NSW GOVERNMENT | Primary Industries

ITM POWER
Energy Storage | Clean Fuel

Exploring Beyond Diesel – 1

Integrated Hydrogen Energy Systems for Agribusiness

10 July 2020 | Webinar

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Director – Australian Hydrogen Council

AUSTRALIAN HYDROGEN ACTIVITY

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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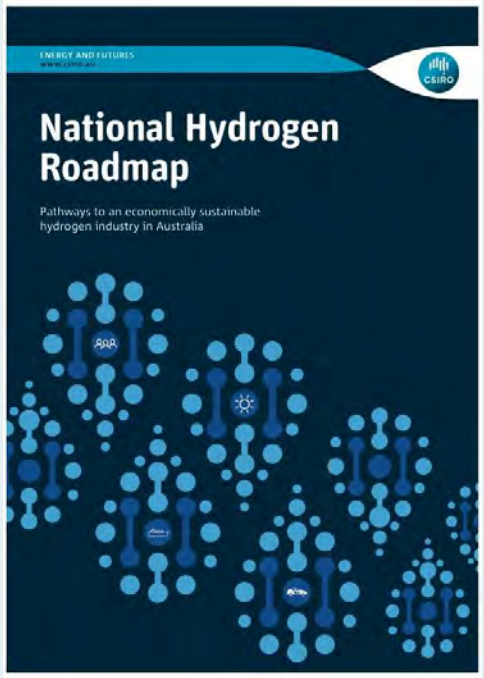

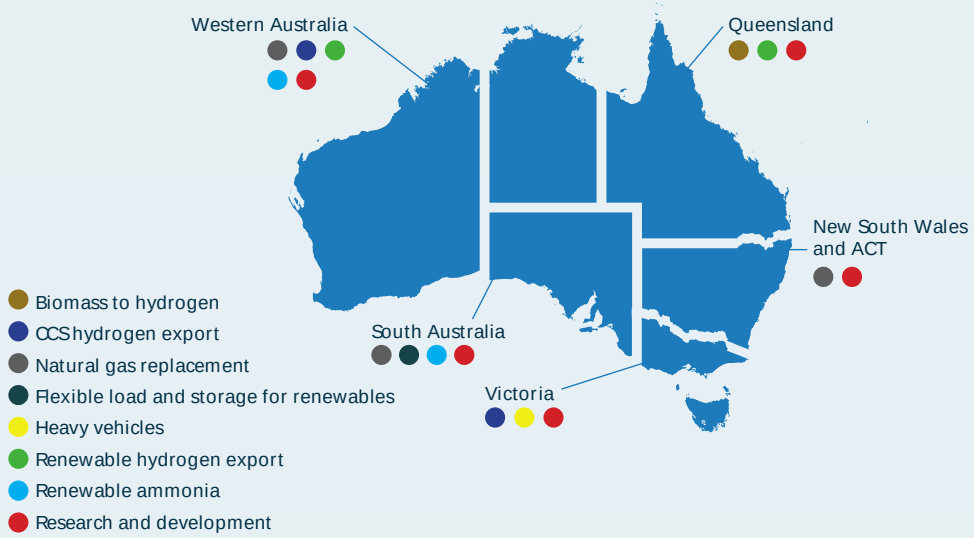

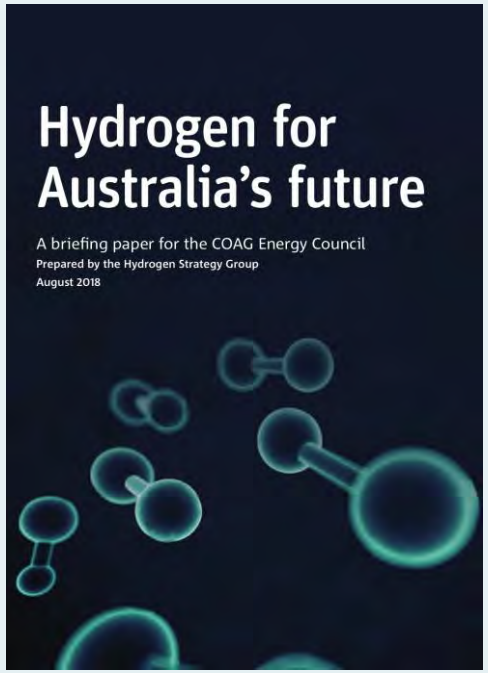

Federal road map launched Aug18 with consolidated States and Territories plan from COAG in Dec19

AUSTRALIAN HYDROGEN ACTIVITY (CONTINUED)

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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The Federal Government grant forms part of its **$50.4 million Regional and Remote Communities Reliability Fund,** part of the Morrison Government's $2 billion Climate Solutions Fund to help remove diesel in off-grid power applications.

