CRC Report No. SM-CR-9

Assessment of Infrastructure Needs to Support Regulatory Requirements for Medium- and Heavy-Duty (MDHD) Zero-Emission Vehicles (ZEVs): Summary of Key Findings

Companion Document for the Final Report:

Assess the Battery-Recharging and Hydrogen-Refueling Infrastructure Needs, Costs and Timelines Required to Support Regulatory Requirements for Light-, Medium-, and Heavy-Duty Zero-Emission Vehicles

September 2023

COORDINATING RESEARCH COUNCIL, INC.

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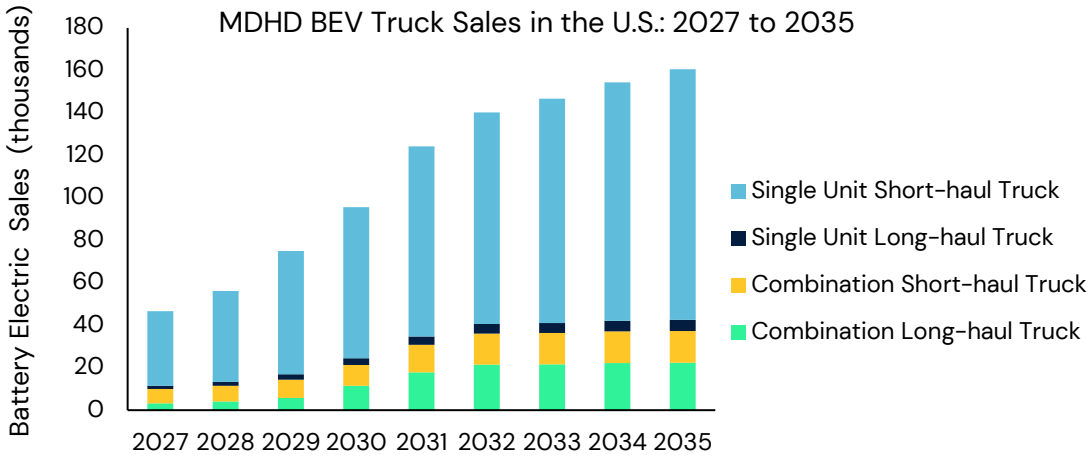
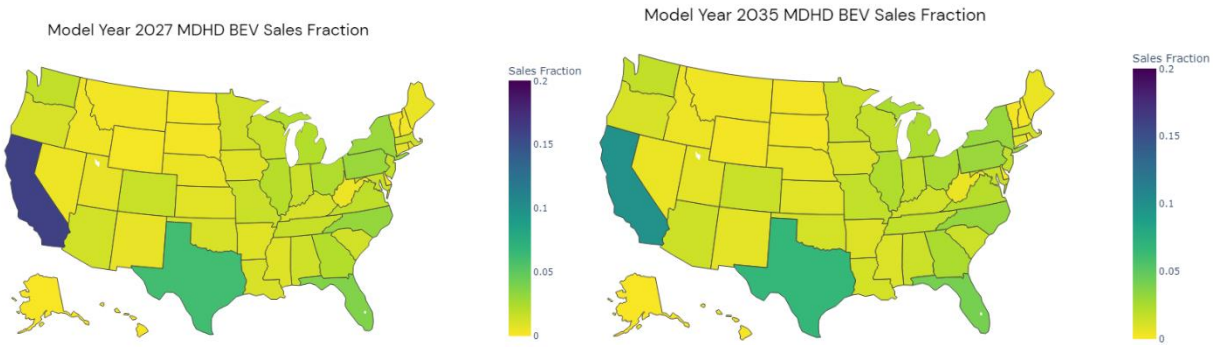
List of Acronyms

Acronym	Description
AEO	Annual Energy Outlook
BEV	Battery Electric Vehicle
DCFC	Direct Current Fast Charger
EIA	Energy Information Administration
EVSE	Electric Vehicle Supply Equipment
FCEV	Fuel Cell Electric Vehicle
HD	Heavy Duty
MCS	Megawatt Charging System
MD	Medium Duty
MDHD	Medium- and Heavy-Duty
MOVES	Motor Vehicle Emission Simulator Tool
ZEV	Zero Emission Vehicle

