DSM CAPITAL PARTNERS

INVESTING IN HYDROGEN

MARCH 2021

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WHY HYDROGEN? WHY NOW?

Why Hydrogen?

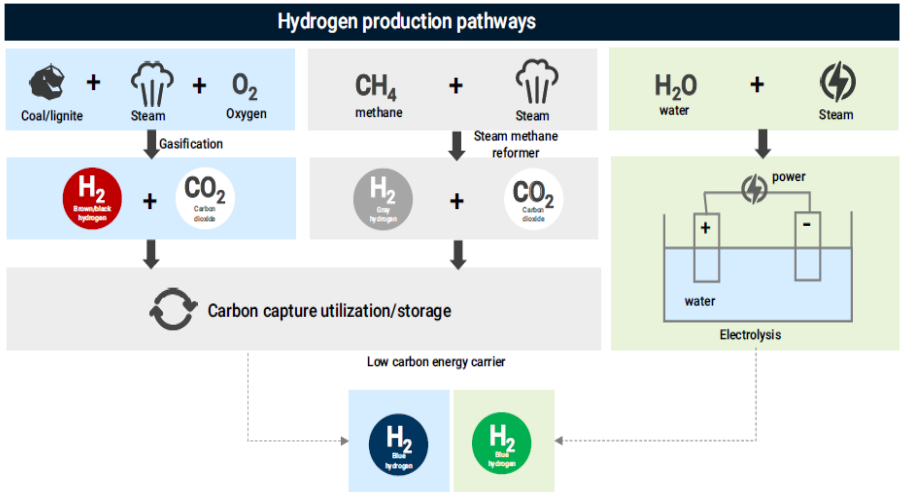
- **Clean and Green**
  - Can be sourced renewably with zero direct emissions
- **Versatility**
  - Light, durable and high energy per unit mass which enables storage across various scales from cartridges to caverns and transportation as a liquid / gas
  - Can be mixed with other gases e.g., natural gas
- **Address tougher to de-carbonize emission sources**
  - Heavy industry (steel, refining, etc.), heating, heavy transport (long haul trucking, shipping)

Why Now?

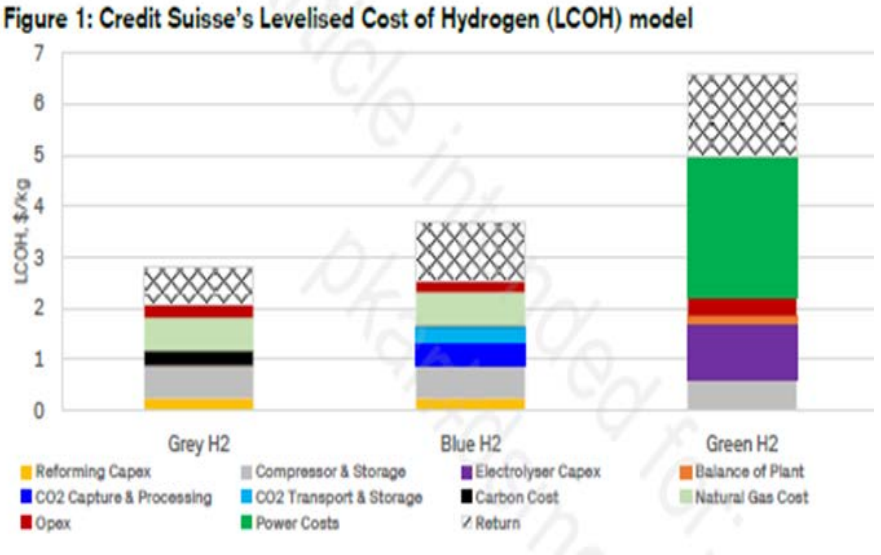
- **Coming together of**
  - De-carbonization imperative / ESG
  - Policy Support
  - Declining production costs
- **Leading to**
  - Accelerating project announcements
  - Hydrogen could provide up to 15-20% of the world's energy mix by 2050 by some estimates
- **Potentially significant investment implications in certain sectors**

Source: DSM

HYDROGEN PATHWAYS



Source: S&P Global Platts, Goldman Sachs Global Investment Research



- Important to remember that H_2 is an energy vector and not a source and must be produced. Currently >95% of H_2 production is grey/black/brown while <1% is green.
- Currently most of the H_2 produced is used as feedstock for Ammonia & Methanol production. Also used in refineries (hydrocracking, desulphurization etc.). There are some smaller applications as well.
- Green H_2 is not currently cost competitive with Blue or Grey H_2 but current estimates suggest its cost could approach Blue H_2 by 2030.

Source: Goldman Sachs Investment Research, Credit Suisse

WHERE ARE THE POTENTIALLY PROMISING APPLICATIONS?

