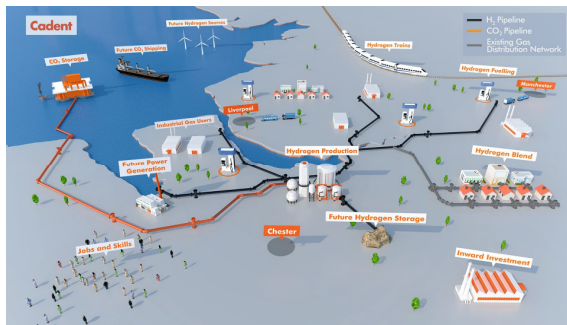


Hydrogen Fuel and Approach to Decarbonisation – From Production to Consumption



**HyNET
update
March 2019**

Andy Brown, Engineering Director, Progressive Energy



HyNET Update, March 2019

- Introduction to Progressive Energy
- Decarbonising Heat
- The HyNET Project
- Conclusion



Company Overview: Progressive Energy

- A clean energy projects company formed in 1998
- Mission is to develop a range of clean energy projects including electricity storage, renewable gas, grid conversion to hydrogen...
- Also provide advisory services to Government and commercial clients

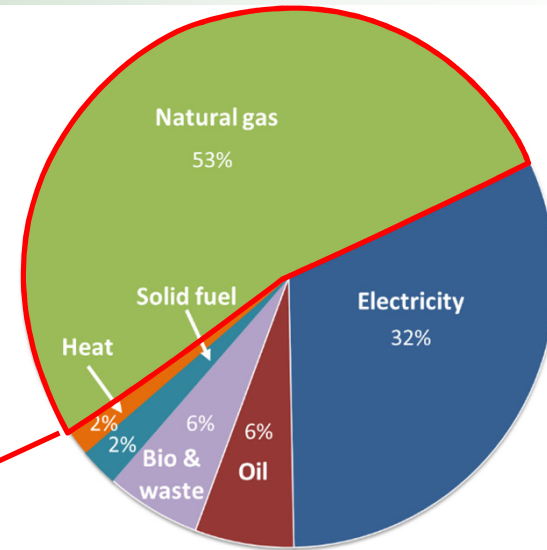
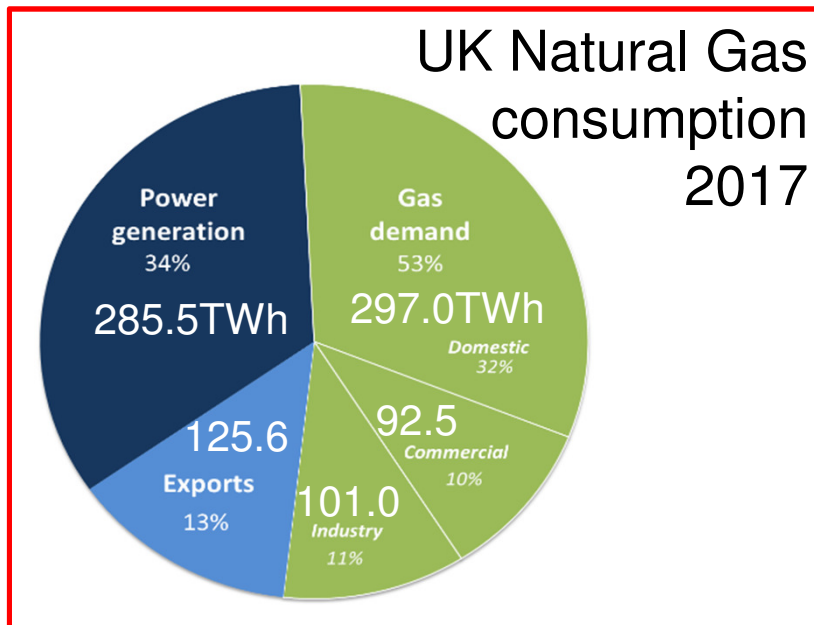
Example Projects, Clients, Collaborators





