The University of Texas at Austin
Center for Electromechanics

HYDROGEN @ SCALE IN TEXAS

DOE H2@SCALE DEMONSTRATION PROJECT AT UT

MAY 2020

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Presenter:
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Center for Electromechanics

Organized Research Unit - UT Austin J J Pickle Research Campus

- Perform leading edge basic and applied research in electrical and mechanical engineering, with a special emphasis on applied engineering leading to prototype development in electromechanical devices and systems with high specific power, force, and/or energy storage or other unique attributes. Imbedded in this mission is educating and developing students and CEM staff members into engineering leaders of tomorrow.

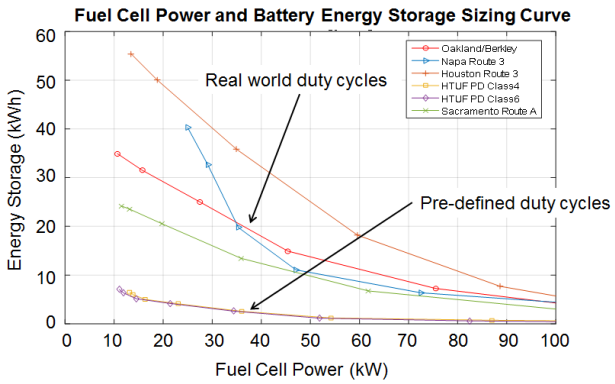
CEM Vehicles and Hydrogen Research Program

Advance state-of-art and aid commercialization and adoption of new technologies

1. Research and Development
   - Prototype vehicle builds and demonstrations
   - Testing of advanced vehicle components

2. Education
   - Evaluation of zero emissions vehicles for fleet operators
   - Students involvement on projects

3. Technology Transfer
   - Projects with industry partners
   - Working with small business to evaluate technologies



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Hydrogen R&D at CEM

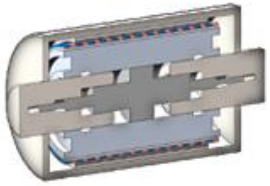
Fuel Cell Parcel Delivery Van

UT-CEM Hydrogen Station

22 ft Fuel Cell Hybrid Bus

$NaSi + H_2O \rightarrow H_2$
Hydrogen generation

Conformable storage vessels



H_2 Compressors

Hydrogen Utility Vehicle

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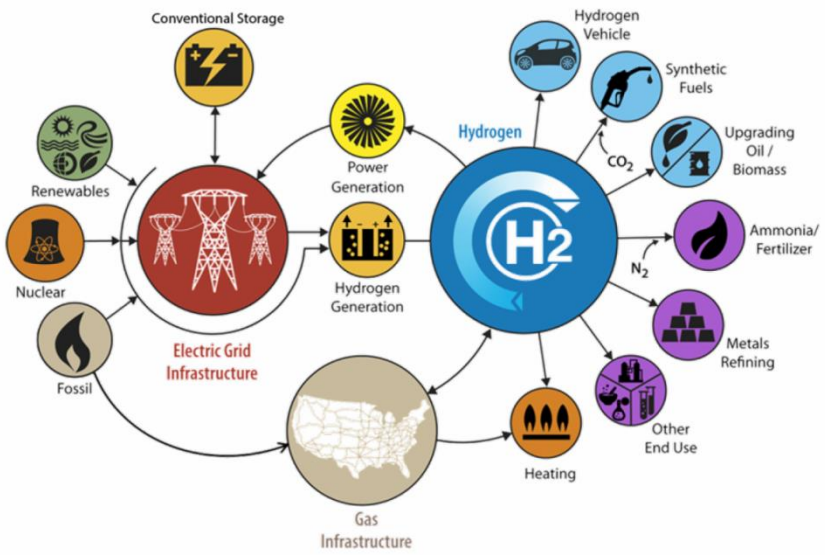
Hydrogen at Scale Vision

Hydrogen can Fuel a Sustainable Energy Transition by enabling U.S. energy security, resiliency and decarbonize the energy sector

