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California Energy Commission

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Re: Docket No. 08-ALT-1

1516 Ninth St.

Sacramento, CA 95814-5512

I wish to make the following comments on the “Investment Plan for The Alternative and The Renewable Fuel and Vehicle Technology Program” , Peter Ward, Draft Staff Paper, California Energy Commission, Publication Number CEC-600-2008-007-D, December 2008.

One of the objectives stated in the introduction of the document is:

“Accelerate the commercialization of vehicles and alternative and renewable fuels including buy-down programs through pre-commercial demonstrations and market-path deployments, advanced technology warranty or replacement insurance, development of market niches, and supply-chain development.”

The program for hydrogen fuel cell vehicles (HFCVs) does not include a vehicle commercialization component even though this element is included for all other vehicles. I don’t disagree with such an assessment as the funding for hydrogen fuel cell vehicles would exceed state funds and should be a federally funded program (see Cunningham, Gronich, et al, 2008). However, it is reasonable to expect an early fueling infrastructure program that is commensurate with the expected demands to be generated by the Zero Emission Vehicle (ZEV) mandate. The ZEV mandate is not mentioned in the report as a basis for any of the assessments for hydrogen fueling stations. If we examine the ZEV mandate there is a requirement of 7500 to 25,000 ZEVs in 2012 to 2014, and 25,000 to 50,000 ZEVs in 2015 to 2017. The ZEV requirement can be met with either battery electric vehicles (BEVs) or HFCVs.

Previously, there has been strong push back by automobile manufacturers on ZEVs on the basis that the technology wasn't ready for mass marketing. And in general these statements were correct and the California state ZEV program was judged to be too aggressive and premature. As such the ZEV program was scaled back to the number of vehicles mentioned above. However, significant progress has been made in fuel cell technology. At the recent Department of Energy "Annual Merit Review" (2008), progress has been reported for the cost and durability of fuel cells. Membrane lifetime of 7800 hours has been reported by 3 M for single membranes in the laboratory and projected costs for the mass production of fuel cells has now been projected to be \$78/kw. Honda and Daimler have proceeded with pre-production or production of HFCVs, and GM has always supported HFCVs and recently assigned 500 engineers to that effort. As such it is reasonable to expect 2000 to 4000 of the ZEVs to be HFCVs in the 2012 to 2014 timeframe. That is a significant demand that will require a sufficient network of large stations to meet that demand by 2012.

The CEC draft report also has the following statement:

The level of state funding that is envisioned for this program over the next seven years and the breadth of eligible activities will send a strong and consistent market development signal and will stimulate private investment in new fuels and vehicle technologies.

One of the significant deterrents to the automobile manufacturers is the lack of a suitable fueling infrastructure being in place prior to the vehicles being available. Germany is proceeding with a program that will bring together several automobile manufacturers and energy companies to provide stations and vehicles to Berlin. Bonhoff (2008) described to the Hydrogen Technical Advisory Committee the German government program that is devoting 500 million euros for the demonstration of hydrogen and fuel cell technologies from 2007 to 2016. They have been in active discussions with industry to build five retail hydrogen stations in Berlin to service the HFCVs. The automobile companies have found such a commitment on the infrastructure side to be critical. The automobile manufacturers have identified five blue dot areas within the LA basin where they

would want to see stations from Irvine to the San Fernando Valley along the 405 freeway.

The CEC draft report's funding chart also identifies two potential strategies:

Support implementation of high-volume fleet and retail hydrogen fueling stations strategically located to serve early market vehicles.

Promote mixed-use hydrogen fuel infrastructure to support transit fuel cell buses, possible hydrogen/compressed natural gas blending for transit buses, light-duty vehicle fleets, and other applications (such as forklifts).

I am proposing that the CEC take an enabling position for five fueling stations to be built in 2011 (2 stations) and 2012 (3 stations) to meet the expected demand created by the ZEV mandate and create the fueling infrastructure environment in Southern California to match the industry's needs. The primary emphasis should be placed on meeting the retail needs of the automobile manufacturers in the five blue dot areas and only where mixed-use infrastructure can be incorporated to an already attractive site should it be employed.

Secondly, there is a new objective to be considered that was created by Governor's Executive Order S-03-05 to achieve an 80% GHG emission reduction from 1990 levels by 2050, which was not part of the original ZEV mandate. The CEC report makes the following assessment for that expected scenario:

"Market penetration begins in 2012 for each of the three types of SULVs, reaching about 55 percent of new vehicle sales by 2050. The market penetration rate steadily increases throughout the time period for fuel cell and battery electric vehicles. However, plug-in electric vehicles peak at 35 percent of new vehicle sales in 2035. After that, they lose market share to battery electric vehicles as these vehicles become more capable of providing the service life and function of plug-in electric vehicles. By 2050, fuel cell vehicles comprise 22 percent of new vehicle sales and battery electric vehicles comprise 26 percent, while the plug-in vehicle sales have fallen to 7 percent of new vehicle sales."

