

<b>DOCKETED</b>	
<b>Docket Number:</b>	20-IEPR-02
<b>Project Title:</b>	Transportation
<b>TN #:</b>	233356
<b>Document Title:</b>	Comments by the California Hydrogen Business Council on Commissioner Workshop on Heavy-Duty Zero-Emission Vehicle Market Trends
<b>Description:</b>	N/A
<b>Filer:</b>	System
<b>Organization:</b>	California Hydrogen Business Council
<b>Submitter Role:</b>	Public
<b>Submission Date:</b>	6/8/2020 12:41:55 PM
<b>Docketed Date:</b>	6/8/2020

*Comment Received From: California Hydrogen Business Council  
Submitted On: 6/8/2020  
Docket Number: 20-IEPR-02*

**Comments by the California Hydrogen Business Council on  
Commissioner Workshop on Heavy-Duty Zero-Emission Vehicle  
Market Trends**

*Additional submitted attachment is included below.*

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## Comments by the California Hydrogen Business Council on Commissioner Workshop on Heavy-Duty Zero-Emission Vehicle Market Trends

June 8, 2020

### I. Introduction

The California Hydrogen Business Council (CHBC)<sup>1</sup> appreciates the opportunity to submit these comments on the Commissioner Workshop on Heavy-Duty Zero-Emission Vehicle Market Trends. Generally, we were disappointed to see that the agenda for this workshop did not include any focus or panelist experts on hydrogen fuel cell electric vehicles (FCEVs), one of the two types of ZEVs recognized in California policy, including Executive Order B-18-48. This omission has become a common pattern at the Commission and risks creating a misperception that ZEV is equivalent battery electric vehicles (BEVs), which negatively impacts the FCEV industry. We also greatly appreciate staff and Commissioner Monahan for their comments and questions during the workshop that recognized hydrogen fuel cell electric technology is an important piece of the Heavy Duty (HD) ZEV market and their expression of support for including this solution in future 2020 IEPR update workshops. We strongly agree with having additional workshops focused on HD ZEV and fueling related topics and look forward to participating in such discussions.

Our more specific comments are summarized as follows, and elaborated on in the Comment sections below.

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<sup>1</sup> The CHBC is comprised of over 100 companies and agencies involved in the business of hydrogen. Our mission is to advance the commercialization of hydrogen in the energy sector, including transportation, goods movement, and stationary power systems to reduce emissions and dependence on oil. The views expressed in these comments are those of the CHBC, and do not necessarily reflect the views of all of the individual CHBC member companies. CHBC Members are listed here: <https://www.californiahydrogen.org/aboutus/chbc-members/>

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## II. Comments

### a. Declining cost of fuel cell electric buses and superior operational capability is making them a competitive and important option in this sector.

Fuel cell electric buses (FCEBs) have made massive cost reduction advances, despite limited deployments relative to battery electric buses (BEBs). In 2010, a fleet of 20 fuel cell electric buses was deployed for the Vancouver Olympics at \$2M each, whereas by 2017, the price had dropped to \$1.3M, and last year the Department of General Services announced their pricing for FCEBs at just over \$1M, within 11% of the price of the closest battery electric offering and with greater operational capability.

This cost reduction came almost exclusively from design advances based on field experience going back more than 20 years. Fuel cell manufacturers are only just beginning to implement the sort of very high volume "roll-to-roll" manufacturing processes that drove down battery prices so rapidly over the past 5 years. Even ahead of this, the latest generation of fuel cell modules have reduced cost, weight and volume all by 35% or more, while extending lifetime by nearly the same amount. Recycling costs, still an unknown in the battery arena, are minimized because 97% of the platinum is recycled.

Looking ahead, there are many reasons to expect further cost reductions and greater competitiveness in the ZEV bus sector. FCEBs utilize a battery less than 1/6 the size of a BEB battery pack, while providing superior range and operational capability, with no performance degradation from full tank to empty, cold weather to hot. The lifetime cost of this small battery pack is also improved, as the fuel cells maintain battery state of charge in a narrow band, reducing stresses that can rapidly degrade battery packs. Hydrogen storage tanks are the other additional component in a FCEB, and proven cost decreases are on the way in decreased carbon fiber costs, and innovative new architectures allowing conformance to vehicle packaging envelopes. Servicing costs are also rapidly reducing. NREL's estimated service costs for fuel cell electric buses have dropped from \$1.61 per mile in 2010, to \$1.25 per mile in 2014, and down

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to \$0.32 per mile for the latest models, equal or better than CNG costs!<sup>2,3</sup> These will drop even further through improved technician training at Sunline Transit's West Coast Center of Excellence and new advanced training facilities at AC Transit. Additionally, FCEB manufacturers continued efforts to advance reliability and maintainability will further drive down per mile operating costs.

All of this is confirmed by recent studies by Deloitte<sup>4</sup> and McKinsey,<sup>5</sup> showing that by 2027 total cost of ownership (TCO) for FCEBs will drop below that of not only diesel and CNG, but also battery electric buses, well before the end of the decade. This TCO advantage comes not only from rapidly dropping capital and fuel costs, but also from the lower operational costs of operating a bus with equivalent capabilities to the diesel and CNG buses that our transit systems were designed for.