- Transportation / Mobility
  - FCEVs - Heavy Duty trucking – BEV is not really an option, Low carbon public transport – FCEV as well as BEVs. Light FCEVs may not be competitive with BEVs. Benefits in energy density, charging time and range.
  - Materials handling (aka forklifts) had been very successful
  - Maritime/Shipping – Liquified H_2 or NH_3
  - Aviation: Liquified H_2 could work for shorter haul flights. Long Haul flight likely use synthetic fuels.
  - Rails: Replacing diesel on hard to electrify lines.

- Selectively in Heavy Industry: High temperature industrial processes, H_2 as a reducing agent and H_2 as a feedstock
  - Chemicals incl. Petrochemicals e.g., ammonia, refining
  - Metals e.g., low carbon steel
  - Building Materials e.g., cement

- Home heating and household use
  - US, 50%+ households connected to the gas network. Netherlands and UK 80-90%. Blend H_2 with Natural Gas in the pipeline.

- System Balancing

HOW DO WE GET THERE?

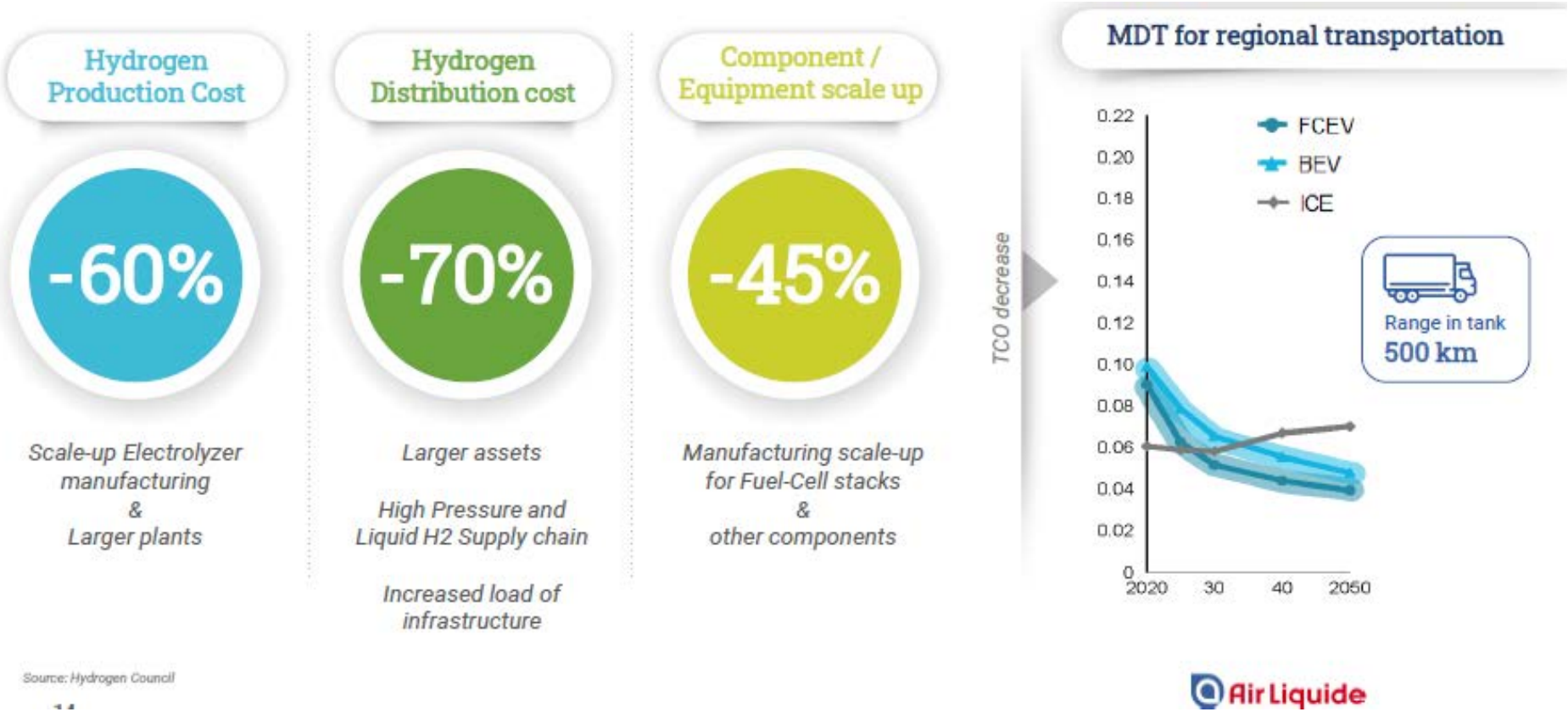
- Cost of Green H_2 declines– current expectations based on technology and cost roadmaps suggest ~60% reduction by 2030 and another 10% by 2040
  - Lower cost of renewable power as well as better electrolyzer efficiency
  - Scale benefits
  - Cost of capital, buildability (permitting etc.), resources / location (wind/sun for renewable power and water for electrolysis)

- Green H_2 becomes more available
  - Pipelines for industrial and home applications
  - Potentially Ammonia as a transportation vector
  - Distribution networks for various FCEV applications is currently sparse. Germany which has the largest refueling network has 86 stations today.