First, I agree with beginning market penetration as early as 2012 (see Cunningham, Gronich, Nicholas, 2008) but it is difficult to see why electric platform vehicles only reached 55% of new vehicle sales by 2050. It is a given that the electric platform vehicle is going to be more expensive than gasoline vehicles. However, there is a significant possibility that fuel costs are going to be less than combustible fuels in that timeframe. Certainly we should be past peak oil production by any experts view. And one should expect a carbon tax or cap and trade government policy by then to further enhance electric platform vehicles. Figure 2 of the report shows that with a combination of Super Ultra Low Carbon, Ultra Low Carbon and gasoline vehicles that the 80% reduction target is not met. It also assumes that biomass is used for 50% of the HFCVs and for E 85 vehicles. I believe that is a far greater demand that can be reasonably be expected from biomass feedstock including waste streams and dedicated crop resources. Also the all battery vehicle vs the plug-in hybrid vehicle obviously reduces the demand for a combustible fuel that is unlikely to be the case. So even the case shown that does not meet the required target GHG reductions is optimistic. My point is that the electric platform is essential to achieve the target and a greater penetration rate of electric platform vehicles is more likely to be the case than a mixed fuel scenario. See Greene et al (2008) for an analysis of new vehicle penetration rates that arrive at an 80% new vehicle penetration rate by 2050.

Also, I did not find the economic analyses to support the conclusion made in the report that the battery electric vehicle (BEV) would gain ascendancy over the plug-in hybrid by 2035. If any economic assessment of these alternatives is made then that is a difficult statement to support. Kromer & Heywood (2007) (see page 118) did a comparative analysis for hybrid electric, plug-in hybrid for 30 mile and 60 mile range batteries, fuel cell vehicles and 200 mile range battery electric vehicles. Battery system costs were at \$200/kwh, fuel cell system costs were \$50/kw and hydrogen system storage costs were \$15/kwh. The estimated incremental OEM costs were \$1900 for HEV, \$4300 for 30 mile PHEV, \$6100 for 60 mile PHEV, \$3600 for HFCV and \$10,200 for BEVs. If battery costs could be decreased to \$150/kwh then BEVs would be \$6900 more costly than the

advanced gasoline engine vehicle. Considering the additional weight and volume of an all battery electric vehicle it is difficult to arrive at the above conclusion.

Third, given the results from Kromer & Heywood (2007), it should be clear that the targets for the electric platform vehicles are far more relaxed than the DOE 2015 targets for fuel cell and storage system costs. Prior assessments for the commercialization of these vehicles were on the basis of making them cost competitive to advanced gasoline vehicles. To achieve the 2050 carbon reduction goals that is unrealistic. To achieve such a societal goal we need to recognize that it is going to be more expensive and the question is really how to implement the least expensive approach. And with government policies and the above targets, it can now be expected to have a more robust response from the industry for these vehicles in response to the ZEV mandate.

Fourth, the report does not mention carbon sequestration strategies. In a DTI (James, et al, 2008) report on the production of hydrogen from fossil, renewable and nuclear resources, natural gas is the main fossil resource until 2025, but coal and biomass with carbon sequestration were the low cost producers of hydrogen fuel for vehicles in subsequent years. Coal and biomass with sequestration offer the possibility of providing a hydrogen fuel cost of \$2 to 3/kg (untaxed) that meets DOE's target and a fuel cost that would be less on a cents/mile basis than gasoline vehicles. As such there is the probability that some of the additional cost of all electric platform vehicles can be offset with a lower fuel cost. The co-production of hydrogen for fuel and electricity with sequestration offers the promise of both low fuel and electricity costs to the consumer. The report does not include biomass with sequestration which could have a significant negative impact on GHG emissions. Both solar and wind are intermittent sources of energy. Electrolysis is an expensive option even when the electrolyzers operate 24/7. As such, carbon sequestration strategies should be included especially in light of forthcoming policies associated with cap and trade or carbon tax policies.

Finally, the draft CEC Investment report purports the following strategy:

A funding strategy that emphasizes 2020 goals spurs commercial development of market-ready clean fuels and technology, which fulfills 2020 state mandates and

maximizes reductions of GHG emissions in the earliest timeframes possible. This would generate additional private investment to accelerate advances in new fuels and technologies and provide time for technology to mature to achieve even greater amounts of GHG emission reductions and achieve the 2050 goals.

From the discussion above, I believe that electric platform, both plug-in and fuel cell, vehicles are the essential development and that success in 2050 will depend on such new revolutionary technology. As such the meeting of 2050 targets should have a greater weighting factor for Super Ultra Low Carbon options.

In summary, I believe the report needs a comparative analysis of the costs of different options to achieve the 2050 goal for carbon reductions. That strategy needs to stress the new revolutionary electric-platform vehicle technologies and have less emphasis on the combustible fuel options. The report needs to better understand the fueling infrastructure requirements that are likely to be needed to support the ZEV mandate for 2012 to 2014. Five large permanent stations will be needed by 2011 and 2012 to give assurance to the automobile manufacturers that they will be able to sell their vehicles to the public. Existing or new stations at Burbank, Torrance, and Fountain Valley and at UCI in Irvine should receive consideration for operational support. All of the above infrastructure options need to be considered for funding in the 2008/09 and 2009/10 budgets.

Sincerely,
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