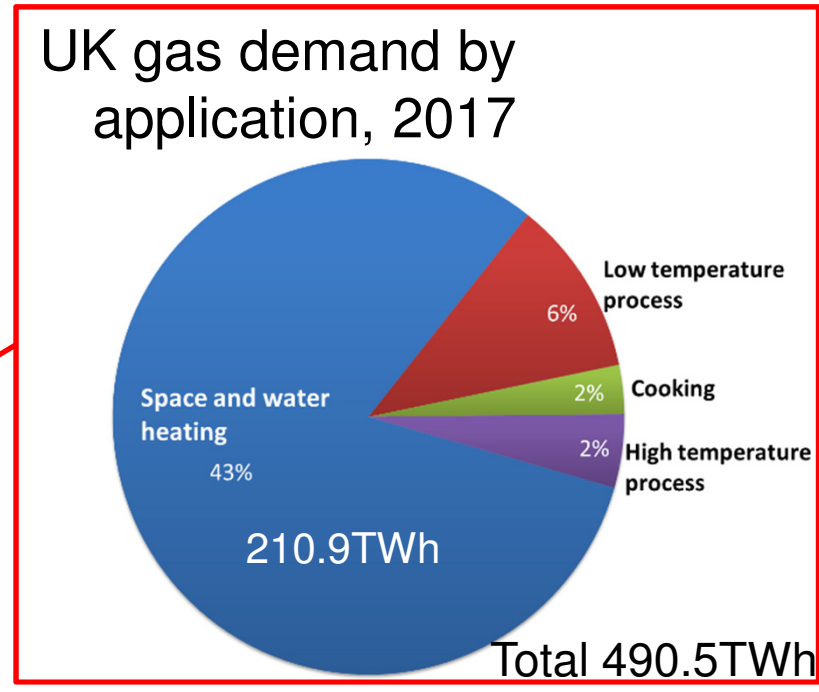
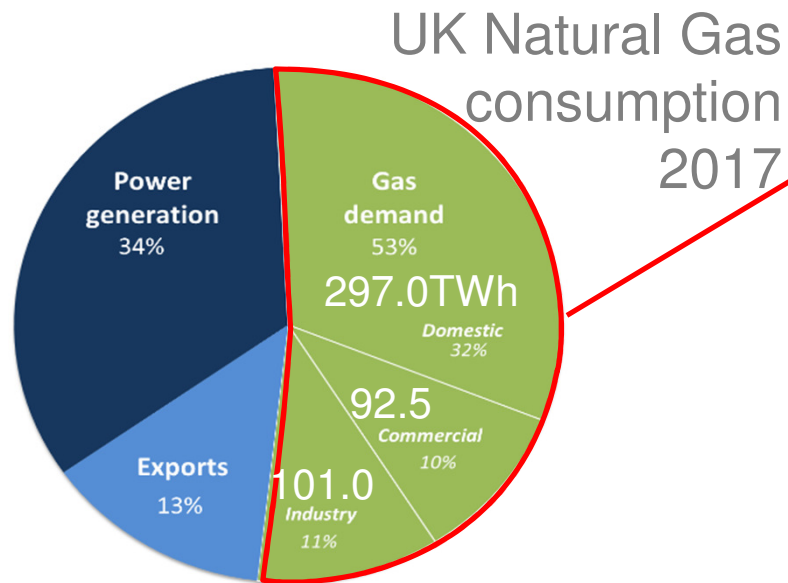
Decarbonising heat: the problem

UK energy consumption for heat and other end uses by fuel 2017
(excluding transport)





