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The role of hydrogen blending in Australian natural gas networks

Paul Medwell, Doug Proud, Adam Gee,
Neil Smith, Alfonso Chinnici and Peter Ashman

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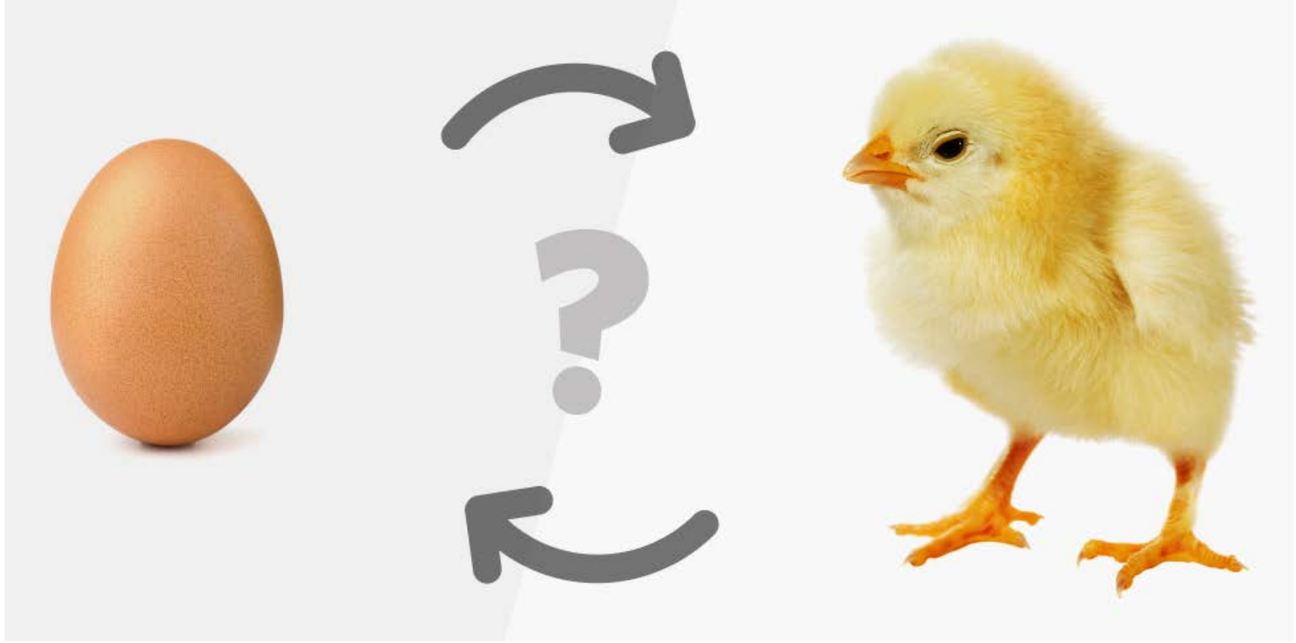
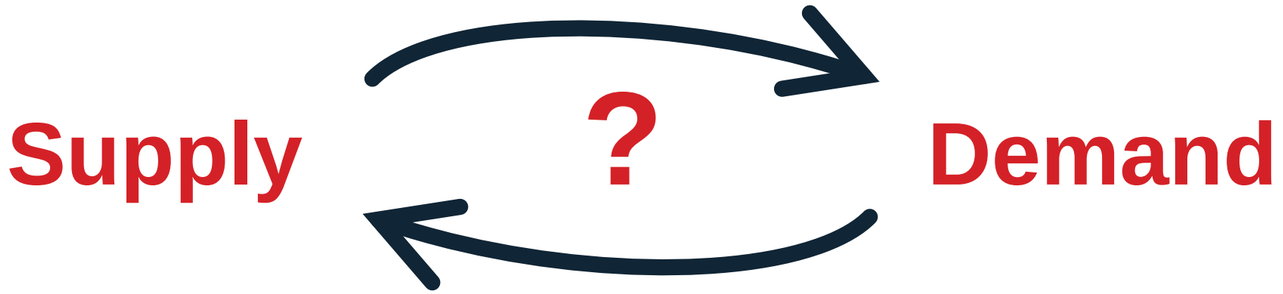
Chicken or egg?