Federal Government funding for off-grid hydrogen systems is now available starting with Daintree project

AUSTRALIAN HYDROGEN ACTIVITY (CONTINUED)

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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Transport for NSW is calling for expressions of interest from leaders in the energy, transport, manufacturing and financing sectors to participate in trials of **zero emission buses** and associated technologies including fuel cell electric buses.

H2OzBus program developed to provide FCEB for TfNSW Zero Emissions Bus EOI

AUSTRALIAN HYDROGEN ACTIVITY (CONTINUED)

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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New York-based Hyzon Motors, a spin-off of Horizon Fuel Cell Technologies, **will establish a division of the company in Australia** it has announced. The company, which was established in March, will set up technical support and project management capabilities in Australia serving both the Australian and New Zealand markets.

Fuel cell truck program for Australia developed to provide FCET for replacement of diesel trucks

AUSTRALIAN HYDROGEN ACTIVITY (CONTINUED)

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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Australian Government
Australian Renewable Energy Agency
ARENA

More than **$3 billion** of hydrogen projects bid for ARENA funding!

Recent ARENA $70m EOI call for hydrogen projects was oversubscribed with over $3b in project value bid

AUSTRALIAN HYDROGEN ACTIVITY (CONTINUED)

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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Momentum is growing in WA for a switch from gas to renewable energy with **BP announcing it will consider the feasibility of building a green ammonia plant near Geraldton** with a $4.4 million feasibility study part-funded by the Federal Government.

BP announced major green ammonia plant near Geraldton WA for export sales to Japan and South Korea

WHAT WE DO?

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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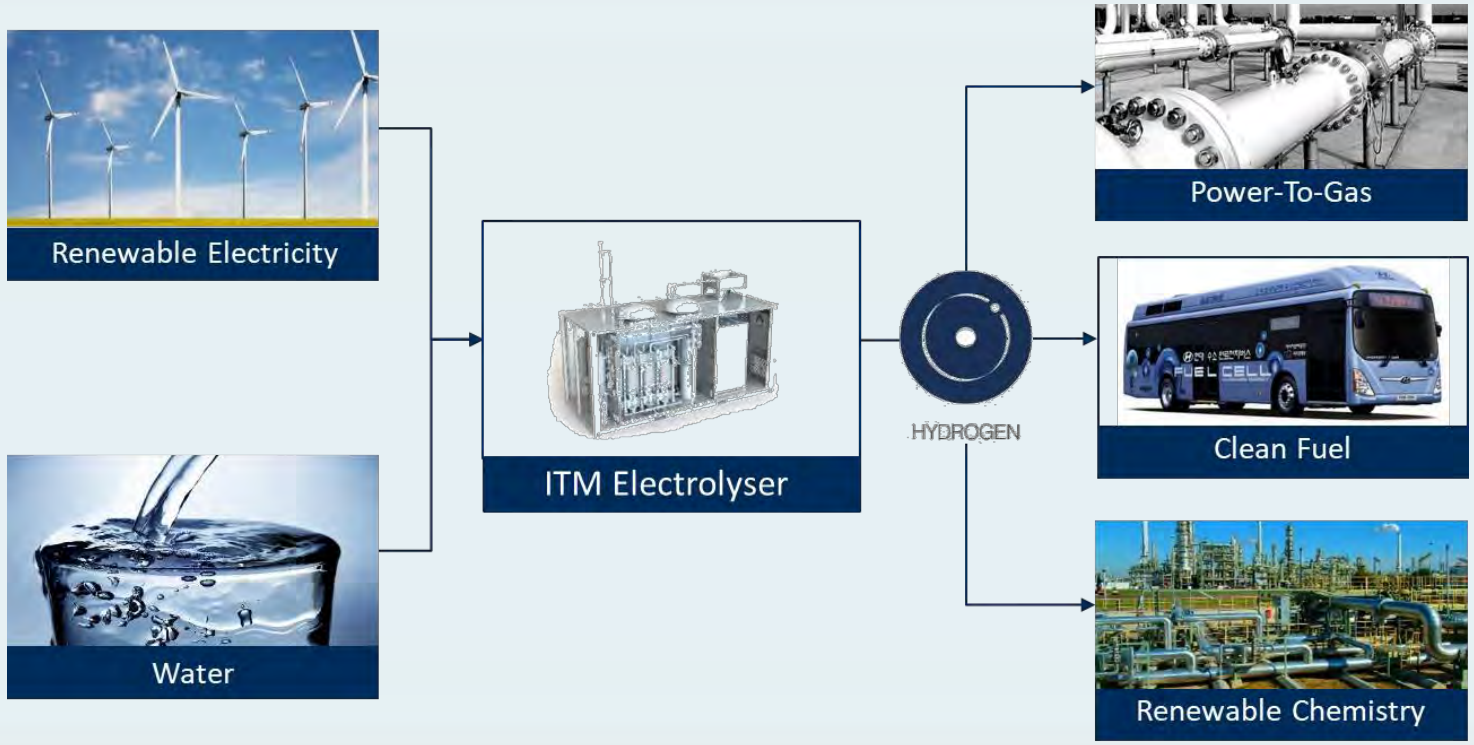