- Hydrogen can be produced from diverse domestic resources for use in multiple sectors, or for export.
- Hydrogen has the highest energy content by weight of all known fuels – 3X higher than gasoline - and is a critical feedstock for the entire chemicals industry, including liquid fuels.
- Hydrogen and fuel cells can enable zero or near zero emissions in transportation, stationary or remote power, and portable power applications.
- Hydrogen can be used as a “responsive load” on the grid to enable grid stability and gigawatt-hour energy storage, and increase utilization of power generators, including nuclear, coal, natural gas, and renewables.
- Hydrogen can enable innovations in domestic industries (such as steel manufacturing and energy storage) and in transportation (e.g. in vehicles, rail, aviation, and marine applications) and iron making.



https://www.energy.gov/eere/fuelcells/h2scale

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Hydrogen at Scale in Texas

Texas is ideally situated to be a leader in producing hydrogen for a sustainable energy system

- Texas is one of the largest producer in the nation of hydrogen with a large hydrogen pipeline network
- Texas also has excellent resources of natural gas — the main feedstock for manufacturing hydrogen — and of solar and wind, which can be used to produce renewable hydrogen by electrolyzing water.
- Major industry leaders on the Hydrogen Council have a significant presence in Texas – Shell, Toyota, Air Liquide, and others.

Recently becoming a Hot Topic in Texas with multiple ongoing studies around CCS and the role of Hydrogen

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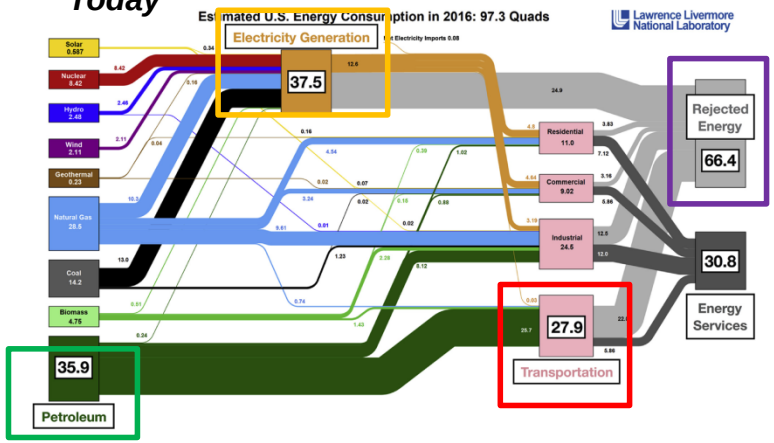
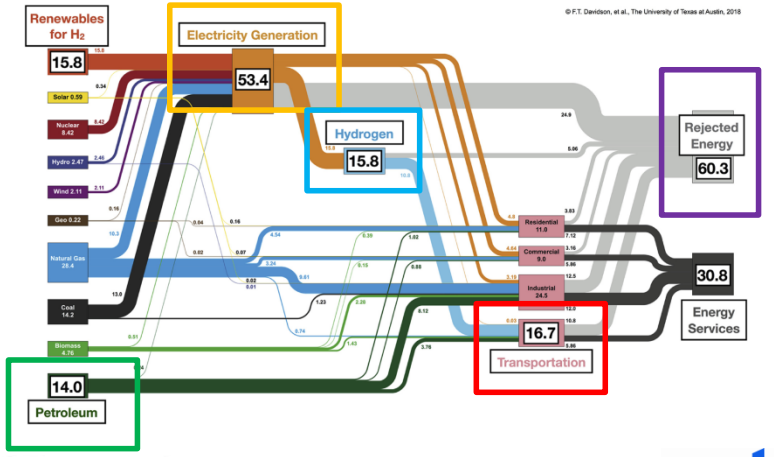
Potential for Hydrogen Energy Systems

- UT Energy Institute Study shows potential for Hydrogen to provide significant energetic benefits while decarbonizing the global energy system.
- **If used in Transportation, would provide a reduction of rejected energy of nearly 10% and 30% reduction in CO2 emissions**
- Cost of infrastructure remains a barrier - producing, storing, and transmitting hydrogen

Today



Hydrogen potential



Chapman, A. J., Itaoka, K., Hirose, K., Davidson, F. T., Nagasawa, K., Lloyd, A. C., ... Fujii, Y. (2019). A review of four case studies assessing the potential for hydrogen penetration of the future energy system. *International Journal of Hydrogen Energy*, *44*(13), 6371-6382. https://doi.org/10.1016/j.ijhydene.2019.01.168

