IRTENZ

TECHNOLOGY & INFRASTRUCTURE

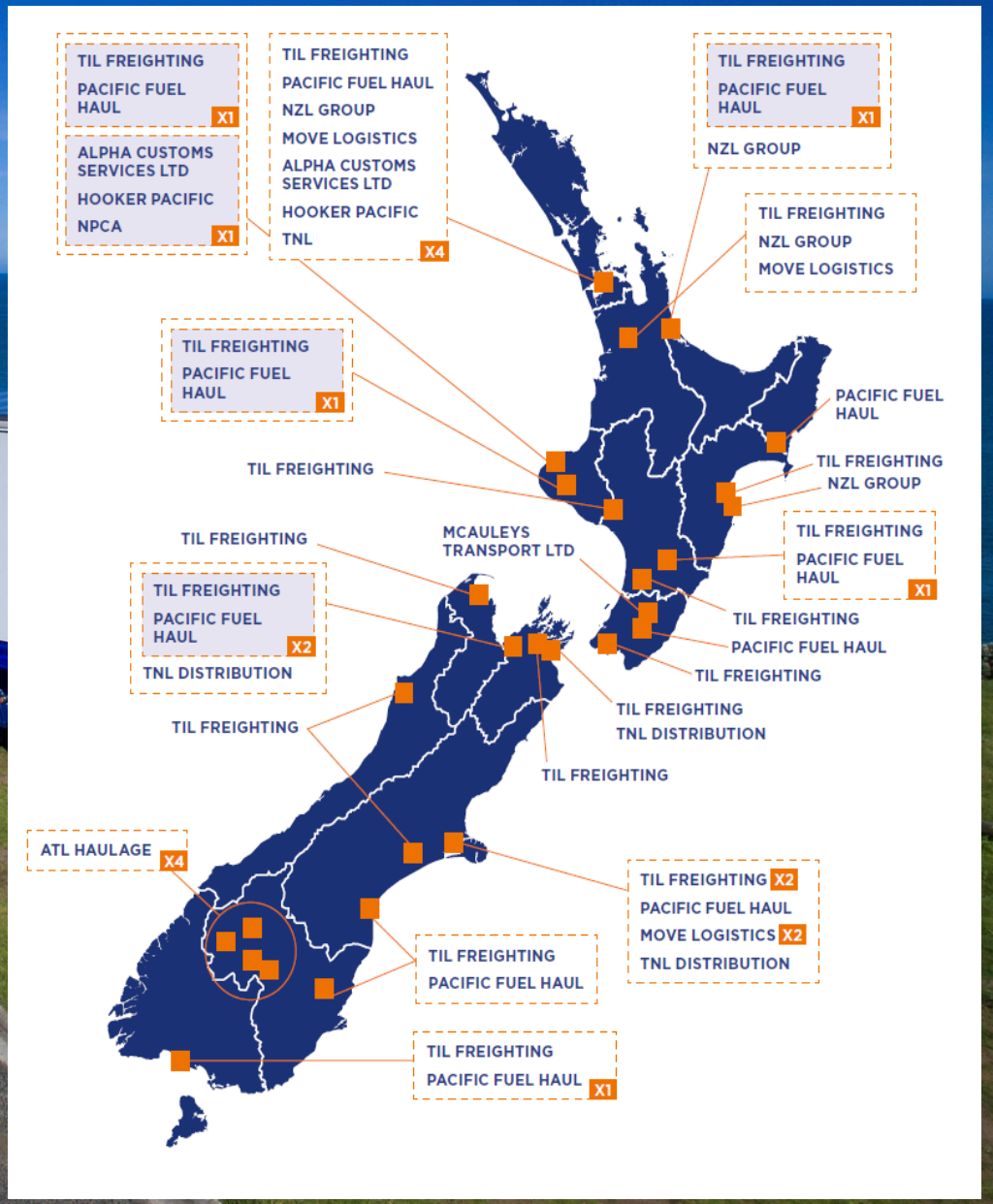
Rapid change, constrained frameworks

TIL LOGISTICS GROUP LIMITED

CEO: Alan Pearson

TIL BECOMING THE LEADING NZ TRANSPORT & LOGISTICS COMPANY

- We use 32m litres of fuel p.a.
- We travel 82 million kms p.a.
- We operate over 500 forklifts within 57 sites
- We have 20 Warehouses with 245,000 pallets of capacity



PACIFIC FUELHAUL Ltd.

