New Zealand company formed 2016, incorporated 2017

- Highly experienced development, technical and operations capability & rigor within the energy and clean-tech sectors
- Integrated renewable energy production, distribution and wholesale trading
- Hydrogen production, systems & refueling design, commissioning and operation expertise
BRIEF INTRO TO HIRINGA ENERGY – WHAT WE DO?

HIRINGA IS CONNECTING THE GREEN HYDROGEN VALUE CHAIN

Make Clean Hydrogen
We develop commercial scale green hydrogen production projects using electrolysis from renewable electricity and biogas, forming joint ventures where appropriate with commercial and industrial partners.

Develop Hydrogen Infrastructure
Together with partners, we develop and invest in hydrogen distribution and refuelling infrastructure across New Zealand to decarbonise heavy transport.

Facilitate Market Use of H₂
Partnering with New Zealand’s largest road transport companies.
Working with global manufacturers to introduce hydrogen technologies.
Establishing offtake for industry and export.
New Zealand Hydrogen Council

- The New Zealand Hydrogen Council was formed in September 2018 to support the progression and uptake of low emission hydrogen in New Zealand.
- Strong growing membership across public & private sectors and universities
- Contact: Dr Linda Wright (Chief Executive) linda@nzhydrogen.org

Government activities

- New Zealand’s hydrogen strategy consists of two parts; the hydrogen vision published in 2019 and a hydrogen roadmap which is under development.
- Funding support has included EECA supporting heavy transport pilots, Covid Recovery financing for Hiringa’s refuelling infrastructure and Endeavour Funding for R&D
SO WHY HYDROGEN?
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.
- Hydrogen is the leading contender to address up to 18% of our emissions - we need green hydrogen to play a major part.
- How do we get green hydrogen to the scale and cost required.
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.

There is no one silver bullet for decarbonising transport.
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 CO$_2$ 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

Line Haul Long Distance | Average Fleet | Heavy Commercial | Average Light Commercial | Average Passenger
---|---|---|---|---
FCEV | BEV

1 x $700k-$1m truck $\approx$ $9m$ in light vehicles

Source: MoT NZ 2017 Vehicle Fleet Data Spreadsheet v 4.0 Sept 2018
TYPICAL ANALYSIS OF THE HEAVY TRANSPORT FLEET MODELS AN “AVERAGE” TRUCK

The "average" truck in NZ based on the MoT 2010 dataset for Heavy Trucks > 10t GVM is 19.5 t GVM and travels 27,000km pa

- Analysis fails to account for actual emissions the different truck sub-classes are responsible for.
- Cost and fleet analysis should account for the “lives” of trucks where new trucks enter the market at higher duty:
  - 1st life – 5-7 years 100% purchase cost
  - 2nd life – 5-7 years 40% purchase cost,
  - 3rd life – 7+ years <10% purchase cost

Vehicle count by truck size and annual distance travelled (Trucks > 10 t GVM)

- Average Heavy Truck: ~27,000 km, 19.5 t

Ministry of Transport Data, 2010
When emissions are accounted for, a very different pattern emerges:

- **Over 80%** of heavy trucking transport emissions originate from trucks that are heavier and drive further than the “average truck”

- **Less than 20%** of emissions addressable with a zero-emission truck based on the “average” heavy truck

- A heavy trucking decarbonisation strategy should introduce new zero emission vehicles in the 1st Life and leverage the “trickle-down” effect

**Cumulative Emissions by truck size and annual distance travelled**

- **Average Heavy Truck:** ~27,000 km, 19.5 t

Ministry of Transport Data, 2010

The energy to change. Together.
EFFICIENCY IS DEFINED IN MANY WAYS…

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

**Efficiency**

- Hydrogen maximises the payload and therefore revenue per trip
- Cargo Tare weight
  - 2x Battery Electric Truck = 1x Fuel Cell Truck
- Emissions Reduction
  - Hydrogen maximises the CO₂ reduction per vehicle, is efficient use of capital
  - Trucks are low hanging fruit:
    - 150x Battery Electric Cars = 1x Fuel Cell Truck
POWER GRID IMPACTS OF BATTERY VS HFCEV TRUCKS

Grid Power Draw (kW)

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

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

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

- H₂ production can be turned off to avoid peak prices.

