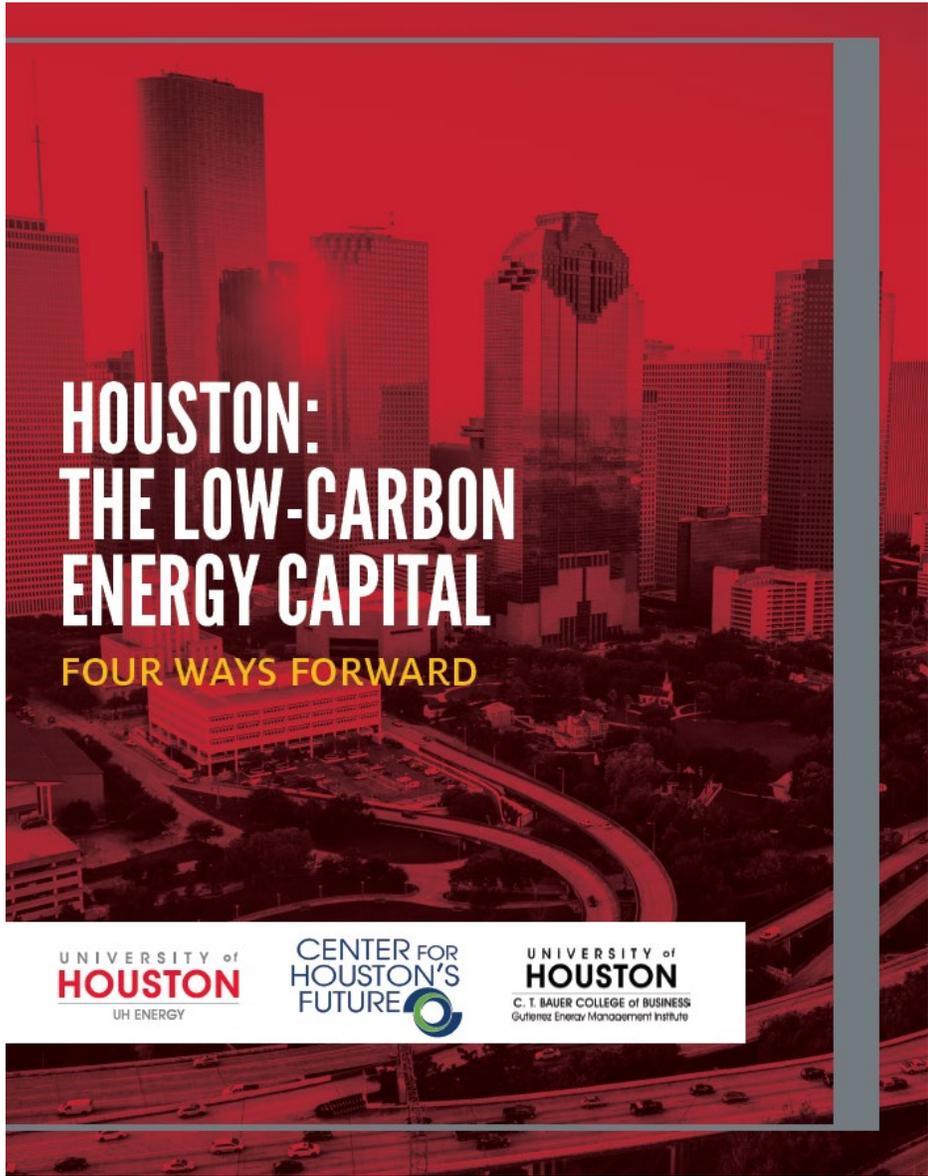


Building a Houston Hydrogen Hub

March 16, 2021



Hydrogen is increasingly recognized as a critical enabler to decarbonization, alongside energy efficiency, renewable power adoption, and electrification

Examples of momentum for decarbonization



Why Hydrogen?