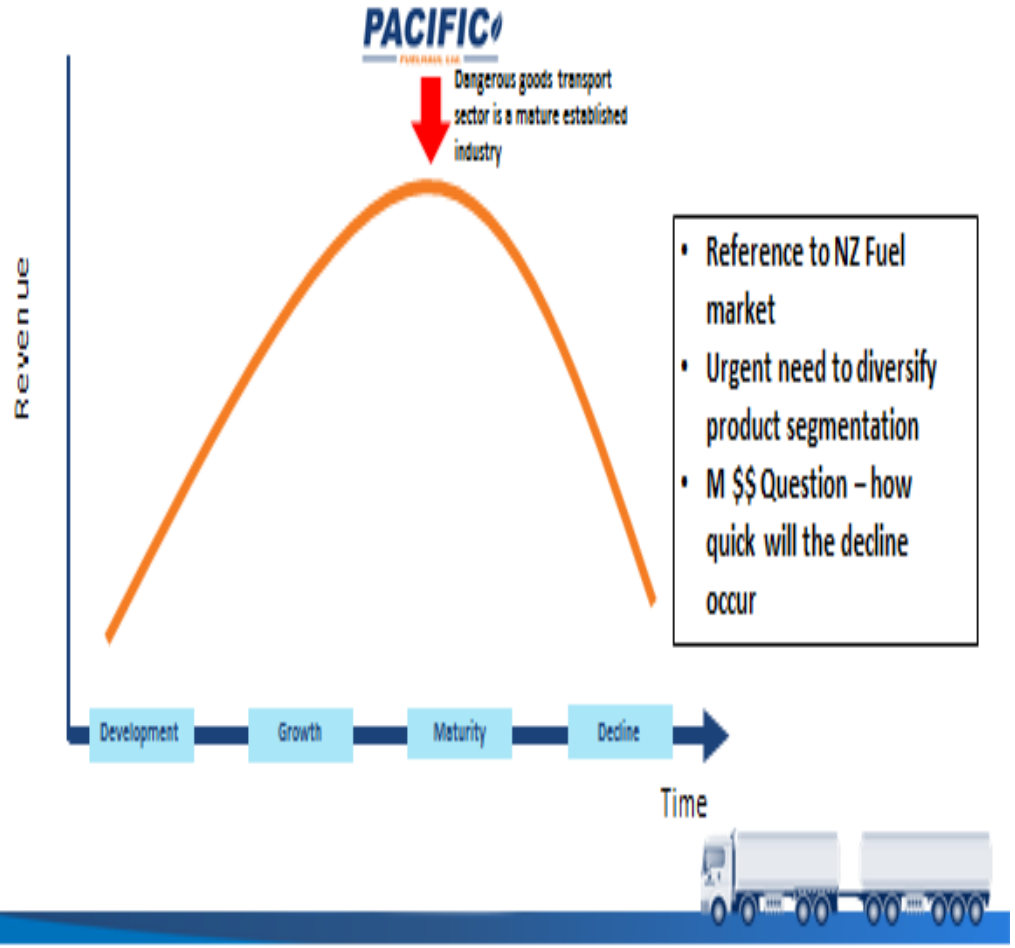
A TIL GROUP COMPANY

We carry millions of litres of petroleum and gas products across NZ.

This world will change in the future and we need to be part of the change. Actually WE NEED TO LEAD IT.

THE OPPORTUNITY FOR OUR BUSINESS

Industry Life Cycle Analysis



So how do we lead ?

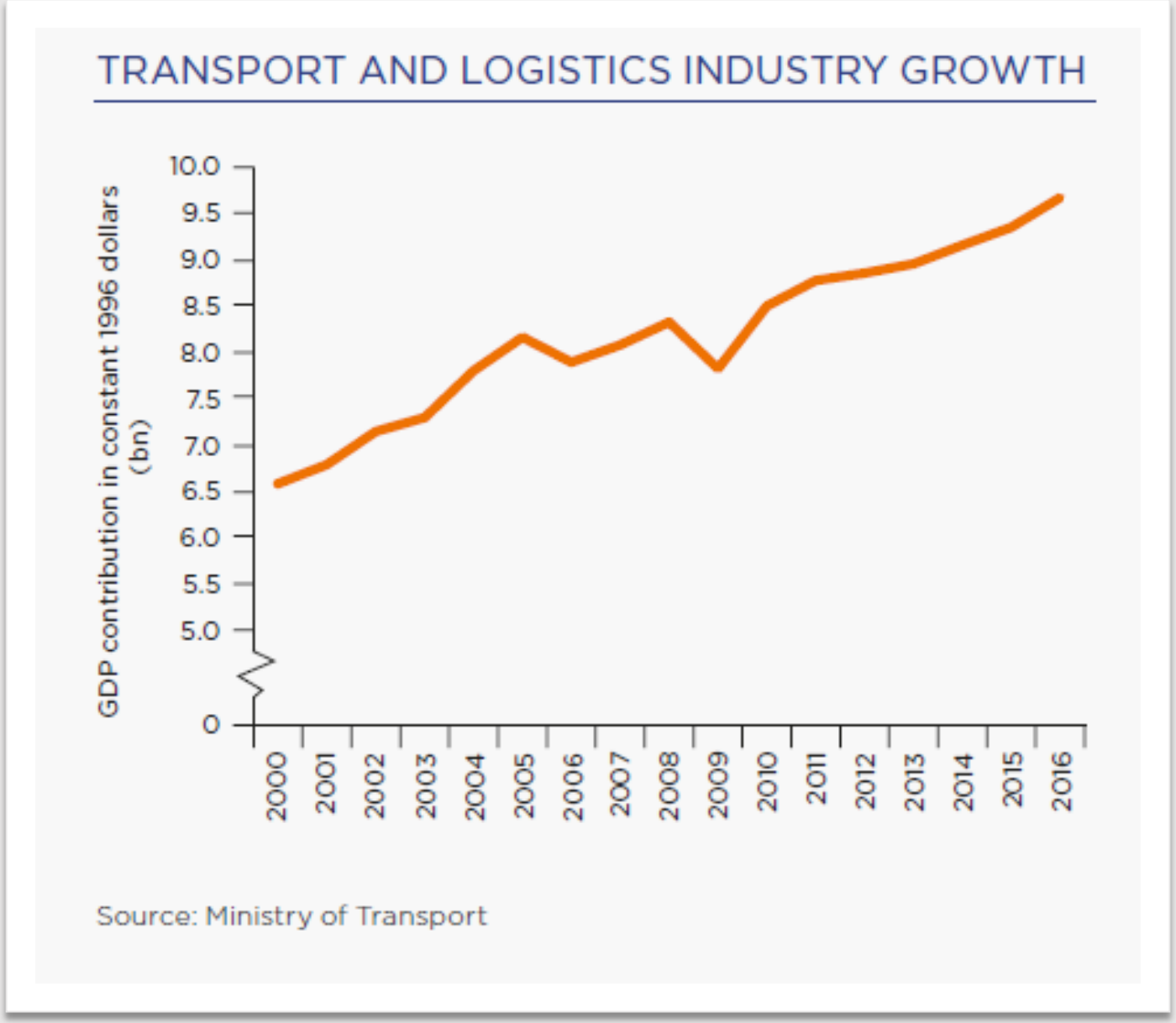
- By joining the Carbon Reduction Coalition and making a public commitment to reducing our carbon emissions.
- Partnering with Hiringa to pioneer the commercial introduction of Hydrogen into NZ.
- Recruiting a GM Safety & Environment