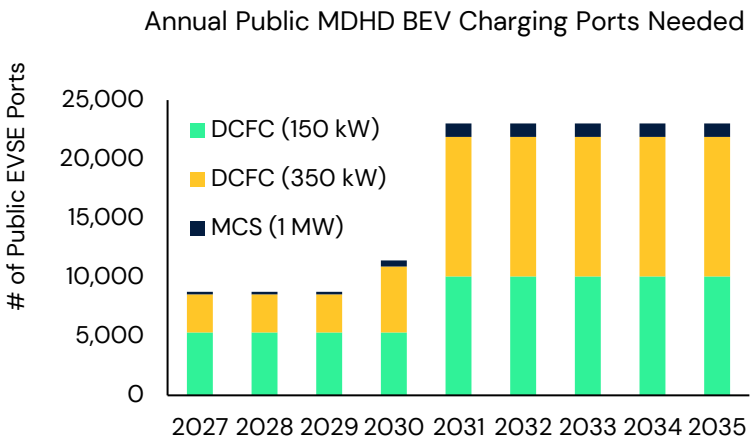
Battery Electric Vehicles & Infrastructure

- Between 2027 and 2035, approximately 1 million Class 2b-8 battery electric vehicles (BEVs)[1] are expected to be sold in the U.S., starting from 46,000 in 2027 and increasing to 160,000 in 2035 as shown in the graph below.
- California will account for more than 15% of the nationwide BEV sales in 2027, and as ZEV sales mandates in other states gradually phase in, the sales fraction in California will drop back to 10% in 2035.



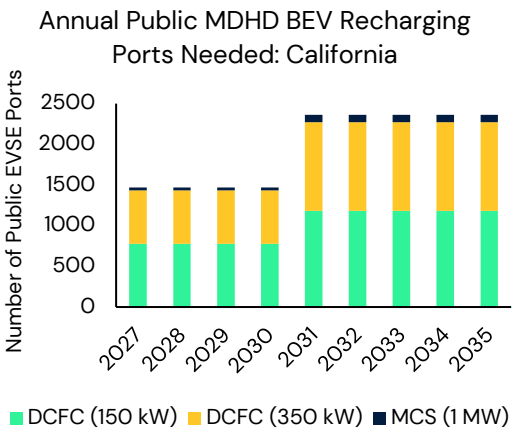


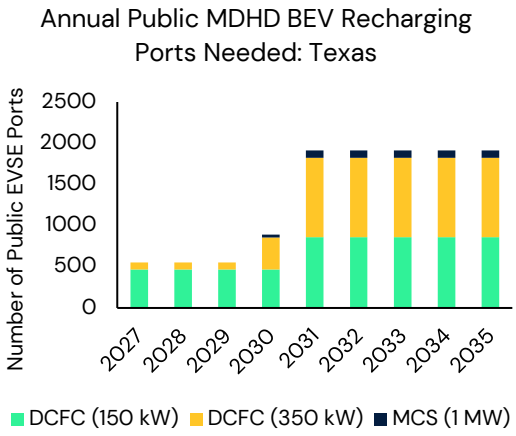
- Every year between 2027 to 2030, roughly 10,000 public Direct Current Fast Charging (DCFC) charging ports will need to be built specifically for MDHD vehicles, and starting in 2031 the charger deployment rate will need to increase to more than 23,000 ports per year. That amounts to more than 400 DCFC ports per week.

