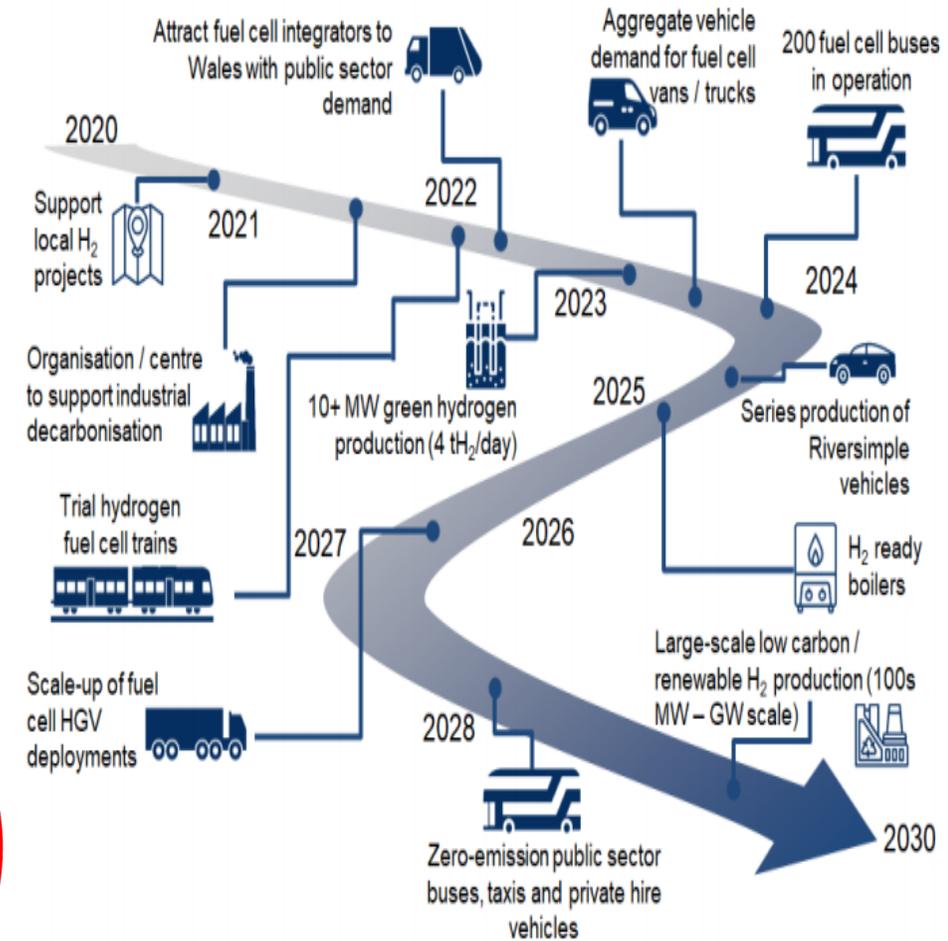
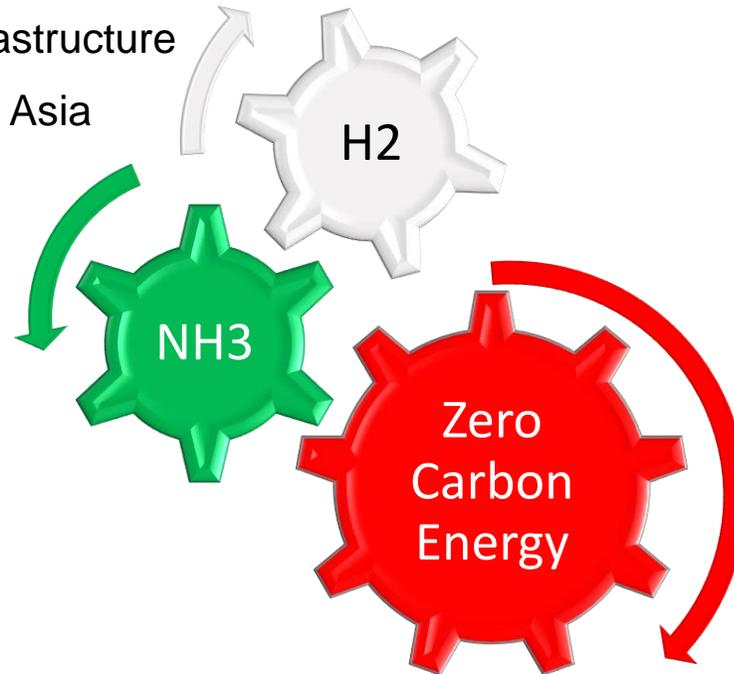
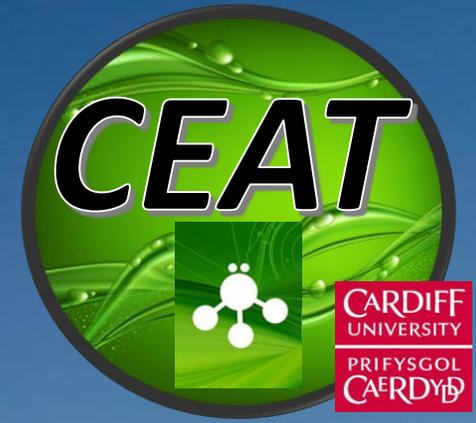