ITM Power provides integrated hydrogen energy systems that turn renewables and waste water into hgas

SCALEUP FROM 10KW TO WORLD'S LARGEST 10MW FOR SHELL

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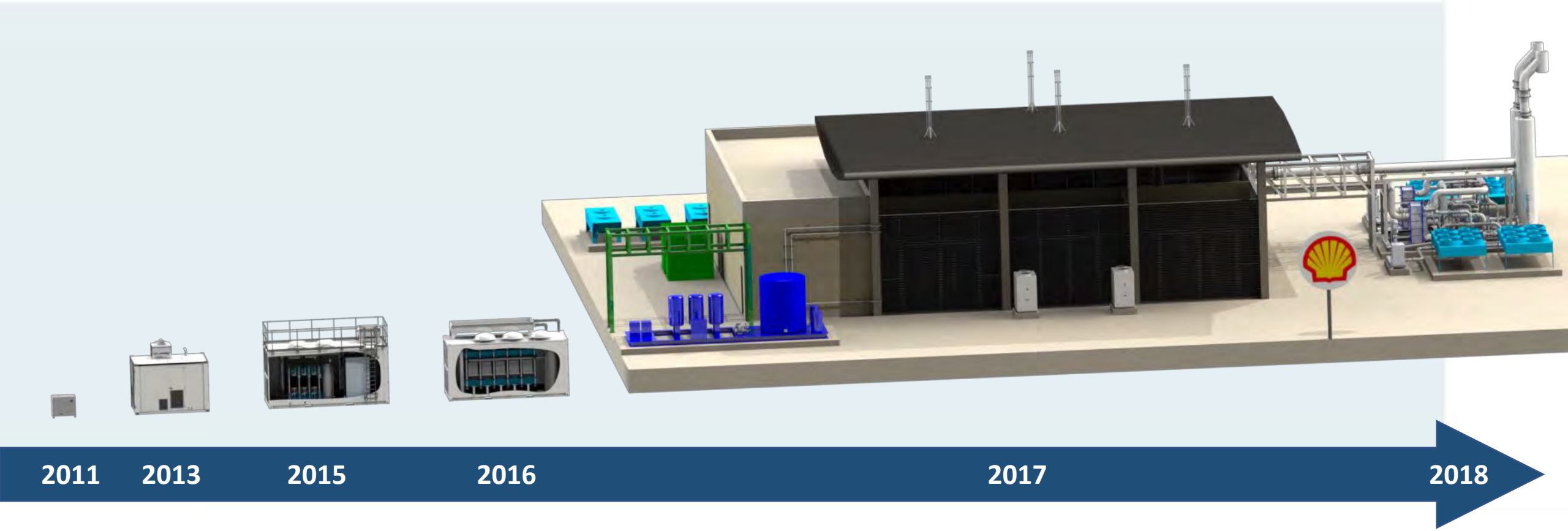

