Híringa Energy

Zero Emission Energy

The Why, What and How of Hydrogen
Fuel Cell Market predicted to grow at compound annual growth rate (CAGR) of 15.5% through to 2027 (Grand View Research)

European hydrogen market expected to grow 70x by 2030

Unprecedented growth and cost reductions for solar and wind power expected to continue

European truck manufacturers commit to 2040 for complete phase out of carbon emitting powertrains

Japan commits ¥70bn (NZD$1bn) to support hydrogen for financial year ending March 2021.

EU Green Hydrogen Package targeting spend of €150bn by 2030.

Australia launches $300m Advancing Hydrogen Fund Queensland appoints Minister for Hydrogen.

Germany earmarks €9bn for the expansion of hydrogen capacity

The world is quickly moving to a hydrogen economy

INTERNATIONAL MOMENTUM BUILDING FOR HYDROGEN

The energy to change. Together.
HYDROGEN CAN MATERIALLY CONTRIBUTE TO DECARBONISATION ACROSS SECTORS

- New Zealand’s electricity production is 80-85% renewable however only 40% of New Zealand’s energy use is renewable.
- We simply cannot achieve net zero emissions with renewable electricity alone.
- We need green hydrogen to play a major part.
- How do we get green hydrogen to the scale and cost required?
FOC U S S I N G O N C O M M E R C I A L S C A L E A P P L I C A T I O N S

- Markets that exist today
- Applications that have price support and/or volume growth
- Also considers relative technology competitive advantage

Hiringa is developing:
- Refuelling infrastructure focused on heavy & commercial vehicles
- Hydrogen eco-systems to decarbonise heavy industry
- Large scale export projects with key partners

Strategic Focus

- Virtual Grid Firming
- Heavy Transport
- Remote power
- Industrial Feedstock
- Export
- Process Heat
- Synthetic fuels

Price support

Volume growth potential
ACCELERATING ELECTRIFICATION & EXPANDING THE REACH OF RENEWABLE ENERGY

HYDROGEN ENABLES PARALLEL DECARBONISATION OPPORTUNITIES

Converting NZ’s entire supply of suitable biomaterials to 120-160 million L/yr of renewable diesel requires 40-50 MW of H₂ production.

- Utility Renewables
- Renewable fluctuations
- Electricity Grid
- New build renewables
- Grid balancing with electrolysers

1. Direct Electricity Use
   - Vehicles
   - Gas pipe injection

2. Direct H₂ Use
   - Ammonia
   - Methanol

3. H₂ to X
   - N₂
   - CO₂
   - Biomaterial
   - Renewable Diesel

HİRINGA

Ideal for cars, small trucks/buses
- Good for 100-300km range
- High efficiency
- High battery weight
- Scaling requires grid upgrades

Ideal for trucks, buses, medium aviation & maritime
- Quick refuel time
- High payload
- Long ranges
- Easily scaled up
- Upfront infrastructure cost

Ideal for large aviation and maritime
- Unlocks new decarbonization possibilities
- Can retrofit existing ship bunkers
- Upfront conversion cost

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HYDROGEN SUITS THE HIGHEST IMPACT SEGMENTS OF THE FLEET

PAYLOAD AND UTILISATION DRIVEN APPLICATIONS ARE THE BIGGEST GHG EMITTERS

- FCEV’s light weight and fast refuelling is best technology fit for heavy and highly used vehicles
- The heaviest trucks drive the most kilometres and emit over 150x more CO₂ than average passenger vehicles
- These are the newest vehicles in the fleet, on frequent replacement cycles
- Hydrogen network targets this segment to maximise decarbonisation impact
- Reduces the burden on light vehicle transition

![Graph showing CO₂ emissions by vehicle type]

Source: MoT NZ 2017 Vehicle Fleet Data Spreadsheet v 4.0 Sept 2018
FUEL CELL AND BATTERY VEHICLES ARE COMPLIMENTARY

FCEV MORE SUITED TO HEAVY VEHICLES AND HIGH UTILISATION / RANGE CASES

Hiringa Energy’s first 8 stations will provide 100% coverage of North Island freight routes, providing inter-regional connectivity and complementing urban BEV fleets.
ZERO EMISSION TECHNOLOGIES WILL VARY WITH APPLICATIONS

- There is no one silver bullet for decarbonising transport
- Each class of transport will have a mix of technologies applies according to the use case / application
- Biofuels, BEV and FCEV all have an important role to play

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HOW HYDROGEN FUEL CELL ELECTRIC VEHICLES WORK

TECHNOLOGY BUILDS UPON VEHICLE ELECTRIFICATION

- Electric drivetrain
- No combustion
- Low noise
- High torque
- Minimal moving parts
- Rapid refuelling (<15mins)
EFFICIENCY IS DEFINED IN MANY WAYS...

