1.44B of electricity exported to Brazil in 2020)

HOW IS HYDROGEN USED AS A FUEL?

Production & Use of Hydrogen as a Fuel Creates a Closed-loop Circular Economy

PRODUCING GREEN HYDROGEN FROM ATOME'S ELECTROLYSER

Green Hydrogen will be produced using ATOME's electrolyser which is powered by renewable hydropower energy from the Itaipu Dam. Within the electrolyser, a process called electrolysis takes place, which splits water into hydrogen and oxygen. The hydrogen is captured and used in dual fuel trucks and barges & oxygen is released into the air.



USING HYDROGEN IN DUAL FUEL TRUCKS & BARGES

Hydrogen has the highest energy density of all fuel types; the only by-product of its use is water and therefore does not emit any green house gases. Hydrogen is therefore burned in dual fuel trucks & barges to create energy. Water is emitted from the exhaust.



THE BENEFITS OF DUAL FUEL

An Affordable & Flexible Transition to Decarbonisation

- Battery vehicles, hydrogen fuel cells & 100% hydrogen combustion engines are very expensive, not commercially available & have long lead times
- Batteries are very heavy, therefore reduce the available load for heavy goods and have short ranges, requiring more frequent recharging
- Dual fuel technology is affordable, and commercial now, making it the superior solution compared to fuel cells and 100% hydrogen internal combustion engines.



LOW COST

Dual Fuel provides fleet operators with affordable technology and hydrogen



FLEXIBILITY

Dual Fuel vehicles can still run fully on diesel, removing the reliance on hydrogen refueling infrastructure and driver range anxiety



LOW EMISSIONS

Dual Fuel retrofitted vehicles can burn up to 30% hydrogen, 70% diesel blend, reducing emissions up to 30%



SPEED OF WORKS

Dual Fuel technology can be installed on existing vehicles in under a week, minimising time off the road



FUEL SECURITY

















ATOME Energy will be producing green hydrogen in Paraguay on a take-or-pay basis, reducing reliance on imported fuel



INCREASED RANGE









By storing hydrogen on board, vehicles benefit from up to 300km more range on land or 30% more run time on waterways

COMPARING EMISSION FREE TRUCKS

	Battery Electric	Fuel Cell Electric	H ₂ Internal Combustion	H ₂ Diesel Dual Fuel
 Technology	Uses electricity to charges a battery, which provides power to the vehicle	Uses hydrogen to generate electricity which charges a battery, providing power to the vehicle	Combusts hydrogen in the presence of oxygen which provides power to the vehicle	Combusts hydrogen & diesel simultaneously in the presence of oxygen which provides power to the vehicle
 Refueling Time	Overnight Charging Required 	Under 45 Minutes 	Under 45 Minutes 	Under 20 minutes, and can run on diesel only when hydrogen runs out
 Truck Cost & Availability?	From \$300k with long lead times, requires rare materials, limited commercial availability	From \$300k with long lead times, requires rare materials, limited commercial availability	From \$200k, not yet commercially available	Below \$60k with conversion time under 7 days for land vehicles
 Installed onto Existing Engines?	No, requires full powertrain replacement which is very large & heavy	No, the whole powertrain must be removed & reinstalled	Yes, with significant modification and high cost	Yes, therefore no need to dispose of a working vehicle
 Vehicle Emissions	Zero carbon emission 	Zero carbon emission, water only 	Zero carbon emission, water only 	Emissions reduced by 20% to 30% compared with diesel vehicles
 Road Range	Up to 300km 	Up to 300km 	In excess of 400km 	In excess of 600km 

COMPARING EMISSION FREE BARGES

Fuel cell, battery electric and hydrogen internal combustion barges are not yet commercially available. There are only a few currently operational, with very high costs and considerably reduced performance (such as range and refueling time). Dual fuel is the only cost-effective, commercially available technology which will provide a transition to the decarbonisation of barge transport.

	Battery Electric	100% Hydrogen	H ₂ Diesel Dual Fuel
 Commercial Availability	Not commercial with very high barge costs & long lead times	Not commercial with very high barge costs & long lead times	Available now with conversion costs under \$150k
 Refueling Time	Overnight Charging Required with a significant decrease in range 	Similar to Diesel 	Refueling done in parallel with diesel, therefore no additional time added
 Installed onto Existing Engines?	No, requires full powertrain replacement which is very large & heavy at high cost	Most or all of the powertrain must be removed & reinstalled at high cost	Yes, therefore no need to dispose of a working barge
 Vehicle Emissions	Zero carbon emission 	Zero carbon emission, water only 	Emissions reduced by 20% to 30% compared with diesel barges



DUAL FUEL LIMITED

An Affordable Transition To Decarbonising Commercial Transport



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