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DOE Award for H2@Scale in Texas

Two unique RD&D tracks to understand the potential of integrating hydrogen with multiple co-located platforms and existing resources

- Demonstration of multiple renewable H_2 generation options, co-located with vehicle fueling and a large base load consumer to enable cost-effective hydrogen energy solutions

- Develop a framework for actionable H2@Scale pilot plans in Texas and the Port Houston and Gulf Coast region

Additional Partners: Toyota, Waste Management and ONE Gas, SoCal Gas, Air Liquide, OneH2

Project Duration: 3 years, Coming Soon!

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Demonstration Activities at UT

Renewable hydrogen generation

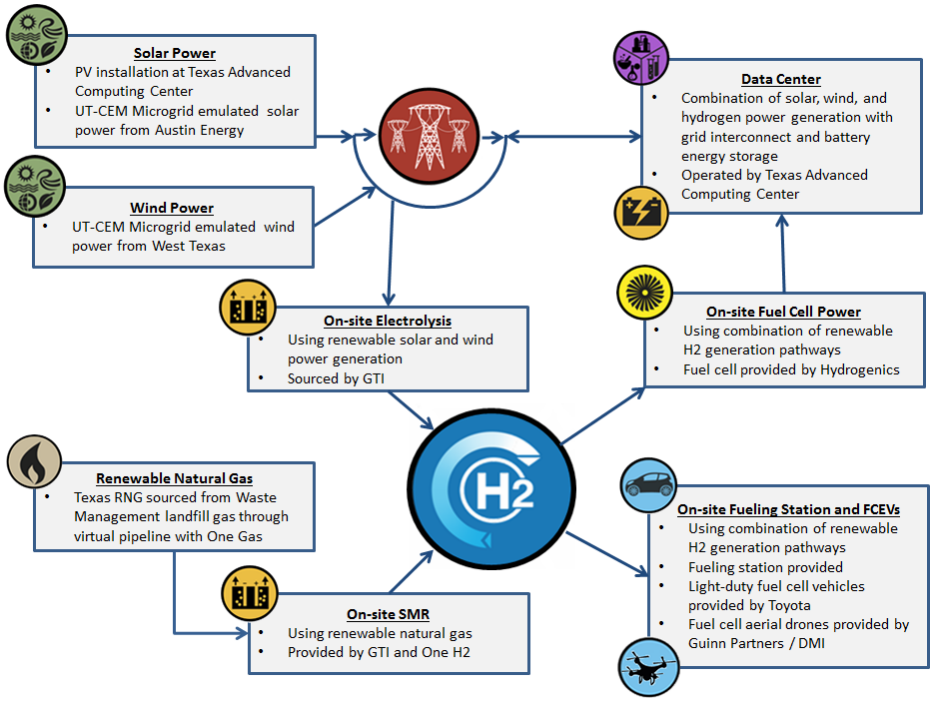
- Steam methane reformation using renewable natural gas
- Electrolysis using wind and solar power

Large scale, industry user of hydrogen gas

- Fuel cell system powering part of the Texas Advanced Computing Center

Vehicle refueling

- Light-duty Vehicles
- Fuel cell drones (pending)



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Port Houston Framework for Hydrogen

- Identify key stakeholders and existing hydrogen infrastructure and business in Port Houston and Gulf Coast region
- Identify policy and regulation barriers and opportunities
- Define use and implementation plans leveraging existing industry resources and renewable power in Texas
- Develop actionable plan for H2@Scale demonstration and roll out of fuel cell vehicles in Port Houston

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Current Project Status

- Award announcement in August 2019
  - Award amount was less than proposed
- Budget and Scope revised and submitted to DOE in December 2019
  - Pending contract at this time… should be soon!
- Updated Scope
  - Maintains hydrogen generation and fuel cell power for computing center
  - FCEVs are maintained but with a reduced scale fueling station
  - Port Houston study retained with increased interest from DOE, industry, and other groups
- Additional Partners
  - SoCal Gas is now a contributing partner
  - Seeking additional industry partners to participate in Port Houston study

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Thank You!

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