- Hydrogen utilization is imminent in the World.
- Wales has a unique agenda to become a leading hub in H2 utilization.
- However, storage and distribution of H2 is very complex.
- Thus, ammonia offers a solution that,
 - Enables the use of a well-known molecule;
 - Ensures more H2 than H2 itself;
 - Can use a 150 years mature infrastructure
- Japan is commercialising solutions for Asia
- Nothing similar exists in the West.

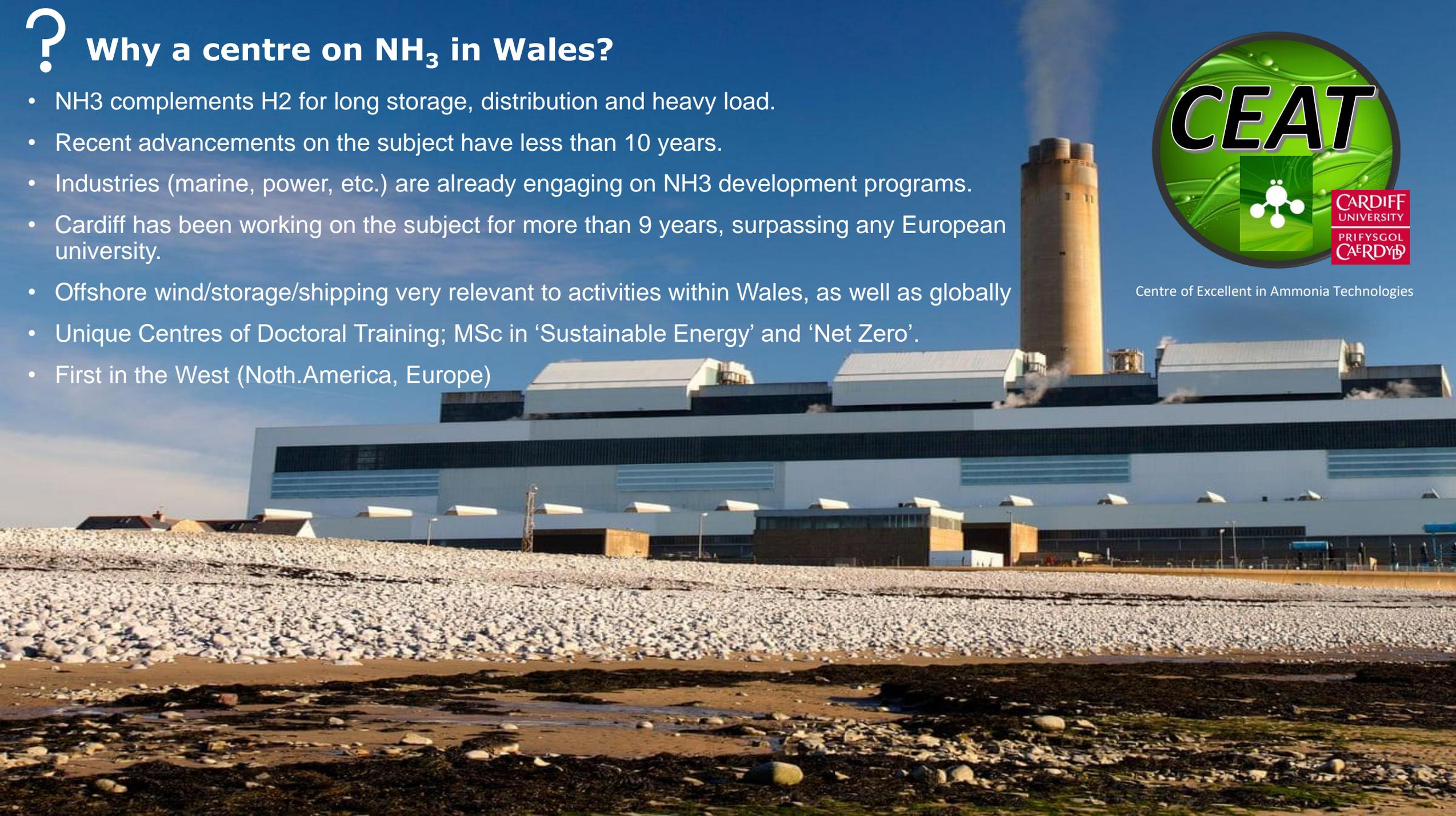


? Why a centre on NH₃ in Wales?

- NH₃ complements H₂ for long storage, distribution and heavy load.
- Recent advancements on the subject have less than 10 years.
- Industries (marine, power, etc.) are already engaging on NH₃ development programs.
- Cardiff has been working on the subject for more than 9 years, surpassing any European university.
