

# Clean Fleet Report

## One Million Hydrogen Riders in California

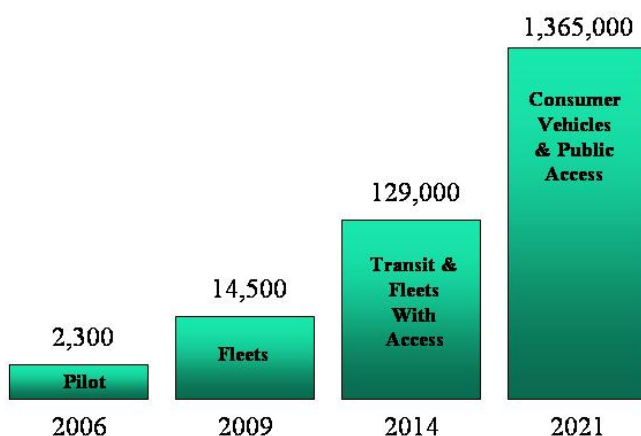
California will have one million daily riders on hydrogen vehicles by 2021 if this Optimistic Scenario becomes a reality. Although this will be less than 3% of the state's population, it will be a major milestone in achieving energy independency and a reduction in global warming. Most encouraging is that California has a long history of successful innovation that spreads throughout the world.

In the early years, most of the hydrogen riders will be on buses. New CARB Zero Emission Bus regulations could lead to 1,000 hydrogen buses in the state.

Daily ridership of hydrogen vehicles in California is currently over 2,000 per day. The biggest growth of ridership is the result of eight hydrogen buses now running six to 16 hours daily, carrying an average of 200 to 400 riders per bus per day. Jaimie Levin, Director of Marketing for AC Transit, reports rider enthusiasm and strong community support and predicts that the day will arrive when some hydrogen buses will carry over 1,000 riders daily. SunLine Transit Agency and Santa Clara VTA report enthusiastic rider acceptance of their hydrogen buses.

*(Continued on page 4)*

## Hydrogen Daily Rider Growth



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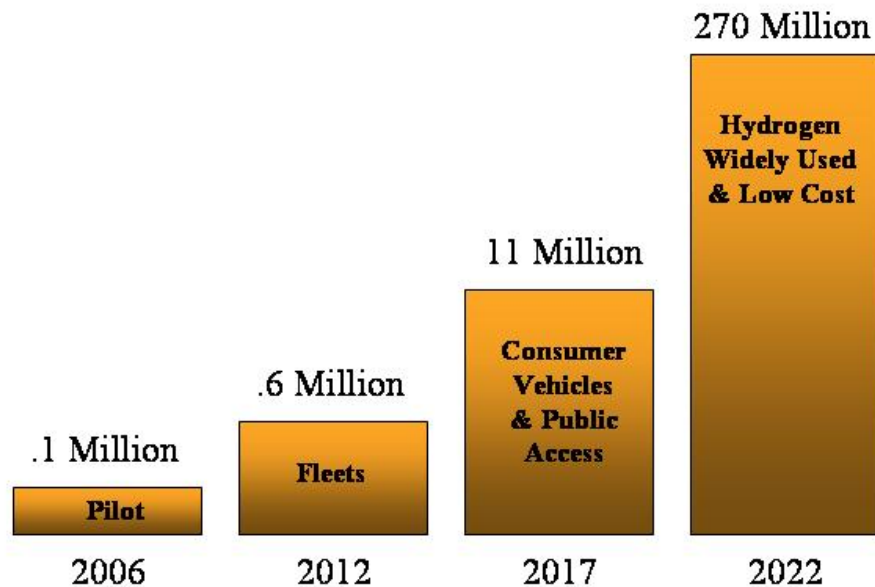
## CALENDAR

- Sept 20 **Cleantech Venture Forum**  
[cleantech.com](http://cleantech.com)
- Sept 25 **ZEV Technology Symposium**  
[arb.ca.gov/msprog/zevprog](http://arb.ca.gov/msprog/zevprog)
- Oct 4 **Renewables to Hydrogen Forum**  
[hydrogenassociation.org](http://hydrogenassociation.org)
- Oct 8 **American Public Transportation**  
[apta.com](http://apta.com)
- Oct 25 **International Conference on Hydrogen and Fuel Cells**  
[hamburg-messe.de/H2Expo](http://hamburg-messe.de/H2Expo)
- Jan 18 **California Hydrogen Business Council**  
[californiahydrogen.org](http://californiahydrogen.org)