Versatile

- Carrier
- Process heat
- Power conversion

Clean

- Burning
- Fuel cell

Abundant, but

- Plentiful
- Must manufacture transport, ship

Unique hydrogen roles in decarbonization

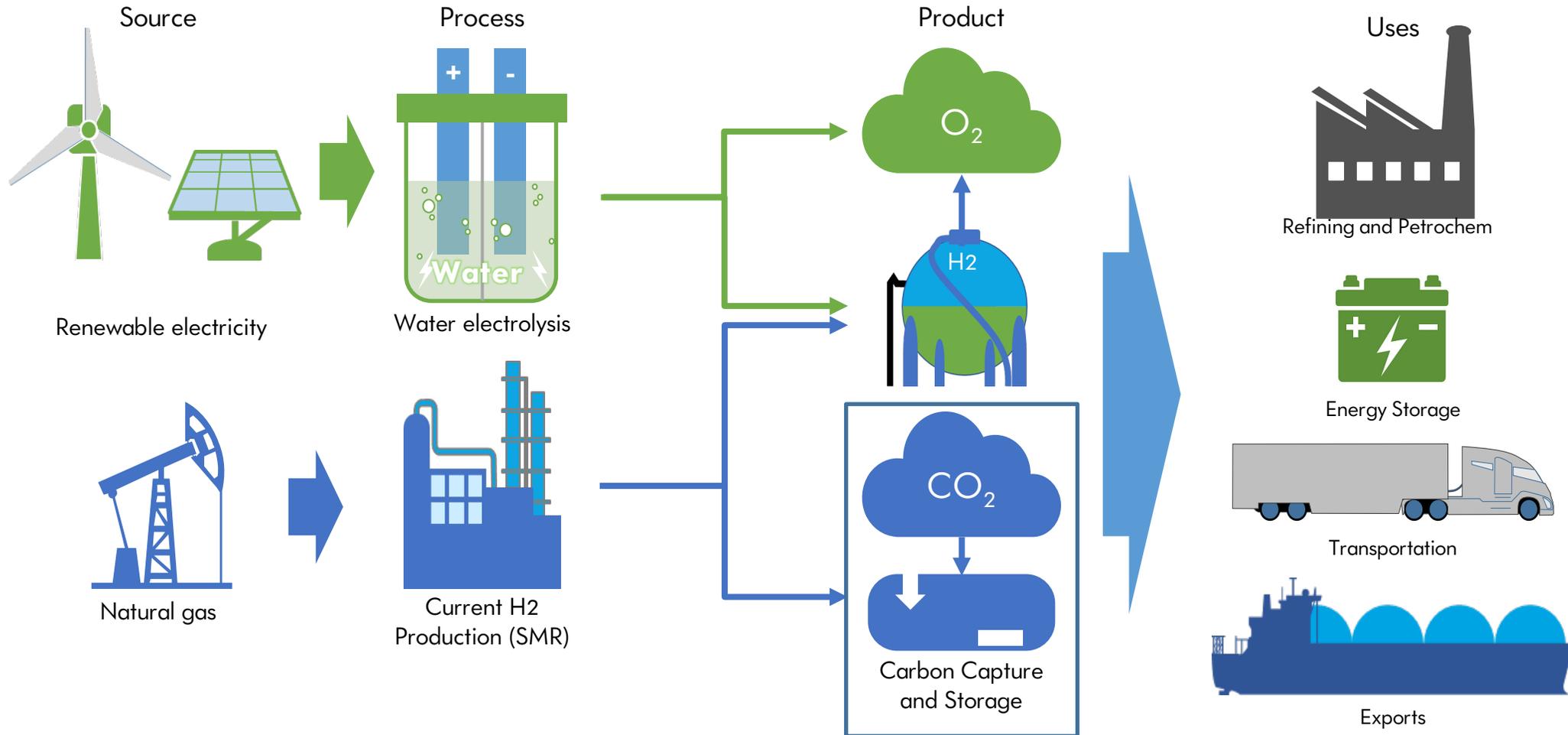
Increasing electrification potential

<ul style="list-style-type: none"> Light transport Short term power storage Light industry Residential heating/cooling 	<ul style="list-style-type: none"> Heavy transport Power backup, long-term storage Refining / chemicals feedstocks (no option) Steel and cement, heavy industry process heat
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Increasing hydrogen potential