- Hydrogen maximises the CO$_2$ reduction per vehicle, is efficient use of capital
- Trucks are low hanging fruit:
  - 150x Battery Electric Cars = 1x Fuel Cell Truck

**Payload**
- Hydrogen maximises the payload and therefore revenue per trip

**Time**
- BEV charging increases strain on grid
- Flexibility of electrolysis relieves pressure on grid and works well with intermittent renewables

**Emissions Reduction**
- Tare weight: 30t = 1x Fuel Cell Truck
- Cargo: 30t

**Network**
- Electrical
- % Input Energy
  - Diesel
  - Battery
  - Electric

**Characteristics**
- Fuel Cell
- Battery Electric

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Power consumption for H₂ production can be decoupled from refuelling by up to 24 hrs.

FCEV refuelling has low power draw and can continue throughout peak times without price penalty.

H₂ production can be turned off to avoid peak prices.

Battery fast charging (20 min) requires the grid to cope with intermittent intense demand – this is inefficient.

Based on BEV and FCEV trucks with 1000 kWh equivalent energy storage.

NOTE: BEV trucks with 1000 kWh batteries are not currently available, due to the weight of such a large battery. This slide is indicative only.
EFFICIENT USE OF THE POWER NETWORK

**Single Battery Electric Truck Charging**
Charging faster puts more strain on the grid

- **1000 kWh**
  - 20 mins: 200 homes
  - 40 mins: 600 homes
  - 60 mins: 2400 homes
  - 80 mins: 800 homes
  - 100 mins: 1200 homes
  - 200 mins: 2400 homes

**Power Draw Equivalent (kW)**
- **145 homes**
- **240 homes**
- **600 homes**
- **800 homes**
- **1200 homes**
- **2400 homes**

Charging faster puts more strain on the grid, with current technology taking 330 mins and costing $0.45/kWh. Faster charging options are available, but at higher costs.

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## TRUCK CASE STUDY: AUCKLAND TO PALMERSTON NORTH RETURN (500KM EACH WAY)

**FCEV ONLY COMMERCIAL VIABLE ZERO EMISSION OPTION FOR LONG HAUL FREIGHT OPERATORS**

<table>
<thead>
<tr>
<th>2021 FCEV Case</th>
<th>Hyzon CF85-FTT</th>
<th>2021 BEV Case</th>
<th>TR Group Comparable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>650 km</td>
<td>Payload</td>
<td>27 tons</td>
</tr>
<tr>
<td>Refuel time</td>
<td>~20 mins</td>
<td>Payload</td>
<td>22 tons</td>
</tr>
<tr>
<td>Hydrogen price</td>
<td>$14/kg</td>
<td>Recharge time</td>
<td>~1.8 hrs</td>
</tr>
<tr>
<td>Trip time</td>
<td>18 hrs, 1 refuel during unloading</td>
<td>Earnings per trip: $737</td>
<td>Trip time: 33 hrs, 8 charging stops</td>
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<tr>
<td>Earnings per trip</td>
<td>$3,399</td>
<td>Per trip revenue</td>
<td>$2,770</td>
</tr>
<tr>
<td>Per trip revenue</td>
<td>$3,399</td>
<td>Hydrogen cost</td>
<td>-$1,249</td>
</tr>
<tr>
<td>Hydrogen cost</td>
<td>-$1,249</td>
<td>Ownership cost</td>
<td>-$1,325</td>
</tr>
<tr>
<td>Ownership cost</td>
<td>-$1,413</td>
<td>Charging cost</td>
<td>-$2,520</td>
</tr>
</tbody>
</table>