Our mission is to provide zero emission solutions that are operationally efficient, practical, sustainable, and convenient.

Some facts concerning our Industry

- Highly competitive with a large number of operators
- Amount of freight activity in New Zealand is principally driven by:
  - the level of business activity or GDP
  - international trade in and out of New Zealand
  - overall population levels.
- Trend for businesses to utilise third party logistics (3PL) providers
- RBNZ anticipating >3% growth per annum in GDP over the next 2 years, although this has recently been tempered.

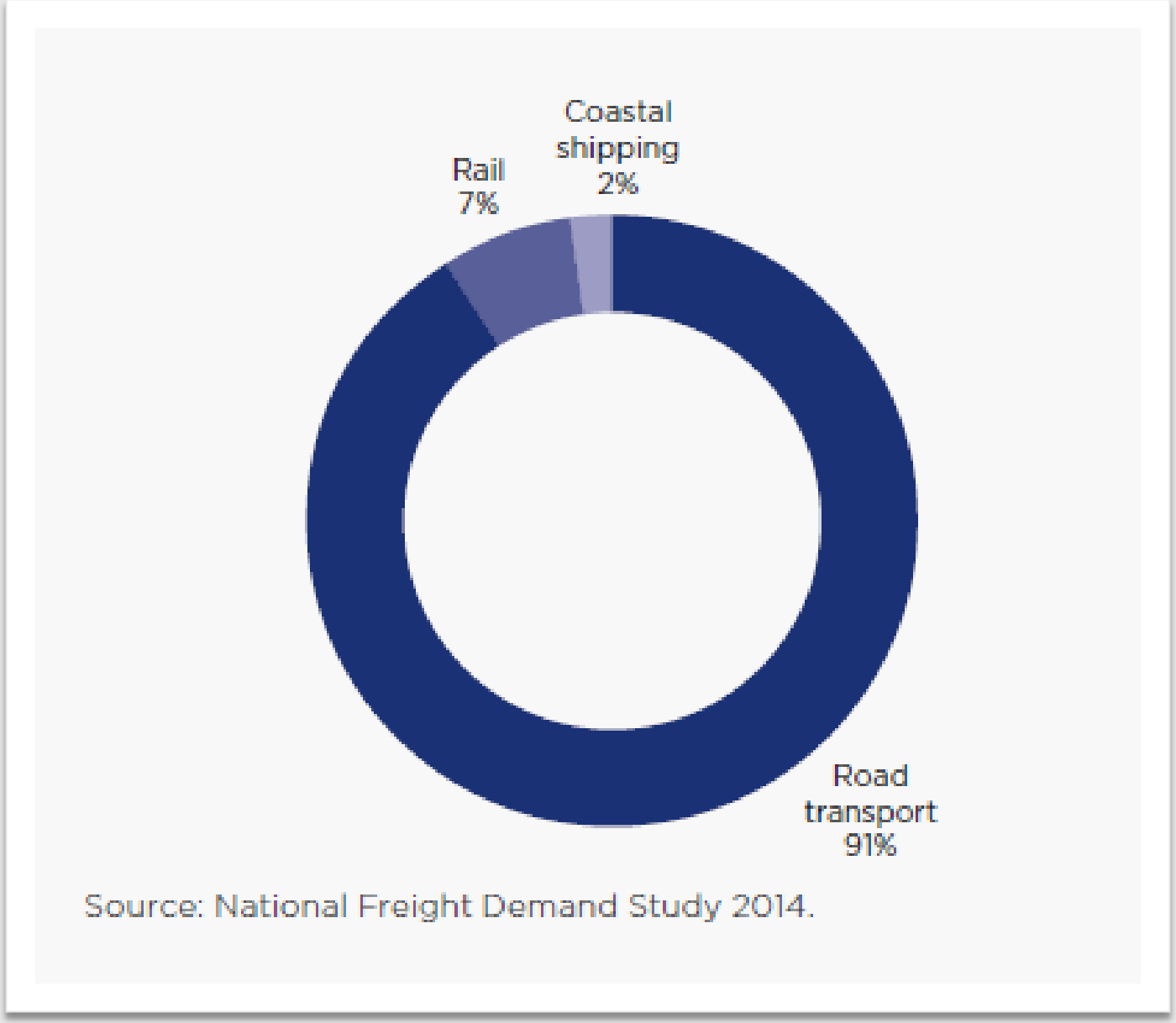
Reserve Bank of New Zealand Monetary Policy Statement, August 2017



