

DOCKETED

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ITM POWER – RENEWABLE HYDROGEN

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- Income streams
- Inter department relations
- Key areas to focus on
- Summary

£16.85m under contract | £4.15m in negotiation | total £21.0m

ITM POWER – RENEWABLE HYDROGEN

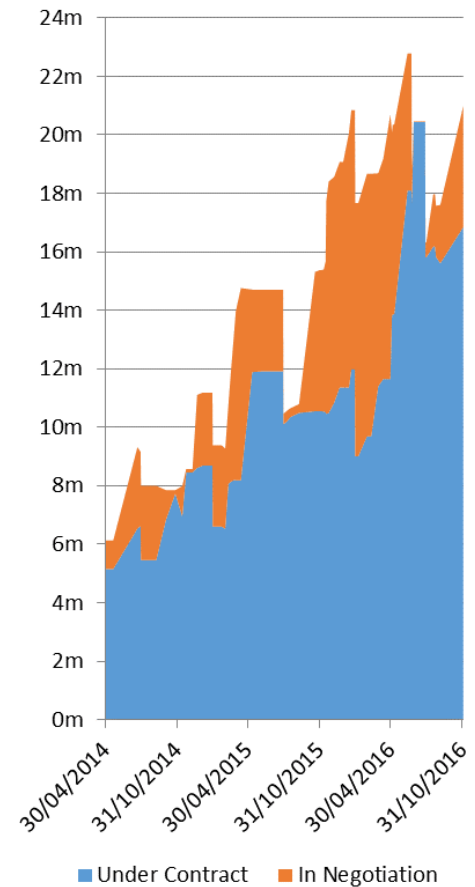
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ITM Power | History

- First AIM listed fuel cell & hydrogen company
- Two facilities in Sheffield | 70 staff
- Subsidiaries in Germany & California
- Manufacturing business model
- Seeing global growth year on year

