California Energy Commission

Title: Hydrogen Presentation

Presenters: Chair David Hochschild

Date: 3/14/22

Hydrogen Classifications

Hydrogen (H_2) is classified by color into three types according to the feedstock used and method of H_2 production: gray, blue, and green.

Production Cost Estimates

- **Gray hydrogen** is produced from fossil fuel feedstocks without carbon capture at the point of production.
- **Gray hydrogen** accounts for more than 95% of global hydrogen production today.

$2.08

- **Blue hydrogen** is produced from fossil fuel feedstocks with carbon capture at the point of production.
- **Blue hydrogen** exhibits significant potential in reducing emissions in end-use segments in the near term.

$2.27

Green hydrogen encompasses multiple carbon-neutral production pathways:

Electrolytic hydrogen or power-to-gas (P2G), is the conversion of electrical power into a gaseous energy carrier, such as hydrogen or methane, using an electrolyzer. When powered with renewable electricity, P2G is a green hydrogen source.

- **Other green hydrogen** generation pathways exist, including biogas reforming and artificial photosynthesis.

$5.27 to $9.37

Use of Hydrogen

Electric grid support

Hard to electrify transportation

Hard to electrify industrial applications

Limitations of Hydrogen

- **High Cost:** Currently green hydrogen is significantly more expensive than gray hydrogen to produce. $5-9 per kg compared to $2 per kg.
- **Limited Pipeline Capacity:** Studies suggest a 20 percent blend of Hydrogen could be used in existing natural gas pipeline, if achieved this would only reduce the GHG intensity of the pipeline by 7 percent.
- **Low Efficiency:** Significant wasted energy compared to electrification. A FCEV would require 2 times the clean electricity as a BEV. A hydrogen water heater would require more than 4 times the clean electricity as an electric heat pump water heater.
- **Air Pollution:** Combustion of hydrogen in a power plant or appliance produces NOx.

Hydrogen Investments through CEC

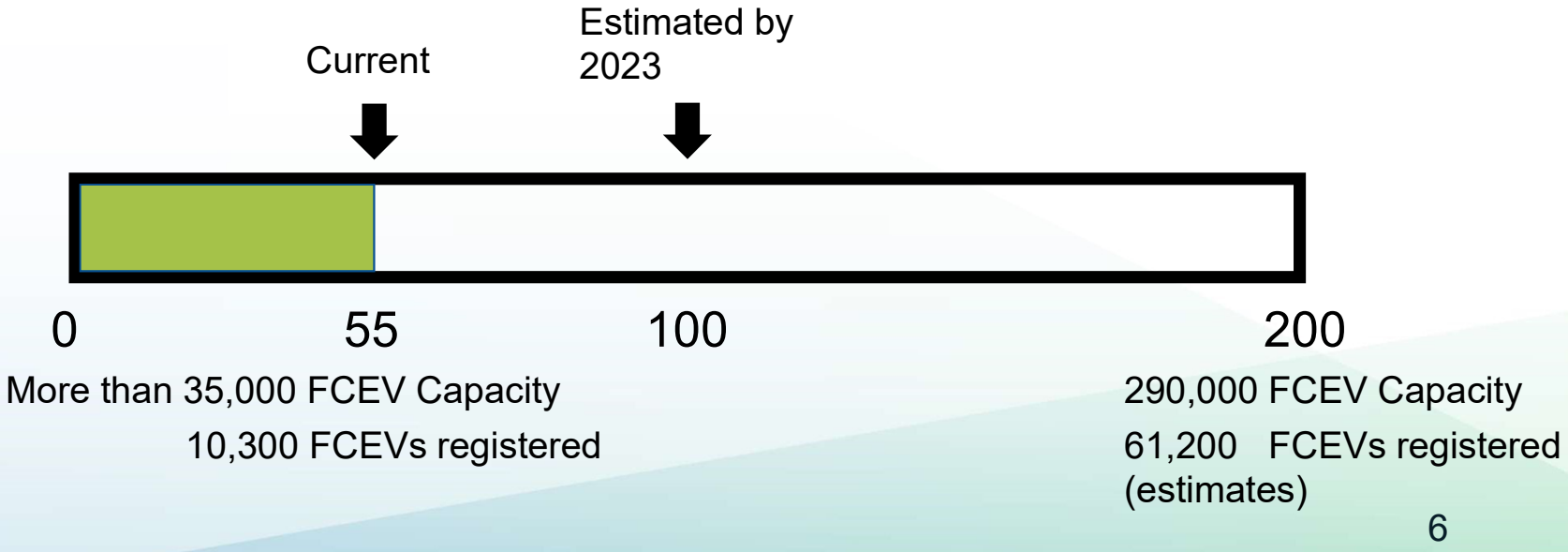
California has a higher per capita investment in hydrogen fueling infrastructure than any other country in the world and is second only to Japan in total investment.

Source	Amount	Purpose
Clean Transportation Program (CTP)	$235 M spent $113 M queued ($86M in CTP + $27M in General Fund)	$166M for fueling stations for light duty vehicles $35M for medium- and heavy-duty fueling infrastructure $17M for studies, standards, and regional readiness planning $17M for production
EPIC/PIER	$47M	hydrogen use studies and demonstration, advanced production.
GO 2022-23 Budget	$100M	Advance production and drive down cost of green hydrogen and expand market.
GO 2022-23 Budget	$$$	A portion of heavy duty vehicle infrastructure investments would likely include hydrogen.

Proposed

Hydrogen Transportation Infrastructure

- The CEC is looking at focusing on medium and heavy duty vehicle hydrogen infrastructure.
- The CEC is funded to reach the state goal of 200 hydrogen fueling stations through the 2021-2022 budget.



Thank You!
Discussion/Questions