NEW ZEALAND FREIGHT BY MODE

- Primary mode of freight in New Zealand is by road
- TIL primarily utilises road transportation but can utilise rail or coastal shipping for freight transport where it makes economic sense
- Road freight is expected to increase by almost 60% over the next 30 years

National Freight Demand Study 2014



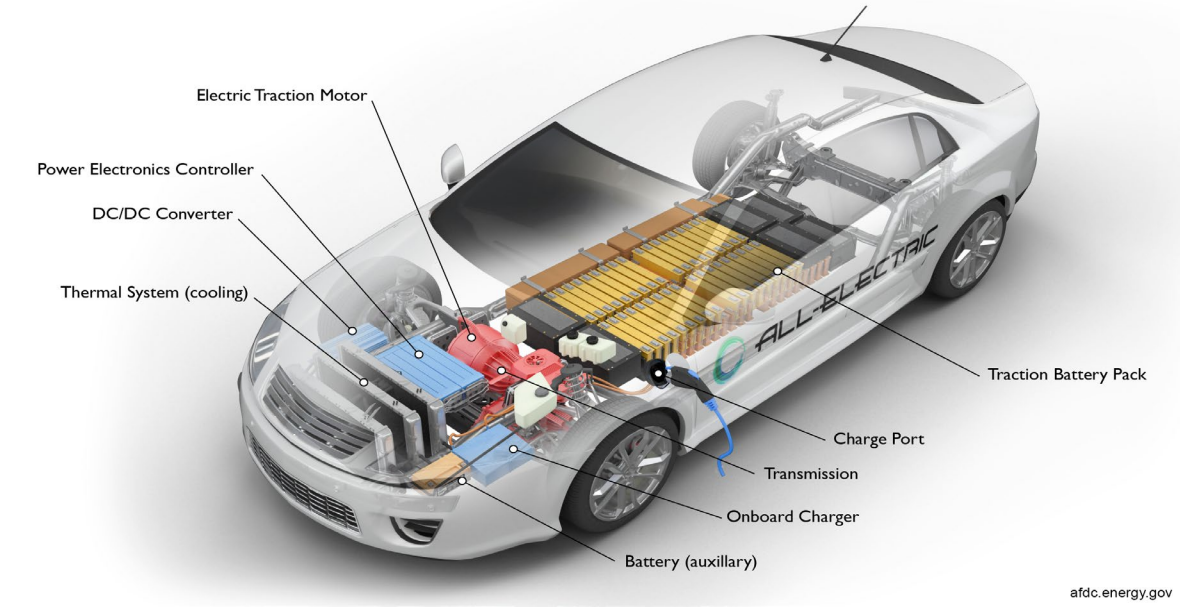
ABOUT TIL LOGISTICS GROUP

So how do we transport this growing freight task if Fossil fuel is causing environmental damage and more efficient modes will not bridge the gap?