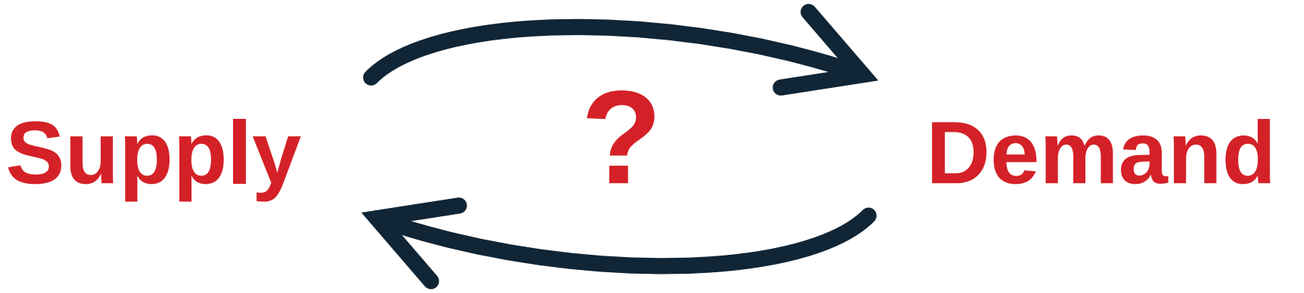
Metaphorical…



Hydrogen analogy…



Hydrogen: supply or demand?



- **Why produce hydrogen if there is not enough demand to cover costs?**
- **Why plan to use hydrogen if the fuel is not available at a low cost?**

- **How to break cycle?**

Hypothesis: blend hydrogen into natural gas (demand)

Low-hanging fruit. Flexible and immediate customer-base.

Not a long-term solution, but a catalyst for hydrogen investment.

Hydrogen: Swiss-army knife of decarbonisation

- **Overwhelmed for choice**
  - Energy panacea?
  - Niche applications?
  - Wait and see what eventuates

For hydrogen to have impact…

- **Need SCALE**
- **Scale needs investment**
- **Investors need evidence**

Hydrogen investment

- **Global stock market index for hydrogen shares**
- **Hype**

Solactive World Hydrogen Index

Gas blending – start with what is known

- **Overwhelmed for choice**
  - Most use-cases are “potential”
- **KISS principle**
  - Displace gas with gas
- **Gas blending**
  - Add some hydrogen to natural gas
    - 0 – 20% hydrogen

Not a long-term solution

Catalyst for hydrogen projects

➔ Get something happening

Gas blending – the first step to hydrogen at scale

- **Blending hydrogen with natural gas will not achieve net zero, but…**
  - Leverages existing customer base
  - Re-use existing infrastructure
  - Tolerate variability in hydrogen supply
  - Reduces need for storage
  - Acceleration of the hydrogen industry
  - Builds skills and expertise
  - Builds public confidence
  - Builds investment

Gas blending – the first step to hydrogen at scale

- **We cannot eliminate gas tomorrow**
  - But we can blend hydrogen with natural gas tomorrow
  - Alternative technologies are not available tomorrow at the required scale
- **Energy transition will take time, money and resources**
  - Blending just needs hydrogen production
  - No new infrastructure, regulations, appliances, vehicles, technologies, etc.
- **Blending will accelerate hydrogen production and build hydrogen capacity**
  - Trojan horse to get hydrogen into the energy mix
  - Hydrogen can then be used to enable transition away from gas in the future

Production can be re-purposed

- **AGIG – Hydrogen Park South Australia**
  - Hydrogen production not limited to gas blending

