CLEAN AIR TASK FORCE

Hydrogen & Ammonia Hubs Proposed Demonstration Program

Introduction

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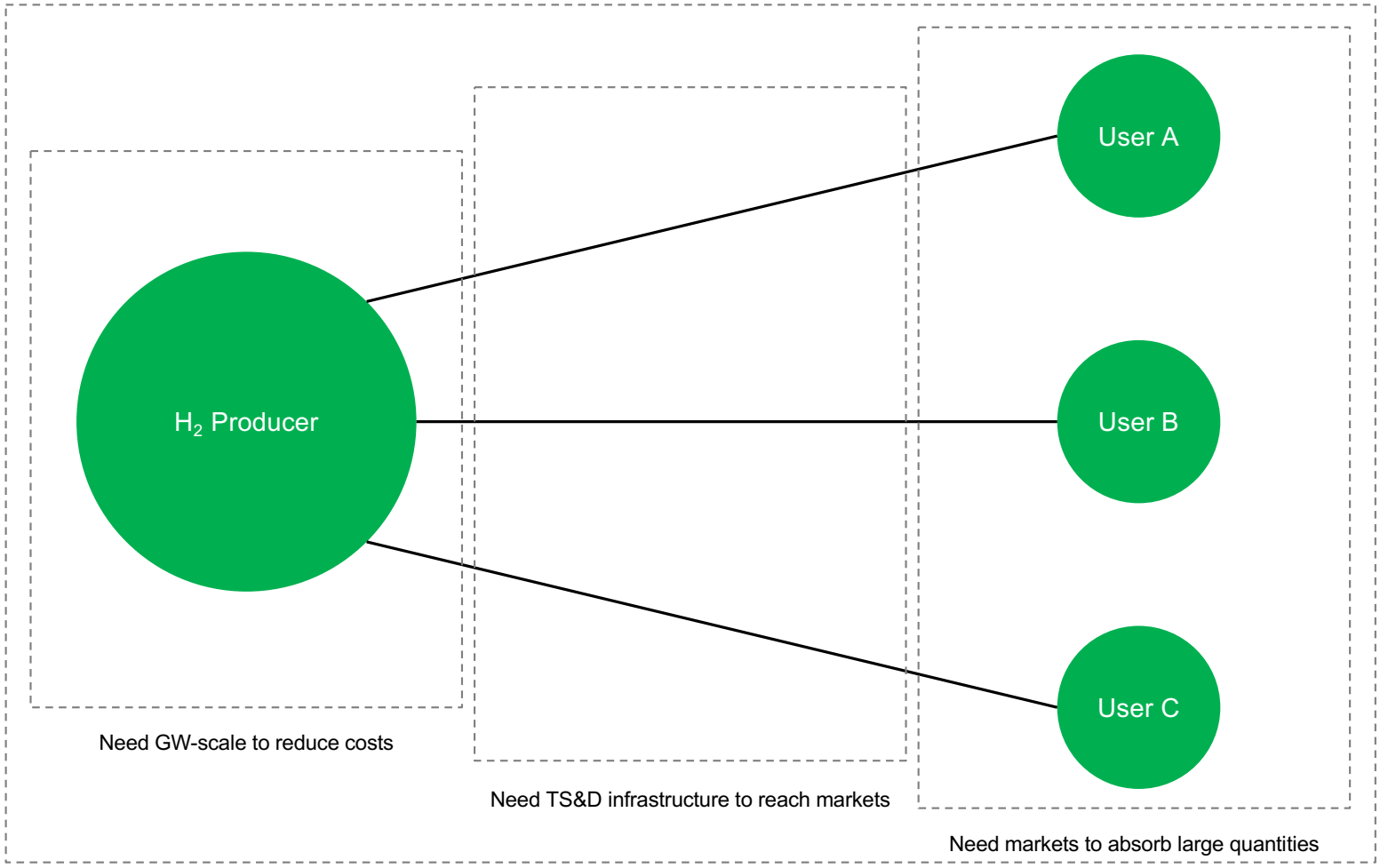
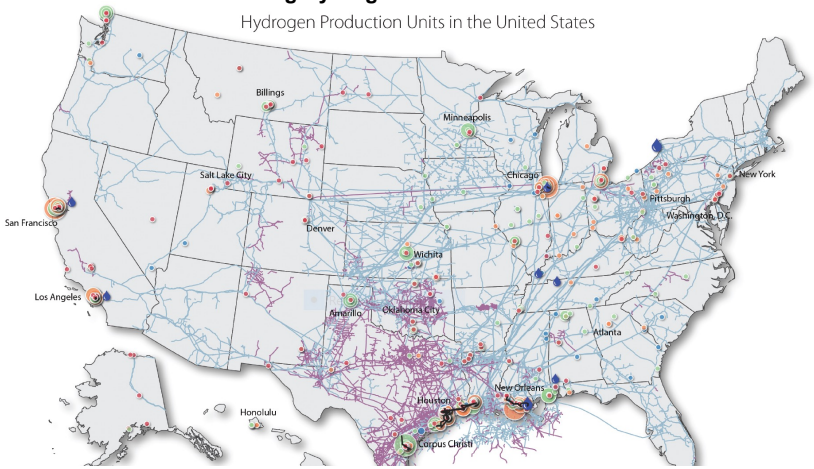
6 May 2021

Why hubs?