**b. Hydrogen fueling infrastructure costs are more cost effective, convenient, and resilient than electrical infrastructure for large transit fleets.**

The infrastructure concerns expressed by Prologis in the Session on Moving Goods are well appreciated at California's transit agencies, who are at present conducting detailed analyses on conversion of their heavy-duty bus fleets to zero emissions. While demo fleets of a few buses may not require major electrical upgrades, the large fleets of 25 or more buses are finding that hydrogen provides far lower infrastructure costs than grid charging, offers intrinsic energy storage, fast refueling, and resilience against grid outages.

Hydrogen fueling infrastructure can be grown modularly, without lengthy and expensive utility studies and public works projects, uncoupled to the activities of neighbors. In sharp contrast to

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<sup>2</sup> American Fuel Cell Bus Project Evaluation: Third Report <https://www.nrel.gov/docs/fy17osti/67209.pdf>

<sup>3</sup> Zero Emission Bay Area (ZEBA) Fuel Cell Bus Demonstration Results: Sixth Report [https://afdc.energy.gov/files/u/publication/zeba\\_fcb\\_rpt6.pdf](https://afdc.energy.gov/files/u/publication/zeba_fcb_rpt6.pdf)

<sup>4</sup> *Fueling the Future of Mobility*, Deloitte, January 2020 <https://www.ballard.com/about-ballard/newsroom/news-releases/2020/01/08/deloitte-ballard-joint-white-paper-assesses-hydrogen-fuel-cell-solutions-for-transportation>

<sup>5</sup> *Path to Hydrogen Competitiveness: A Cost Perspective*, Hydrogen Council; January 2020 [https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness\\_Full-Study-1.pdf](https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf)

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battery electric charging equipment, hydrogen fueling stations can accommodate growth in the number of buses in the fleet before needing to be upgraded. This simplifies capital and operational planning.

Active and expanding fleets, such as those in Orange County, Oakland, and Palm Desert, show hydrogen fueling costs drop to 1/3 or less than equivalent grid charging as the fleet scales especially when looking at very large fleets of 200 vehicles or more. All of these benefits also come with requiring no operational changes from diesel or CNG fueling.

**c. Truck fleets are likely to find the same advantages in supporting hydrogen freight transport fleets, especially large fleets.**

It is implicitly true that what transit agencies are discovering is entirely applicable to trucking fleets - the larger the fleet, the better hydrogen works.

Larger trucks consume twice the energy or more per day as buses, as Tesla described in the workshop, and have operational schedules that require fixed fueling and maintenance windows.

Fuel cell electric trucks, because they rely on a material fuel, also have the advantage of supply diversity, along with a competitive marketplace for infrastructure and fuel supply.

Hydrogen allows flexibility to building and fleet owners, as they look at their long-lived assets, as energy mixes change, and electrical grid demands rapidly increase. Hydrogen fuel also adds flexibility because unlike pure electricity, it can be stored in large quantities for long durations. Production of hydrogen from electricity can also help stabilize the electricity grid, as penetrations of renewable generation increase, by making beneficial, low or zero carbon use of otherwise curtailed electricity and providing ancillary grid services.



- d. To achieve the goal of emissions reductions, we encourage incentives and grants to help accelerate scrappage of older HD trucks and adoption of ZEV replacements, including hydrogen fuel cell electric trucks.**

In order for zero emissions trucks to make significant changes in overall statewide emissions, older trucks must be scrapped and replaced with zero emissions trucks. Scrappage in this context is actually quite wasteful, until significant numbers of zero emissions trucks are on the road to displace older, dirtier trucks, which will happen with scale and as costs fall below the need for incentives. In the meantime, incentives and grants should be made available for demonstration and market transformation.

- e. Maintaining support for the full suite of ZEV HD technologies, including hydrogen fuel cell electric options, is all the more critical with COVID-19, which heightens the threat of respiratory illness, especially in disadvantaged communities.**

As Angelo Logan and others reminded workshop participants, the urgency of protecting people from the respiratory damage of diesel particulates emitted by conventional heavy-duty vehicles and equipment – and particularly people who live in disadvantage communities near industrial and freight corridors - has been heightened by the coronavirus pandemic. Now is the time for California to fully support and accelerate development of all zero emissions options to reduce and ultimately eliminate these deleterious and toxic emissions. Giving equal and meaningful attention and support to both battery electric and hydrogen fuel cell electric heavy-duty vehicle technologies is all the more important because both are nascent markets, as well as complementary.



### **III. Conclusion**

We thank you for your consideration of these comments and look forward to working together to plan and participate in further discussions as part of the 2020 IEPR Update about the state of the hydrogen fuel cell electric transportation and fueling markets, how these technologies can enable California's important clean air, clean energy, equity, and resilience goals, and what is needed to accelerate California's transition to zero emissions transportation.

Best regards,

A handwritten signature in blue ink, appearing to read 'Emanuel Wagner', with a long horizontal flourish extending to the right.

Emanuel Wagner  
Deputy Director  
California Hydrogen Business Council