Scale of gas blending

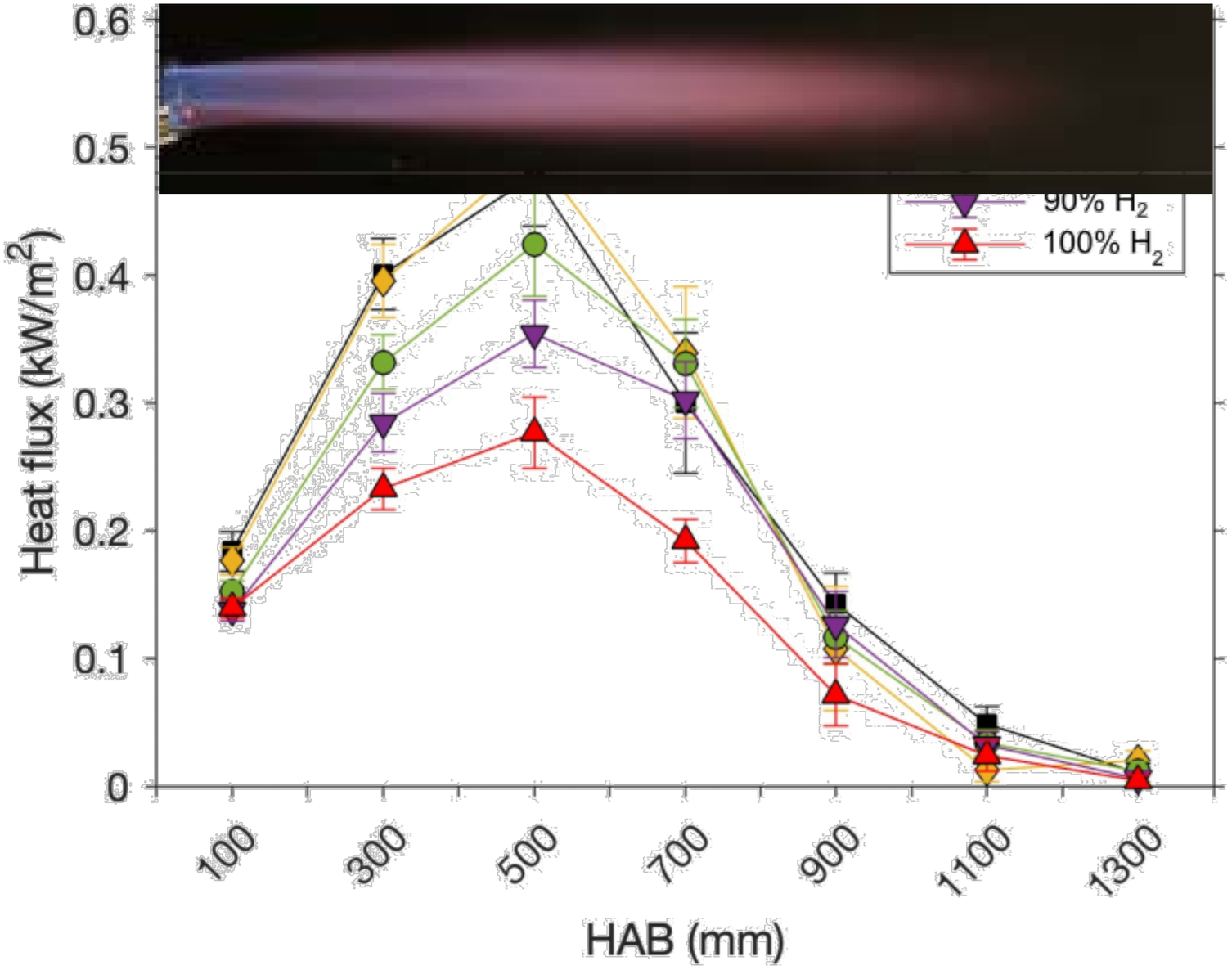
- **Australian natural gas consumption: ~1600 PJ of energy per annum**

  [Australian Energy Update 2023, DCCEEW]

- **Blending natural gas with 10% hydrogen (percentage on molar basis)**
  - Energy basis is ~3%
  - Sponge for 400,000 tonnes of hydrogen per year ➔ 1.5 GW of hydrogen production
  - Variability and flexibility built into the network
- **What are the consequences?**
  - Most appliances can tolerate 10–20% hydrogen
  - Fits within current regulatory frameworks (e.g. Type A / B approvals)

