Why is the State of California providing public funding for hydrogen fueling stations?

The California Energy Commission (CEC) is committed to meeting the goal of 200 publicly available hydrogen refueling stations. The CEC has allocated $20 million per year through the Clean Transportation Program (CTP) budget for these stations to support passenger, light-duty fuel cell electric vehicles (FCEVs). It is anticipated that the 200 hydrogen fueling station goal established by Executive Order B-48-18 will be met in 2027. These 200 stations will have a capacity to support over four times vehicle manufacturers’ best-case expected volume of FCEVs expected in California.

In addition to the CEC’s investments to support the hydrogen fueling stations for passenger vehicles, trucks, and buses, the CEC has invested in hydrogen production. CEC funding also supports emerging hydrogen end-use opportunities such as aviation, rail, and marine vehicles. Other state agencies also provide funding for hydrogen fueling infrastructure. For example, the California State Transportation Agency and the California Department of Transportation (Caltrans) have funded hydrogen fueled transit buses and supporting infrastructure, and Caltrans has applied for funding from the California Transportation Commission to support hydrogen truck fueling stations.

---

1. Additional funds have been allocated to construct hydrogen stations for medium-duty and heavy-duty trucks and buses.

---

### Hydrogen refueling stations in California

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>63 public hydrogen stations open today</td>
</tr>
<tr>
<td>112 stations under development</td>
</tr>
<tr>
<td>200 stations expected by the end of 2027</td>
</tr>
</tbody>
</table>
Does the CEC favor infrastructure funding for electric vehicles?

State investments support customer choice between different zero-emission vehicle (ZEV) options – plug-in electric vehicles, electric vehicles (EVs) and FCEVs. Until 2017, CEC investments in hydrogen fueling stations significantly outpaced funding for EV charging stations, despite far greater EV adoption by drivers. The gap between FCEV and EV sales has only widened since - the 15,432 FCEVs sold in California through March 2023 are approximately 1% of the 1.5 million ZEVs sold in California.

Is the number of passenger, light-duty hydrogen FCEVs in California expected to grow in the future?

In 2022, approximately 2,574 hydrogen FCEVs were sold or leased in California, a fraction of the nearly 350,000 EVs sold that same year. Widespread adoption of hydrogen FCEVs is unlikely to accelerate unless global automakers bring new FCEV models to market to meet customer needs and preferences.

Currently only two models of passenger, light-duty hydrogen FCEVs are sold in California. Over seventy-five percent of new passenger, light-duty hydrogen FCEV sales are a single model, the Toyota Mirai. Honda plans to introduce a new FCEV model next year and other automakers may bring additional FCEV models to market in the future, but FCEV models are expected to lag far beyond the number of EV models on the market.

Are passenger, light-duty hydrogen FCEVs catching on worldwide?

Passenger, light-duty hydrogen FCEV sales in California are a significant percentage of the global total. As of early 2022, FCEVs sold in California—where they account for only one percent of the ZEV fleet—were equivalent to over 40% of the total number of passenger, light-duty hydrogen FCEVs sold in the leading markets of Germany, Japan, and South Korea combined. These other countries offer large incentives to buy FCEVs, but sales remain low.


Is the CEC funding hydrogen fueling stations to support medium- and heavy-duty hydrogen FCEVs?

In addition to its investments in passenger, light-duty hydrogen FCEV infrastructure the CEC is also investing in infrastructure to support medium- and heavy-duty hydrogen FCEVs. Generally, hydrogen refueling stations designed to support passenger, light-duty FCEVs cannot support medium/heavy-duty FCEVs due to physical space limitations and site layouts. Further, potential nozzle incompatibility between vehicle classes and flow rates will impact usability. The CEC’s EnergIIZE funding program supports both EV charging and hydrogen fueling infrastructure for medium- and heavy-duty ZEVs, as do other CEC funding opportunities.

What are the barriers to hydrogen FCEV adoption?

The hydrogen fueling market faces significant headwinds outside of the CEC’s control. Refueling a hydrogen FCEV is not necessarily comparable to refueling a gasoline fueled vehicle, as stations must compress new hydrogen between refueling sessions, although there have been recent improvements in back-to-back filling capability. In addition, shortages in global hydrogen production have forced hydrogen fueling stations in California to temporarily shut down, and drivers report that stations are unreliable.

