International Energy Agency (IEA) strategic initiatives and activities for hydrogen

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MBIE IEA-H2TCP REPRESENTATIVE FROM 2014 - ELECTED CO-VICE-CHAIR FROM 2017
ACKNOWLEDGEMENTS

- Mark Pickup – Principal Policy Advisor MBIE
- Linda Wright – CEO, NZ Hydrogen Association
- Paul Lucchese – Chairman, IEA H₂TCP
- Mary-Rose Valladares – General Manager, IEA H₂TCP
- John B. Haldane – British geneticist who in 1923 envisioned a network of hydrogen-generating windmills powering Britain
Hydrogen Overview

- International Energy Agency estimates global hydrogen market is forecast to increase from US$122 billion in 2018 to US$155 billion in 2022.
- Current use of hydrogen is 55% ammonia synthesis, 25% in refineries, 10% for methanol production, and 10% other.
Light Vehicle Activity

- Vehicles: 11,000 (53% USA, 38% Japan, 9% EU) (Mar 2019)
  - Hyundai Nexo, Toyota Mirai, Honda Clarity
    Cost: ~US$70,000 (excl. tax credit), 500 km – 750 km range
  - Mercedes-Benz GLC F-Cell for lease.
  - Audi and Kia vehicles in 2020 (March 2019)
- Refuelling stations: 369 (41% Europe, 37% Asia, 21% N. America) (Feb 2019)
- HFCV adoption is 8-10 years behind EVs
Buses

- JIVE (Joint Initiative for hydrogen Vehicles across Europe) will deploy nearly 300 FC buses in 22 cities across Europe by 2023 costing US$720k each.
- 20 London double decker FC buses for 2020 at US$700k each
- Tokyo plans to deploy 100 hydrogen FC buses for 2020 Olympics
Trucks

- Arizona based Nikola has pre-orders for 8,000 hydrogen FC trucks with a range 800 – 1200 km. c.f. Nikola battery powered trucks with battery sizes of 500 - 1,000 kWh and ranges of 320 - 640 km but reduced by 25% in extreme conditions.

- Hyundai has entered an agreement to supply 1,000 hydrogen FC trucks to Switzerland from 2019 – 2024.

- This year Toyota and Paccar unveiled the first of 10 hydrogen FC trucks for use in the Los Angeles area.
Forklifts, Trains and Ferries

- Plug Power awarded two US$600-million contracts in 2017 (qz.com) for forklifts for warehouses at Amazon and Walmart on the basis that they:
  - don't require frequent replacements during operations.
  - operate in freezing temperatures.
- Alstom operates 2 hydrogen FC trains on 100 km line in Germany.
- First commercial H₂ powered 20m catamaran is currently under testing in San Francisco funded by California Climate Investments program.
H21 North England proposed project plans to convert 3.7 million homes from natural gas to zero emission H₂ by 2034 using CCS.

Hydrogen Energy Supply Chain (HESC) project will export of 3 tonnes of hydrogen from 60 tonnes of brown coal with CCS from 2020 from Victoria to Japan.

Recent renewables auctions in Chile and Morocco came in at US$30/MW-h giving potential for hydrogen at US$2/kg per kilo. (‘The Economist’ Nov 29th 2018)
IEA Technology Collaboration Programmes

- International Energy Agency (IEA)
- Committee on Energy Research and Technology (CERT) – 4 WPs
- Renewable Energy Working Party (REWP) (9 TCPs)
- Hydrogen Technology Collaboration Programme (TCP)
- Organisation for Economic Co-operation and Development (OECD)
- International Renewable Energy Agency (IRENA)

Members H2TCP
1. Australia
2. Austria
3. Belgium
4. China
5. Denmark
6. Finland
7. France
8. Germany
9. Greece
10. Israel
11. Italy
12. Japan
13. Korea
14. Lithuania
15. The Netherlands
16. New Zealand
17. Norway
18. Spain
19. Sweden
20. Switzerland
21. United Kingdom
22. Commission of the EU
23. Hychico (Argentina)
24. Hydrogen Council
25. United Nations Industrial Development Organization (UNIDO)
26. NOW (Germany)
27. Reliance Industries (India)
28. Shell
29. Southern Company (USA)