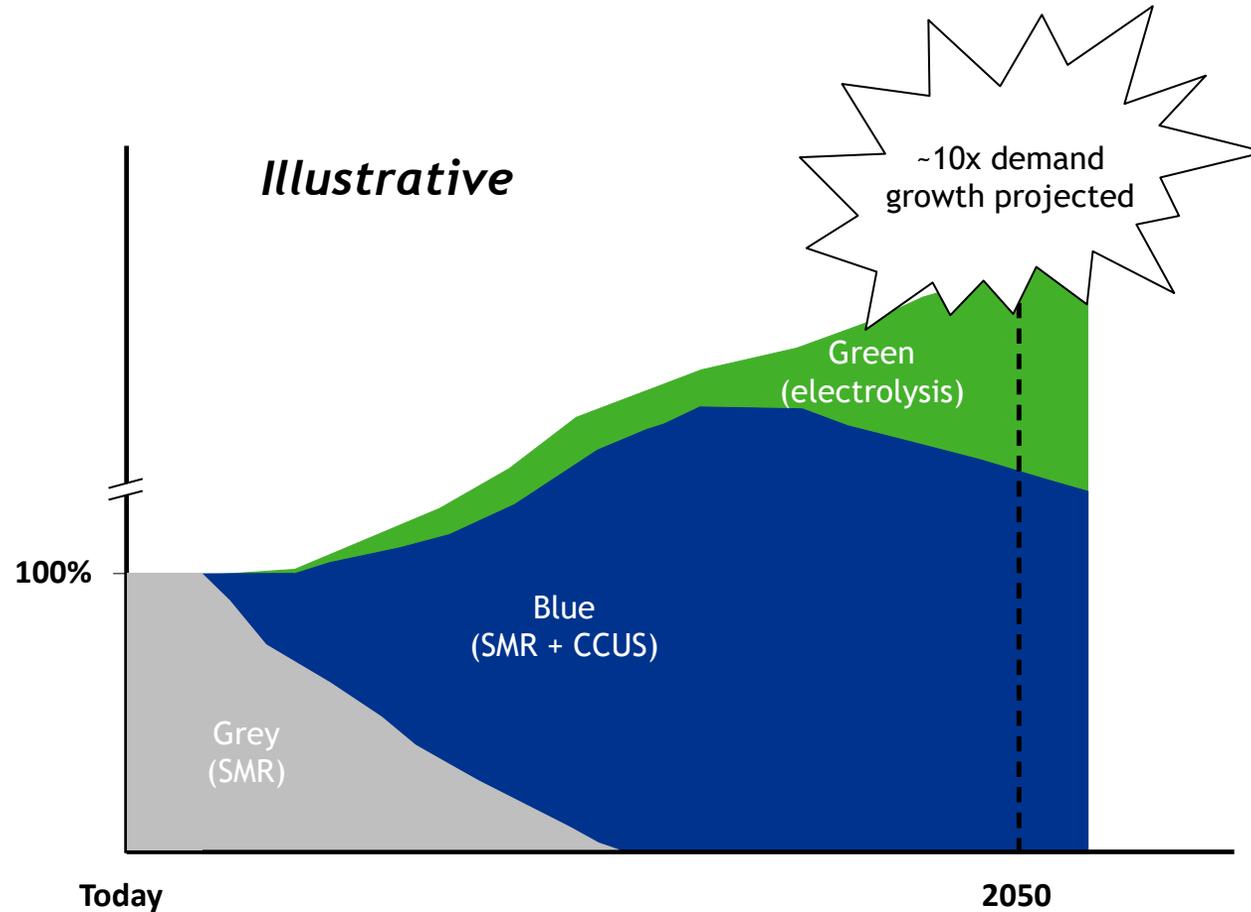


Typical Clean Hydrogen Production Options



Hydrogen market capture strategies are customized by region

Hydrogen demand and mix over time



Regional Hydrogen Strategy Drivers

- Goals: 2050 net zero or similar
- Funding: Carbon fees or other
- Leverageable assets (blue)
 - H2 system
 - At-scale CCUS hub
- Leverageable assets (green)
 - Geologic storage
 - Low power prices

Global Hydrogen Market Enablers

- Cost and supply chain improvements; e.g.,
 - Electrolyzers
 - Renewables
- H2 and renewable synergies