ITM Power has achieved 100X scale-up over last decade

ITM LINDE JV FORMED AND 20% INVESTMENT OCT19

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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JV purpose:

- Business development for large scale projects
- Feasibility & FEED studies with input from ITM & Linde
- Development of turnkey solutions for industrial applications
- Bring market & competition knowledge to ITM for product management
- Exclusive procurement of equipment & services from ITM & Linde
- Provides a route to offer full EPC solutions and downstream equipment

ITM scalable stack architecture is primary reason for JV

ISD CLOSED-LOOP SYSTEM DESIGN PHILOSOPHY

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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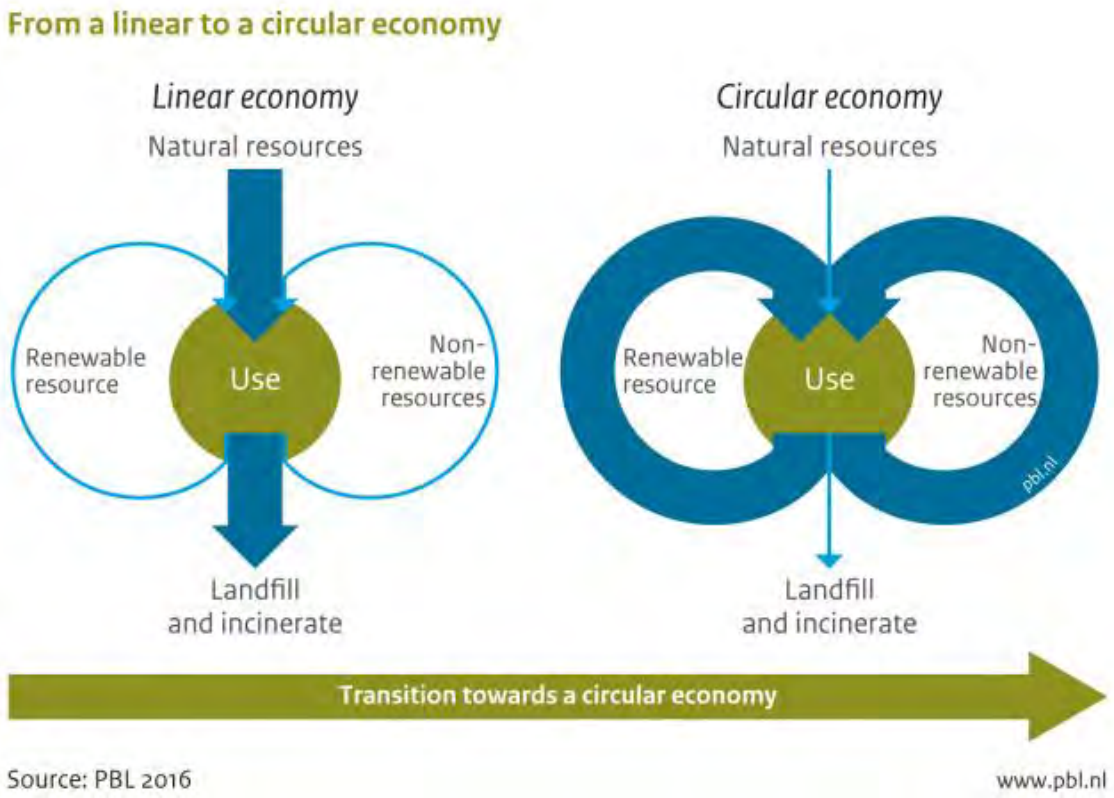
TRANSITION TO CIRCULAR ECONOMY

- Reduce & fix input costs for energy
- Reduce & fix waste output costs
- Create new on-farm revenues
- Integrated Sustainable Design (ISD)