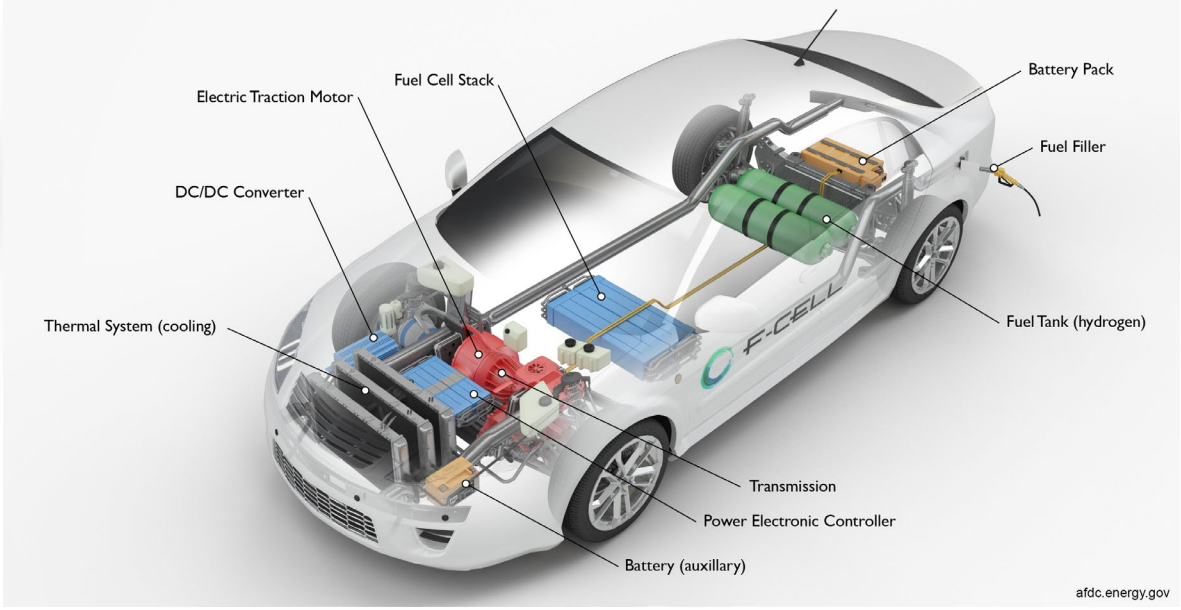
BATTERY AND FUEL CELL VEHICLES

TWO ELECTRIC VEHICLE TECHNOLOGIES

All-Electric Vehicle



Hydrogen Fuel Cell Electric Vehicle



Battery Electric Vehicles (BEV) are electric vehicles that use stored electrical energy in a battery to power the electric motor. They are charged from an external electrical power source.

There are no emissions from a BEV

Fuel Cell Electric Vehicles (FCEV) are electric vehicles that use compressed hydrogen gas to power the electric motor. Hydrogen gas and oxygen from the air combine in a fuel cell to produce electricity.

There is no combustion and the only emission is water vapour.

Fuel cells are up to 95% recyclable

HYDROGEN FUEL CELL ELECTRIC VEHICLE SOLUTIONS (FCEV)

TECHNOLOGY IS PROVEN AND APPLICATIONS ARE GROWING

- Japan moving to a “Hydrogen Society” and Toyota, Honda and Hyundai are producing fuel cell vehicles.
- China and South Korea have ordered tens or thousands of FCEV buses.
- Bus fleets are operational in the UK, Europe, US, China.
- Heavy fleet operators in US and EU have pre-ordered FCEV trucks.
- First hydrogen trains are now operational in Germany, UK converting diesel fleet.
- First hydrogen ferries are now in manufacture.
- Tens of thousands of forklifts are in operation in US warehouses including Amazon, Walmart, BMW, Proctor & Gamble.

“We are confident that hydrogen power will transcend the transportation sector and become a leading global economic success.”