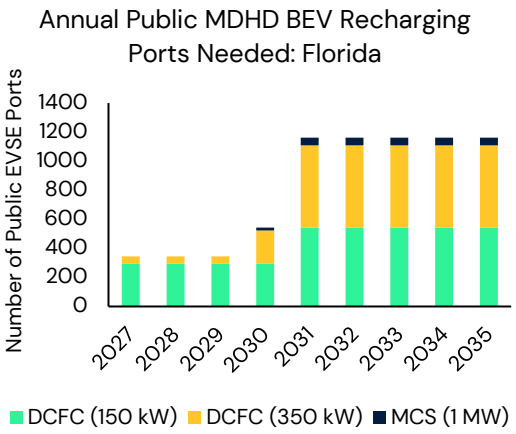


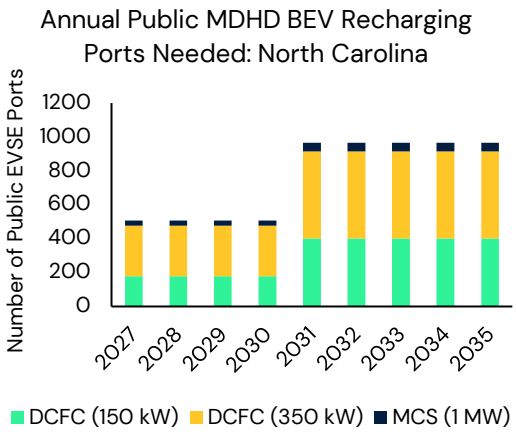
[1] Include single unit and combination trucks as defined in MOVES 3.

- State specific MDHD charger deployment needs are also provided in the charts below.