Decarbonising heat: the problem





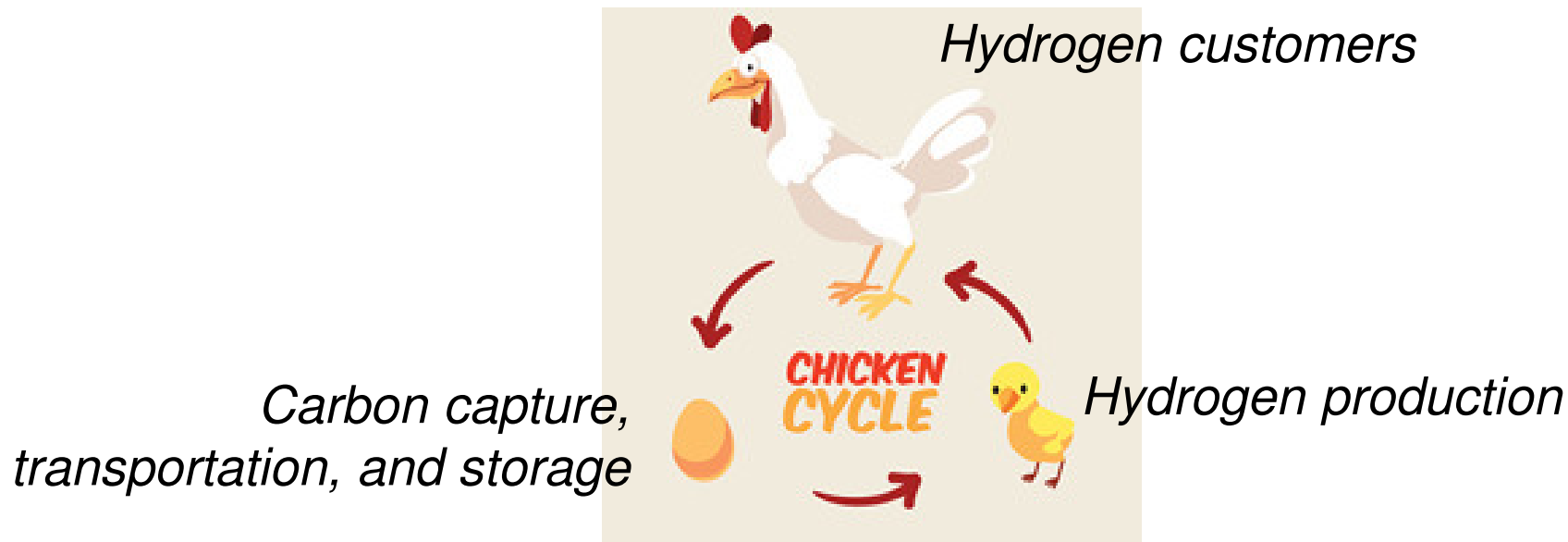
Decarbonising heat: the conundrum

- Some Natural Gas applications, could be electrified (renewable), but not all, leaving a massive gap
- Hydrogen could be a suitable energy vector
- To demonstrate hydrogen as a viable substitute for Natural Gas for heating, we would need to produce hydrogen in bulk
- Natural Gas is the only suitable feedstock to make hydrogen
- Making hydrogen from Natural Gas produces CO₂, implying CCS
- There is no CCS infrastructure, because there is no hydrogen plant to produce the CO₂
- There is no 'home' for bulk hydrogen, so cannot produce it
- Without bulk hydrogen available, there is no market 'home'



