Systems Analysis Sub-Program Overview

Support a strong foundation of data, build relevant analytical models and execute integrated analysis

Objectives

Evaluate
- Technologies and pathways
- Energy security benefits
- H2@Scale scenarios and identify needs

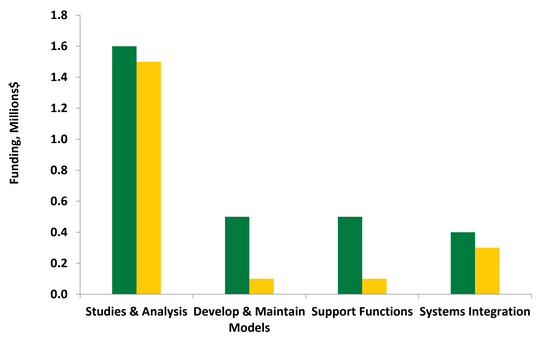
Guide
- Selection of R&D technology options

Estimate
- Potential value of early-stage R&D efforts

Identify
- Technology gaps including H2@scale

$ Budget

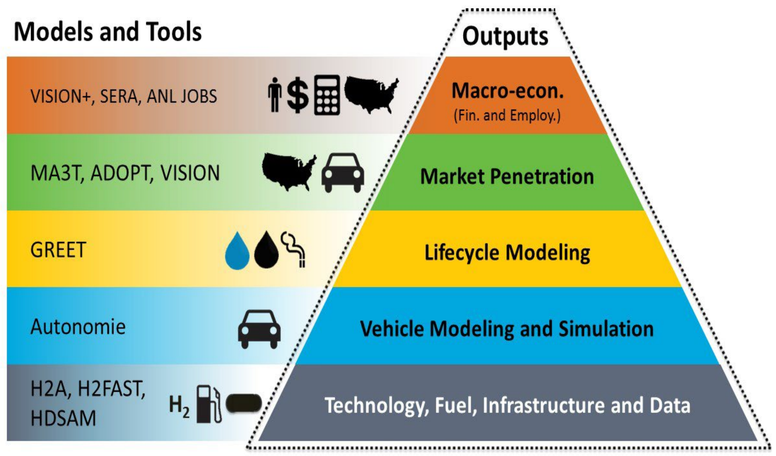
FY 2018 Appropriation = $ 3M; FY 2019 Appropriation = $ 2M



FY 2019 Emphasis:
- Identify gaps and drivers for early stage infrastructure R&D
- Assess early stage R&D impact on energy security
- Integrate analysis to ensure optimization
- Assess targets and metrics for medium and heavy duty trucks
- Conduct H2@scale analysis

Models & Tools

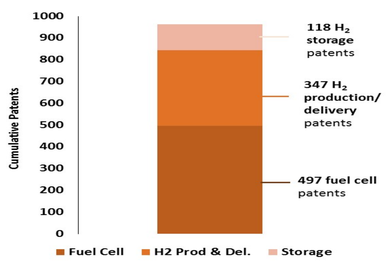
A versatile, comprehensive and multi-functional portfolio:



Model Description Factsheets Available at: www.energy.gov/eere/fuelcells/systems-analysis

R&D Innovation

Cumulative H_2 and fuel cell patents enabled by FCTO (2018)



962 patents enabled by FCTO funds

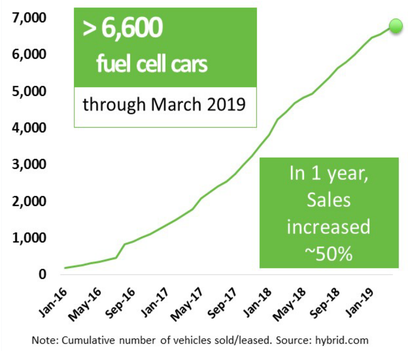
Approx. **37%** of H_2 and fuel cell patents **come from National Labs**

Fuel Cell Vehicle Sales and Station Growth

U.S. Fuel Cell Car Sales Experience Steady Growth

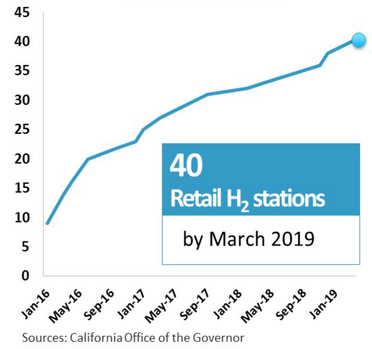
Number of California Retail H_2 Stations Increasing

Fuel Cell Cars Sold/Leased in the U.S.