For example, Rotterdam is transforming from a global O&G to hydrogen hub, following this grey to blue to green pattern



From - energy hub of today...

- Refining hub
- European gateway and logistics point
- Global market clearing point (e.g., refined products, bunker fuel)

To - energy hub of tomorrow...

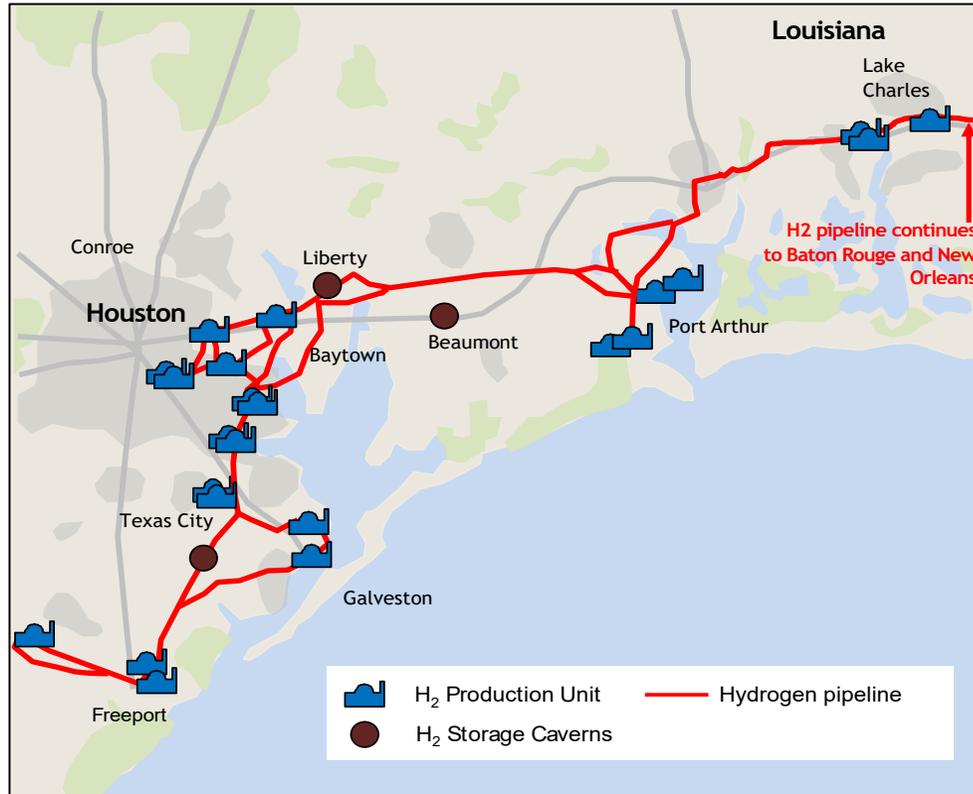
- Clean (blue and green) H₂ production hub
- H₂ gateway and logistics point with Northwest Europe
- Trading market for H₂ with pricing transparency

Source: Rotterdam Vision



The Houston area anchors a world leading H2 system, with the key attributes to rapidly scale clean H2