Decarbonising heat: the conundrum

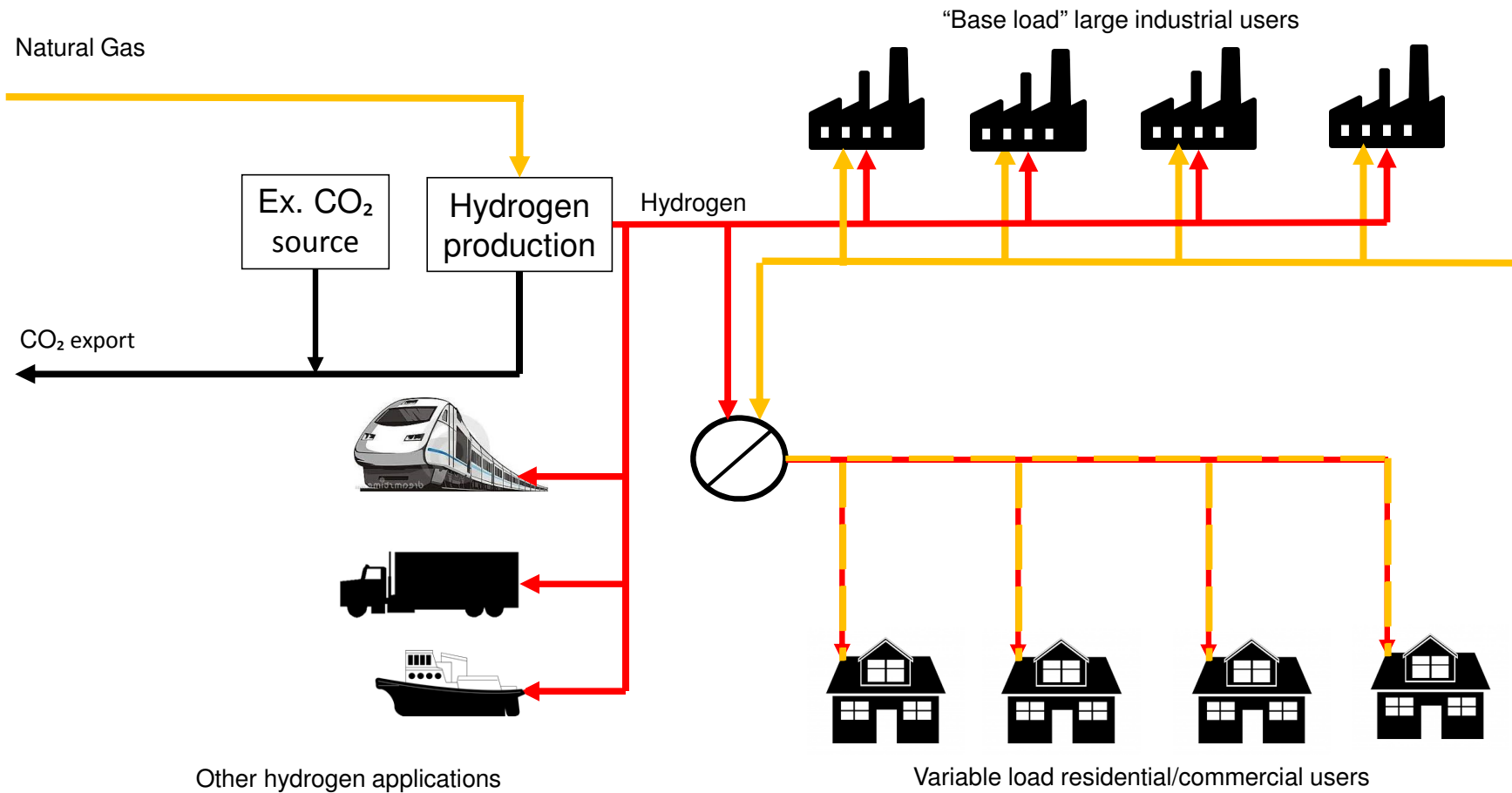
This is a real “chicken and egg” situation”.



HyNET breaks the cycle.