- Technology that enables H_2 usage in a range of applications becomes more viable scalable e.g., Fuel Cell efficiency and cost

- Capex in retrofitting or complete overhauls to enable H_2
  - Natural gas pipelines, Iron & Steel plants etc.
  - Could vary significant by application and timing could depend on natural end of life capex cycles in some cases.

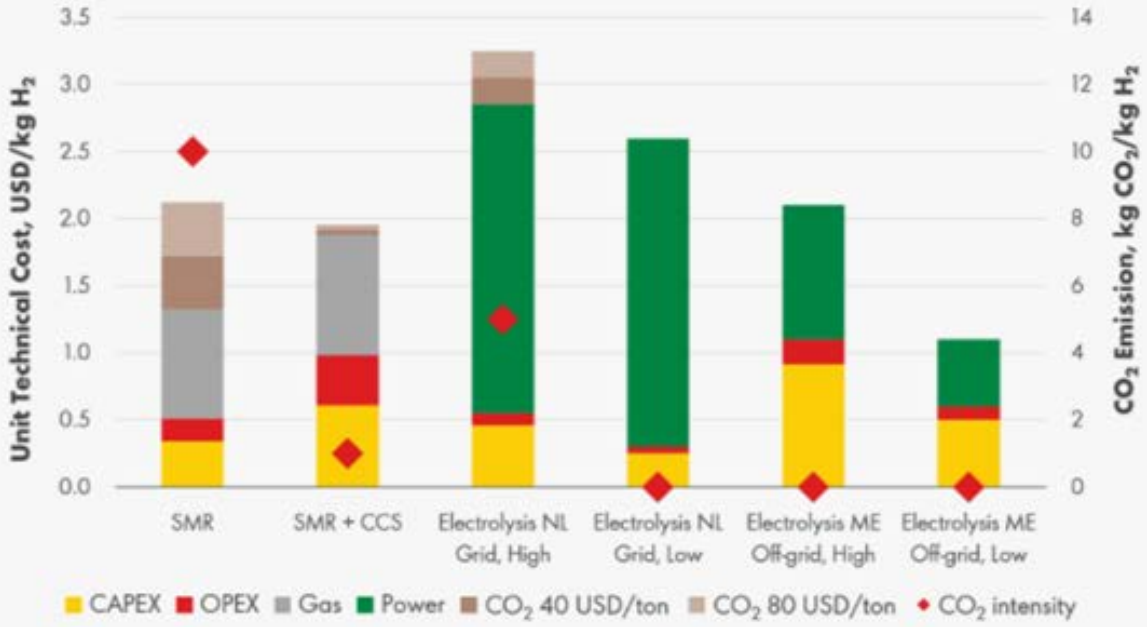
2030 COST REDUCTION POTENTIAL



Source: Air Liquide

H2 COSTS LIKELY VARY SIGNIFICANTLY BUT COULD BE COMPETITIVE AROUND 2030

Unit Technical Cost of H_2 after 2030



Key assumptions:

- Large scale H_2 production
- Steam Methane Reforming (+CCS):
  - Natural gas price is 5 USD/MMBtu
- Electrolysis the Netherlands Grid:
  - Power price is 5 cent/kWh in both cases
  - Electrolyzer capacity factor – 100%
  - High case: 70% green power (2030 target); Electrolyzer CAPEX 750 USD/kW
  - Low case: 100% green power (2030+ target); Electrolyzer CAPEX 250 USD/kW
- Electrolysis Middle East Off-grid:
  - Powered by solar PV under a PPA
  - Electrolyzer capacity factor – 50%
  - High case: Power price is 2 cent/kWh (2030); Electrolyzer CAPEX 750 USD/kW
  - Low case: Power price is 1 cent/kWh (2050); Electrolyzer CAPEX 250 USD/kW

Source: IEA, McKinsey

September 2020 7

Source: Royal Dutch Shell / Shell International B.V.

ESTIMATE OF COST COMPETITIVENESS WITH CONVENTIONAL SOLUTIONS

Exhibit 18: Required hydrogen production cost for breakeven with conventional solutions, without carbon costs