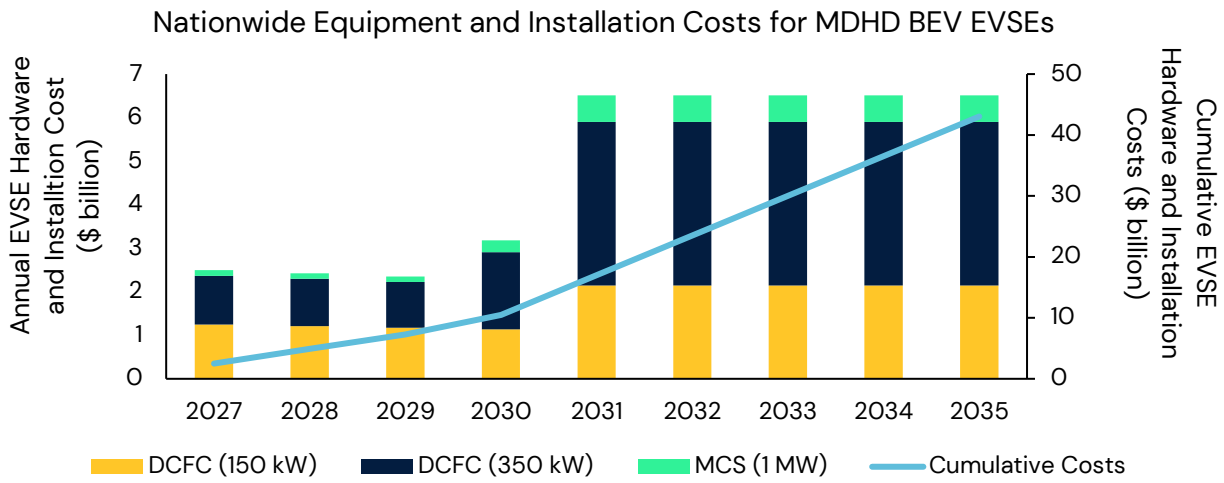






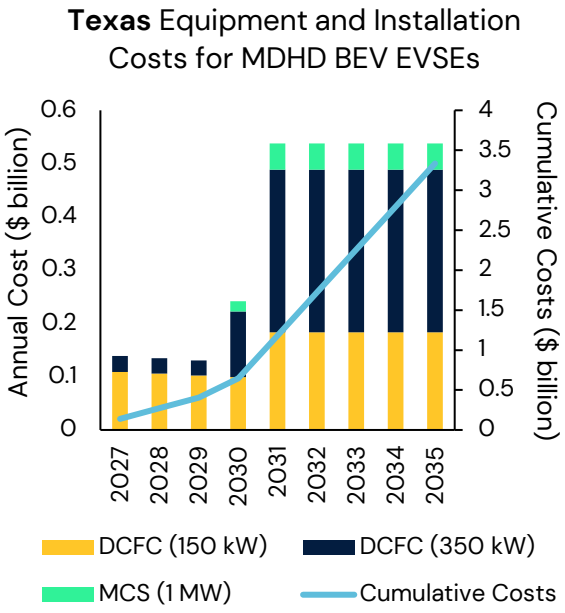


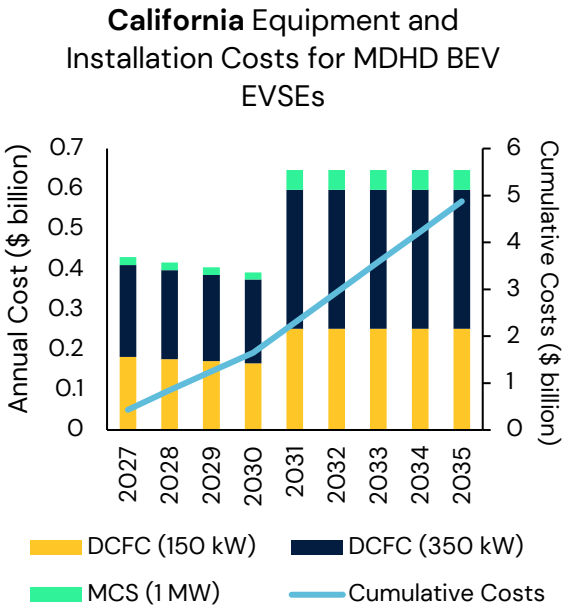
- Between 2027 and 2035, there will be a need for more than $43 billion[2] to develop the public charging infrastructure for MDHD vehicles. That is an annual average of $2.5 billion between 2027 until 2030, and roughly $6.5 billion from 2031 through 2035.



[2] Cost estimates for BEV charging infrastructure include EVSE hardware and installations, while utility upgrades, land acquisition, and other soft costs are not quantified.

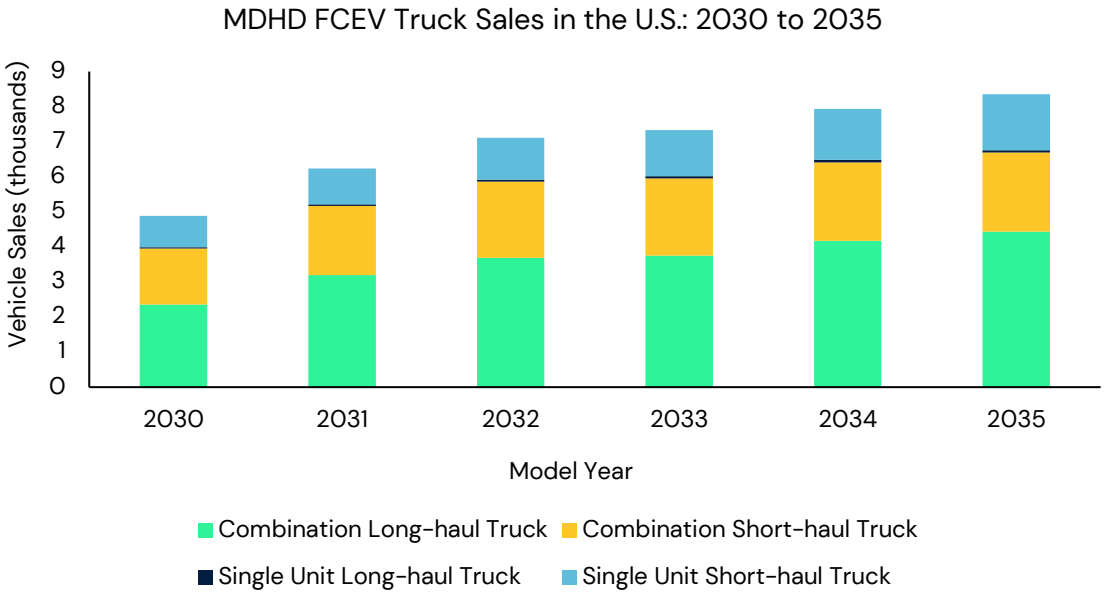
- Between 2027 and 2035, there will be a need for almost $5 billion and $3.5 billion to develop the public charging infrastructure for MDHD vehicles in California and Texas, respectively.