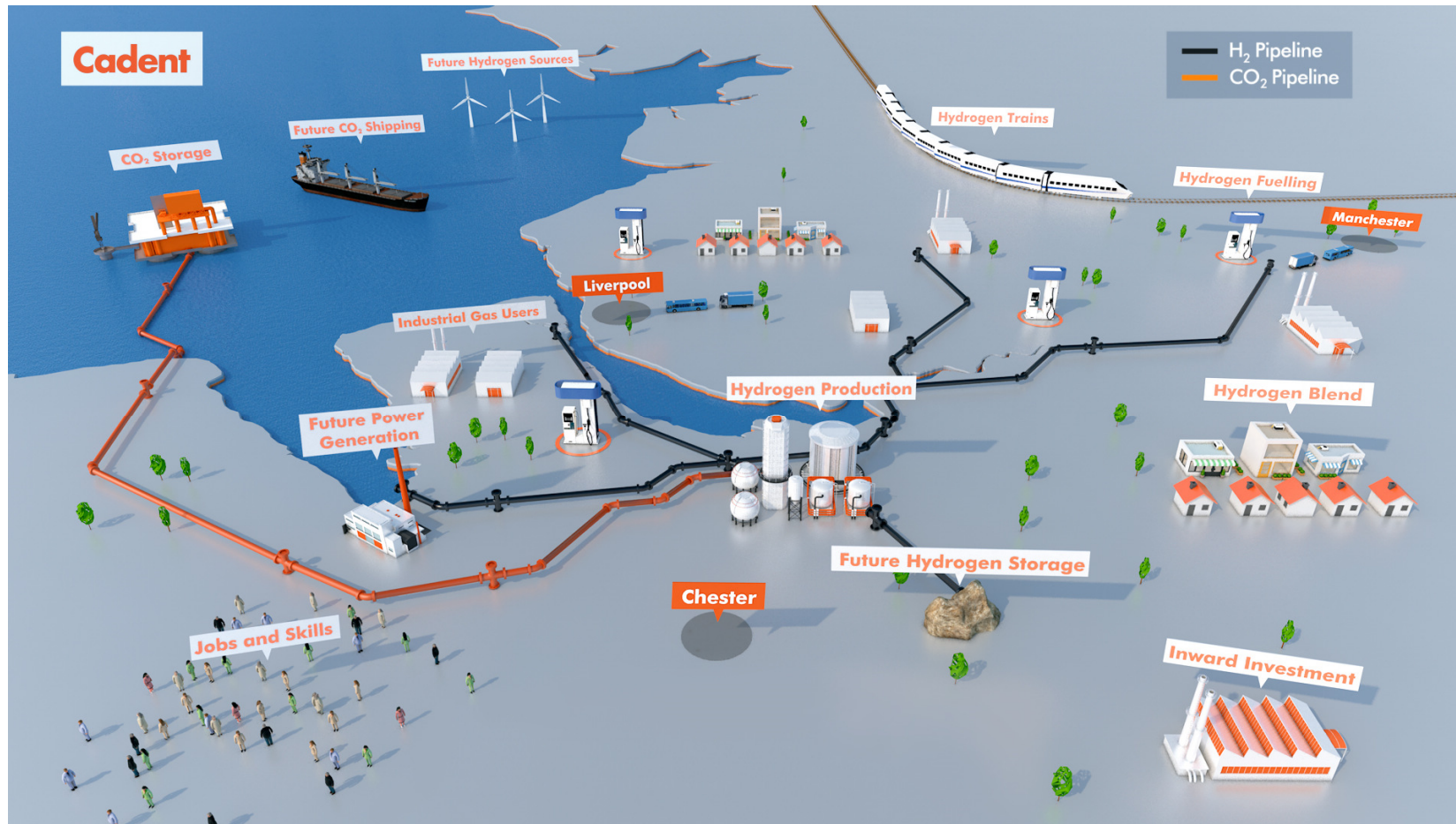


The HyNet Project: concept





The HyNet Project in the North West





The HyNet Project: what it delivers

- A hydrogen production plant big enough to be “proof of commercial concept” and scalable
- An ‘immediate’ reduction in CO₂ emissions from 2½M people, without cost or inconvenience of any modification to existing appliances



100% methane



71.6% CH₄/28.4% H₂



The HyNet Project: what it delivers

- A hydrogen production plant big enough to be “proof of commercial concept” and scalable
- An ‘immediate’ reduction in CO₂ emissions from 2½M people, without cost or inconvenience of any modification to existing appliances
- A route for industries to reduce CO₂ emissions, saving on ETS costs – when ‘low hanging fruit’ measures have been done
- CCS infrastructure (can use existing CO₂ from CF Industries ammonia plant, offshore structures and ≈60km of NG pipeline)
- Opportunities to expand the hydrogen economy in the North West, e.g. road, rail and sea transport, power
- Opportunities for other industries in the area to export, rather than emit their CO₂



The HyNet Project: some engineering challenges

- Different combustion characteristics of Natural Gas and Hydrogen
 - Higher flame temperature (increased NOx formation, impingement damage)
 - Different Wobbe index (e.g. CV changes affect metering)
 - Lower ignition energy
 - Higher flame speed
 - Mixture limits for existing equipment e.g. domestic, spark ignition engines, kilns
- Design of hydrogen production plant with CCS
- Engineering of CO₂ and hydrogen pipelines