- Offshore wind/storage/shipping very relevant to activities within Wales, as well as globally
- Unique Centres of Doctoral Training; MSc in 'Sustainable Energy' and 'Net Zero'.
- First in the West (Noth.America, Europe)



Centre of Excellent in Ammonia Technologies



RATIONALE

World's largest renewable energy project proposed for north-west Australia ditches electricity in favour of ammonia exports

ABC Kimberley / By Ben Collins and Vanessa Mills
Posted Yesterday at 3:29am, updated Yesterday at 3:59am

Air Products announce \$5 billion renewable hydrogen to ammonia project in Saudi Arabia

DATE POSTED: 16TH AUG 2020
SHARE THIS POST



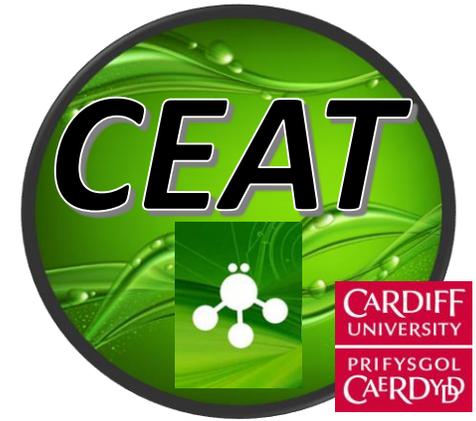
POST AUTHOR
Philip Sharman
IFRF DIRECTOR



The proposal is to



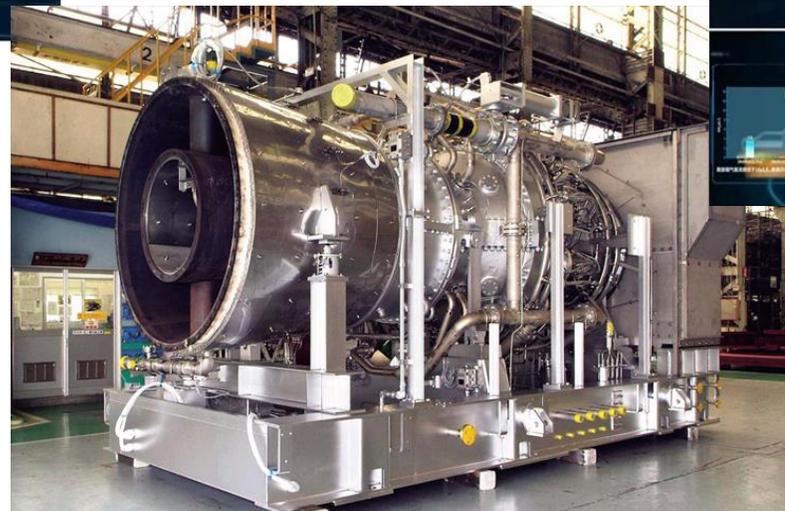
Norwegian ammonia shipping network
[<https://www.ammoniaenergy.org/>]