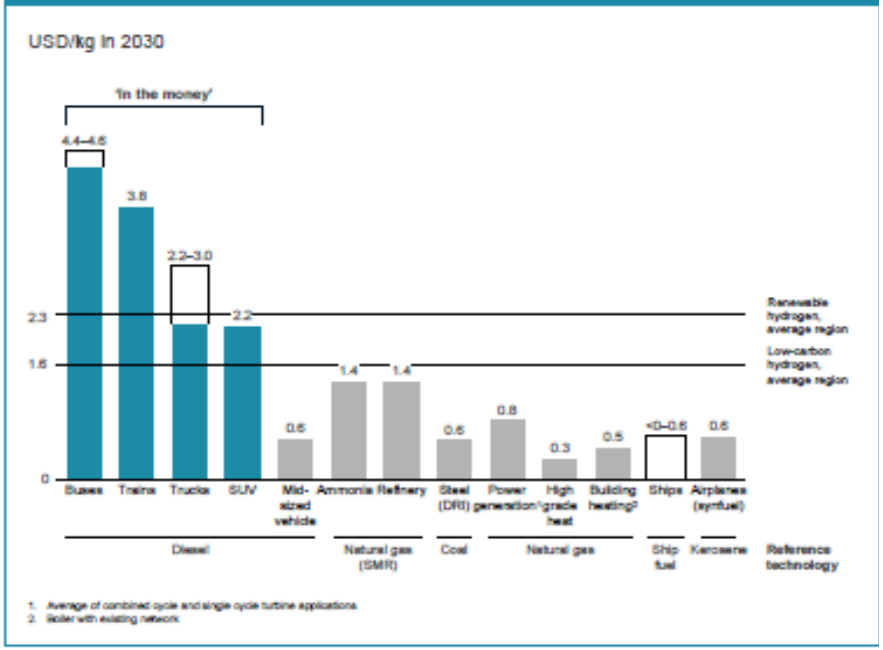
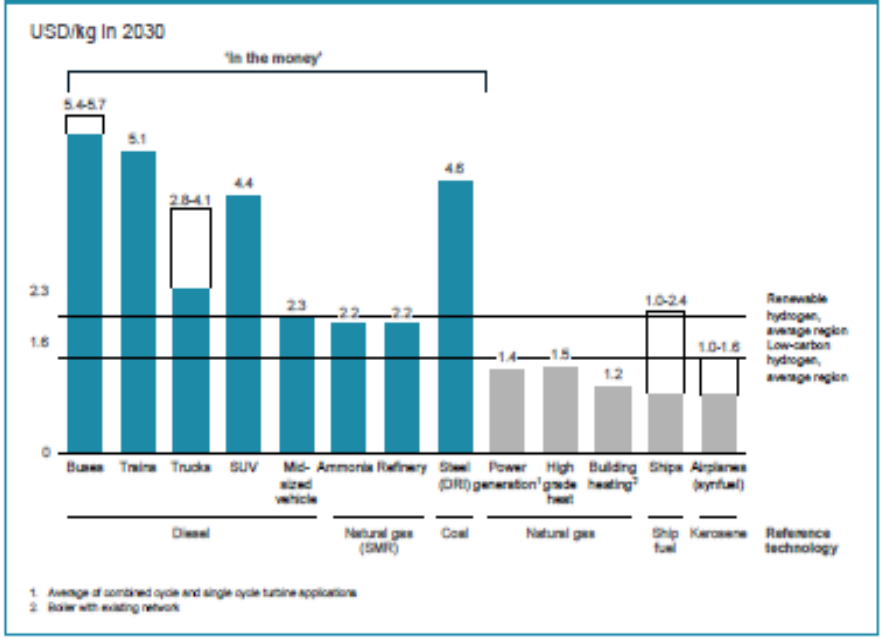


Exhibit 19: Required hydrogen production cost for breakeven with conventional solutions, with 100 USD/t CO_2e