£16.85m under contract | £4.15m in negotiation | total £21.0m

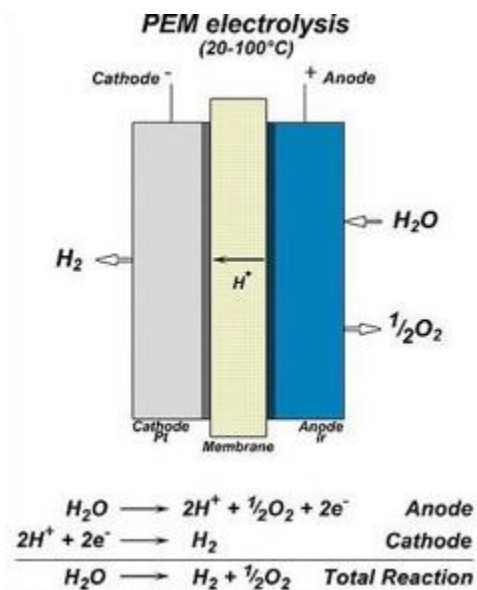
Items under contract
and in Negotiation



ZERO CARBON HYDROGEN

The Perfect Fuel

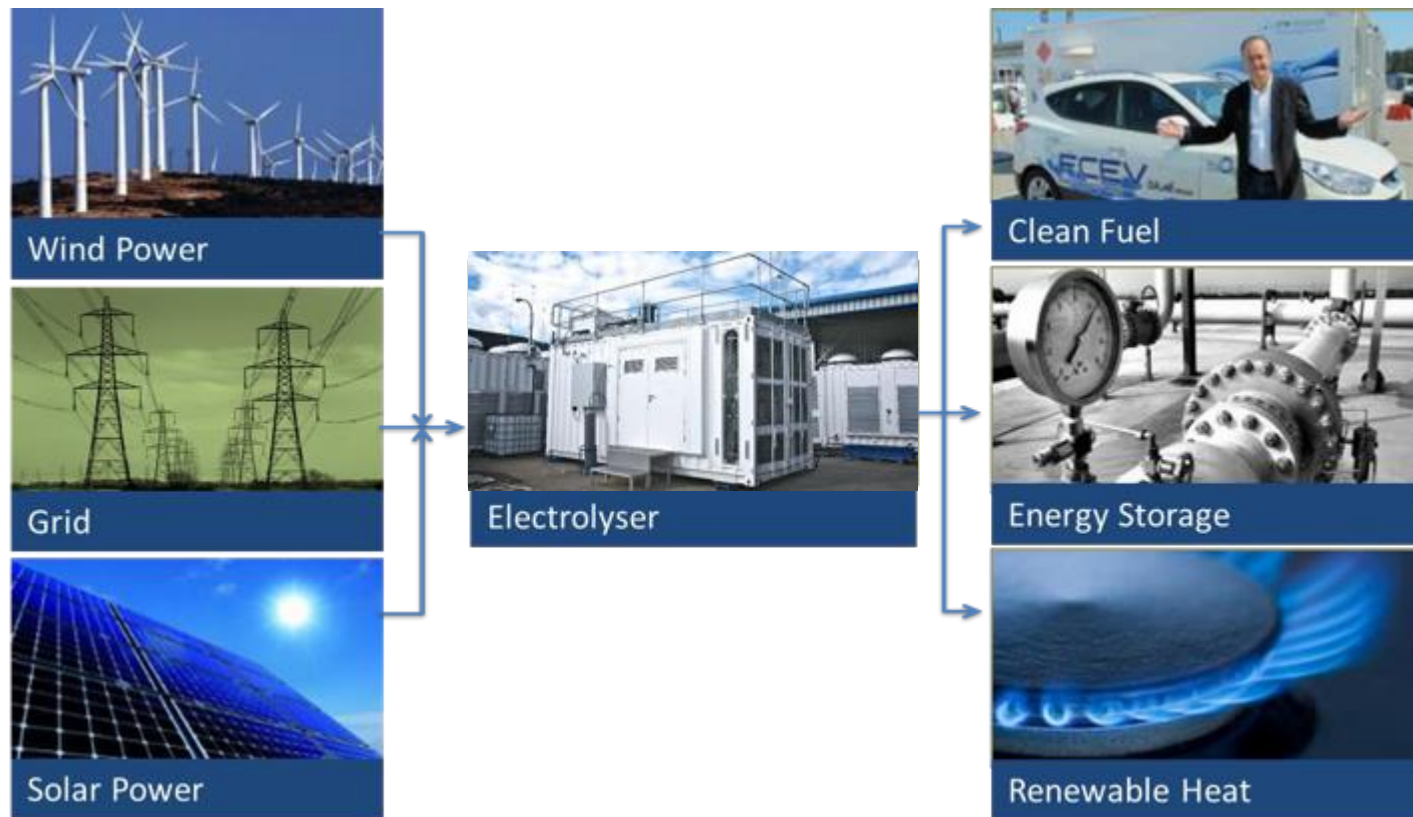
- Made from renewable power and water
- Energy storage for renewable power
- Zero carbon footprint
- Low water use compared to gasoline production