Excellent in Ammonia Technology



First ammonia-coal co-firing power plant in China for decarbonisation of large power
[<https://www.ammoniaenergy.org/>]



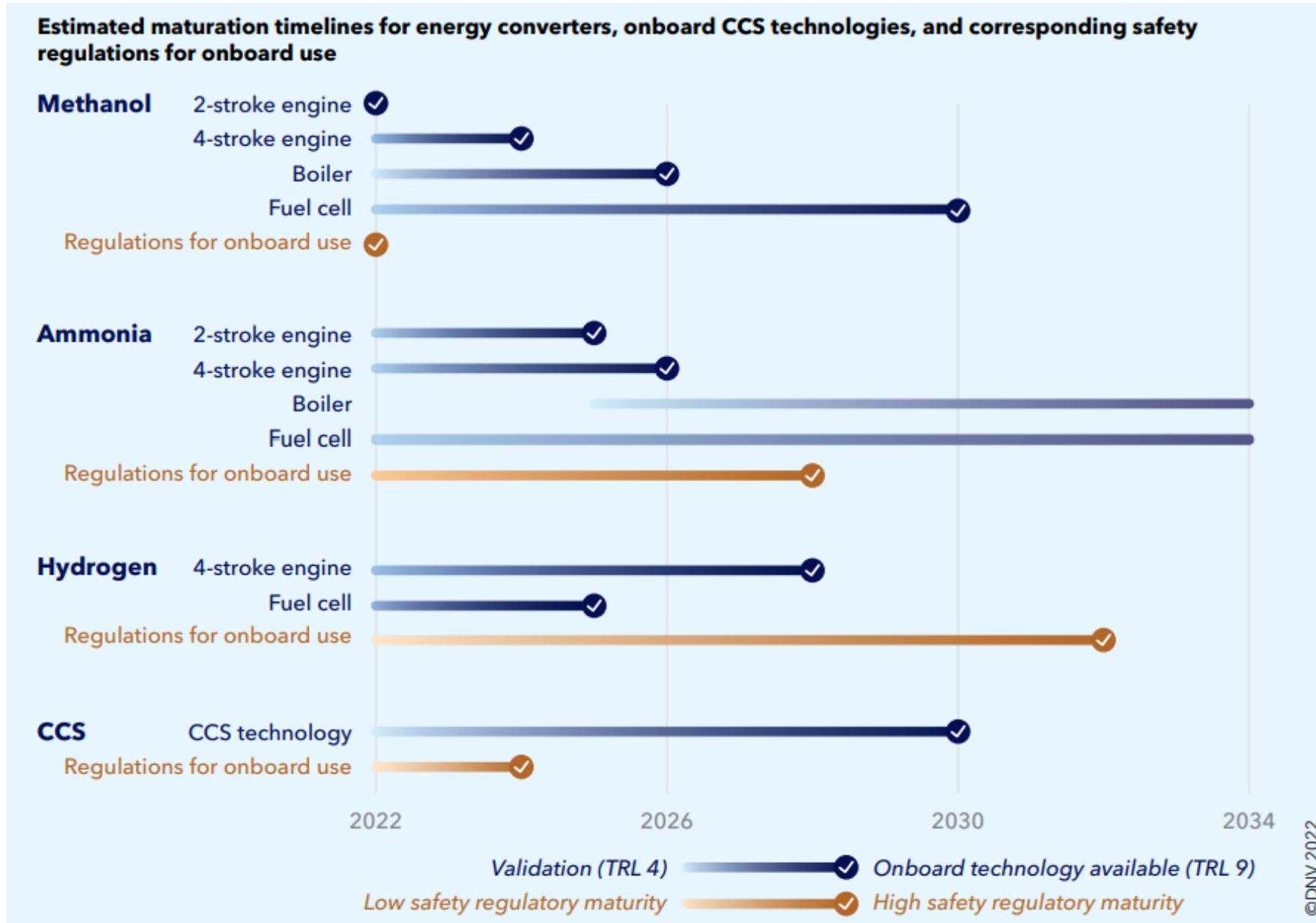
First Ammonia Gas Turbine Engine, MHI (H25), 40 MW Power
[<https://power.mhi.com/news/20210301.html>]

PRESS RELEASE

GE and IHI Sign Agreement to Develop Ammonia Fuels Roadmap across Asia

June 22, 2021

RATIONALE



DNV Maritime
Forecast to 2050 ,
2022.