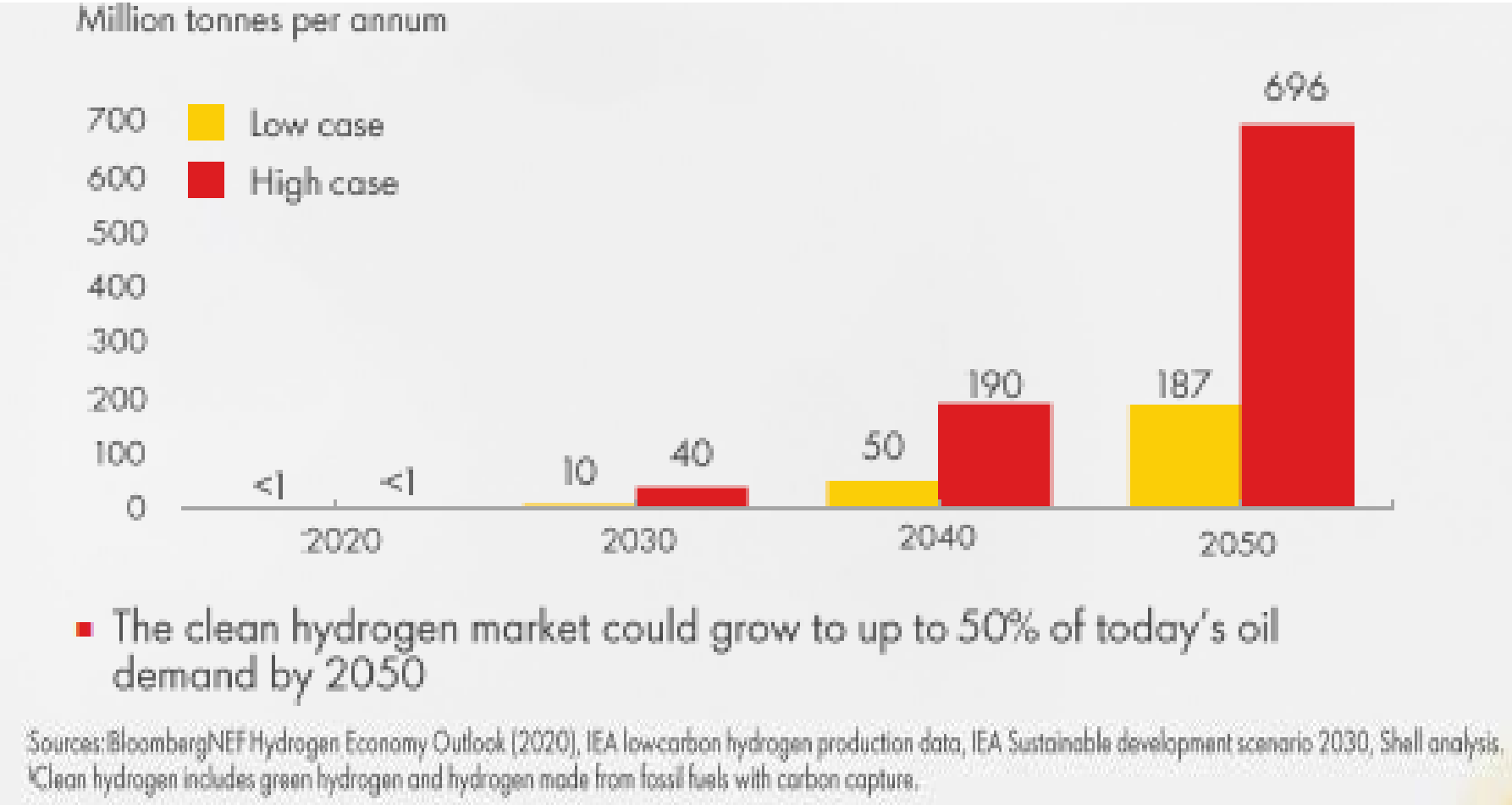
Green H_2 could be cost competitive across a range of applications by 2030

Source: Hydrogen Council

WHAT ARE THE RISKS / CHALLENGES?

- Slower declines in price at point of use for Green H_2.
- Expectations for continuously declining cost of production and price for Green H_2 make long term investment decisions challenging.
- Potential for technical challenges with some of the more promising technologies out there.
- Ability for enough renewable power growth to power the production of H_2
- Availability / access to water in some locations.
- Accidents with H_2 handling could negatively impact public opinion
- Potential policy shifts given policy support is critical for H_2 to take off

GLOBAL DEMAND PROJECTIONS FOR CLEAN H2



Source: Royal Dutch Shell

SO WHAT ARE THE PLAYS …

- Public listed Hydrogen investment opportunities are mostly in two broad categories
  - Smaller cap, mostly unprofitable pure plays that in many cases with still evolving technology roadmaps and cost curves

- Major companies across several sectors (Utilities, Oil & Gas, Capital Goods, Chemicals, Metals & Mining, Autos among others) which have a Hydrogen business.
  - In most cases the Hydrogen business is currently immaterial from a revenue / profit standpoint
  - In some cases could require significant capex and possibly opex prior to generating revenues
  - In some sectors like Oil & Gas the growth of Hydrogen and renewables could be detrimental to other parts of the business

