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Nel Hydrogen has been motivated to provide this comment – based on strong concerns over the conspicuous omission of hydrogen in the draft ZEV Investment Plan – as also expressed in the March 21st California Legislative Hearing for the *Senate Transportation and Housing Committee* and the *Senate Environmental Quality Committee*, and the March 24th Board Hearing of the *California Environmental Protection Agency - Air Resources Board*.

The proposed draft of the VW ZEV Investment Plan exclusively favors potential VW-branded and promoted BEV technologies over FCEVs that are currently being marketed by other car manufacturers who have a greater market share, and thus greater potential impact. The proposed investments into 150/320kW fast chargers will not add value to existing BEVs or Plug-in Hybrid vehicles on the market, as currently no vehicle model is capable of charging at such speeds. Instead, hydrogen fueling is more cost-effective and achieves higher environmental benefits than the fast charging investments proposed by VW.

The omission of hydrogen from the draft Plan conflicts with Court Decree requirements to promote “*brand neutrality*” and reduce “*adverse environmental impacts*” to the “*widest extent possible*” with the ZEV investments. Additionally, VW included costs for demand charges on primarily fossil electricity, which is not a creditable cost under the Court Decree. Further substantiation of these critical elements is provided in later sections below.

Therefore, we *strongly* encourage ARB to require – as a prerequisite for approval of the ZEV Plan – that VW includes all or several of the following investments into hydrogen:

- Several additional hydrogen fueling stations in California – to increase the availability of rapid fueling for all types of ZEVs and maximize impact. This would also provide VW valuable experience for more substantial investments in hydrogen in later investment cycles – not only in California, but across the US.
- Visible and substantial marketing of FCEVs and hydrogen fueling in the ZEV “marketing, outreach and education investments.”
- Inclusion of renewable hydrogen production, fueling and FCEV market outreach in the Green City investments – exemplifying the true nature of Green Cities by showcasing myriad ZEV technologies and their integration with the energy system.
- Investments in renewable hydrogen production located in California disadvantaged areas that produce abundant renewable electricity – increasing the share of ZEV investments in these areas, facilitating permanent business and job growth.

Nel Hydrogen thanks the ARB for both their time and for their vigilant efforts to support California’s clean air goals. Their dexterous command of the role as sole authority over the VW ZEV Investment Plan exemplifies the remarkable environmental efforts of California.

Best regards

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Critical elements of the draft VW ZEV Investment Plan

No known outreach by Electrify America (VW) on submitted hydrogen proposals – outreach likely only conducted for BEV proposals

In the draft ZEV Investment Plan, VW states (on page 10) that proposals were carefully considered and outreach was made to each proposer before issuance of the draft Plan: *“Working teams (at Electrify America) will follow up with proposal submitters in order to clarify submissions, discuss specific ideas, and incorporate some or all of the submissions into the plan as Electrify America begins implementing the California ZEV Investment Plan”.*

To the best of our knowledge, none of the nine hydrogen proposals submitted to VW have received any request from Electrify America for feedback or dialogue. This raises the question of whether Electrify America has placed sufficient attention and consideration on the submitted hydrogen proposals. Further, if outreach was made on BEV proposals—which were included in the draft Investment Plan—why have similar outreach efforts not been made on hydrogen proposals?

Nel Hydrogen Inc. asked Electrify America and VW the above questions in an email dated March 29, 2017 – with relevant ARB stakeholders and board members in Cc:. As of today, no responses have been received from either Electrify America or VW.

Draft ZEV Investment Plan exclusively favors specific VW promoted ZEV technology

On page 30 of the draft ZEV Plan, VW states: *“The ZEV infrastructure is intended for, and compatible with ZEV technologies that are not limited to ones supported by VW group brands. Instead, the goal is to promote universal access to the extent possible.”* Yet, both the content and investments in the draft Plan directly contradict this statement for the following reasons:

- 1. Draft ZEV Plan only supports charging for BEVs – the only ZEV technology being marketed by VW – and not the other ZEV technology – FCEV – currently marketed by other car manufacturers with higher US market shares**

Currently, car manufacturers with a combined California and US market share substantially higher than VW are offering FCEVs to consumers at affordable prices. VW is currently not offering FCEVs, but is more publicly active on BEVs. A draft ZEV Plan that includes Court Decree-forced investments exclusively funneled towards BEVs marketed by VW – and without investments toward FCEVs from competitors – will naturally be very favorable for VW.