Note: Cumulative number of vehicles sold/leased. Source: hybrid.com

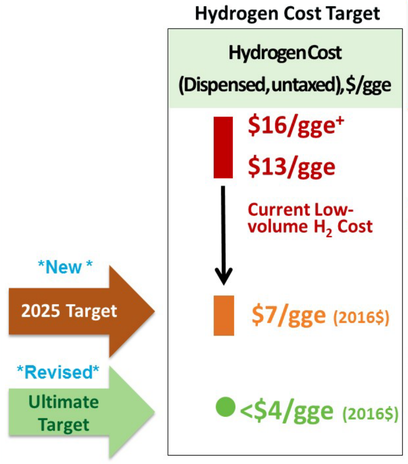
Number of Retail H2 Fueling Stations in the U.S.



Sources: California Office of the Governor

H_2 Cost Target

Hydrogen Cost Target



See DOE Record 18004 – "Hydrogen R&D Cost Target Calculation – 2018 Update"
Note: Expert review included National Laboratories and U.S.DRIVE

Hydrogen Cost Target was modified to include an interim target of $7/gge (2016$) for 2025 and an ultimate target of $4/gge (2016$).

- H_2 Cost Target is applied across FCTO
  - Target setting
  - Subprogram R&D progress gauge

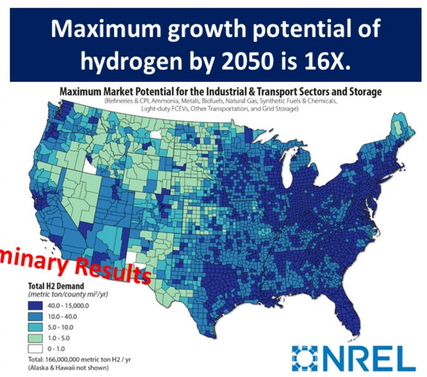
	Target	Assumptions	Comment
2025 Cost Target	$7/gge	• Adv. Gasoline ICEV • EIA 2016 AEO gasoline price • Vehicle fuel economies from ANL Autonomie Analysis	Aligns with U.S.DRIVE target setting process
Ultimate Cost Target	<$4/gge	• Gasoline HEV • EIA 2016 AEO gasoline price • Vehicle fuel economies from ANL Autonomie Analysis	

H2@Scale Analysis

SA171

Application	Maximum Scale (MMT* H_2 / year)
Refineries & CPI§	8
Metals	12
Ammonia	4
Synthetic Fuels and Chemicals	14
Biofuels	4
Natural Gas Supplementation	10
Light Duty (FCEVs)	57
Other Transport (Medium- & Heavy- Duty Fuel Cell Veh.)	29
Electricity Storage	28
Total	**166**

Maximum growth potential of hydrogen by 2050 is 16X.



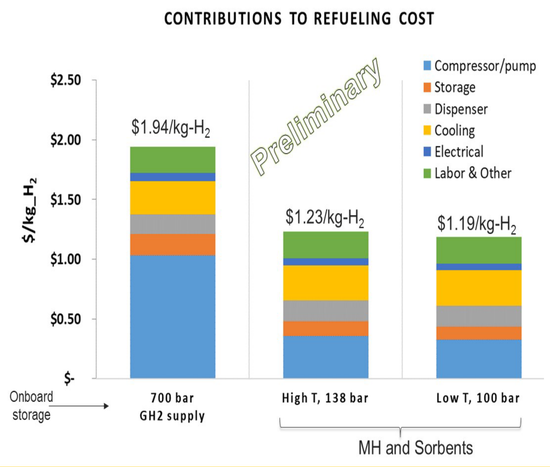
Economic potential for hydrogen is estimated to be 15-50 MMT/yr in 2050