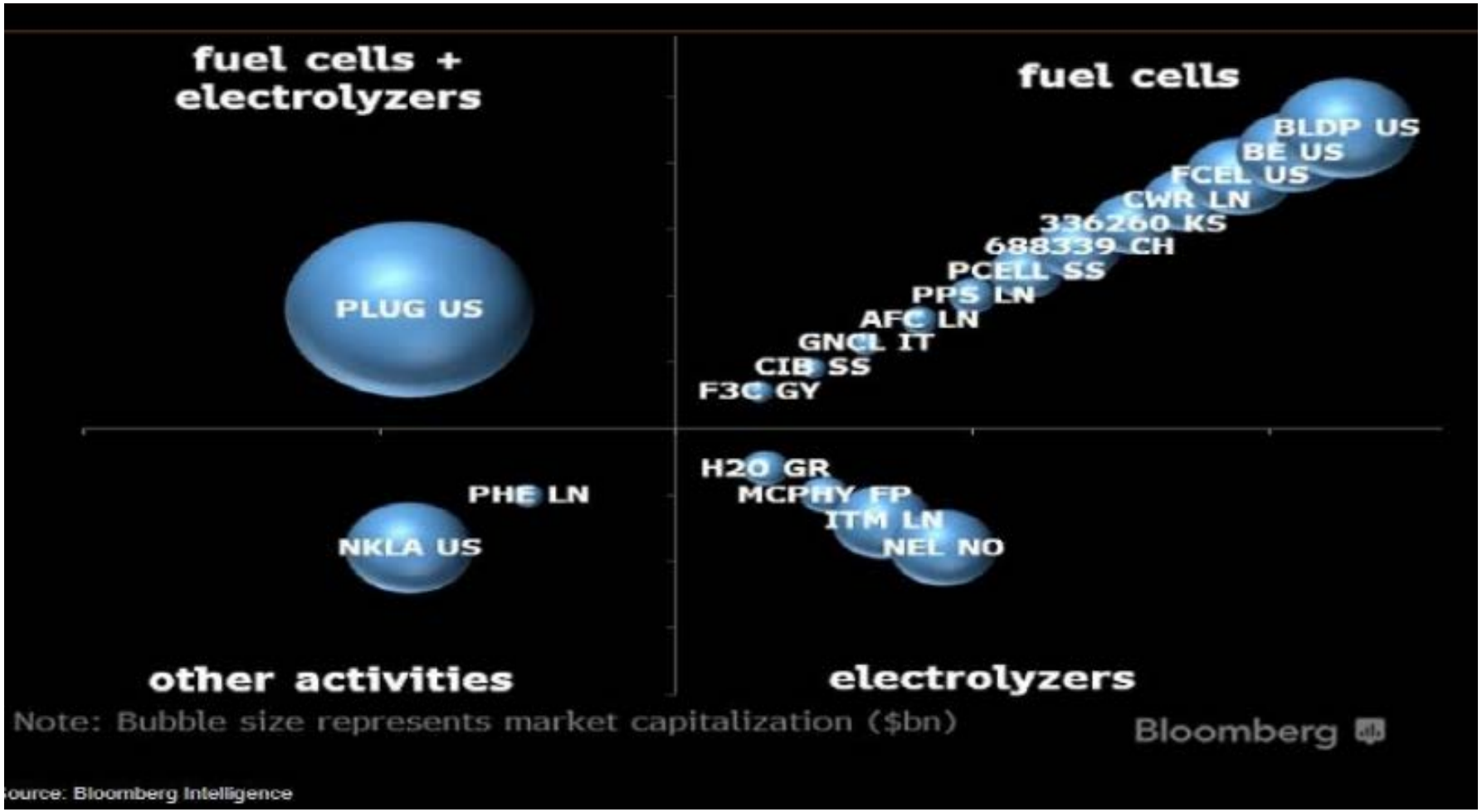
HOWEVER, THERE ARE SOME AREAS OF OPPORTUNITY …

- Select Pure Plays
  - Largest here is Plug Power (PLUG) which has a market cap of 25B+.
    - The stock is up 47% YTD even though it is off 33% from its highs.
    - Bloomberg Consensus expects revenue to reach $1B in 2023, the same year that the company breaks even from an EPS standpoint.
  - There are several other smaller players that could be interesting as well

- Select Machinery & Capital Goods Companies
  - An example here would be Cummins which is focused on both electrolyzers for producing H_2 as well as Fuel Cells for rail, highway (mostly trucks) and stationary applications
  - The company targets 400M+ in H_2 revenues. This compares to BB consensus estimates of ~22B in revenues in 2021 and ~25B for 2025.

- Industrial Gas Companies
  - An area we like … more on this in a moment

PURE PLAYS…PLUG BY FAR THE LARGEST



INDUSTRIAL GASES: UNDERAPPRECIATED PLAYS

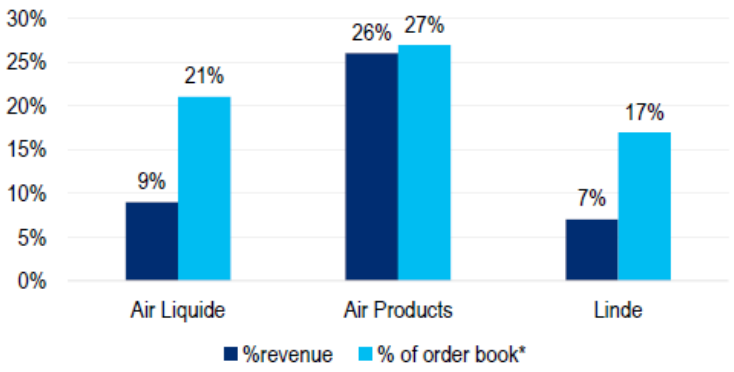
INDUSTRIAL GASES: ALREADY SIGNIFICANT PLAYERS IN H2

Figure 5. Existing Hydrogen capabilities – N.B. US industrial hydrogen supply is more commonly outsourced, key to the No. of SMRs