Heat radiation from flames with hydrogen

- Low radiant fraction
- Dependent on burner design and geometry



Source: Future Fuels CRC, RP1.4-03 / RP1.4-08

Hydrogen blending – Type A appliances

- ***Most*** **Type A (domestic) appliances will tolerate this level**
- **Open flued gas space heater…**

	Natural gas (NG)	10% H_2 in NG	21.7% H_2 in NG
CO, ppm	88.6	89.6	82.9
CO_2, ppm	50000	51000	44000
CO/CO_2	0.00018	0.00017	0.00019
NO, ppm	13.0	12.0	9.6
NO_2, ppm	11.6	13.0	14.1

Source: Future Fuels CRC, RP1.4-05

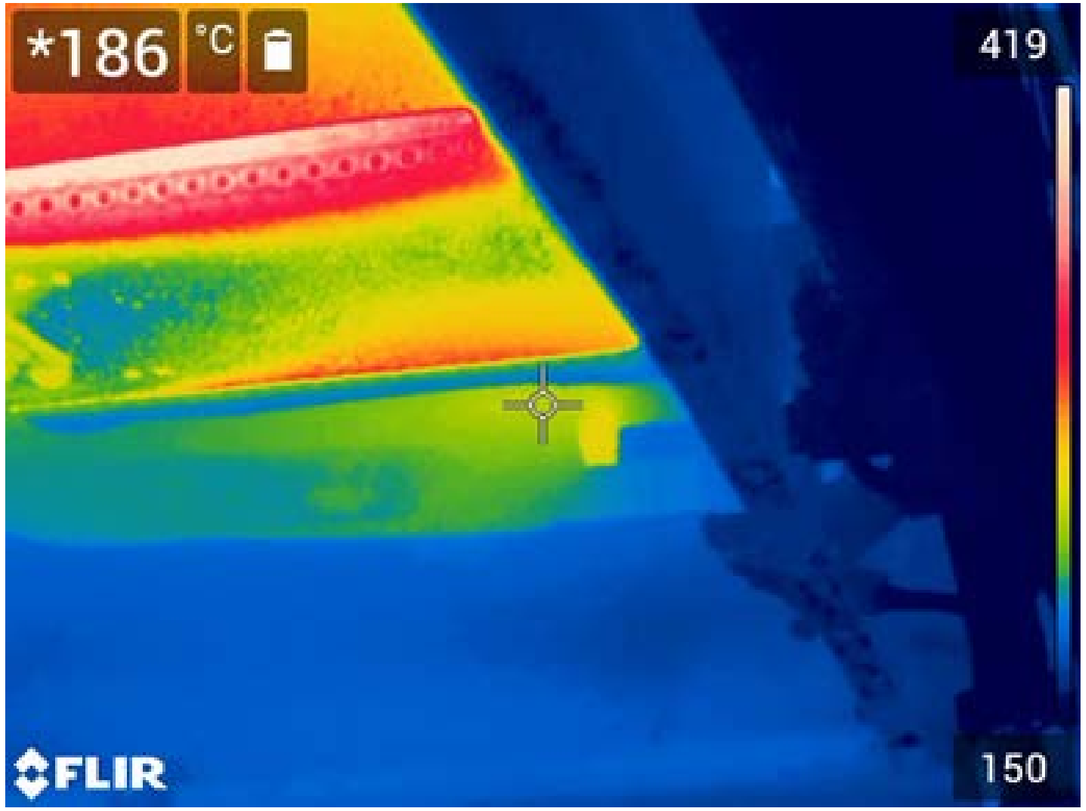
Hydrogen blending – light back

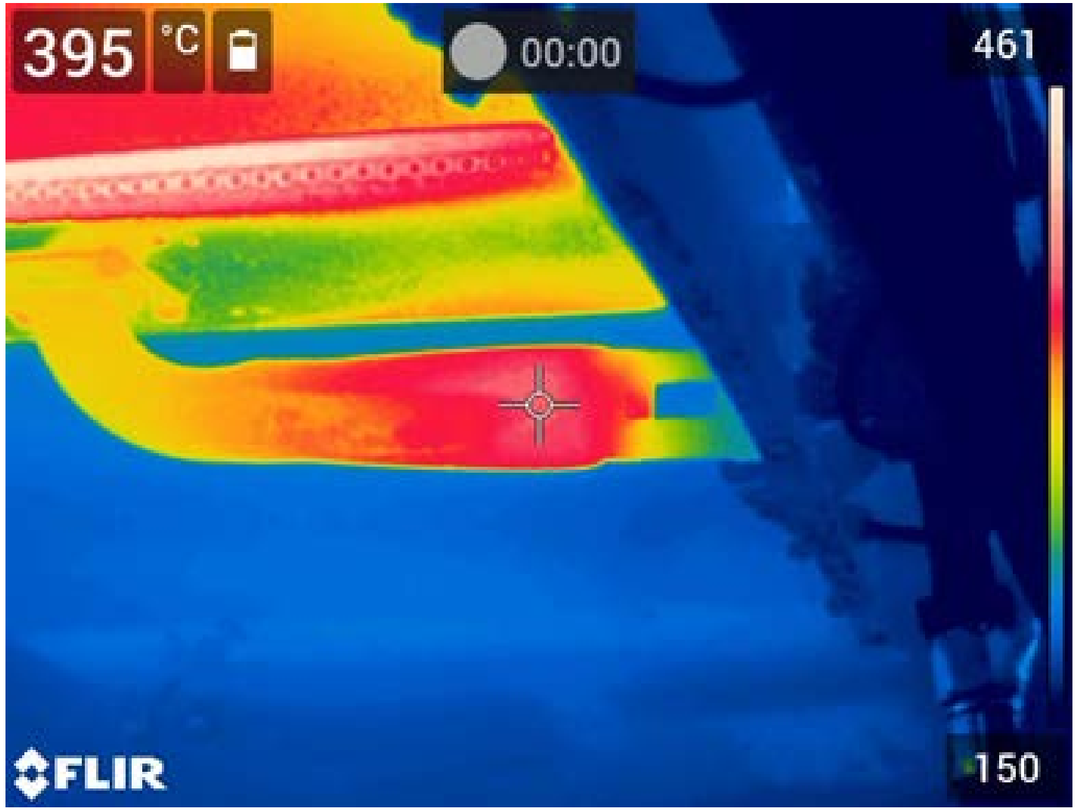
- **All devices (new and legacy) performed satisfactorily with up to 21.7% H_2**
- **Light back is possible with misuse of manual igniter**
  - Also possible with 0% H_2

Source: Future Fuels CRC, RP1.4-05

Hydrogen blending – light back in BBQ

- **Thermal imaging camera from underneath barbeque**
- **Natural gas (left) and 21.7% H_2 (right)**