- Euisun Chung, Executive Vice Chairman of Hyundai Motor Group, 2018

FUEL CELL VEHICLES HEAVY VEHICLE ADVANTAGES

A ZERO EMISSION ADVANTAGE FOR FLEET OWNERS AND OPERATORS

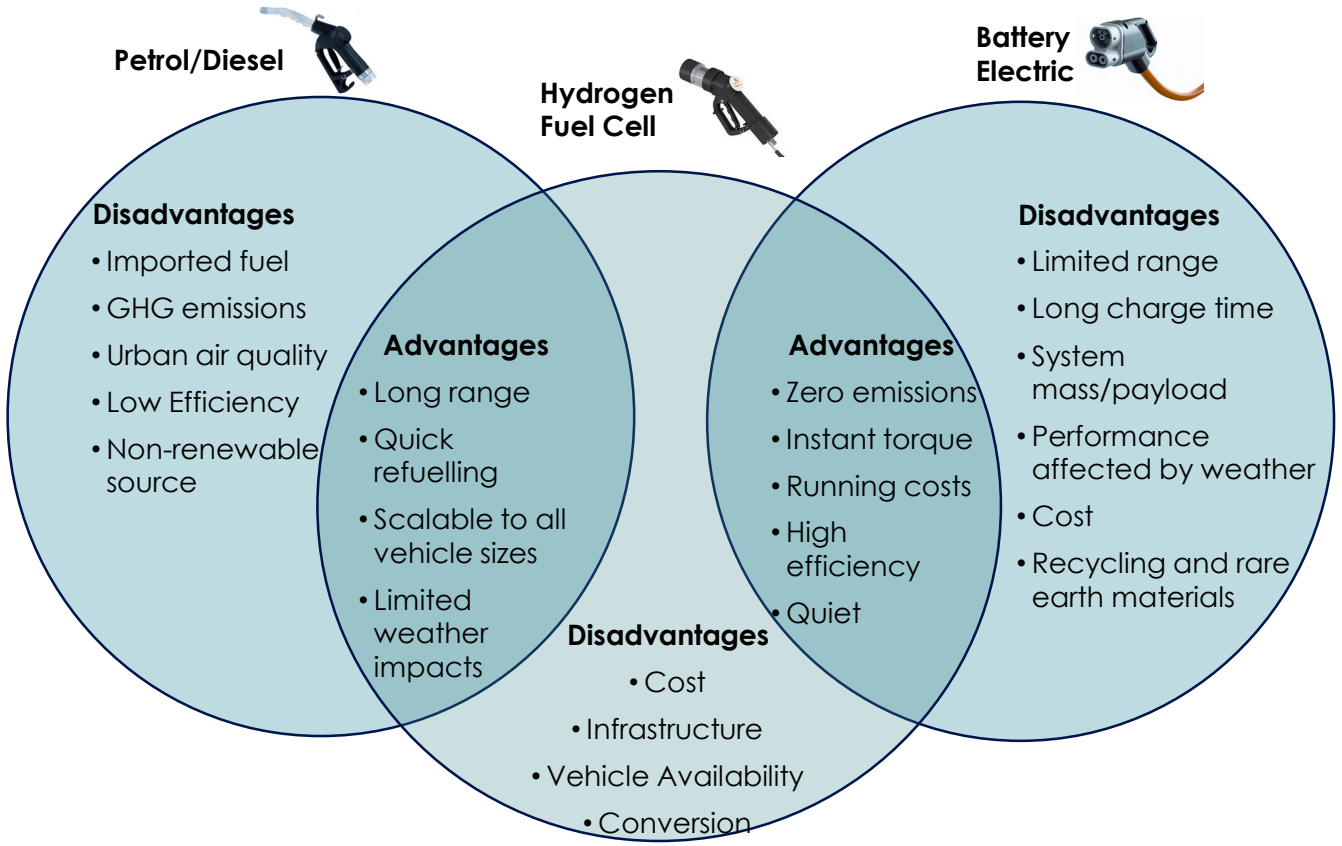
Benefits of hydrogen FC technology

- **High Performance** – long operating time, instant torque and acceleration, no degradation.
- **Increased utilisation** – Refueling and range equivalent to diesel/petrol.
- **Increased payload** – 3-8 tonnes per truck over BEV solutions = less vehicles.
- **Maintenance** – less parts than ICE, improved lifetime over batteries.
- **Efficiency**– hydrogen FCs are up to 3 times more efficient than ICEs.
- **Reduced environmental impact** - quiet, zero emission, no NOX, reduced environmental impact of battery production and disposal, 95% recyclable.

Outcomes for fleet operators

- **Reduced** long term cost of ownership
- **Increased** operational efficiency and total cost of ownership over BEVs
- **Zero emission** branding benefits

BEV AND FCEV SHARE TECHNICAL ADVANTAGES

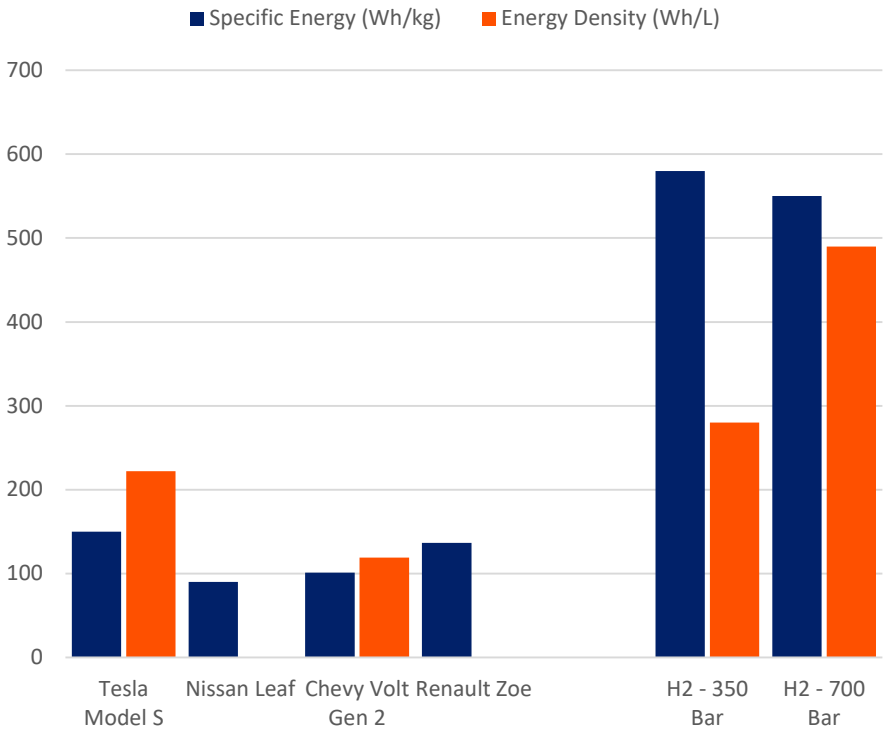


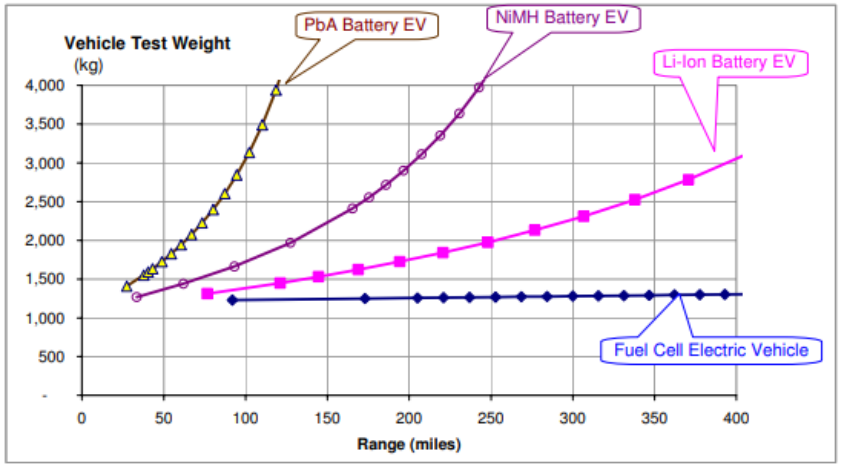
Hydrogen holds a niche position of blending the best of Diesel with the best of EV.