WHY HYDROGEN FUEL?
ENERGY STORAGE | CLEAN FUEL

RAPID RESPONSE ELECTROLYSER

Enabling efficient conversion of surplus electricity into chemical energy



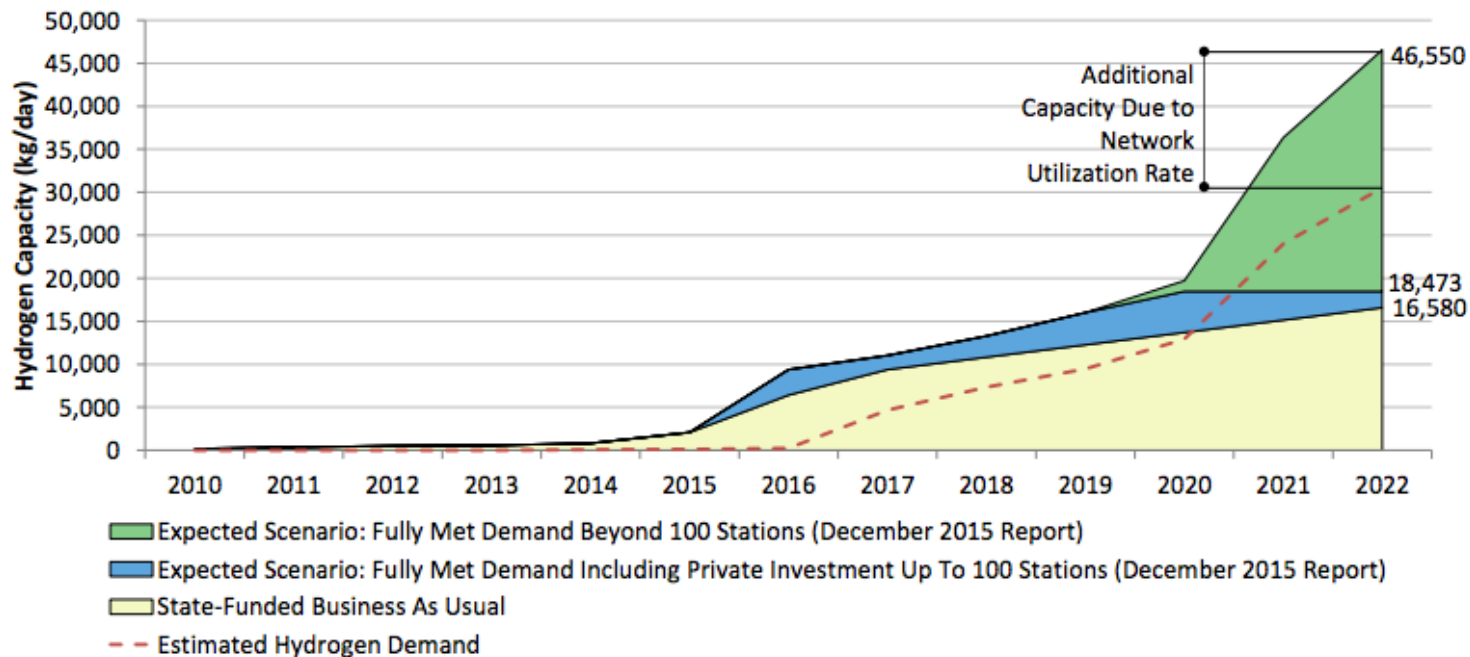
RAPID RESPONSE INTEGRATION
HYDROGEN ENERGY SYSTEMS

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WHY DO WE NEED MORE HYDROGEN FUEL?

- Example - California predicting a shortage of hydrogen around 2020-2022

Figure 22: Comparison of Capacity in Future Scenarios with and without Additional Private Investment



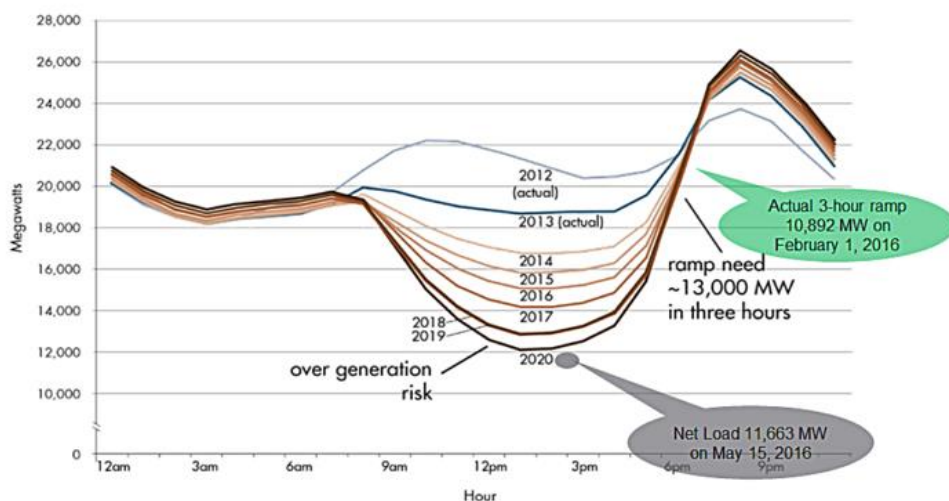
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HYDROGEN: THE NEED
HYDROGEN ENERGY SYSTEMS