**Lost revenue from less payload:** $630

**Time cost of charging stops:** $1,107

**Earnings per trip:** -$1,075

Hydrogen price: $14/kg

180 kW fast charge, $.45/kWh
FCEV’S HAVE A SIGNIFICANT ROLE TO PLAY IN DECARBONISING BUS FLEETS

NEW ZEALAND GOVERNMENT DRIVING ZERO EMISSION PUBLIC TRANSPORT

• Hydrogen FCEV buses particularly suited to the high demand / km routes
• Produces lowest cost/passenger km
• Has biggest impact on emission reduction

Hiringa Energy refuelling New Zealand’s first FCEB. The bus has been manufactured in Christchurch by Global Bus Ventures (GBV)

1 BUS ≈ 40 CARS
200 BUSES ≈ 8000 CARS

IN FUEL CONSUMPTION & EMISSIONS REDUCTION
OTHER TRANSPORT SECTORS ARE ACCELERATING GLOBALLY

NEW ZEALAND VERY WELL SUITED FOR EARLY ADOPTON

AIR TRAVEL

- Strong interest for conversion of turbo-prop planes from 2025 – New Zealand as a prime early market
- Airbus announced 3 x new hydrogen plane models from 2035

PUBLIC TRANSPORT – FERRIES, TRAINS

- Hydrogen for FCEV ferries and for fuel cell to power charging
- Train conversions to extend zero emission rail beyond electrified network

PASSENGER VEHICLES

- Hyundai and Toyota planning to introduce light vehicles – can be refuelled at Hiringa stations (2/3 range with current design) – stations can also be upgraded to achieve full range
HOW TO ACHIEVE COMMERCIALITY
HEAVY VEHICLE FOCUS BUILDS RAPID COMMERCIALLY VIABLE INFRASTRUCTURE

Hyzon & Hyundai trucks available in 2021

- Designed for regional markets
- Range 650 & 400km
- Payload 27 & 22 tons
- Refuel time 10-15 mins
- Connected to Hiringa Network
- Fuel use and emissions of 150x cars

Major Fuel User

- Consumption of 40-70 kg/H₂ per day versus ~0.25 kg/ H₂ per day for cars
- Support station commerciality

Leverage Network

- Truck leasing models secure network fuel sales
- Network enables hub-based and point to point applications
- Operated across all major NZ highways

Broad Market Use

- Prime-mover & rigid unlocks range of freight applications
- Compatible with all freight + trailer fleets
- Suitable for retail freight, food, industrial, construction

Future Platform

- Next generation unlocks additional fleet opportunities for:
  - Dairy industry tankers and liquid haul
  - Bulk haul

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RAPIDLY BUILDING FLEET SCALE DRIVES COSTS DOWN

ACCELERATES TOTAL COST OF OWNERSHIP PARITY WITH DIESEL

\[ \text{Total Cost of Ownership ($/km)} \]

\[ \text{Year of Truck Purchase} \]

LEGEND

- Diesel Range
- Price volatility
- FC Unsupported
- RUC exemption + market growth
- Operating cost support (RUC exemption)
- Capex cost support
- RUC Exemption + market growth + CapEx support
- Heavy vehicle uptake

The energy to change. Together.
Competitive network coverage is achievable

Building a national H2 refuelling network by 2025

Trucks go long distances before refuelling, and use key freight routes, so not many truck stops are required:

- Phase 1A (4 stations) - Hamilton, Palmerston North, Tauranga, South Auckland will cover over 90% of North Island freight routes
- Phase 1B (4 stations) extends network to Christchurch, Taranaki Taupo and Wellington, covering 100% of NI freight routes, 80% of SI freight routes
- Phase 1 + 2 (24 stations) provide full national coverage of freight routes

We can achieve a network competitive with diesel within 5 years
ESTABLISHING MINIMUM INFRASTRUCTURE SCALE TO ENABLE COMMERCIAL VIABILITY

NETWORK APPROACH PROVIDES ECONOMY OF SCALE SYSTEM RESILIENCE AND MODULARITY FOR EXPANSION

- Initial pilot network design provides economy of scale and lowers unit cost.
- Multiple production facilities.
- Each production facility provides back-up / redundancy for each station.
- Vertically integrated network provides commercial robustness and flexibility.

