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Comments on Draft CEC AB118 Investment Plan

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1. **Page 5** – the SULC definition unfortunately refers to fuel cell, vehicles, should instead be more general, referring to hydrogen fueled vehicles. Specific reference to FC shuts the door on Hydrogen Internal Combustion Engines (HICE). Ford delivered 30 HICE (they call it H2ICE) buses last year, SunLine operates a Hybrid electric HHICE transit bus. A fuel cell transit bus will cost – today, in production of tens of vehicles – a million dollars more per unit than the HHICE or H2ICE. Recently published research reports peak efficiency approaching 50% for direct injected hydrogen engines, very competitive with fuel cells. As the engine does not require precious metal catalyst, the HICE approach offers substantial long term cost savings while using zero-carbon fuel and the potential advantages of diverse "home grown" fuel sources. Unfortunately, there are tens of millions.. maybe hundreds of millions more going to FC development, so the HICE possibility appears to be getting short changed. **Please reword to use the word "hydrogen" to replace "fuel cell".**
2. **Page 9** – Note that for the next few years it is a lot easier to get substantial carbon savings with HD vehicles as compared with LDVs. In fact, it is likely even better than you represent, as California transit fleet replacement with electric or hydrogen fueled buses will allow one MMT savings for buses alone.[1] ZE buses are going into production (for Canada) later this year, so we only have to decide to do this and fund it, New Flyer is ready to take orders! The Hydrogen Bus Alliance is compiling non-binding commitments for production of hundreds of FC vehicles for European transit firms within the next 7 years, they expect the price to be halved during that period of time. Port trucks are another near term target that would allow big fuel use reductions in a period of a decade or so. I would offer that Table 2 could be, probably should be, much more aggressive. Or, there might be two or three such tables showing the distinctions of BAU and more aggressive approaches. There may be considerable funding … generalizing from the banking industry to a more comprehensive stimulus package … available to jump start this investment need.

3. **Pg. 11 – Gap Analysis offers critical opportunities**
    a. We suggest the present process of funding is inadequate, even misguided, as the low hanging fruit … ethanol for example … is funded first, and hence most of the $35 billion per year goes for programs of limited yield. The tough long term, high yield programs do not get funded unless there are "left over" funds. The world could be operating on efficient HICE engines, but there has been only sporadic funding since the seminal work of 70 years ago which showed extremely high efficiencies (upwards of

[1] Approximately 10,000 transit buses are used in California, with resulting use of some 170M dge per year, resulting in some 1.7 MMT CO2 emissions. 8900 of these buses are at the largest 16 transit firms, most of these are subject to the ZEB rule.

50%) could result be attained with the very high (14:1 and over) compression ratios attainable only with hydrogen fuel. Likewise, the implementation of a widespread NG fueling infrastructure has awaited Detroit and Honda, which has chosen only most limited efforts for lack of fueling infrastructure!

b. Vehicle availability is critically dependent on engine development, there is a public nee for certified engines operating on natural gas and hydrogen which are suitable for hybrid electric medium and heavy duty vehicles. Cummins is not doing it as there is no guaranteed market, John Deere has pulled out of the business entirely for the same reason. One approach is to mandate purchase of thousands of NG and hydrogen vehicles, alternatively a publically supported program yielding engines developed which could be licensed for production. (paying back the development cost?)
c. Several firms, NREL too, have provided indications that *renewable* hydrogen will be very competitive, lower priced than last summers diesel and gasoline prices, if developed at large scale. As attractive cars and buses are now available, the key is the infrastructure and the long term availability of massive amounts of "green" hydrogen at competitive pricing. The time is right to get significant funding from federal sources as well to support several parallel programs in
    i. Wind to hydrogen, already demonstrated in small scale by Statoil-hydro, ISE/SCAQMD and most recently by XCEL Energy/NREL
    ii. Municipal waste to hydrogen, the French firm CNIM is looking for buses to use waste hydrogen from their municipal waste plants.
    iii. Chlor-alkali plant waste hydrogen,
    iv. H2S (sour well gas) to hydrogen, in the literature for years, but little implementation.
    v. Geothermal to hydrogen… I know of no prior work, but we have great resources.

4. **Pg. 15 - SULC fuels**
    a. Here it is important to focus on the HD segment, which in several ways is way ahead of the automotive.
        i. The fuel cell buses being supplied to Canada and London have 12,000 hour, 5 year warranty on the fuel cells.
        ii. Buses now appear to already meet the cited 2009 DOE durability goal,
        iii. Bus range is over 300 miles, 500 km.
        iv. Expectations are that these buses will operate 16 hours per day, 7 days a week. Total fuel displacement will be about 17,000 gallons diesel equivalent per bus per year.

v. The Hydrogen Bus Alliance is projecting a 50% cost reduction for these buses in the next 7 years, orders for hundreds of buses are being assimulated for a focused coordinated procurement.

b. Repeating item 3-c above, significant funding will be needed to develop renewable hydrogen programs at the scale needed for providing significant amounts of hydrogen at attractive and competitive prices.

5. **Pg. 16 – Battery Electric**

Opening up a seldom-spoken secret… FC vehicles are a lot easier than battery electrics! Range, battery safety, BMS…. are each distinct but related serious issues. Although there seem to be real opportunities for electric medium and heavy duty vehicles it has been extremely difficult to get adequate funding for vehicle development. Although there has been good progress in battery and BMS development, it has not kept up with the hype and expectations that have been built by BEV proponents.

6. Pg. 19 – Sustainability Studies

Crazy… but this whole section ignores the one clear path to sustainability, renewably sourced hydrogen. If we are serious about this, spending these amounts suggests someone is serious, this should be totally revamped! To use bunker crude to ship palm oil to Long Beach and call it a sustainable fuel is just hogwash!

It would seem to me that there is a structural problem, to attain sustainability is going to require thinking beyond what is represented here… wind hydrogen, solar, geothermal as well as waste to energy, forest biomass (is mentioned!), pyrolysis should be part of this discussion. Particular attention should be paid to the content of the recent NRC study.

7. **Pg. B-3, B-4 Tables B-2, B-3**

So diesel demand is 12 times the number of gallons of gasoline demand???

And figure B-1 of page B-6?