Reducing input and waste costs / Generating new revenue

HYDROGEN AS MULTI-SECTOR INTEGRATION VECTOR

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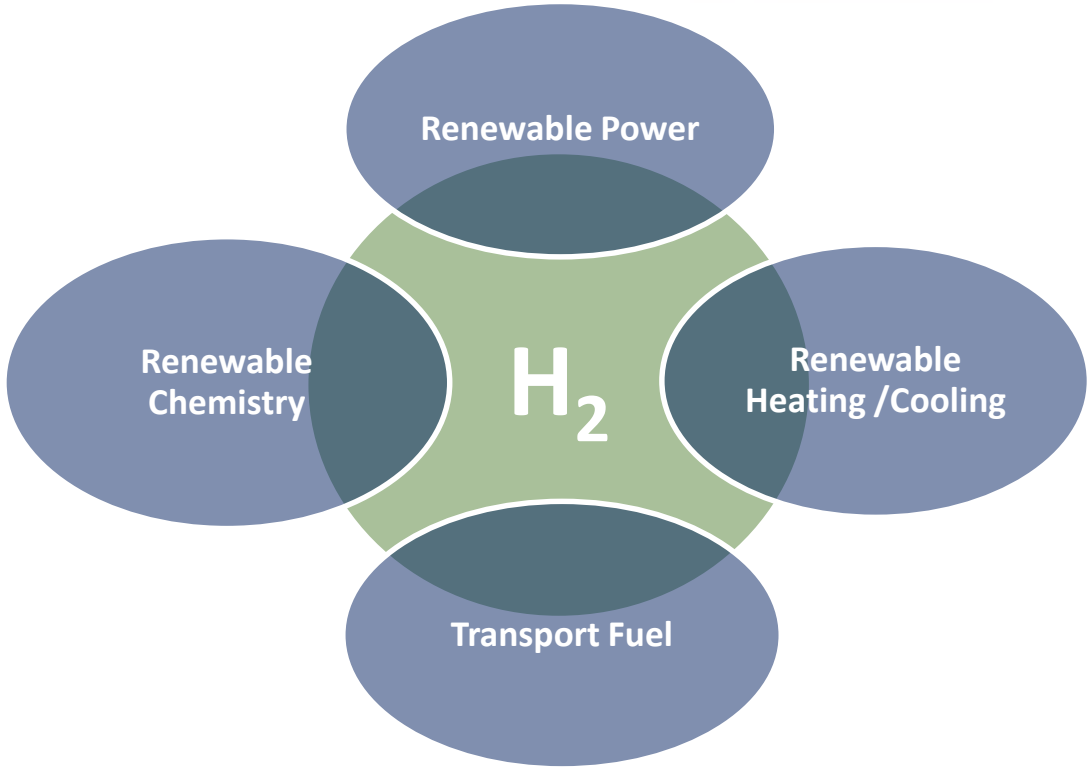
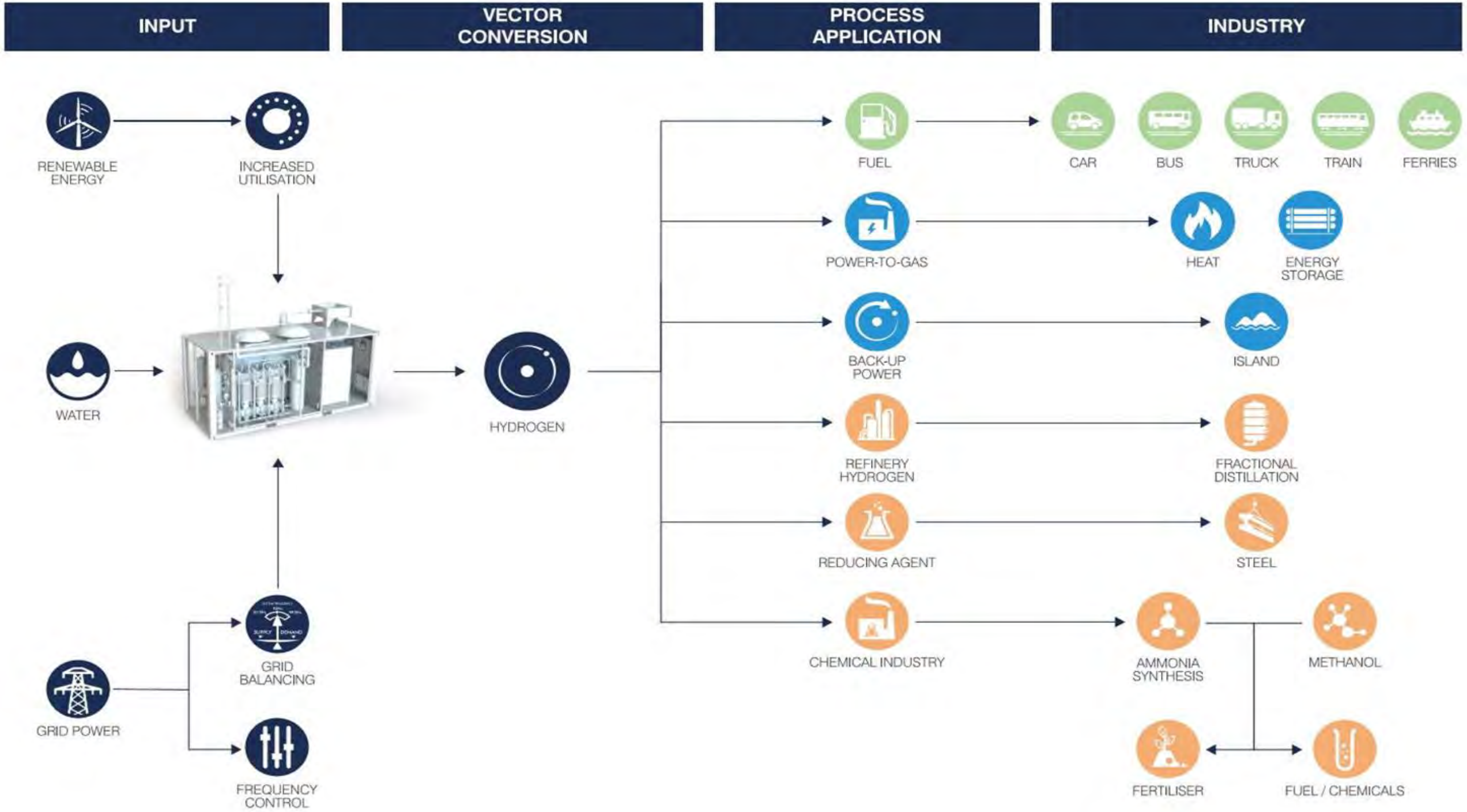
SECTOR COUPLING VIA HYDROGEN