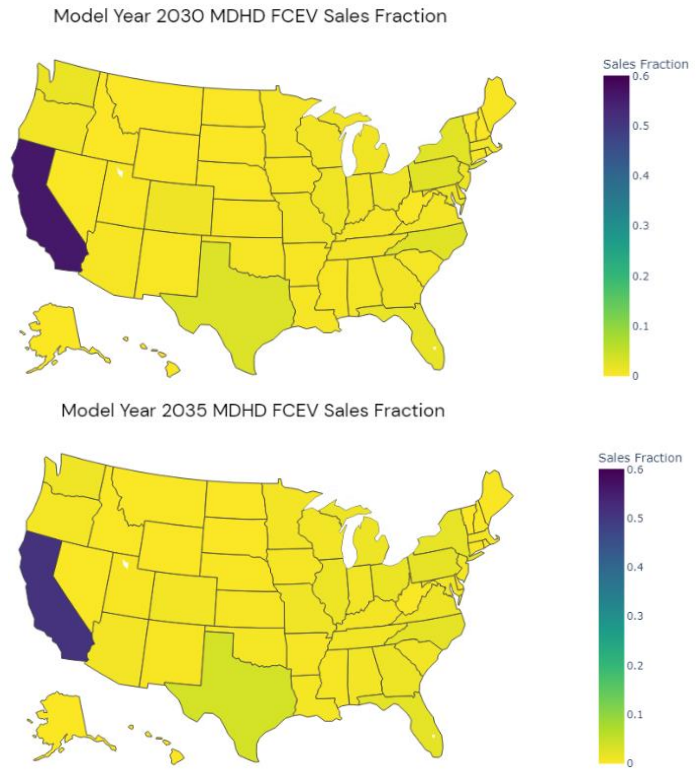


Fuel Cell Electric Vehicles & Infrastructure

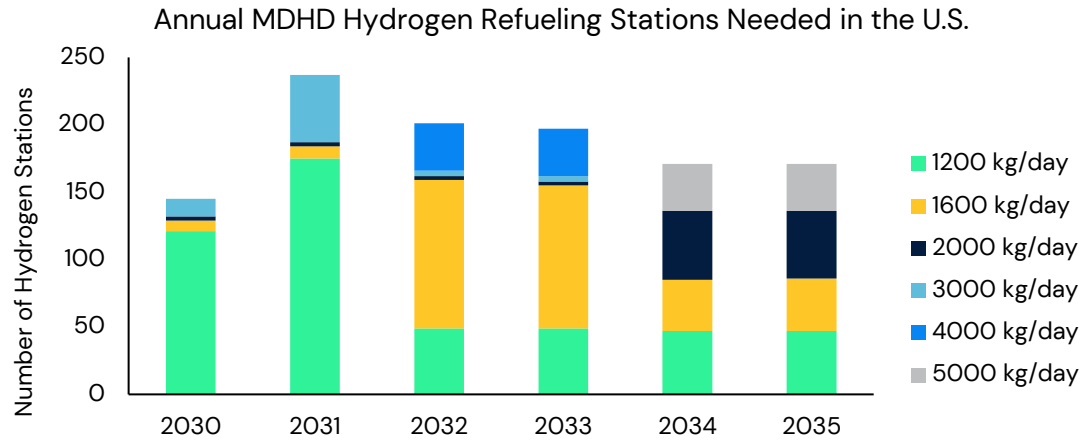
- MDHD FCEVs are expected to enter the U.S. market starting in 2030. Between 2030 and 2035, almost 42,000 FCEVs are estimated to be sold in the U.S.