BEIS Programmes

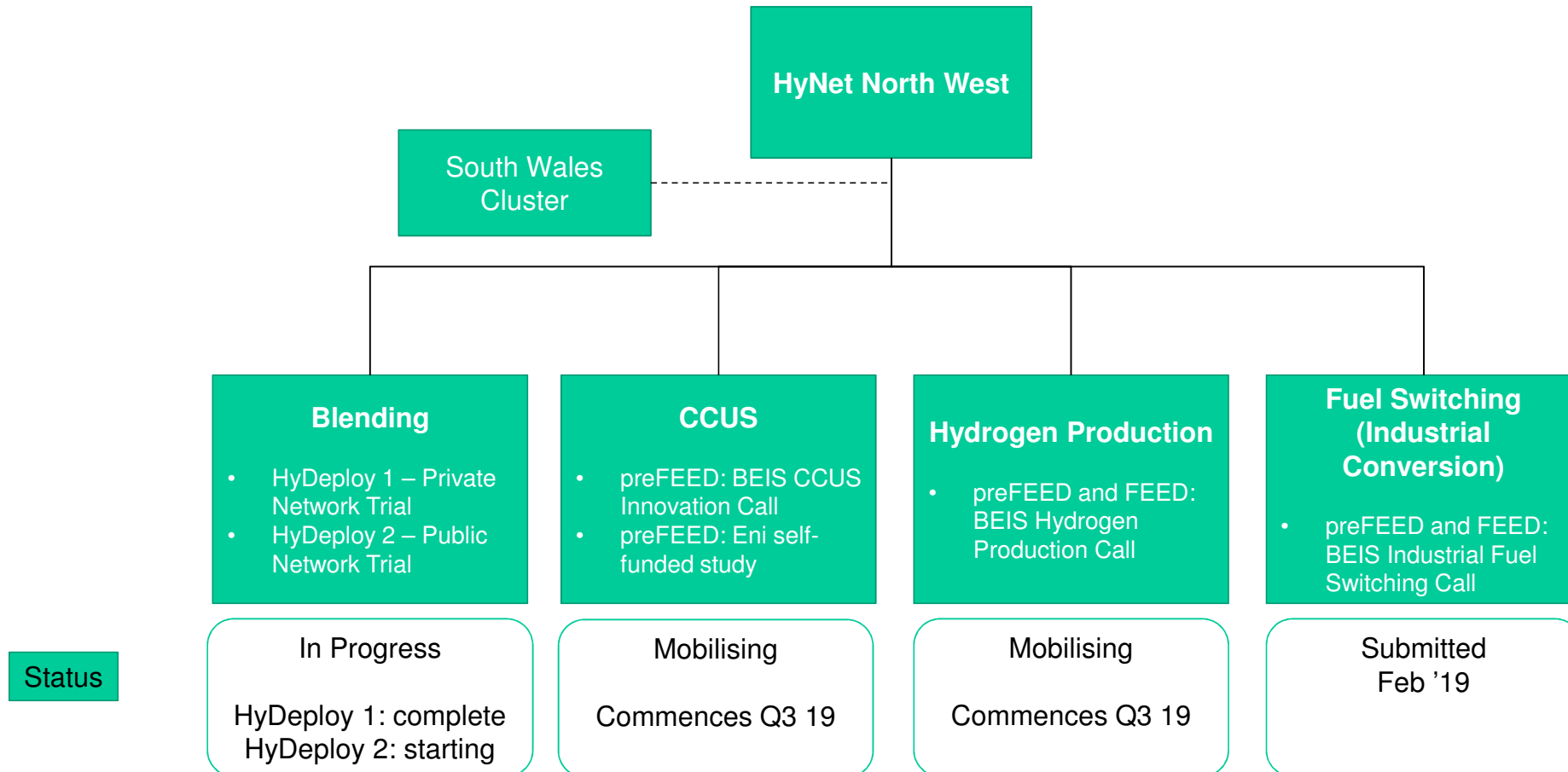


Department for
Business, Energy
& Industrial Strategy

- Fuel Switching
- Fuel Switching
- HyDeploy & Fuel Switching
- HyDeploy & Fuel Switching
- HyDeploy & Fuel Switching
- CCuS programme
- CCuS programme & H₂ supply