RATIONALE

Why the Centre next to the Aberthaw Power Station?

- Japan (leader in ammonia power) has secured a national £345M ammonia program for the use of the chemical in powergen.
- Large demonstrators (~450MW) are currently being commissioned to fully replace coal by ammonia.
- IHI and Jera, industrial leads, are now commercializing the technology in China, Malaysia, India and South East Asia countries.
- Wales can also demonstrate the concept, and commercialize its own technology for power plants all around Europe (ie. Germany, Poland, UK, etc.), positioning Wales as main European Leader in the subject.

ARTICLE

JERA targets 50% ammonia-coal co-firing by 2030

By [Julian Atchison](#) on January 21, 2022



Jera

[Our Company](#)

[Our Business](#)

JERA to Conduct International Competitive Bidding for the Procurement of Fuel Ammonia

2022/02/18

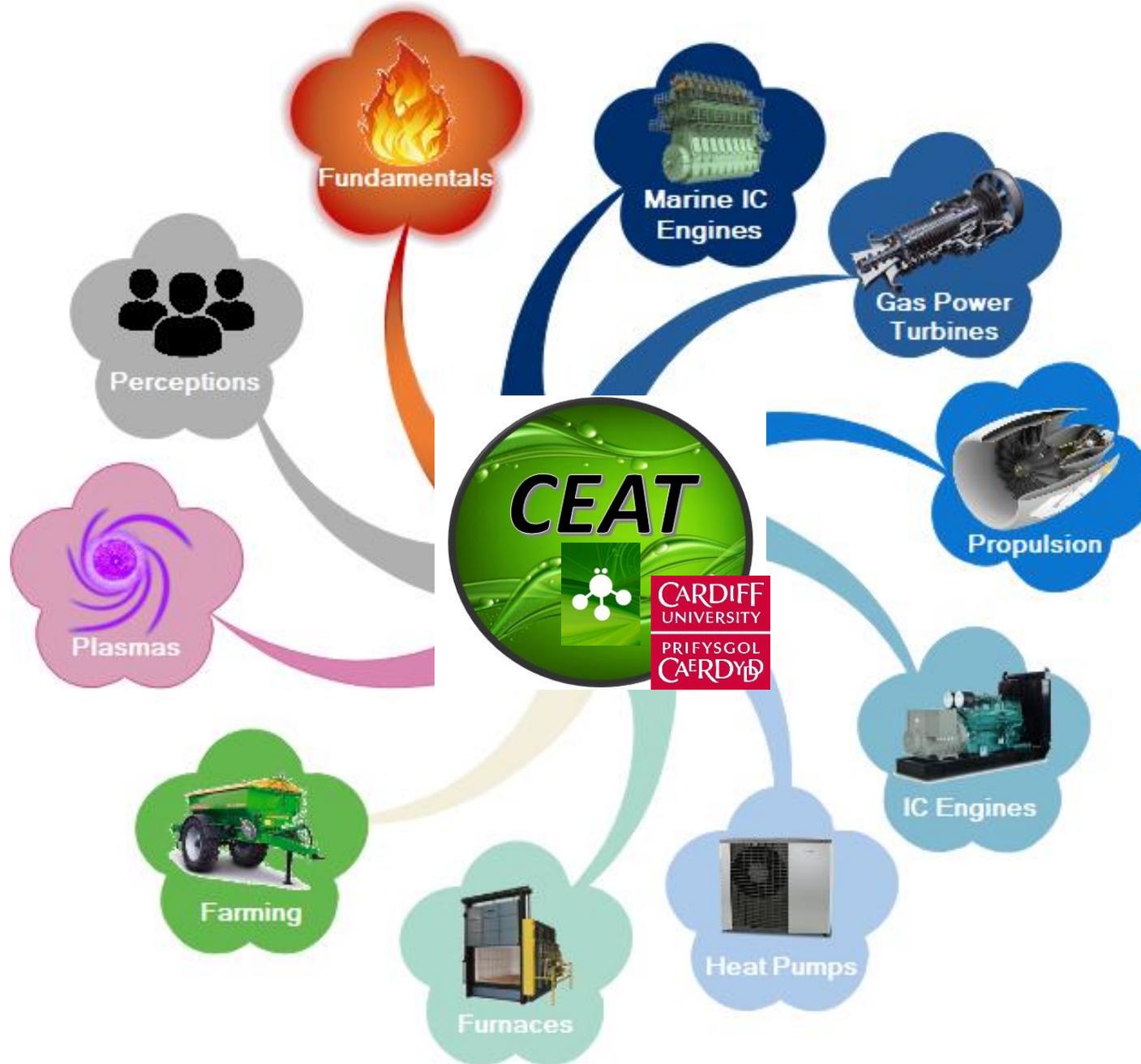
JERA Co., Inc. ("JERA"), having decided to conduct an international competitive bid for the procurement of fuel ammonia, has today sent a request for proposals ("RFP") describing bidding conditions to more than 30 companies.