- Renewable Power
- Heating / Cooling
- Transport fuel for e-mobility
- Commodities – oxygen, syngas, NH3



Sector Coupling via hydrogen to reduce costs / new revenues


INPUT
VECTOR CONVERSION
PROCESS APPLICATION
INDUSTRY
RENEWABLE ENERGY
INCREASED UTILISATION
WATER
HYDROGEN
GRID POWER
GRID BALANCING
FREQUENCY CONTROL
FUEL
CAR
BUS
TRUCK
TRAIN
FERRIES
POWER-TO-GAS
HEAT
ENERGY STORAGE
BACK-UP POWER
ISLAND
REFINERY HYDROGEN
FRACTIONAL DISTILLATION
REDUCING AGENT
STEEL
CHEMICAL INDUSTRY
AMMONIA SYNTHESIS
METHANOL
FERTILISER
FUEL / CHEMICALS

MULTITUDE OF INPUT RENEWABLE ENERGY SOURCES ON-FARM

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Many renewable energy sources are available on-farm

PV | Wind | Anaerobic digestion using organic waste |Organic Rankine Cycle (ORC) using inorganic waste

MULTITUDE OF INPUT RENEWABLE WATER SOURCES ON-FARM

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Many renewable water sources are available on-farm

Rainfall | Groundwater | Recycled water |Fuel cell stack recovery

CLEAN HYDROGEN FUEL PRODUCED ON-FARM INSTEAD OF DIESEL

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Typical fuel cell vehicles:

- Quad / motorbikes
- Tractors
- SUVs
- Trucks

Hydrogen fuel cell electric vehicles are better suited to on-farm demands than battery electric

POWER TO GAS : ENERGY STORAGE / TRI-GENERATION ON-FARM

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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Hydrogen gas for heating and cooling:

- Replace LPG and fuel oil for drying / heating
- Lower cost storage than batteries
- Re-convert to electricity via turbine or fuel cell
- Waste heat to cooling via absorption chillers
- Hot water as by-product for wash down

Stabilise electricity, heating and cooling costs via combined cycle tri-generation using fuel cell or turbine