Today hydrogen is largely produced from fossil natural gas through a process known as steam methane reformation which emits upstream greenhouse gas emissions, and transitioning to fully clean and renewable hydrogen production is still an emerging area. Hydrogen fuel prices also remain far above equivalent gasoline and electricity prices, reducing the customer incentive to adopt hydrogen FCEVs in the absence of hefty manufacturer fuel subsidies. If these barriers are not addressed and new hydrogen FCEV models are not introduced by automakers, public investments in hydrogen fueling infrastructure may become stranded assets.

Does state support for passenger, light-duty hydrogen fueling stations risk funding stranded assets?

The CEC currently allocates $20 million per year to passenger, light-duty hydrogen fueling stations, which funds approximately 13 stations capable of supporting 15,000 new hydrogen FCEVs—or over five times the number of new hydrogen FCEVs sold in 2022.

The CEC, as a responsible steward of public funding, strives to mitigate the likelihood of stranded assets. If global automakers do not produce new hydrogen FCEV models and drivers do not embrace these vehicles, then publicly funded hydrogen fueling stations will not become self-sufficient and the current public funding allocation, 20% through the CECs Clean Transportation Program for passenger, light-duty hydrogen fueling stations, may become stranded. Allocating more public funding to passenger, light-duty hydrogen FCEV infrastructure may exacerbate the potential for stranded publicly funded assets. In any case, the hydrogen refueling industry may be unable to absorb more public funding in the near-term, as a recent CEC hydrogen funding solicitation was undersubscribed due to a low number of bids from hydrogen station developers.
What is the CEC doing to improve the hydrogen FCEV driver experience?
The CEC is planning to host a public workshop in mid-2023 on how the hydrogen fueling customer experience can be improved. The CEC is committed to supporting refueling infrastructure for hydrogen FCEVs. This must occur in partnership with the private market. Automakers must bring more FCEV models to market in California, including vehicles that drivers desire like sport utility vehicles (SUVs) and light trucks. The hydrogen industry and hydrogen station operators must improve the refueling user experience by increasing the reliability of hydrogen supplies and reducing wait times between fueling sessions. This must be a joint effort that goes beyond state funding and the single metric of the number of stations deployed.

When will CEC meet the statutory 100 hydrogen fueling stations goal - funded/built? What about 200 stations funded/built?
The CEC anticipates funding over 100 hydrogen fueling stations in 2023. It is anticipated that 100 stations will be operational by the end of 2024. The CEC has offered public funding to reach 200 hydrogen stations. The most recent grant funding opportunity (GFO-22-607) was intended to offer public funding to reach 200 hydrogen fueling stations. The notice of proposed award was released in April 2023. The solicitation was under-subscribed due to limited applicant interest by hydrogen station developers. The CEC will monitor the market, private investments, and ongoing station development from the CEC’s previous funding opportunities to help meet the 200 station goal by the end of 2027.

How many publicly accessible hydrogen fueling stations are currently operational?
There are currently 63 publicly accessible hydrogen fueling stations to support passenger, light-duty FCEVs open today—barring temporary shutdowns—and 112 such stations currently planned or under development.

How many FCEVs are currently on the roads?
As of March 2023 approximately 15,400 FCEVs were on California roads. This is approximately 1% of the approximately 1.5 million EVs sold in California. As of mid-2022 there were 61 medium- and heavy-duty FCEVs sold in California, which were all transit buses. When there are 200 hydrogen fueling stations in operation (in 2027), they will support approximately 274,000 passenger, light-duty hydrogen FCEVs. Auto manufacturers estimate that there could be 65,000 FCEVs in 2028.4

Has the CEC always allocated the 20% statutory carve-out of CTP funds to hydrogen refueling stations?
The CEC has annually allocated 20% of CTP funding for passenger, light-duty hydrogen fueling stations. The CEC worked with industry and public stakeholders to develop GFO-19-602, which was responding to industry’s expressed desire for this greater certainty in public funding programs. Hydrogen fueling station developers were also still developing stations from prior funding solicitations at that time. In response to the industry feedback, the CEC designed a

---

multi-year solicitation – GFO-19-602 – which is providing $116 million in funding for hydrogen fueling station in batches over five years. This approach was intended to provide funding continuity for hydrogen fueling station developers and deployment from that solicitation is currently ongoing. While not issued every single year, this multi-year solicitation and other hydrogen public funding solicitations (PON-13-607, GFO-15-605) reflected 20% of overall CTP funding and the $20 million annual allotment.