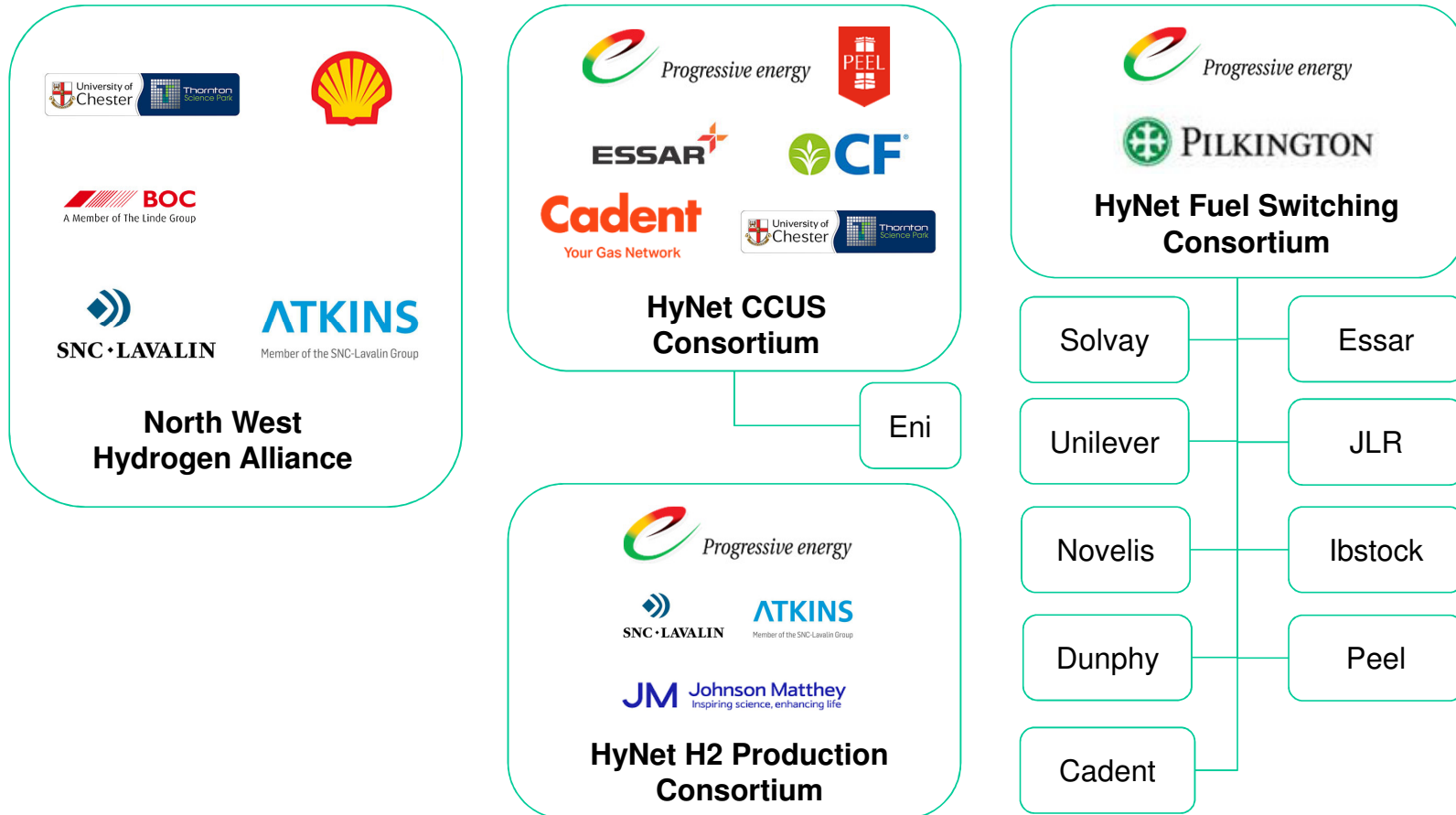


The HyNet Project: enabling the vision





The HyNet Project: enabling the vision



Hydrogen Fuel and Approach to Decarbonisation – From Production to Consumption

Conclusion:

**HyNET NW is a project that demonstrates
Hydrogen Fuel and Decarbonisation – From
Production to Consumption**

Any questions?