Source: Modified from Hyundai Motors

KEY PERFORMANCE METRICS – RANGE & PAYLOAD

Specific Energy and Energy Density Affect Range and Payload



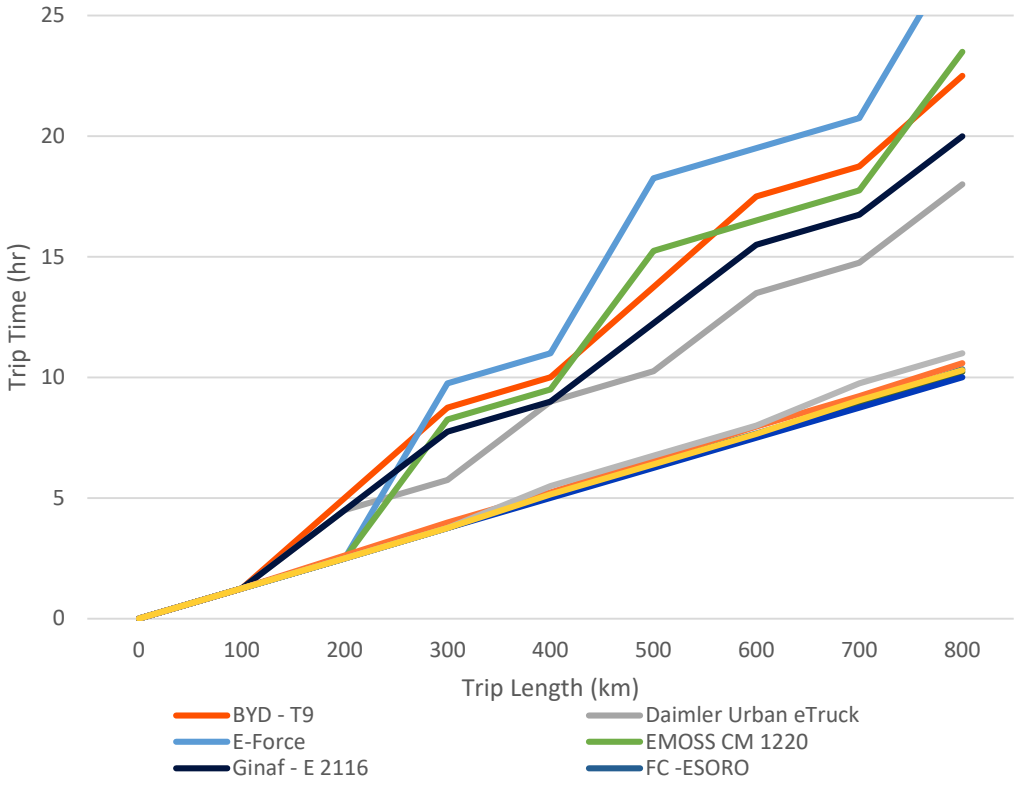


- Specific energy and energy density are key metrics when range and payload are critical
- Low energy density systems result in a cycle of diminishing returns

Source: Hoogendoorn 2018, C.E. Thomas, 2009

KEY PERFORMANCE METRICS – UTILIZATION

Refuel Time is Critical to Keeping Vehicles In-use



Source: ICCT Zero Emission Freight White Paper vF 2017, Hiringa Calculations at 80 km/h average speed

- Refuel times affect total trip lengths/goods hauled per day/per truck
- With short trip lengths (~200 km) there are little differences between technologies
- Above 200 km, long re-charge times start to affect total trip hours
- Some operators mitigate this by using two BEV vehicles
- Use of FCEV offers route flexibility

KEY PERFORMANCE METRICS – INFRASTRUCTURE

Refuelling Requires Yard Footprint and Power Capacity

- Operators must consider capabilities for on-site charging or refuelling vs. off-site locations
  - Footprint
  - Power
  - Peak v. off-peak pricing
  - HS&E considerations
  - Energy capture and optimization