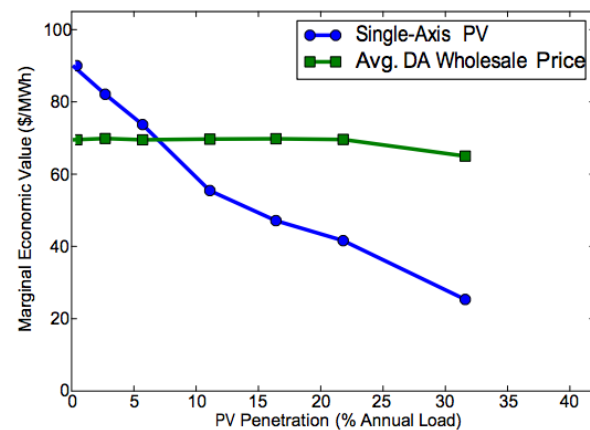
AN ENERGY REVOLUTION

Renewable Energy is Transforming the Energy Landscape

- World power generation reached 5,000GW in 2015
- Wind reached 432GW and solar reached 65GW of global installations in 2015 (~10%)
- Both need energy storage to sustain the growth rate, a variety of technologies are required
- Many US states have renewable mandate targets to increase installed capacity



PV has decreasing value with increased penetration.



in the Economic Value of Variable Generation at High Penetration Levels: A Pilot Case Study of California Andrew Mills and Ryan Wiser, June 2012
<http://retd.lbl.gov/EA/EMP>