	Linde	Air Liquide	Air Products
SMR	150+ units	46 large Units	80 units
Electroylsis	80+ units	40 Units	units
Pipelines	1000 km	1850 km	1050 km
Storage	2.4 Bcf		
Refuelling stations	200 Units	120 Units	150 Units
Investments	ITM - 20% Oct '19	Hydrogenics - 18.6% Jan '19	Oct '19
Tech. Partnerships			Technip - SMR know-how ACWA/TKA/Halor Topsoe - Project NEOM

- $2-3B businesses for each of the 3 major players
- Example of B2B outsourcing – lower cost and better reliability
  - Reliability – long term supply contracts with high service levels
  - Demand Aggregation & Scale – multiple clients can be supplied via pipelines/trucks from a large scale SMR
  - Capex outsourcing – Gas company incurs capex
- Mostly Grey/Black/Brown H_2 and some Blue H_2
- APD order book has a large unique project, NEOM

Hydrogen Revenues & Order Books



Source: Citi Research

HOW ARE INDUSTRIAL GAS COMPANIES POSITIONED FOR GREEN H_2

STRENGTHS

- Active across the H_2 value chain and strong technical knowledge of the molecule
- Unique expertise in storage & distribution e.g., slat cavern storage, existing H_2 pipeline networks
- Technology Partnerships e.g., Linde with ITM & PLUG
- Ability to profitably use O_2 (Green H_2 by-product)
- Track record of large-scale project execution
- Strong balance sheets
- Customer relationships and knowledge of business models

WEAKNESSES

- New technology that is still evolving esp. electrolyzers
- Challenge in planning long-term capital deployment with uncertainties in H_2 price evolution and technology & cost curves that are still rapidly changing
- Some existing infrastructure may not be leverageable for Green H_2 and may be negatively impacted by Green H_2
- Some modest displacement of oil refining applications.

OPPORTUNITIES

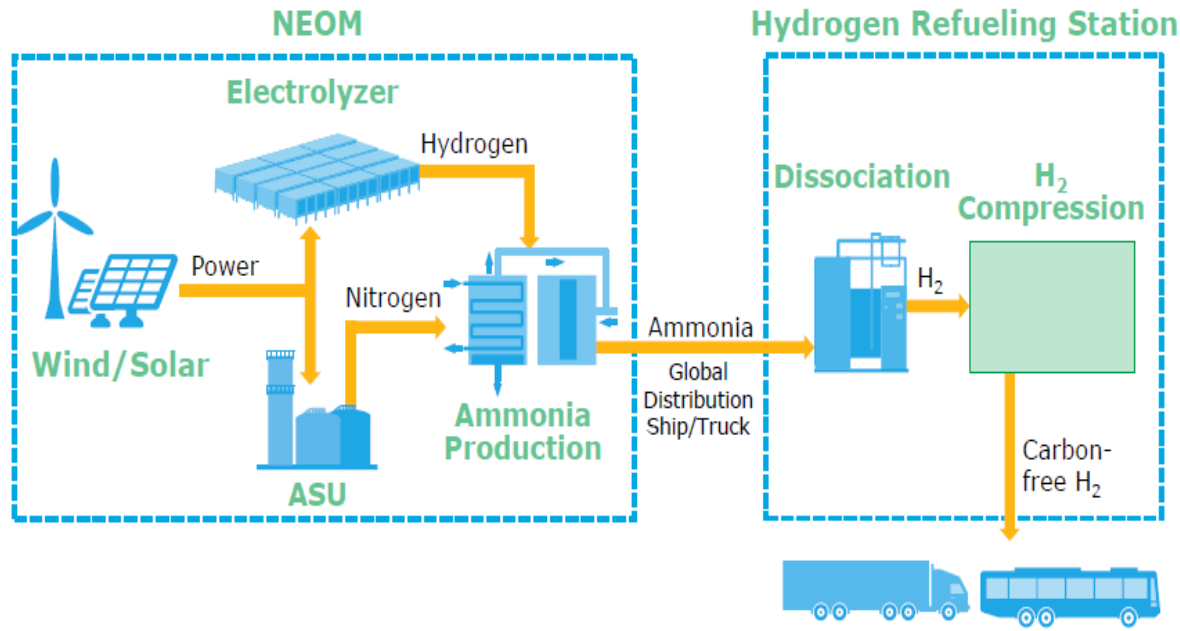
- Potential for entering new H_2 markets
- Role in connecting H_2 networks and in distribution for fleets / mobility

THREATS

- Potential new competitors with large balance sheet
- Disintermediation by utility companies and industrial customers
- Ambitious policy goals but vague implementation plans in some cases
- Policy e.g., open pipelines that might be highly regulated (currently industrial gas pipelines are dedicated and hence protected from competition)

APD: NEOM PROJECT

- JV between APD, ACWA Power and NEOM in NEOM Saudi Arabia
- Expected to go live in 2025
- $7B Investment
  - $5B for production with 1/3 owned by each of the 3 partners
  - $2B for distribution owned 100% by APD
- Expected to power buses and trucks
- Avoids all emissions from the equivalent of 700K cars
- With a typical or even slightly lower ROIC hurdle it could be decent size contributor to earnings

