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Hydrogens true cost!!!!!!

Attached is a data analysis that was created by compiling local data on hydrogen resources and their true cost that is associated with the emissions and the added impacts associated with the current form of hydrogen production. The analysis includes a section on what we in Sacramento would need Hydrogen prices to be at to make it a competitive fuel source for ZEVs compared to BEVS.

Additional submitted attachment is included below.

Hydrogen Emissions and Cost Analysis

1 kg of H2 has the same average energy output as 52.5 kWh			
50-55 kWh / kg H2	H70	52.5 kWh / kg H2	52.5
	H35	26.25 kWh / kg H2	26.25
For Hydrogen cost to be the same as an EV kwh cost; Hydrogen would have to be no more than \$6.3 per kg.			
Cost per kWh =		\$0.15	
Cost per kWh (equivalent of H2)		\$0.15	0.15
Results: Hydrogens economic viability is not at the pace needed to compete with traditional ICE or EVs. There would need to be heavy subsidies, greater infrastructure and demand for costs to decrease. Further, the environmental impact of current Hydrogen production comes at a greater carbon intensity than traditional Gasoline and electric vehicles.			
1 kg of h2 = 1.55 gallons of gasoline 1 kg of h2 = 1.60 gallons of biodiesel			

Current Hydrogen is primarily produced through fossil fuel combustion to run electrolysis system to split H2O into H2*

Current pricing around Sacramento					
H2 pressure	Vehicle Type	Price /kg	Fuel source of H2 production	Carbon intensity (kgCO2/ kg)	per gallon
H70	Light duty	\$29.99	Natural gas (Grey Hydrogen)	9.82	36.5304
H35	Medium and Heavy duty	\$36.00			

Cost needed to make H2 competitive with Evs		Millions kWh		Cost difference / kg	
Total kWh/yr used to produce H2		227,325		H70	\$29.99
Cost of kWh to produce yr kg/H2		34,09875		H35	\$36.00
				Difference	(\$6.01)
Description		Cost			
Cost needed per kg of H2		\$ 7.88			

H2	Fuel Source	Cost per kg	Cost / kWh equivalent	Percent Renewable Energy + Hydro	Percent non- renewable	(lbs) of CO2 (per kg)	(lbs) CO2 per kWh	(lbs) of NOx
	Grey Hydrogen (H70)	\$ 29.99	\$ 0.57	-	-	24.25	0.46	0.01968
	Grey Hydrogen (H35)	\$ 36.00	\$ 1.37	-	-		0.92	

Emissions data for Hydrogen production			
KG produced at Air Products Manufacturing Corporation, Sacramento			
5025 83rd Street, Sacramento, CA 95826			
4.33 million kg annually H2		4.33	
4.78 million kg of methane		4.78	
45.44 million kg of co2		45.44	
Hydrogen source	Fuel used	Co2 emitted per kg of H2	Average Co2 emitted per kg of H2
Grey Hydrogen	Coal / Natural Gas	10 - 12 kg	11
Blue Hydrogen	Methane (CH4) + carbon capture	1.7 - 9.3 kg	5.5
Green Hydrogen	Renewables	0 kg	0
PSI per Hydrogen	kwh / kg H2	H70 MJ/L	H35 MJ/L
H70 = 10,000 psi	52.5	5.6	2.8
H35 = 5,000 psi	26.25		

1 megajoule = 0.27kwh

Hydrogen Emissions and Cost Analysis

Hydrogen transport Cryogenic Tanker Co2 emissions data		
Description	Value	Units
Fuel efficiency (low end)	4	mpg
Fuel efficiency (high end)	6	mpg
Average MPG (4–6 mpg)	5	mpg
Converted to L/100 km (4–6 mpg avg)	47.043	L/100 km
Total Trip Emissions (tons CO₂)	1.5	tons
Fuel efficiency (low end)	6	mpg
Fuel efficiency (high end)	8	mpg
Average MPG (6–8 mpg)	7	mpg
Converted to L/100 km (6–8 mpg avg)	33.60214286	L/100 km
Total Trip Emissions (tons CO₂)	1.1	tons
Typical LH2 Tanker Capacity (liters)	49200	liters
Hydrogen Density (kg/L)	0.071	kg/L
Estimated Hydrogen Payload (kg)	5000	kg
Total Trip Emissions (tons CO ₂)	2.6	tons
Total Trip Emissions (kg CO ₂)	2600	kg
CO₂ Emissions per kg H₂ transported	0.52	kg CO₂/kg H₂
Hydrogen Production (H70) Co2 emissions data		
Producing hydrogen through SMR emits approximately 9.3 kg of CO ₂ per kilogram of hydrogen	9.3	kg CO ₂ /kg H ₂
Total kg CO₂ / kg H₂	9.82	kg CO₂/kg H₂

Hydrogen Emissions and Cost Analysis

Energy efficiency adjusted for energy content						
1 kg of H2 (H70) has the same energy output as 52.5 kWh			Energy output \$ (energy equivalent)			
			Hydrogen		Electricity	
1 kilogram	52.5 kWh	52.5	1 kg	\$29.99	\$7.88	52.5 kWh
1 gram	0.05 kWh	0.05	1 gram	\$0.03	\$0.01	0.05 kWh
			Actual energy used			
Cost per kWh =	\$0.15	0.15	Vehicle Type	Energy usage (in kWh)	Energy loss (in kWh)	
Cost of Hydrogen per gram	\$0.03	0.03	Electric Vehicle	45.67	6.83	
			Hydrogen	31.5	21	
			Actual KG used		KG's lost	
Vehicle Type	Total fuel input	Energy use for motion	Energy loss	Electric Vehicle	0.87	0.13
Electricity vehicles	100%	87%	13%	Hydrogen	0.60	0.40
Hydrogen	100%	60%	40%	Actual \$ used towards motion		\$ lost per gallon purchased
				Electric Vehicle	\$6.85	\$1.02
				Hydrogen	\$17.99	\$12.00

Energy efficiency adjusted for energy content						
1 kg of H2 (H35) has the same energy output as 26.25 kWh			Energy output \$ (energy equivalent)			
			Hydrogen		Electricity	
1 kilogram	26.25 kWh	26.25	1 kg	\$36.00	\$35.96	26.25 kWh
1 gram	0.05 kWh	0.026	1 gram	\$0.04	\$0.04	0.026 kWh
			Actual energy used			
Cost per kWh =	\$1.37	1.37	Vehicle Type	Energy usage (in kWh)	Energy loss (in kWh)	
Cost of Hydrogen per gram	\$0.04	0.03	Electric Vehicle	22.84	3.41	
			Hydrogen	15.75	10.5	
			Actual KG used		KG's lost	
Vehicle Type	Total fuel input	Energy use for motion	Energy loss	Electric Vehicle	0.87	0.13
Electricity vehicles	100%	87%	13%	Hydrogen	0.60	0.40
Hydrogen	100%	60%	40%	Actual \$ used towards motion		\$ lost per gallon purchased
				Electric Vehicle	\$31.29	\$4.68
				Hydrogen	\$21.60	\$14.40