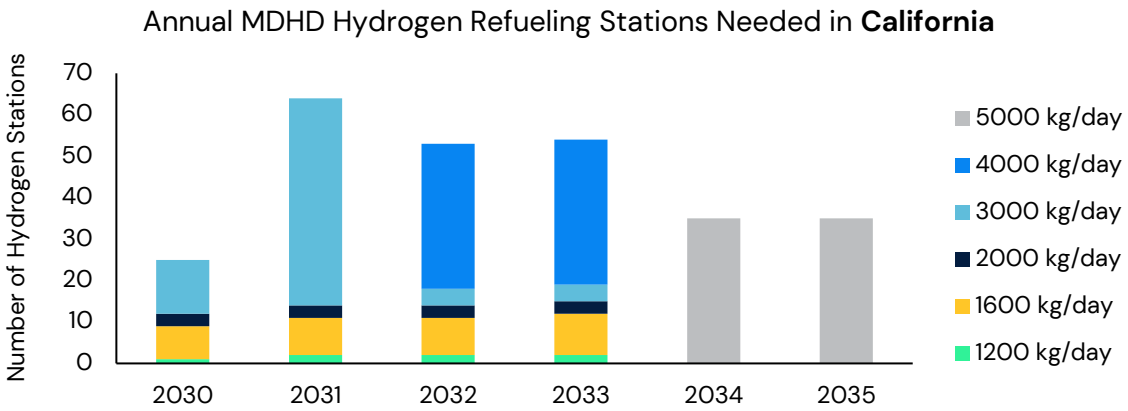


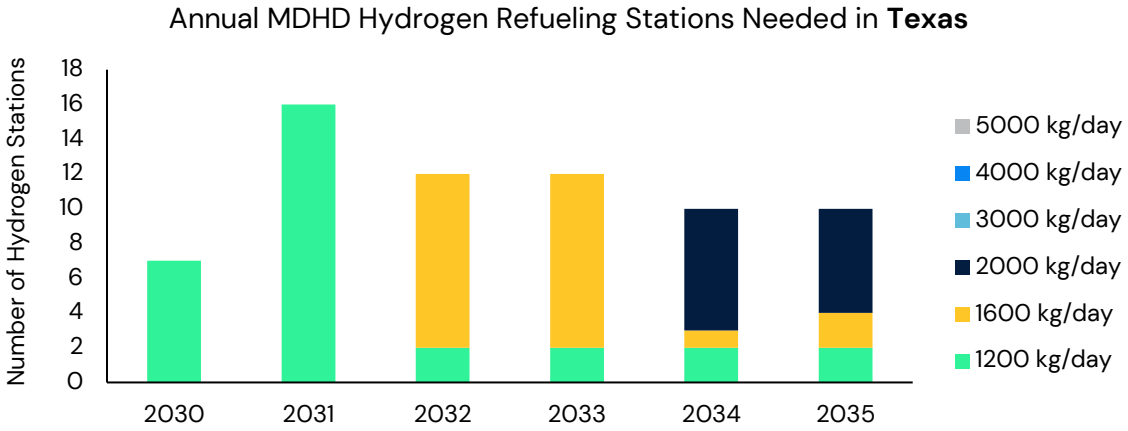
- California will account for more than 56% of the nationwide FCEV sales; unlike BEVs, the FCEV fraction will not drop as much in California due to the high FCEV penetration assumed (51% by 2035).



- Between 2030 and 2035, more than 1,100 MDHD hydrogen refueling stations[3] will need to be deployed in the U.S. – an average of 185 stations per year. 266 of those stations are expected to be in California, and 67 in Texas.