- Executive Committee – 21 country representatives and 8 other entities (contracting parties). Annual fees typically US$12,500
- Tasks are approved by the ExCo and Chaired by Operating Agents from contracting parties.
- No funding is available from the H2TCP
IEA H₂TCP -- Objectives

http://ieahydrogen.org/

- To provide a comprehensive understanding of the various technical and economic pathways for power-to-hydrogen applications in diverse situations
- To provide a comprehensive assessment of existing legal frameworks
- To provide business developers and policy makers with general guidelines and recommendations that enhance hydrogen system deployment in energy markets
IEA H2TCP Strategy

http://ieahydrogen.org/

- To facilitate, coordinate, and maintain innovative RD&D activities through international cooperation and information exchange.

- Seven areas are targeted:
  - Technology
  - Energy Security
  - Environmental
  - Economic, Market
  - Deployment, and Outreach
IEA H₂TCP Strategic Activities

http://ieahydrogen.org/

2014 - 2019 Tasks

- Task 35 - Renewable Hydrogen Production 2014-17
- Task 36 - Life Cycle Sustainability Assessment 2016-18
- Task 37 - Hydrogen Safety 2015-2021
- Task 38 - Power-To-Hydrogen and Hydrogen-to-X 2015-19**
- Task 39 - Hydrogen in Marine Applications 2016-19
- Task 40 - Energy Storage and conversion based on hydrogen 2019-2021
- Task 41 - Data and Modelling 2019-2021**
Task 40 - Energy Storage and conversion based on hydrogen 2019-2021

- **Working groups**
  1. Porous materials (coordination polymer framework compounds, MOFs, ZIFs, COFs, and carbon-based compounds)
  2. Magnesium- and intermetallic alloys-based hydrides for energy storage
  3. Complex hydrides (borohydrides, alanates, amides/imides-systems, magnesium-based compounds, reactive hydride composites)
  4. Ammonia and reversible liquid hydrogen carriers
  5. Catalysis
  6. Electrochemical storage of energy (MH-batteries, ion-conduction)
  7. Hydride-based thermal energy storage
  8. Research and development for hydrogen storage and compression

- Meetings every 6 – 9 months
# Task 38 Subtask

Analysis of Demonstration Projects

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- **Global picture?**
- **Roadmap?**
- **Tasks & storage services**
- **P2H & grid services**
- **Tech-economical and/or regulatory objectives**

Task Engagement

Task 38 Power-To-Hydrogen and Hydrogen-To-X 2015-19


Task 41 Data and Modelling (TIMES, UniSyD & others)

- Data collection of parameters describing the Hydrogen technologies, such as investment costs, efficiencies, lifetimes, learning curves etc.
- Develop knowledge of how to model Hydrogen in the value chain and improve current methods
- Collaboration with analysts in IEA HQ Analytics and the ETSAP community
- Applications and interactions for providing data for IEA, ETSAP and Hydrogen TCP tasks

UniSyD energy systems modelling www.unisyd.org
Task Engagement

- Calls to participate in new HTCP Tasks will be posted via the Hydrogen Association.
- Participants are typically research leaders whose interests align with those of the Task.
- Further information or assistance
  - Jonathan Leaver email: jleaver@unitec.ac.nz
  - Mark Pickup email: Mark.Pickup@mbie.govt.nz
Links and references

- McKinsey (2016) Automotive revolution – perspective towards 2030 How the convergence of disruptive technology-driven trends could transform the auto industry
- Hydrogen Council (2017) Hydrogen - scaling up, 80 pp
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- https://live.eu/
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Thank you
Bio

BE(Hons)(Civil)(Ak), PG Dip Energy Tech(Geoth)(Ak), MS(Petroleum)(Stanford) PhD(Mechanical)(Ak)

- Fellow of Engineering New Zealand
- Plenary speaker at the U.S. National Hydrogen Association Conference 2010.
- Former Chief Petroleum and Geothermal Inspector (7 yrs), Ministry of Commerce
- Author in 35+ hydrogen related journal and conference papers from 2002 e.g.