Existing hydrogen system in the Gulf Coast area



** Existing H2 system could leverage in-place CCUS assets (e.g., Denbury pipeline) to readily add and scale CCUS to convert grey to blue H2

TX Gulf Coast H2 system advantages^{1,2,3}



Over 900 miles H2 pipelines (56% of US; 32% of global)



~3.4MMt of H2 produced annually largely through steam methane reformation (34% of US; 8.5x Rotterdam)



48 H2 production plants

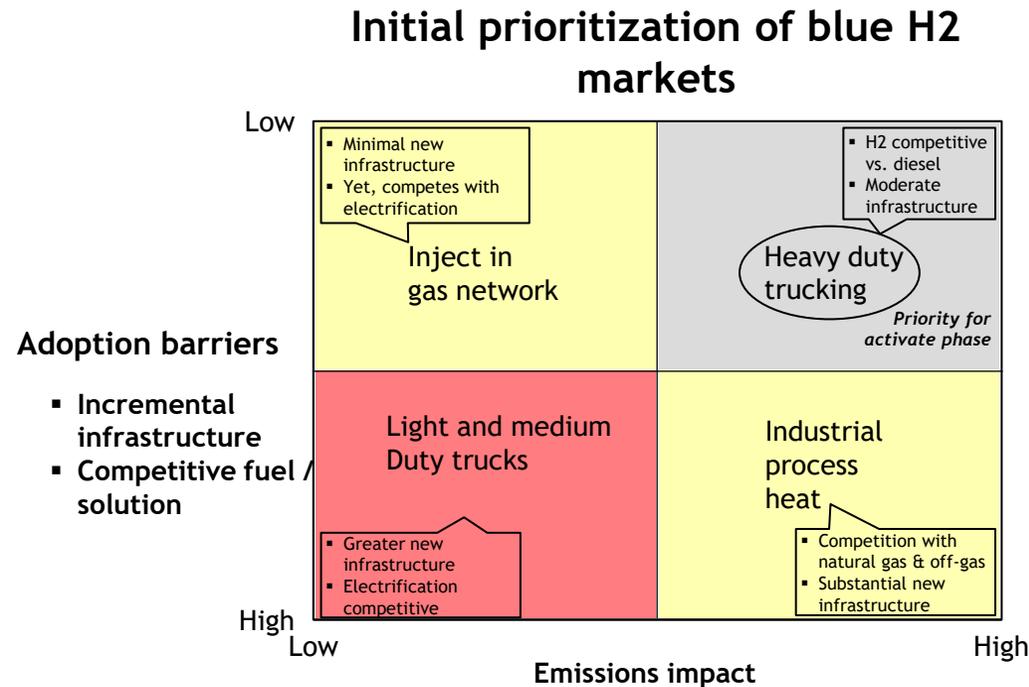


World's largest storage caverns for H2; adjacent to H2 network

Notes: (1) Houston MSA defined Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery and Waller counties; (2) TX Gulf Coast includes a region from Corpus Christi, TX to Lake Charles, LA; (3) Number of global H2 plants estimated by dividing global H2 production by US avg. production per H2 plant (52k tons H2 / year)
Source: H2Tools; USDOT PHMSA - National Pipeline Mapping System; Seeking Alpha; Office of US Energy Efficiency & Renewable Energy; Hydrogen Europe



New markets were prioritized based on relative adoption barriers (or advantages) and emissions impacts



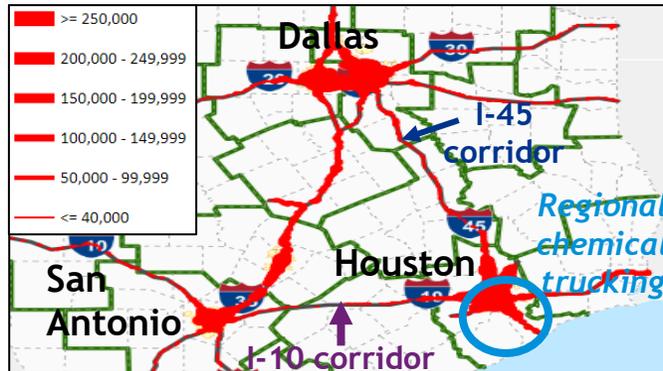
“We see heavy hauling of freight as kind of like an anchor tenant in the hydrogen shopping mall.”