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Cloud-Based Data Management and Communication Protocol Management

Power Generation
- Generation Data
- Weather Data
- Grid Data
- Production Data

H₂ Production
- Power Generation
- Weather Data
- Grid Data
- Production Data

Distribution and Refueling
- Fleet Data
- Refuelling Station

Customers
- 3rd party applications
- Dispenser control and status
- Vehicle refueling communications

API and web services
- 3rd party applications
- Customer UI and POS

Analysis
- Financial Reporting
- Geospatial Data
- Asset Management

Visualisation
- SCADA

Operations
- Analysis and Alarms

Reporting

DATA DRIVEN NETWORK OPERATIONS AND OPTIMISATION ACROSS VALUE CHAIN
**HIRINGA NZ NETWORK – STRONGER METRICS COMPARED TO CALIFORNIA**

### CALIFORNIA (TODAY)

Californian network development focused on light vehicles (LVs), stimulated by LCFS subsidies. Complexity of road network requires high station count.

- **NO. OF FCEVs (LV EQUIV.):** ~10,300
- **Refuelling Stations:** 44
- **Station Utilisation (LV EQUIV./STATION):** 234
- **% Green Hydrogen:** 40%
- **Hydrogen Price:** $19-$29 NZD

### HIRINGA NETWORK 2021/22

Hiringa’s network development focuses on high-use heavy trucks and buses, ensuring robust economics. Initial Phase 1 network will achieve high route coverage.

- **NO. OF FCEVs (LV EQUIV.):** ~3350 \(\rightarrow\) ~8275
- **Refuelling Stations:** 4 \(\rightarrow\) 8
- **Station Utilisation (LV EQUIV./STATION):** 838 \(\rightarrow\) 1035
- **% Green Hydrogen:** 100%
- **Hydrogen Price:** $14-$17 NZD
INDUSTRIAL SCALE GENERATION & OFFTAKE INTEGRATED WITH TRANSPORT AND GRID

HIRINGA/BALLANCE KAPUNI JOINT VENTURE

- Kapuni Ammonia/Urea plant supplied with renewable electricity
- Green H2 produced from excess power
- Plant uses green H2 to produce green Ammonia/Urea providing large off-taker
- Green H2 diverted to higher value transport use as market grows
- Provides "virtual peaking" to electricity market
- Provides a hedge for partners electricity costs

4.3 Mw plant

Peak power

Excess power

New Wind Turbines

Electrolysis

Hiringa / Ballance JV

Existing Ballance Agri-nutrients Ammonia/Urea Plant

H_2 for green ammonia/urea

Transport Market

Hiringa Refuelling

Grid connect

6000t Green Ammonia or 7000t Green Urea / annum

H_2 for zero emission transport market

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SCALING CONCEPT FOR DOMESTIC & EXPORT HYDROGEN & ELECTRICITY MARKETS

- Industrial feedstock for fertiliser and chemicals
- Domestic supply for transport, process heat
- Hydrogen export (as NH3, LH2, MeOH, MCH etc)
- Grid scale firming

Significant opportunity to create a large scale "virtual battery" built in conjunction with new renewables.

Phase 1: 2023-2028 industrial scale
- 100-250 MW electrolysis
- ~40 Heavy FCEVs
- 200-500 MW onshore wind
- Grid firming demand response
- ~200k TPA Green Ammonia & Urea
- ~15 – 30k TPA H2 Export Pilot (Method TBC)
- ~100 Heavy FCEV

Phase 2: 2028+ integrated domestic power, domestic hydrogen & export hydrogen
- 1-2 GW Onshore & Offshore wind generation
- 0.5 – 1 GW+ electrolysis
- Ammonia Methanol MCH LH2 (Method TBC)
- ~75 – 200k TPA H2 Export
- ~75-200k TPA H2 Domestic hydrogen supply

2022 – Kapuni Hiringa Ballance JV
- 17 MW
- 5 MW
- 7000 TPA green Urea
- ~40 Heavy FCEVs

The energy to change. Together.
Hydrogen is the energy to change our future – let’s make it a zero emissions one.

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