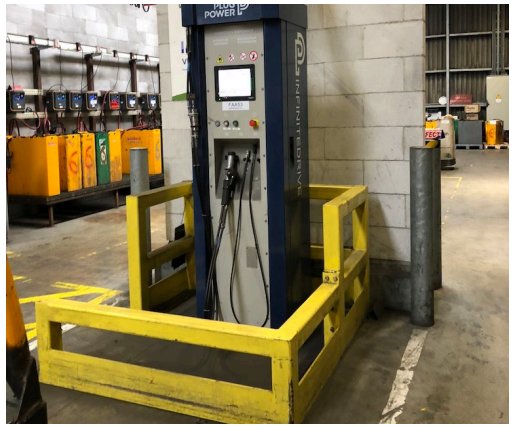
Source: Heliox, COOP

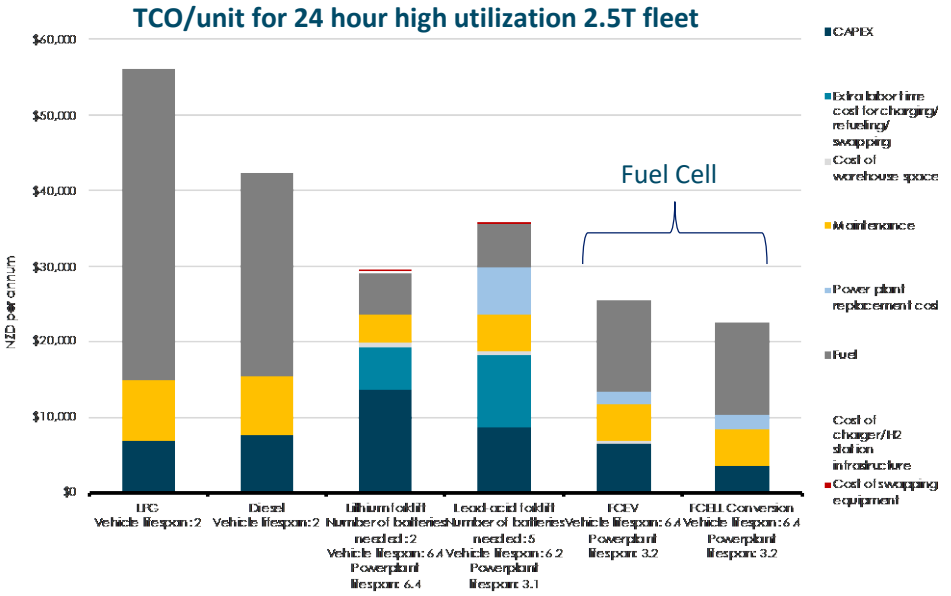
FUEL CELL MATERIALS HANDLING IS FULLY ESTABLISHED

MOST COMPETITIVE TOTAL COST OF OWNERSHIP (TCO) IN HIGH UTILISATION FLEETS

- **>50,000 units** in operation OEM models and conversions available. Large retailers already utilising: Walmart, Amazon, Colruyt, BMW, Carrefour Group, FM Logistic, FedEx, etc.
- **Performance** – can operate over an 8 hour shift at full speed, including -30 ○C cold stores, without performance degradation.
- **Increased uptime** – hydrogen fuel cells can be rapidly refueled in just 1-3 minutes – labor and equipment efficiencies
- **Reduced Maintenance** - constant voltage, reduced wear & improved lifetime vs batteries
- **Increased space** - remove the need for battery rooms & logistics.

Hiringa working with warehouse operators and forklift suppliers to aggregate demand



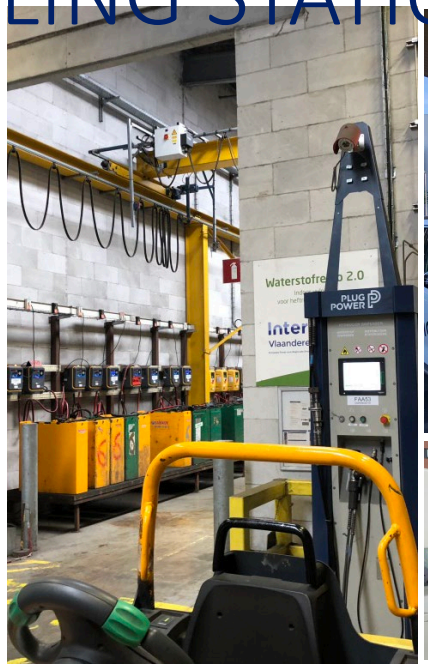


MODULAR INTEGRATED REFUELLING STATIONS

Technology exists and operational in several countries.

Hiringa's solution leverages existing technology while ensuring fit for purpose for New Zealand:

- Flexible & expandable modular platforms
- Integrating with on-site production or delivered hydrogen
- Multiple refueling options/combinations for materials handling, light vehicles and heavy vehicles
- Integrated network will provide economy of scale, enhanced reliability and provide platform for broader uptake



Case examples:

- www.don-quichote.eu
- https://youtu.be/966FwPOYOow

WHAT DOES SUCCESS LOOK LIKE?

- Green supply chains and logistics capabilities
- Reduced emissions & noise in our cities & regions
- New business and export creation
- Reduced imported fuels
- Sustainable industry & businesses

It will require:

- Collaboration at local, national and international level
- New business models and thinking
- New investment structures and innovation

So why bother with EV?

Inconvenient truths –

- Burning Coal to generate electricity to power EV's is not improving the environment.
- Burning coal to generate electricity to make hydrogen is even worse with a 30% yield loss coupled with the need to have access to millions of litres of clean fresh water.
- Currently Hydrogen is expensive
- The world needs to rapidly expand its renewable electricity generation capacity. Whether we like it or not this may need to include nuclear.
- NZ has an enviable portion of renewable energy generation. We also have abundant fresh water and this is what the Japanese are attracted too.

Alternative powered trucks & Trailers

- **Powered drive axles on trailers**
- **Integrated design and engineering with truck manufacturers**
- **Power capture on all axles**
- **Solar panels of trailer tops**

- EV and FCEV will develop in parallel. Both need renewable electricity and not use dirty electricity
- FCEV can use Dirty hydrogen not presently captured but simply vented into the atmosphere.
- NZ has signed the Paris accord and committed to reducing carbon emissions by 5% with further savings by 2050.
- TILL will partner with organisations who have emerging technologies that improve our planets health and future.

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THANK YOU