- Program Lead,
Canadian Energy Systems Initiative



Greater Houston participates in several high-density heavy duty trucking corridors

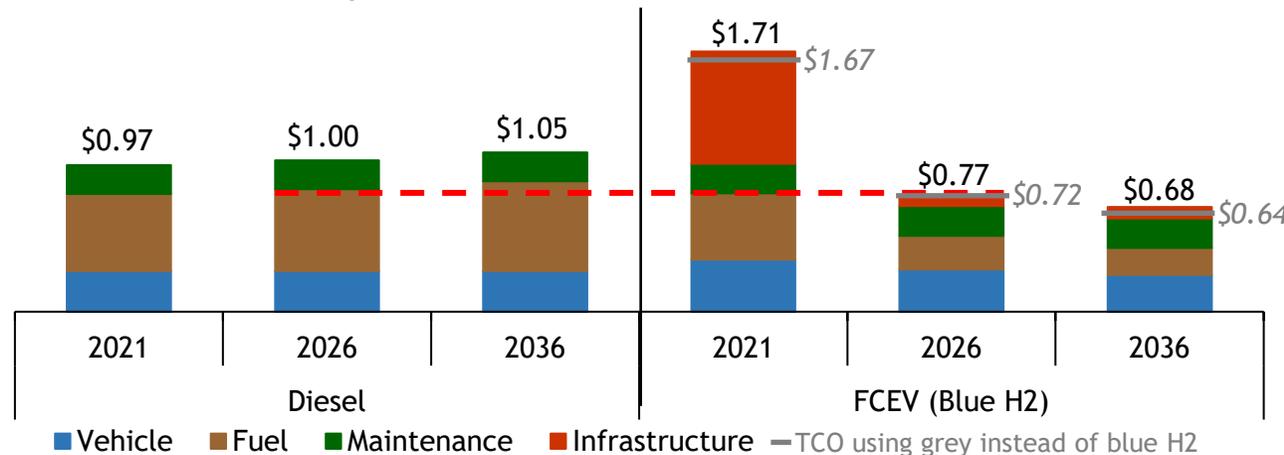
Texas truck traffic, 2018



Several local and regional heavy trucking markets

- I-45: offers long-haul advantage over BEVs and potential to link Dallas / central US distribution hub
- I-10: offers long-haul advantage over BEVs and potential to synergize with P/L to tap CA LCFS market
- Regional trucking: potential easier demonstration, though BEV may be advantaged for shorter trips where payload/capacity less of focus

Total Cost of Ownership, diesel and H2 HDVs on I-45, \$M/truck^{1,2}



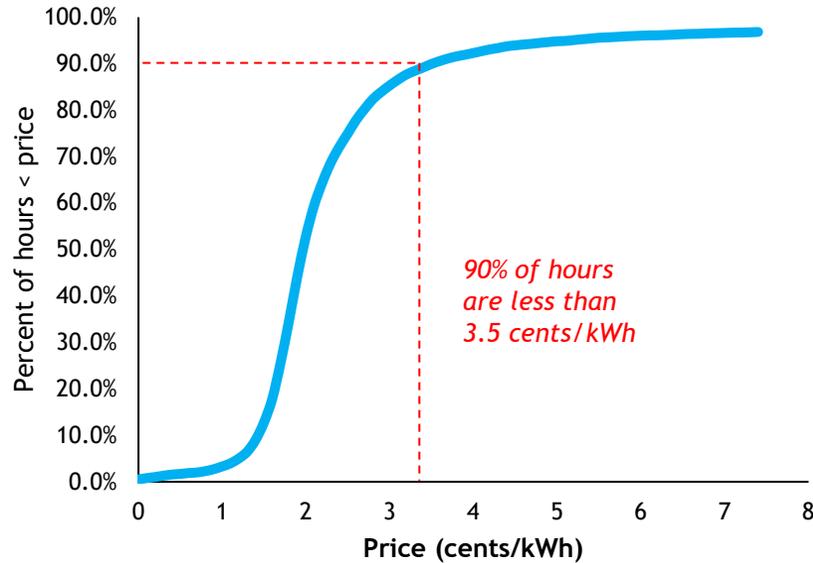
- Lower H2 (SMR) TCO:
 - Low H2 cost
 - Increasing diesel costs
 - Infrastructure scale economies
- ~15% well to wheel emissions reduction for grey H2 vs. diesel