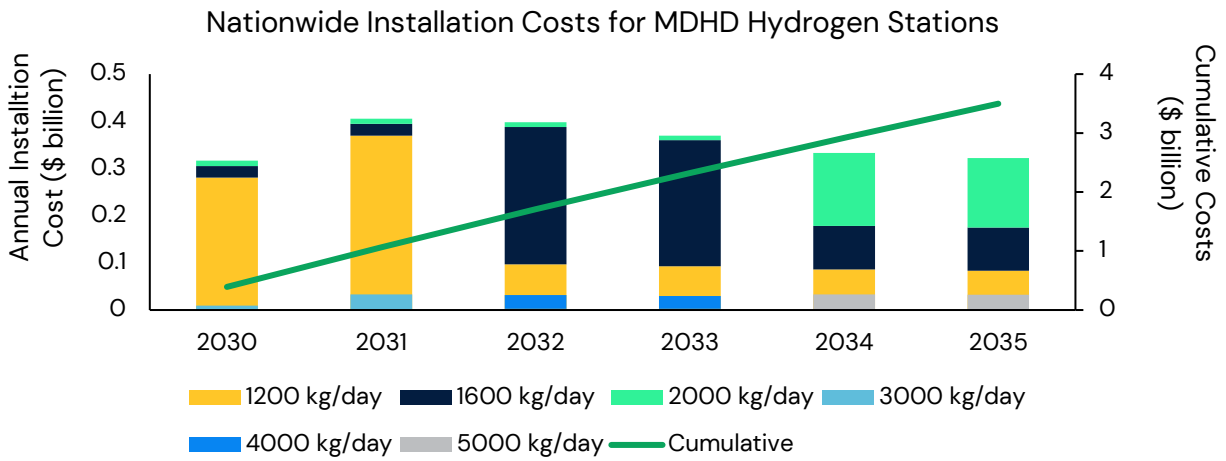


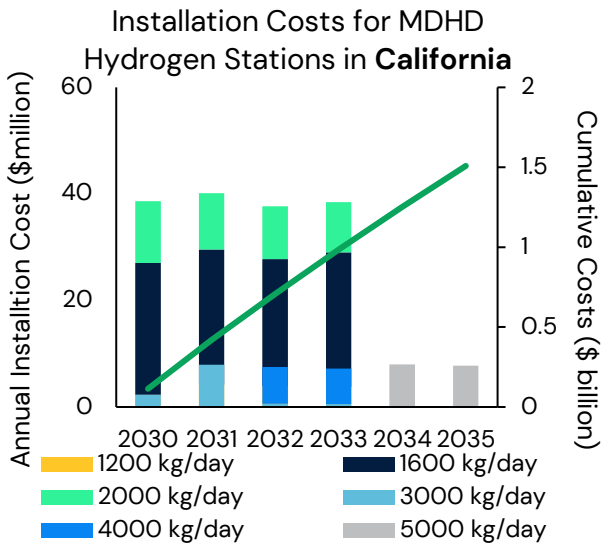


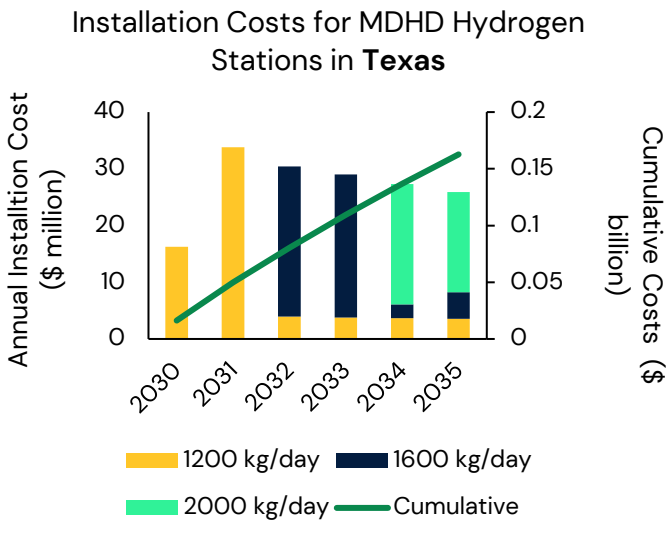


[3] In the current model, hydrogen stations are projected to support buses and refuse trucks, in addition to single unit and combination trucks. However, the demand is going to be mainly driven by the MDHD trucks considered in this study.

- NREL's analysis shows that the sum of the average days for design, permitting, construction, and commissioning of hydrogen stations is around 2.0 years (746 days). The average timeline for the 20% most recent projects has increased to 2.6 years (942 days).
- Although the COVID-19 pandemic slowed down many station development activities, station development over time could become faster and easier as station developers incorporate lessons learned and local authorities become more familiar with hydrogen. This trend should continue as local authorities streamline hydrogen stations permitting, more entities enter the supply chain, and economies of scale are achieved. It should also be noted that the buildout timeline could vary widely due to permitting from city/local agencies, public education and general awareness of hydrogen, property owner changing of demands or backing out, construction delay, hardware supply issues and others.
- Between 2030 and 2035, there will be a need for a total of $3.5 billion[4] to build the needed hydrogen refueling infrastructure across the U.S. That totals almost $580 million per year in necessary investment. Of the $3.5 billion, $1.5 billion is needed in California, and $160 million is needed for Texas.