Would an additional $300 million over the next ten years be able to fund 1,000 hydrogen fueling stations?

It is highly unlikely that an additional $300 million in public funding over the next ten years would be sufficient to fund 1,000 hydrogen fueling stations. To date, construction of a passenger, light-duty hydrogen fueling station with four fueling positions has required a CEC contribution of approximately $1.5 million.

The $20 million (20% carve-out) the CEC currently annually allocates through CTP to hydrogen fueling stations funds approximately 13 new stations per year which are capable of supporting roughly 15,000 new hydrogen FCEVs, or over five times the number of new hydrogen FCEVs sold in 2022. Until the number of hydrogen FCEVs produced by global automakers and sold in California grows substantially, increasing public funding for passenger, light-duty hydrogen fueling stations risks investing in assets that will be un- or under-utilized when other investments in clean transportation infrastructure may be more effective at reducing local air pollution and greenhouse gas emissions.

According to the California Air Resource (CARB) Hydrogen Self-Sufficiency Report, $300 million in additional funding is needed to create a self-sufficient network of hydrogen fueling stations?

CEC and CARB are aligned that $300 million carved out for passenger, light-duty vehicle hydrogen stations will not automatically create self-sufficiency. In fact the report states that, “[t]his study is not intended to be used as an exact predictive tool. Instead, this tool is used to evaluate many scenarios and generate insights from the collection of scenarios. This study also does not intend to decide whether or not the funding amount should be met by any future State program, nor the form, structure, and implementation practices of any such new direct funding program. The study does make a simplifying assumption that the form would be a 5-year grant program to enable quantification. However, neither CARB nor the CEC endorse this particular hypothetical program structure.” (emphasis added).

The report goes on to state that the “study demonstrates that the total State cost to network self-sufficiency will depend on a variety of factors both within and outside of State control. Within the range of scenarios studied, costs can be as low as zero additional dollars beyond AB 8 to as high as several billion dollars.” The report found important variables include the FCEV deployment rate and achieving economies of scale.

The CEC is committed to working with the hydrogen fuel production and hydrogen vehicle industries to reduce barriers to adoption. Barriers include the lack of available vehicle models, high fuel costs, and inconsistent fuel availability to name a few. Arbitrarily creating a carve-out of any funding level, especially approximately one-third of CTP funds will limit the ability to meet state
goals and potentially result in stranded investments. The stations and funding to deploy stations to support passenger, light-duty vehicles are often unable to support medium-duty and heavy-duty trucks and buses.

**Is the hydrogen dispensed at passenger, light-duty hydrogen fueling stations clean and/or renewable?**

The majority of hydrogen dispensed at passenger, light-duty hydrogen fueling stations is produced from fossil natural gas in a process that produces greenhouse gas emissions. While the CEC has funded renewable hydrogen production it is unclear when a majority of hydrogen will be produced without greenhouse gas emissions.

**How is hydrogen provided to passenger, light-duty hydrogen fueling stations throughout the state?**

Hydrogen is transported to passenger, light-duty hydrogen fueling stations almost exclusively by truck.

**Are automakers producing or planning to produce more medium- and heavy-duty FCEVs?**

Currently there are seven models of hydrogen buses, trucks, and other medium- and heavy-duty FCEVs that are listed as eligible for the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project. Automakers have announced upcoming models of new medium- and heavy-duty FCEVs, but it is uncertain how many of these vehicles will be brought to market.

**Has the CEC provided funding to medium- and heavy-duty FCEV fueling infrastructure?**

The CEC has funded hydrogen fueling infrastructure for medium- and heavy-duty FCEVs through the hydrogen funding lane in the Energy Infrastructure Incentives for Zero-Emission Program and other solicitations, such as the joint drayage truck solicitation. The CEC intends to continue funding hydrogen fueling infrastructure for medium-duty and heavy-duty vehicles.

**How do hydrogen fueling stations costs compared to EV charging stations?**

Hydrogen fueling stations for passenger, light-duty FCEVs are not directly comparable to EV charging stations due to the range of hydrogen capacity options and EV charging options and power levels. However, a hydrogen fueling station with four fueling positions costs approximately $6.5 million. A direct current fast EV charging station costs $110,000 or more per charger, depending on the charger power and other sites-specific conditions.

---

5 See californiahvip.org/vehicles/?t_type=379.