RENEWABLE CHEMISTRY – NEW REVENUE STREAMS ON-FARM

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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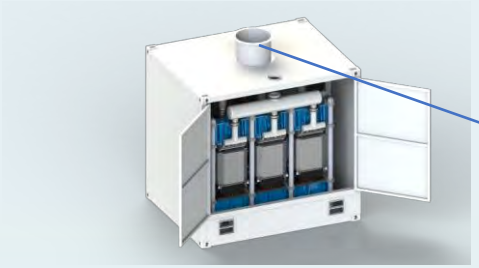
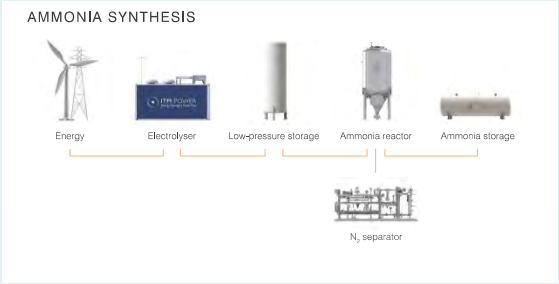
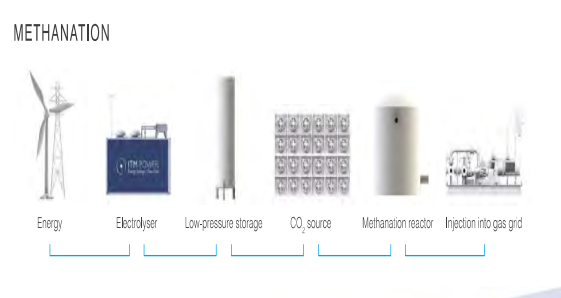
Create value-added products from waste:

- Renewable ammonia production via fuel cell nitrogen
- Create renewable methane/DME via biogas / CO2 source
- Aquaculture opportunity via waste oxygen







Potential new revenue streams via farm waste integrated with renewable hydrogen source

CURRENT EXEMPLAR PROJECT IN AGRIBUSINESS

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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Closed-loop abattoir approved for Gladstone region:

- Solar PV, waste water, biogas, batteries, hydrogen for self-suff
- Fuel cell trucks included from outset together with oxygen sal
- Production cost reduced from >A$300/head to <A$200/head
- Surplus hydrogen to be liquefied for export to Japan and Soutl
- Pitt & Sherry provided closed-loop ISD expertise

INNOVA

RENEWABL

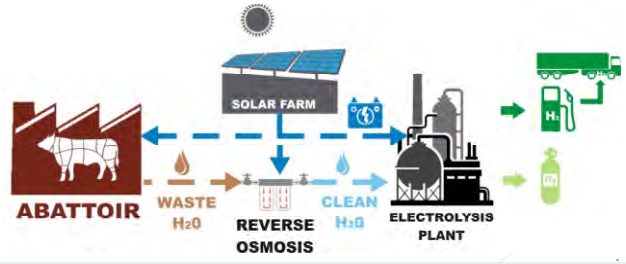
Purify

Approx

Approx

Approx

Potential oxygen applications include: medical and industrial.



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Production cost reduced and fixed via use of integrated hydrogen energy system including fuel cell transport

NEXT STEPS AFTER WEBINAR

EXPLORING BEYOND DIESEL – 1 / INTEGRATED HYDROGEN ENERGY SYSTEMS FOR AGRIBUSINESS

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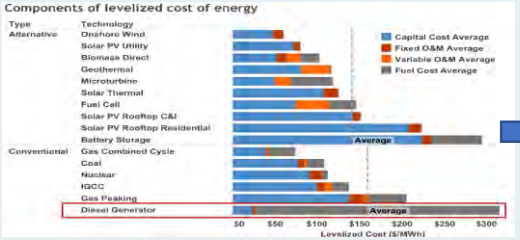
Customer Engagement → Feasibility Study → Front End Engineering Design → Procurement Decision

Staged process to assess and implement hydrogen opportunity on-farm:

- AS3598 audits via NSW DPI funding to quantify stationary and motive energy usage
- Feasibility study to assess relative costs for various clean technology options
- Full FEED study for best options to inform Federal funding application
- Project delivery via mix of grant / debt funding to suit individual farm requirements

Standards Australia



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Proven four stage process to successful integrated hydrogen energy system project delivery on-farm