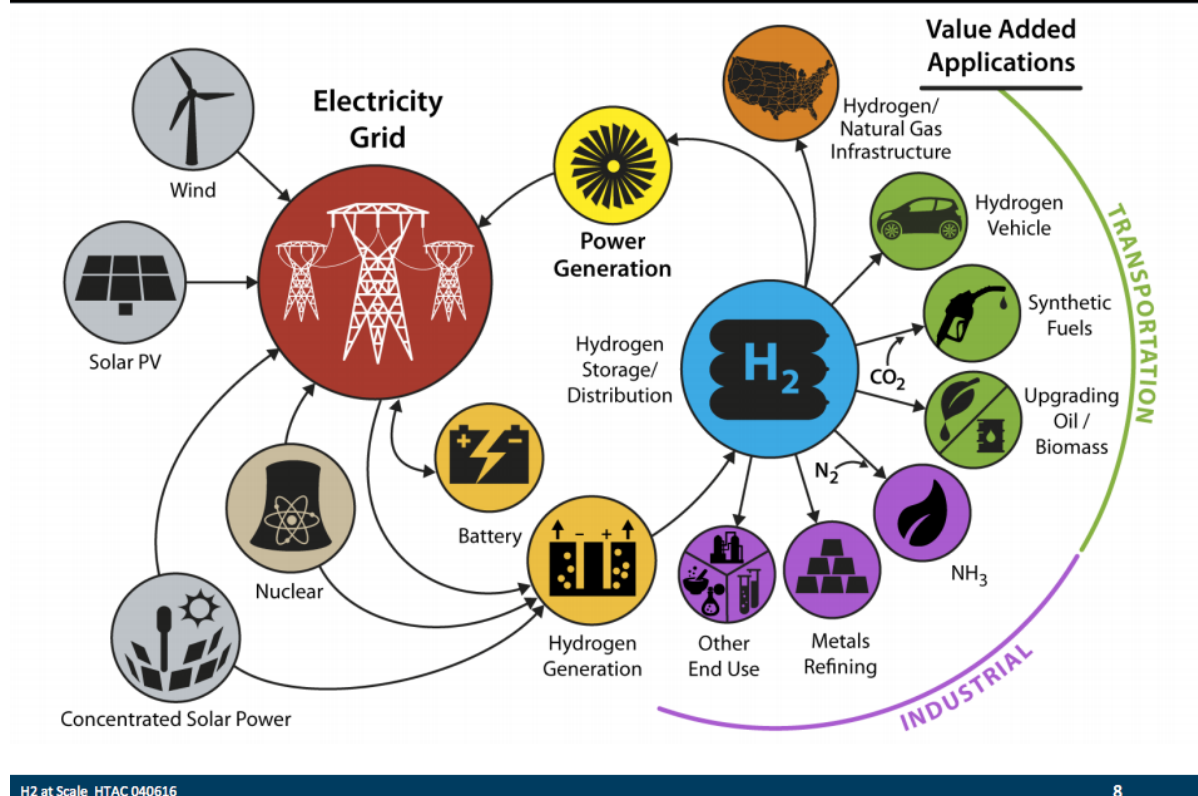
AN ENERGY REVOLUTION

HYDROGEN ENERGY SYSTEMS

US SUPPORT

- DOE backed initiative – H2@ scale looking at using large scale renewables to generate hydrogen
- Hydrogen produced at low price with zero emissions
- Pathway to millions of HFCEVs on the US roads
- Predicting ~4 Quads hydrogen demand by 2050 for vehicles (8 billion gal gasoline) equiv.

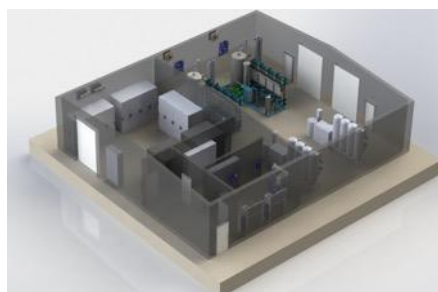
Future H₂ at Scale Energy System



ENERGY STORAGE: THE NEED HYDROGEN ENERGY SYSTEMS

CA EXAMPLE

Solar	Electrolyser	Transport	Vehicles	Credits
PPA \$/kWh (Gov backed loan) (Existing Vs new)	Grant funded % (Dictates size)	Location and customer specific	Linked to roll out plan	Big influence on business plan



Analysis suggests that <\$5/kg solar hydrogen system (wholesale price) is possible given a favourable environment and supportive legislation.

PROBLEMS

HYDROGEN ENERGY SYSTEMS

CA PROBLEMS

- Mismatch between funding for vehicles and stations Vs production routes
- Mismatch between fuel pathways for electrons and gas molecules – LCFS
 - Location of facility, age of RE asset, RECs
 - Price instability for LCFS
- Little recognition for energy storage potential in state vision – ES mandate
- Lack of recognition to value add that electrolysis can play alongside EVs in grid management
- Lack of joined up thinking between state departments



California Environmental Protection Agency
 **Air Resources Board**



PROBLEMS

HYDROGEN ENERGY SYSTEMS



CA PROBLEMS - QUESTIONS

1. Will the grid be available to transport electrons and still receive LCFS?
2. If so how will the energy be recorded? RECs?
3. Will existing renewable assets be allowed to generate LCFS or must they be new and dedicated?
4. Will hydrogen be allowed under the energy storage mandate if vehicle fuel is the end use?
5. Will gov backed loans be available for financing the builds of RH2 systems? And the security for fuel contracts?
6. Can LCFS \$\$ value be stabilised?



California Environmental Protection Agency
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PROBLEMS

HYDROGEN ENERGY SYSTEMS



FCEV REFUELLING STATION

VEHICLES | ROLL OUT

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