Under its "JERA Zero CO₂ Emissions 2050" objective, JERA has been working to reduce CO₂ emissions from its domestic and overseas businesses to zero by 2050, to promote the adoption of greener fuels, and to pursue thermal power that does not emit CO₂ during power generation.

As part of this effort, JERA is working on a project to demonstrate the use of fuel ammonia at the Hekinan Thermal Power Station, aiming to switch 20% of the fuel at Unit 4 to ammonia by the late 2020s. Given the steady progress of this demonstration project, JERA has decided to consider fuel ammonia suppliers in parallel, and to conduct an international competitive bid with the following main conditions:

Main conditions

Buyer	JERA
Supply period	Long-term contract from FY 2027 into the 2040s
Quantity	Up to 500,000 tons per year
Delivery mode	FOB
Other	<ul style="list-style-type: none">• As a rule, CO₂ is either not generated during ammonia production or is captured and stored.• JERA has the opportunity to participate in production projects



Current Outcomes

- 1st National Demonstrator on Green Ammonia Energy (in collaboration with Siemens)
- Director of the Green Ammonia Working Group (UK)
- 2 Royal Society Policy Briefings
- Activity in 8 research grants, with 2 Program Grants
- Publication of 79 (+5 under 2nd review) papers, two books and 3 book chapters
- Editors in Chief of the new Journal on Ammonia Energy
- Lead of the 1st Symposium on Ammonia Energy
- Chair of the Combustion Section of the Ammonia Energy Association

Current Projects

01
Programme Grants
£2.3M

MariNH3
(NH3 shipping)

£1.3M to Cardiff

02

Ocean REFuel
(Offshore-Wind/
NH3 storage)

£1.0M to Cardiff

03
EPSRC CDT

Uniquely inc.
'Ammonia for
Power'

£1.5M (17 PhDs)

EPSRC
£2.7M

04
EPSRC RM

Responsive
Mode
SAFE (Ammonia
Gas Turbines)

£1.2M to Cardiff

05
HORIZON

FLEXnCONFU
Ammonia Power

£350k to Cardiff

06
INNOVATE-UK

Industrialised
Decarbonisation
Research &
Innovation
Centre

£267k to Cardiff

07
BEIS

Fuel Switching
Competition

£45k to Cardiff
(potential of a >
£3M for phase II)

08
WEFO

FLEXIS (Flexible
Integrated Fuel
Energy Systems)

£1.8M to Cardiff

Current Funding Profile

- Current projects are **£7.50M**
- Expected **£3M** for BEIS - phase II

Potential Funding Profile

- Current projects' proposals (under evaluation) **£4.3M**

Future Projects

- Novel Ammonia storage
- Aerospace
- Combined Heat
- Large Fuel Cells

Immediate Recognised Potential

- Milford Haven LNG Terminal converted into a green energy hub;
- Replacement of LNG by ammonia for
 - Cracking – Hydrogen into the WWU gas grid
 - Direct use for power station (20 MW)
 - Fertilizing activities
- Innovation in Solar/Wind energy to support community use;
- Heat district distribution to surrounding locations.



POTENTIAL PARTNERS (Institutions and Industries)