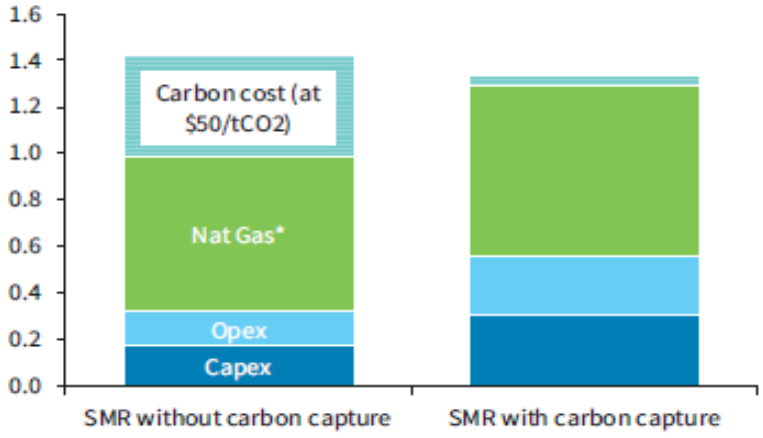


Source: Air Products

IT IS NOT JUST ABOUT GREEN H_2 ….

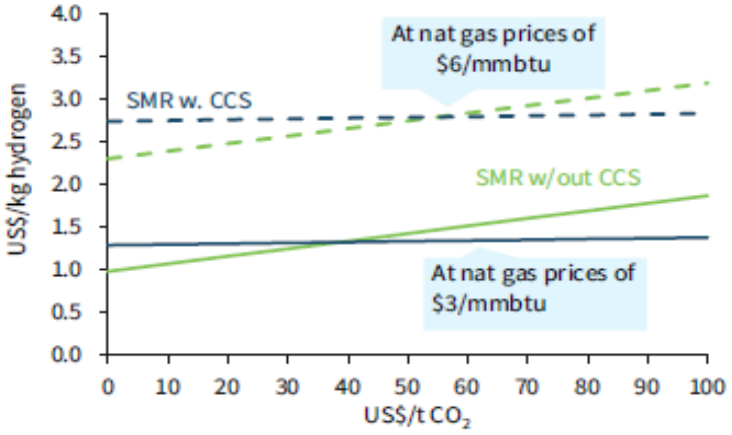
- The path to Green H_2 may go through Blue H_2 which could fill the gaps as other infrastructure especially around storage/transportation/distribution develops.
- Some indications (Shell, Air Liquide) that Carbon Capture could have high capture rates (Shell notes up to 99%)
- Blue H_2 viability depends on carbon pricing vs. the incremental capex & opex.

FIGURE 2. **Carbon price drives by overall grey hydrogen costs (US$/kg)**



Source: Barclays Research

FIGURE 3. **Blue hydrogen is compelling when the carbon price is >US$50/t**



Source: Barclays Research

Source: Barclay's

SOME COMMENTS RELATED TO LINDE …

"Linde reiterated its statement on 7 May that green hydrogen is set to become a multi-billion dollar business in the future. In an interview with German daily Handelsblatt, CEO Steve Angel said that he expects the company's hydrogen sales to quadruple in the future. We understand that the time-line for his ambition is by end of this decade. Today, however, the vast majority is grey hydrogen (produced via SMR with methane gas, as it does not do any coal gasification), while only a small fraction is green (via electrolysis) at Linde. As a consequence, the share of grey hydrogen will diminish in favour of green and blue hydrogen." – Kepler Chevereux

"2020 has seen a large increase in investor / industry focus on ESG and in particular for de-carbonization. Whether this is via hydrogen, carbon sequestration or CO2 repurposing for use in other chemical reactions, the industrial gas industry and LIN in particular, has market leading expertise. While meaningful contribution to earnings of items like "green" hydrogen is beyond 2025 in our view, investor focus on those areas can still lead to multiple expansion from here." – Barclays Capital

"Hydrogen opportunity could add ~0.5% pa to the top line" – UBS

WHAT HAVE WE SEEN SO FAR?

- Surge in investor interest in 2H 2020 coincided with elevated valuations for industrial gas names.
  - An analysis by ISI group from Oct' 2020 suggested a between 5-15 percentage point additional premium relative to the S&P 500.
  - Industrial gas names have traded at an average of 23% premium over the past 5 years and that premium was elevated to 28-39% premium at the time of the analysis.
- Hydrogen along with aggressive ESG initiatives likely keep investor interest high here given solid existing businesses and relatively attractive yields.
- Multiple project announcements so far from all three players of which the NEOM project is the largest/boldest.
- Earnings expectations so far do not factor in much, if any contribution from Green H_2 projects and are perhaps unlikely to be much of a factor before 2025.

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