User A
H_2 Producer
User B
User C
Need GW-scale to reduce costs
Need TS&D infrastructure to reach markets
Need markets to absorb large quantities
Need ecosystem development for further scaling

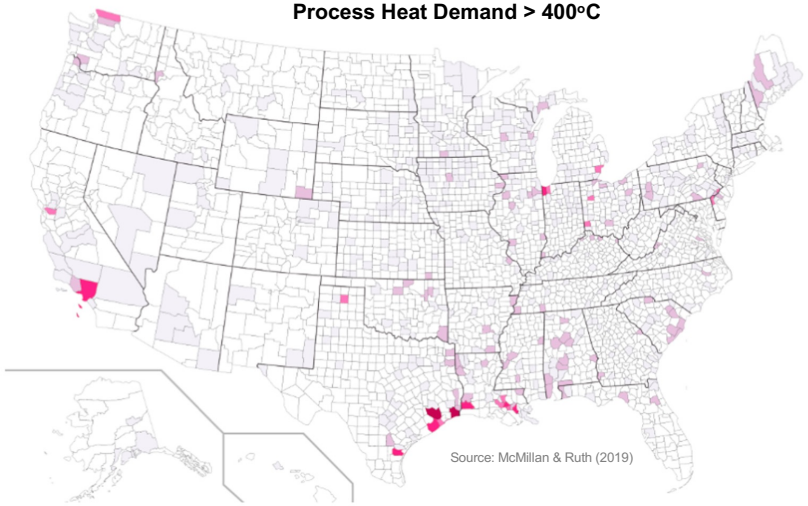
Many potential hydrogen demands are already concentrated

Existing Hydrogen Uses and Infrastructure



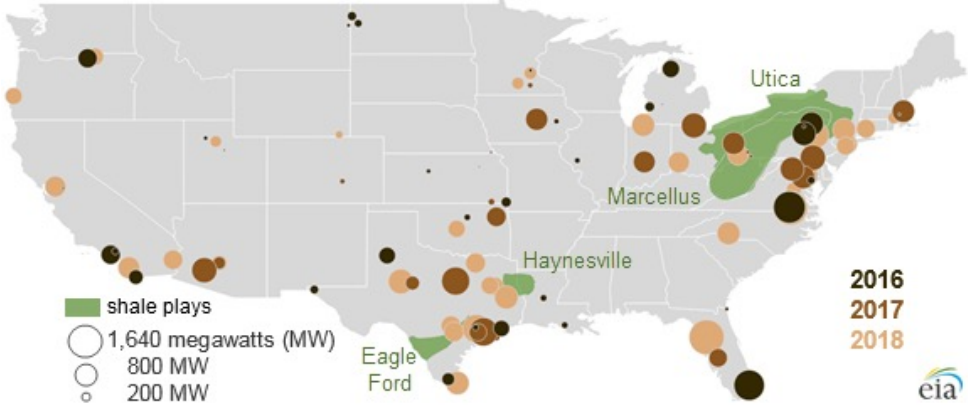
Source: NREL (2019)

Process Heat Demand > 400°C

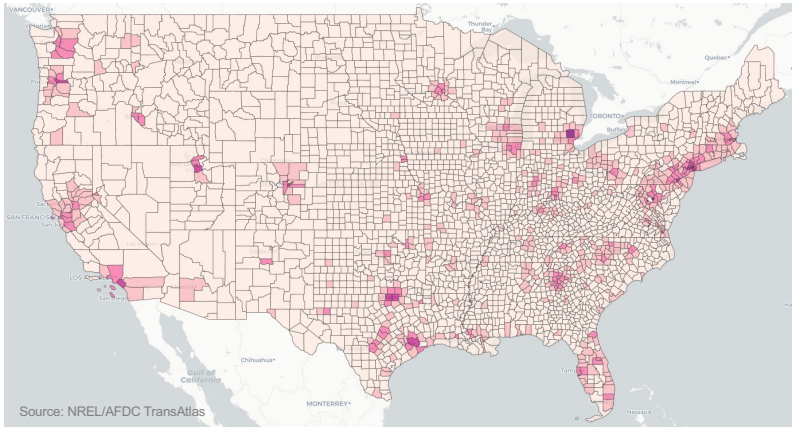


Source: McMillan & Ruth (2019)

Natural gas-fired capacity additions (2016-18)