Not only does this conflict with the Court Decree requirement to support *“brand neutrality”* of the investments, but it also impacts the intent of Court Decree provisions that investments are to offset *“adverse environmental impacts”* arising from affected diesel vehicles to the *“widest extent possible.”*

Investments in a combination of fueling infrastructures for *both* BEVs and FCEVs is critical to reducing and offsetting environmental impacts across myriad vehicle segments with different needs for range and fueling times. Parallel investments by VW toward *both* ZEV types are necessary and will maximize ZEV market impact – and will contribute to meeting the intent and provisions of the Court Decree.

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2. Draft ZEV plan suggests substantial investments into fast charging technology primarily being pursued by VW, and which will not add value to existing BEVs or Plug-in Hybrid vehicles on the market

VW is proposing that over 35% (\$75 million) of the 1st cycle investment in California be spent on 150/320kW fast charging at highways – technologies which VW is primarily developing for use with future BEV models from their own brands.

Most BEV models available and on the road today are limited to a charging speed of 50kW and will be unable to utilize the faster charging at 150kW. Currently, only a single, low-volume vehicle manufacturer is offering luxury BEVs capable of 120kW charging, but with proprietary technology only accessible to their brand. Further, these luxury vehicles likely remain unaffordable and unattainable for individuals in disadvantaged areas. With regard to 320kW charging, VW brands are currently the only group that has stated that *future*, high-end BEV models (e.g. Porsche) may be capable of charging at this power level.

Therefore, the proposed VW investment in fast charging will not benefit *existing* BEVs and Plug-in hybrid vehicle models and others offered in the coming years. Thus, offsetting “*adverse environmental impacts*” through a \$75 million investment in 150/320kW fast charging under the Court Decree can be challenged.

In comparison, hydrogen fueling is conducted using one international standard (SAE J2601) backed by all major, international car manufacturers, ensuring that *any* FCEV brand or model can achieve fast fueling in 5 minutes of 300+ miles range at any publicly available fueling station. In addition, FCEVs are offered across California today at prices affordable for the general population.

Hydrogen infrastructure is more cost-effective and achieves higher environmental benefits than the fast charging infrastructure proposed by VW in the draft ZEV Plan

Offering long-range ZEVs with fast fueling is key to addressing myriad vehicle segments and consumer demands, and thus key to achieving high ZEV market penetration.

Despite the notion that fast charging may be not only be easier and less costly to install than hydrogen fueling, but also results in higher environmental gains – the reality is different in California, as illustrated below, where metrics of the 150kW fast charging proposed by VW and hydrogen fueling are compared.

BEV and FCEV Infrastructure comparison: 150kW DC Charger vs. Hydrogen Fueling Station		 Grid connection ¹	 Renewable hydrogen
Grid connection ¹ :		← 150kW →	
Charge performance ² :	80% in 40 min.		100% in 5 min.
Vehicles served daily ³ :	x 10		x 100
Time utilization daily ³ :	56%		35%
Sales revenue daily ⁴ :	\$235		\$3,340
Renewables share WTW ⁵ :	27%		90%
Infrastructure investment ⁶ :	\$20,000/vehicle		\$20,000/vehicle

¹ **Grid connection:** A single plug 150kW DC Charger and a two hose 70MPa Hydrogen Fueling Station requires a similar grid connection – acting as comparison basis.

² **Charge performance:** A 100kWh battery with ~300 miles of range can be charged 80% in ~40 min. at a 150kW DC Charger. A 5 kg hydrogen tank with ~300 miles of range can be filled 100% in <5 min. at a 70MPa Hydrogen Fueling Station.