- 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.

HFCEV Truck Fills

- 1 MW = 800 homes

BEV Truck Charge

- 3 MW = 2400 homes

The energy to change. Together.
EFFICIENT USE OF THE POWER NETWORK

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

- 1000 kWh
- 200 mins: 300KW @ $0.60 / kwh
- 330 mins: 180KW @ $0.45 / kwh
- 145 homes
- 60 mins: 770KW
- 80 mins: 300KW
- 240 homes
- 60 mins: 1000KW
- 40 mins: 1500KW
- 800 homes
- 20 mins: 3000KW
- 2400 homes

Power Draw Equivalent (kW)

= 10 homes
WHAT HYDROGEN TECHNOLOGIES ARE AVAILABLE?
PLANES, TRAINS, MARINE AND CONSTRUCTION APPLICATIONS ARE ACCELERATING
LIKELY TECHNOLOGY ROADMAP FOR NEW ZEALAND

2022

Material Handling
Buses
Heavy Transport

Chemical Feedstock
Light/Medium Commercial
Passenger Vehicles
& Utility vehicles

Remote and
backup power
Passenger Rail

Domestic Flight
Passenger Ferry

Pipeline injection
Industrial process
heat

Jet Aircraft
Cargo Shipping

2025

2030
LATEST TECHNOLOGY DEVELOPMENTS IN HEAVY TRUCKING

HEAVY TRUCK MARKET OFFERINGS BUILDING QUICKLY

The energy to change. Together.
Renewable power

Water

Electrolysis

Compressed hydrogen

Hydrogen Storage

Fuel Cell Modules

Battery System

Electric Motor

Water

Source: Cummins

Source: E-Motec

The energy to change. Together.

Provided the hydrogen is created using electrolysis, a FCEV truck meets the definition of a Heavy Electric RUC Vehicle as it **derives its motive power wholly or partially from an external source of electricity**.

- Electric drivetrain
- No combustion
- Low noise
- High torque
- Minimal moving parts
“POWER TO X” CASE STUDY: EARLY SCALE, LOW COST H2 & ELECTRICITY

- 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 electricity costs
Developing fuel supply for Emirates Team New Zealand prototype hydrogen powered foiling chase boat, to be built at the team’s North Shore build facility, capable of standing up to the demands of supporting an AC75 throughout all aspects of an America's Cup campaign.
PARTNERING WITH LEADING ZERO EMISSION AVIATION COMPANY, UNIVERSAL HYDROGEN

The energy to change. Together.
HOW DO WE UNLOCK HYDROGEN'S POTENTIAL?
IMPORTANT TO FOCUS ON THE APPROPRIATE HYDROGEN MARKETS

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

Examples include:

a) Refueling infrastructure focused on heavy & commercial vehicles
b) Hydrogen eco-systems to decarbonise heavy industry
c) Large scale export projects that leverage a) & b)
WE NEED TO CREATE HIGH-CAPACITY PRODUCTION AND REFUELLING INFRASTRUCTURE

**Development 2017-2020**
- Establish partnerships, develop technology and design network

**Establish commercial footprint 2021-2022**
- Network establishment
- 50+ vehicles

**Scale and extend 2022-2026**
- Full national network coverage
- 2000+ heavy and light commercial vehicles
- Marine, rail, aviation & stationary energy

**Full scale network 2030**
- Phase 3 2030
  - Full infill coverage
  - All new vehicles low emission
  - 10,000+ vehicles

- Phase 1 stations cover over 95% of North Island freight routes
- Phase 2 stations provide full national cover of freight routes
Assessment of station location requires many factors to be considered. Hiringa uses data analytics tools and a geospatial platform to accelerate and optimise the analysis:

- Truck and bus routes and movements
- Locations of hubs and depots
- Renewable energy location, quality & quantity
- Cost to transport to customer
HIGH CAPACITY REFUELLING STATIONS IMPROVE CAPITAL EFFICIENCY

• Onsite production of hydrogen and vehicle refuelling
• High capacity – throughput of over 2,800 kg-H₂ per day
• Capable of filling bulk containers for H₂ delivery to mobile refuel sites
NETWORKS NEED TO BE MODULAR, SCALABLE AND RESILIENT