Source: Future Fuels CRC, RP1.4-05

Type B – summary of operation

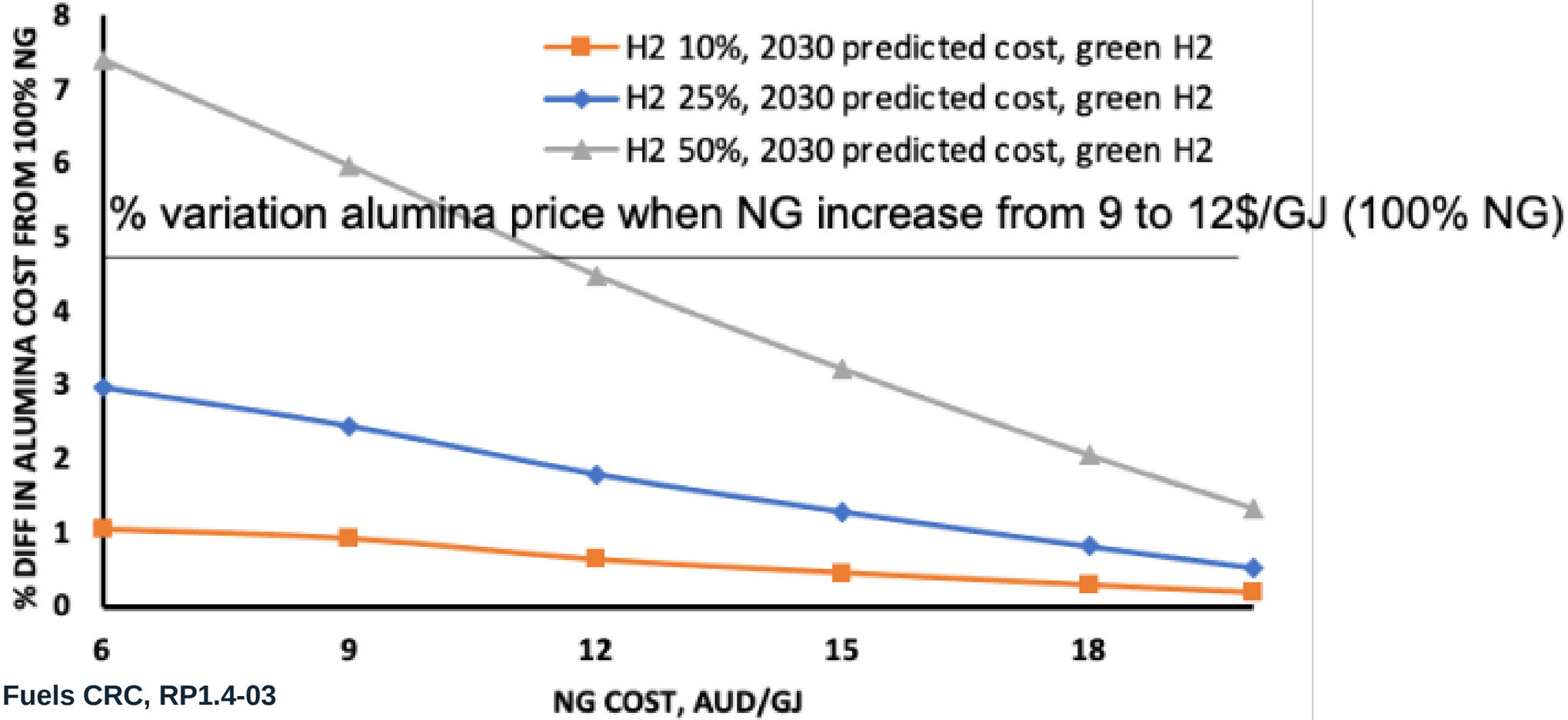
- **Commercial burners (with no modification)**
- **Limiting behaviour when hydrogen concentration increases…**

Appliance/burner	Max H_2 [vol%]	Reason/observation
AN burner	55	Light-back at low rate
AN burner	80	Flame detection (flame rod)
Package burner	99	Flame detection (flame rod) – possibly lower (overheating)
Air-heat burner	40–50	Overheating of burner (+ noise)
Nozzle-mix burner	100	No issues in flame detection or stability
Radiant burner	40	High probability of light-back on ignition

Source: Future Fuels CRC, RP1.4-08

Techno-economic analysis

- Gap exists between predicted H_2 prices and cost parity with natural gas
- Alumina: predicted commodity price increase is negligible (0.01-3%)



Source: Future Fuels CRC, RP1.4-03

Summary

- **Hydrogen has a lot of potential roles in decarbonisation**
- **Hydrogen installations at the scale needed are lagging**
- **Blending hydrogen with natural gas has the potential to “kick start” investment**
- **10% hydrogen (~3% by energy) would be a sponge for 1.5 GW of production**
- **Appliances on the network should be mostly unaffected**
- **Gas blending enables a break in the chicken-or-egg (supply-or-demand) cycle**

→ Once the hydrogen production is there, it can be used for other purposes

Perfection is the enemy of good

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For further information…

paul.medwell@adelaide.edu.au