* MMT: Million metric tonnes
§ CPI: Chemical Processing Industry not including metals, ammonia, methanol, or biofuels
Light duty vehicle calculation basis: 190,000,000 light-duty FCEVs from http://www.nap.edu/catalog/18264/transitions-to-alternative-vehicles-and-fuels
Definition: The maximum scale is the estimated hydrogen demand constrained by the services for which society currently uses energy, real-world geography, and system performance, but not by economics.

Integration of Advanced On-Board Storage Systems with Hydrogen Delivery

SA170

Low-pressure, near ambient temperature material storage reduce HRS cost



Evaluated impact of onboard hydrogen storage options on refueling cost
- Metal Hydride (MH) → 100 bar, near ambient temperature
- Sorbents → 100 bar, near ambient temperature
- Cryo-sorbents → 100 bar, 145K, and near LH_2 temperature
- Cryo-compressed Hydrogen → 350 bar, 35K

✓ MH and sorbents near ambient temperature provides the largest potential for refueling cost reduction

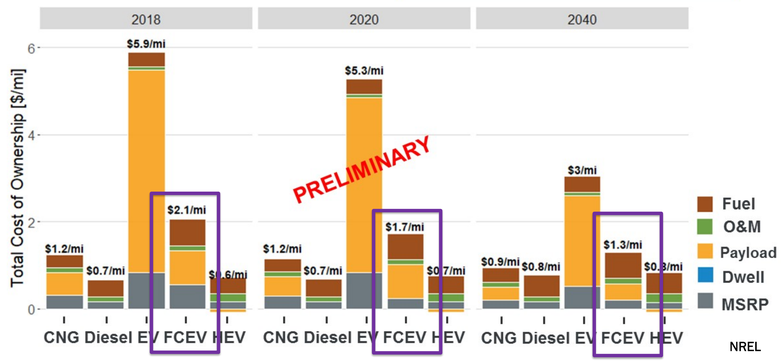
Cost reduction ~40%
- Most of the cost reduction is attributed to low refueling pressure

Fuel Cell Truck Analysis

SA169

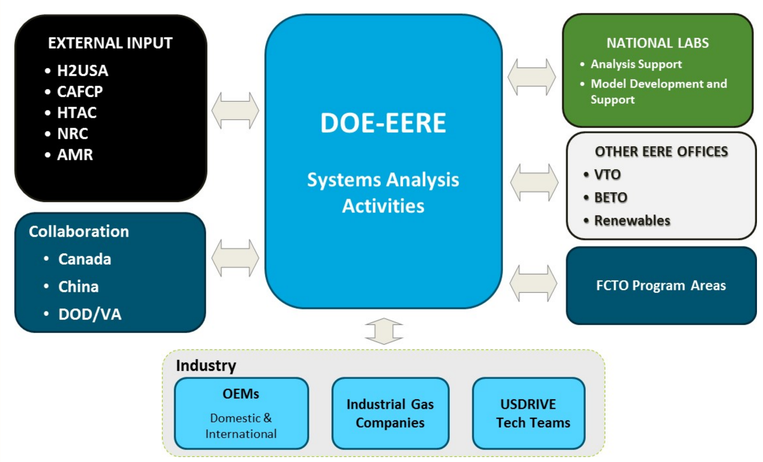
Scenario Parameters
- Class 8 Long Haul in Pacific Region
- 100,000 mi/yr, 10 year life
- Payload Cost = High, Dwell Cost = None
- Fuel, O&M Costs = Mid
- Discount Rate = 7%

TCO result in Pacific region. FCET costs driven by fuel ($7/gge H2 in this scenario) and Payload Opportunity Cost



Collaborations

Collaborations span national and international entities



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