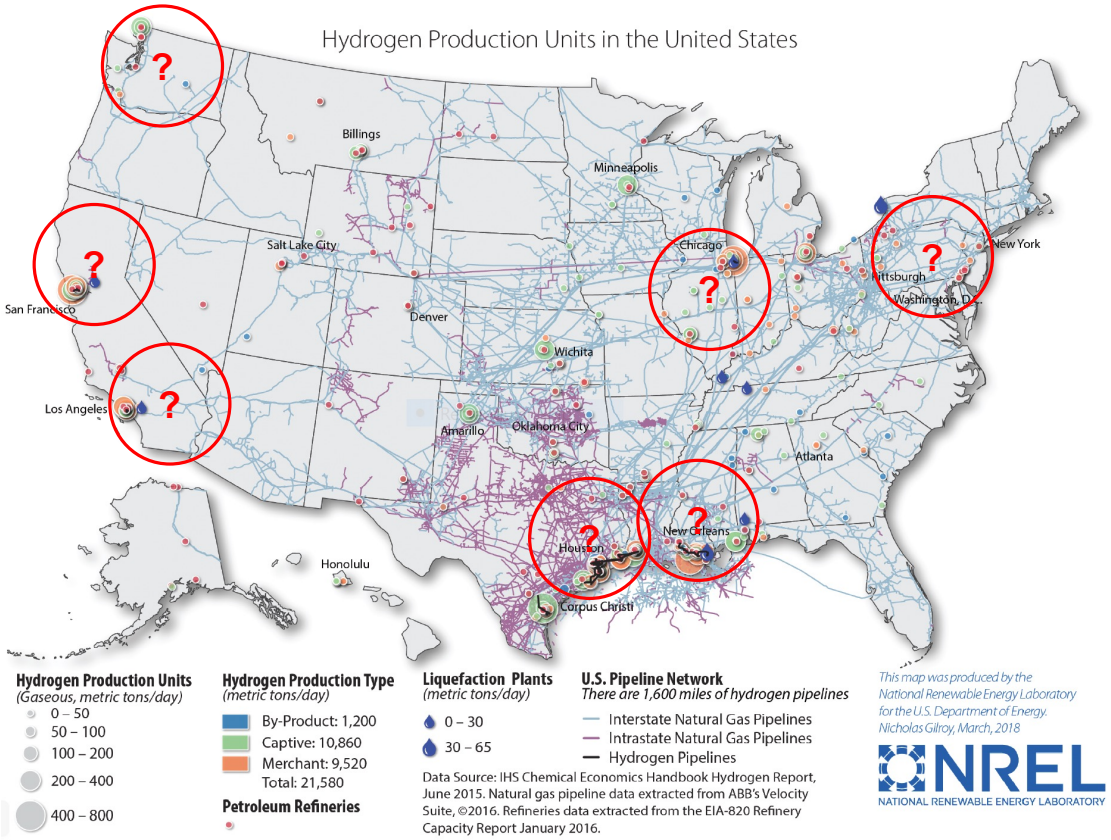
Diesel Fuel Vehicle Density



Source: NREL/AFDC TransAtlas

Each hub can link concentrations of consumers and producers while leveraging regional strengths

Example Producers
Solar / Wind + Electrolysis
Gas Reforming with CCS
Nuclear Electrolysis
Other



Example Consumers
Current Markets (Refining)
Marine Shipping (as Ammonia)
Heavy Trucking
Industrial Process Heat/Feed
Building Heating (via Blending)
Power Gen (with Storage)

Note: red circles are illustrative only

Overview of the hydrogen hubs proposal

Why try to advance a federal funding concept for hydrogen hubs now?

- Growing consensus that hydrogen (and derivatives, e.g., ammonia) will be critical to decarbonize certain sectors
- Political moment of climate, stimulus, infrastructure push

Why support hubs in particular?

- Hubs can take advantage of concentrated supply and demand to build scale quickly
- Hubs can advance integrated supply chains, not just single technologies

Where do hubs sit in the R&D&D&D process?

- Our concept is hubs as large, multi-faceted demonstrations of today's leading technologies (beyond R&D, not yet "deployment")
- Program is designed to ensure that a variety of production and utilization technologies are supported

As currently conceived, how big is the program?

- The program could cover 6 hubs, each one a minimum of 100,000 metric ton per year hydrogen (~11.4 $TBtu_{LHV}$ ~13.5 $TBtu_{HHV}$)
- Each hub could require ~600 MW nuclear, or ~1.5 GW wind or solar, or SMR with ~1 m tpy CO2 sequestration, etc.
- Each hub could fuel ~1 GW NGCC @ 20% CF, or ~1 m tpy DRI, or 1-2% of regional diesel consumption, or other uses (illustrative examples only)
- Total federal expenditure: $15B, to be divided among 6 hubs, with max allocation per hub of $3.75B; objective is to cover 50% of hub cost

As currently conceived, what would the program cover?

- Example: construction of a wind farm, electrolyzers, and a network of fueling stations for trucks
- Example: purchase of nuclear electricity, construction of electrolyzers and hydrogen storage caverns, and conversion of gas turbines
- Example: construction of a steam methane reformer with CCS, a hydrogen pipeline, and use of hydrogen for industrial process heat or DRI
- These are not the only examples; just used to illustrate the potential

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