Notes: (1) 115,620 annual miles driven; (2) station utilization: expand: 50%, rollout: 60% (3) pilot, expand and rollout phases last 10 yrs ea.; (4) YoY H2 truck capex reduction follows three phases (4%: '20-'25, 2.1%: '25-'30, 0.6% ea. yr. afterward)
 Source: ANL: HDSRAM, EIA, KPMG analysis, ICCT: Infrastructure needs and costs for zero-emission trucks



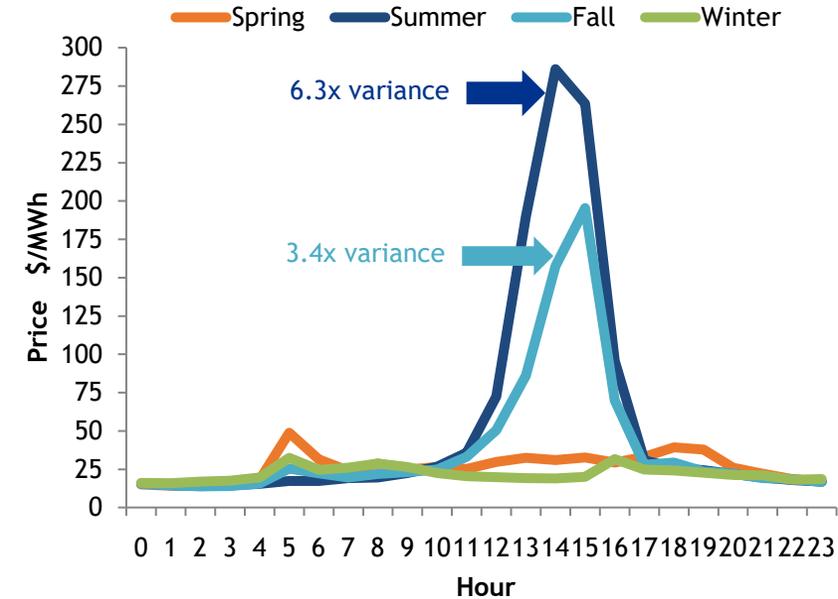
Additionally, Texas and Greater Houston have multiple advantages that could improve green H2 economics, supporting a green industry build out

Houston wholesale price duration curve, 2019



- Low-cost generation and competitive market structure; extensive and growing renewables (#1 wind, #2 solar by '25)
- Increasing role for long-duration storage, potentially hydrogen