³ **Vehicles served / Time Utilization daily:** A 40 minutes 80% charge allows for 10 vehicles served on a single plug during a 12 hour opening period with only 56% of the time used for charging. A 5 min. 100% fueling of a hydrogen tank allows for 100 vehicles served on two fueling hoses within 12 hours with only 35% of time used for fueling on each hose.

⁴ **Sales revenue daily:** A 300 miles BEV with a fuel consumption of 98MPGe EPA (2.94 miles/kWh) compared to a similar gasoline vehicle with 28MPG allows for a “fuel cost per mile competitive” charging price of \$0.294/kWh at a competing gasoline price of \$2.8/gallon. With 10 vehicles each charging 80kWh during a day this translates into a maximum daily revenue of \$235. A 300 miles FCEV with a fuel consumption of 67MPGe (66.85 miles/kg) similar allows for a “fuel cost per mile competitive” hydrogen pump price of \$6.68/kg. 100 vehicles each fueling 5kg during a day translates into a maximum daily revenue of \$3,340.

⁵ **Renewables share WTW:** A DC Charger connected to the Californian grid can achieve a 27% renewable electricity share Well-To-Wheels basis (2016). Hydrogen production connected directly to renewables, taking into account diesel consumption for hydrogen distribution and use of grid electricity for fueling, achieves a 90% renewables electricity share WTW.

⁶ **Infrastructure investment:** Turn-key DC Charger including 150kWh grid connection, installation and permitting estimated to \$200,000 – and serving 10 vehicles a day. Turn-key two hose hydrogen fueling station including 150kWh grid connection, installation and permitting at \$2.0 million serving 100 vehicles a day. Volume prices for both technologies.

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Both technologies require a 150kW grid connection, but the longer BEV charging time compared to hydrogen fueling equates to fewer vehicles served at a fast charger compared to a hydrogen station per day – specifically, 10 vs. 100 vehicles, respectively. During the day-time, the charger would be utilized 56% of the time as compared to only 35% for the hydrogen station, freeing up the hydrogen station for increased customer turnover, no waiting lines, and positive consumer experiences. Even when the charging and hydrogen fueling price per driven mile is the equivalent, the business case results in a 14 times higher sales revenue for hydrogen compared to charging – and thus a *better* business case.

In California, the cheapest hydrogen supply pathway utilizes inexpensive renewable electricity (solar + wind), which is overwhelmingly located in disproportionately disadvantaged areas, resulting in a renewable share of up to 90% (Well-To-Wheel). In addition, Senate Bill (SB) 1505 requires at least 33.3% of hydrogen used as a transportation fuel in California is produced from renewable sources (wind or solar).

With regard to fast charging, VW has not included any effort in the ZEV Investment Plan to ensure the use of renewable electricity. On the contrary, VW proposes to cover costs for demand charges on electricity, which are not creditable costs under the “*Creditable Cost Guidance*” in Appendix C-1 of the Court Decree.

Instead the VW proposed fast chargers are directly connected to the local available grid, and only achieves 27% renewable share, corresponding to the grid average. Vehicle charging in California may occur during the late afternoon and evening, when fossil power plants ramp up production and solar production ramps down. During this transition the renewable share in the grid and utilized for fast charging is substantially reduced. Also demand charges typically apply during this period, thus VW inclusion of costs for demand charges is not only “*non creditable*” under the Court Decree, but also indirectly resembles a reduced renewable electricity share for the fast charging.

The infrastructure investments for fast charging and hydrogen are comparable at approximately \$20,000/vehicle, yet hydrogen provides greater performance metrics for the customer (fast and complete fueling), whilst enabling a higher renewable share, and thus greater environmental benefits.

With hydrogen offering better consumer performance, higher renewable content and cost-effectiveness compared to fast charging – inclusion of hydrogen in the ZEV Investment Plan would directly support the principles of the Court Decree to offset “*adverse environmental impacts*” to the “*widest extent possible*”.