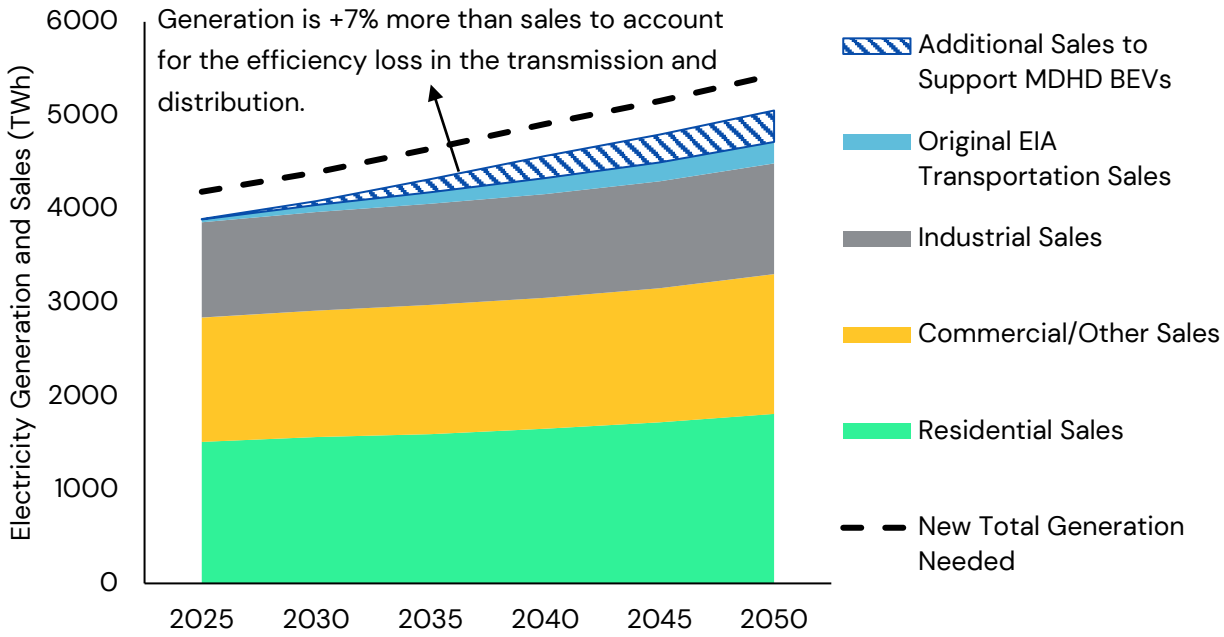




[4] Cost estimates for FCEV refueling infrastructure include refilling station compressors/boil off management and retail site distribution pumps, while costs associated with hydrogen production and distribution such as electrolysis unit, compression or liquefaction unit, distribution pipeline, compressed hydrogen delivery trucks or purification units are not quantified.

Impact of MDHD Electrification on Utilities

- The new electricity demand from MDHD electrification has been superimposed on the latest power sector demand forecast from the Energy Information Administration's (EIA) 2023 Annual Energy Outlook (AEO) Reference Case. Since the MDHD BEV[5] stock considered in the current forecast is relatively negligible, it is assumed that the current EIA does not account for the impact of MDHD electrification on power sector sales and generation, and the electricity demand to support the MDHD BEVs modeled from this study would represent additional power sector sales.



- For MDHD projects that require large-scale utility upgrades, the deployment timeline could extend over multiple years. For example, it can take up to 3 years to increase the conductor size, up to 5 years to add a new distribution feeder, and up to 7 years to add a new substation.

Project Type	Estimated Lead Time
Increases to conductor size or modification of underground conduit	1-3 years
New distribution feeders or increases in substation capacity	3-5 years
Subtransmission and new substations for MCS	Up to 7 years

- To support the projected development of the MDHD BEV landscape, the nation's utilities will need to take unprecedented actions. This analysis suggests that they will need to proactively determine grid accessibility, significantly bolster grid capacity and resilience, simplify authorization for site development, and strongly back regional infrastructure projects through robust incentive schemes.

[5] Available at: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=58-AEO2023&cases=ref2023&sourcekey=0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