- More efficiency and flexibility in supply chain than incumbent fuels
- Multiple production facilities
- Initial pilot network design provides economy of scale and lowers unit cost
- Each production facility provides back-up / redundancy for each station
- Vertically integrated network provides commercial robustness and flexibility

- Kapuni Wind to Hydrogen & Ammonia JV
- Hamilton Refuelling Station
- Remote Warehouse Supply
- Manawatu Refuelling Station
- South Auckland Refuelling Station
- Tauranga Refuelling Station JV

- More efficiency and flexibility in supply chain than incumbent fuels
- Multiple production facilities
- Initial pilot network design provides economy of scale and lowers unit cost
- Each production facility provides back-up / redundancy for each station
- Vertically integrated network provides commercial robustness and flexibility

The energy to change. Together.
HEAVY VEHICLE FOCUS SUPPORTS COMMERCIAL VIABILITY OF INFRASTRUCTURE

Hyzon & Hyundai trucks available in 2022

- Designed for regional markets
- Range: 650 & 400km
- Connected to Hiringa Network
- GCM: 58 & 38 tons
- Fuel use and emissions of 150x cars
- Refuel time: 10-15 mins

**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
INTEGRATING THE VALUE CHAIN ENABLES LOWEST COST RELIABLE HYDROGEN SUPPLY

Cloud-Based Data Management and AI

Communication Protocol Management

API and web services

3rd party applications

Power Generation

H₂ Production

Distribution and Refuelling

Customers

- Generation Data
- Weather Data
- Grid Data
- Production Data
- Fleet Data
- Refuelling Station

- Generation
- PPA and spot prices
- Electrolyser & storage status
- Truck location
- Fuel inventory
- Process data

- Dispenser control and status
- Vehicle refueling communications

- Customer UI and POS

Analysis

Visualisation

Operations

Reporting

- Financial Reporting
- Geospatial Data
- Asset Management
- SCADA
- Analysis and Alarms

Creates Value Chain Efficiency

The energy to change. Together.
POLICY DRIVERS CAN HELP UNLOCK FCEV & BEV TRUCK PARITY WITH DIESEL

RAPIDLY BUILDING FLEET SCALE DRIVES COSTS DOWN

- **EARLY ADOPTION**
  - Stimulus kickstarts uptake

- **SCALE-UP**
  - Accelerated parity increases uptake

- **ACCELERATION**
  - Rapid deployment of FCHVs at diesel cost parity

---

**LEGEND**

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

**The energy to change. Together.**

---

- **Truck purchases needed to bring cost down**
  - 2021: 4
  - 2022: 16
  - 2023: 30
  - 2024: 50
  - 2025: 80
  - 2026: 120

- **Year of Truck Purchase**

- **Heavy vehicle uptake**
If an equivalent government feebate system was offered to heavy transport operators based on reduction in carbon emissions a typical linehaul truck would receive a CAPEX rebate of $1.2m!

<table>
<thead>
<tr>
<th>Metric</th>
<th>Units</th>
<th>Nissan Leaf</th>
<th>HYZON HGV450</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions Avoided</td>
<td>kgCO2e/km</td>
<td>0.170</td>
<td>1.480</td>
</tr>
<tr>
<td>Distance travelled per year</td>
<td>KM</td>
<td>11,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Duration of first ownership</td>
<td>years</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>First ownership distance</td>
<td>KM</td>
<td>110,000</td>
<td>1,600,000</td>
</tr>
<tr>
<td>Government rebate</td>
<td>$NZD</td>
<td>$8,625</td>
<td>$1,200,000 eqiv</td>
</tr>
</tbody>
</table>
Hydrogen is the energy to change our future – let’s make it a zero emissions one.

Andrew Clennett
Chief Executive Officer
M: +64 27 704 7007
E: aclennett@hiringa.co.nz
www.hiringa.co.nz
EXAMPLE FLEET TRANSITION OF 32 TRUCKS FROM ICE TO FCEV

Fleet transition does not need to take place all at once, if the fleet is transitioned gradually over time the operational cost impact can be mitigated while setting up the fleet for lower cost operation in the future.