Average Houston hub wholesale power price, 2019¹

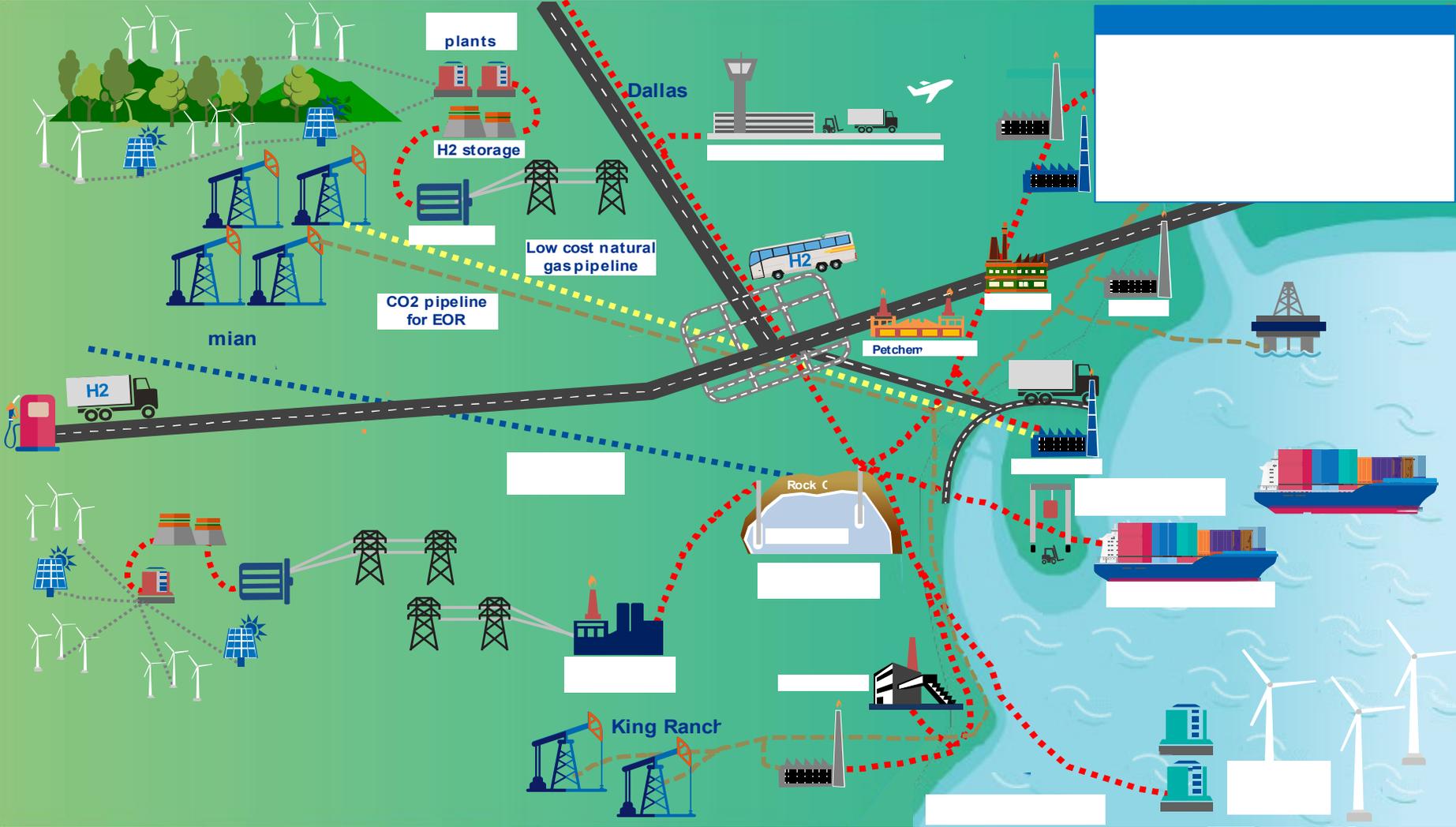


- High seasonal price differentials, coupled with low-cost storage
- Potential for seasonal storage

Notes: (1) variance for high and low prices is calculated based on summer and fall modified off peak hours (11am to 5 pm)
Source: ERCOT, S&P Platts



Our Vision: A 'Houston Hydrogen Hub' integrating world leading infrastructure, market access, production advantages to bring accelerated, at-scale clean H2 volumes to multiple markets





“If you think of hydrogen as an industry, which we’re going to start to think about very soon, then we are one of the largest players not only in the U.S. but also one of the largest global players”

**Texas Inc.
February 15, 2020**