## California Growth of Hydrogen Vehicles and Riders: Optimistic Scenario

Optimistic H2 Growth	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>H2 Vehicles Annual Incremental Delivery</b>																			
FC LDV Auto, SUV, truck			70	70	70	70	140	280	560	1,120	2,240	4,480	8,960	17,920	35,840	71,680	143,360	286,720	573,440
HICE LDV - cars, trucks, SUV			26	8	8	8	14	23	39	67	114	193	328	558	949	1,613	2,742	4,661	7,924
FC Buses			3		3	4	6	8	10	12	14	17	20	25	29	35	42	51	61
HICE buses & shuttles			2	2	2	2	3	6	10	17	28	48	82	66	53	42	34	27	22
HCNG buses				4	6	8	11	15	22	30	42	59	83	100	100	100	100	100	100
FC Class 4 and larger truck/van					1	1	2	3	4	5	8	11	15	21	29	40	57	79	111
Small Specialty & Motorcycle					1	1	2	3	4	5	8	11	15	21	29	40	57	79	111
Military Medium, Heavy, Tactical				2	3	6	10	17	28	48	82	140	237	403	685	1,165	1,981	3,368	5,725
Truck H2 APUs					1	1	2	3	4	5	8	11	15	21	29	40	57	79	111
Forklifts/goods move					4	7	12	20	33	57	97	164	279	474	806	1,371	2,330	3,962	6,735
<b>Total H2 Vehicles</b>			<b>101</b>	<b>86</b>	<b>99</b>	<b>109</b>	<b>201</b>	<b>377</b>	<b>714</b>	<b>1,367</b>	<b>2,640</b>	<b>5,133</b>	<b>10,034</b>	<b>19,608</b>	<b>38,549</b>	<b>76,128</b>	<b>150,759</b>	<b>299,126</b>	<b>594,340</b>
<b>H2 Vehicles Total In Service</b>																			
FC LDV Auto, SUV, truck	40	80	150	220	290	360	500	780	1,340	2,460	4,700	9,180	18,140	36,060	71,900	143,580	286,940	573,660	1,147,100
HICE LDV - cars, trucks, SUV		10	36	44	52	60	74	97	136	203	316	510	838	1,396	2,345	3,957	6,699	11,360	19,284
FC Buses		4	7	7	10	14	20	28	38	50	64	81	102	126	156	191	234	285	346
HICE buses & shuttles		1	3	5	7	9	12	18	28	45	73	121	203	269	322	364	397	424	446
HCNG buses			0	4	10	17	28	44	65	95	138	197	279	379	479	579	679	779	879
FC Class 4 and larger truck/van			0	0	1	2	4	7	11	16	24	34	49	70	99	139	196	275	386
Small Specialty & Motorcycle			0	0	1	2	4	7	11	16	24	34	49	70	99	139	196	275	386
Military Medium, Heavy, Tactical			0	2	5	11	21	38	66	114	196	336	573	976	1,662	2,827	4,808	8,175	13,900
Truck H2 APUs			0	0	1	2	4	7	11	16	24	34	49	70	99	139	196	275	386
Forklifts/goods move			0	0	4	11	22	42	75	132	229	393	672	1,146	1,953	3,324	5,654	9,616	16,351
<b>Total In Service Vehicles</b>	<b>40</b>	<b>95</b>	<b>196</b>	<b>282</b>	<b>377</b>	<b>479</b>	<b>669</b>	<b>1,026</b>	<b>1,706</b>	<b>3,016</b>	<b>5,559</b>	<b>10,528</b>	<b>20,283</b>	<b>39,416</b>	<b>77,159</b>	<b>151,916</b>	<b>300,345</b>	<b>595,510</b>	<b>1,183,114</b>
<b>Riders - Average Daily</b>																			
Auto, SUV, truck - H2 fuel cell		120	180	264	348	432	600	936	1,608	2,952	5,640	11,016	21,768	43,272	86,280	172,296	344,328	688,392	1,376,520
HICE - cars, trucks, SUV			43	53	62	72	88	116	163	243	380	611	1,005	1,675	2,813	4,749	8,039	13,632	23,141
Bus		1,000	2,013	2,314	3,802	6,209	10,097	16,372	22,914	30,027	38,562	48,804	61,094	75,842	93,540	114,778	140,263	170,845	207,544
Shuttle HICE			60	100	140	180	248	364	560	894	1,462	2,428	4,069	5,382	6,433	7,273	7,945	8,483	8,913
HCNG bus				1,323	3,650	7,626	14,289	25,318	39,177	57,248	82,547	117,966	167,553	227,553	287,553	347,553	407,553	467,553	527,553
FC Class 4 and larger truck/van					2	4	7	11	16	24	36	52	74	105	148	209	294	413	580
Small Specialty & Motorcycle					1	2	4	7	11	16	24	34	49	70	99	139	196	275	386
Military Medium, Heavy, Tactical					11	22	42	75	132	229	393	672	1,146	1,953	3,324	5,654	9,616	16,351	27,801
<b>Average Daily Riders</b>	<b>1,120</b>	<b>2,296</b>	<b>4,054</b>	<b>8,016</b>	<b>14,547</b>	<b>25,375</b>	<b>43,199</b>	<b>64,582</b>	<b>91,634</b>	<b>129,043</b>	<b>181,583</b>	<b>256,758</b>	<b>355,851</b>	<b>480,190</b>	<b>652,651</b>	<b>918,234</b>	<b>1,365,945</b>	<b>2,172,437</b>	
<b>Hydrogen Consumption Annual kg</b>																			
FC LDV Auto, SUV, truck			75,000	110,000	145,000	162,000	225,000	351,000	603,000	984,000	1,880,000	3,672,000	6,349,000	12,621,000	25,165,000	50,253,000	86,082,000	172,098,000	344,130,000
HICE LDV - cars, trucks, SUV			18,000	22,000	26,000	30,000	36,800	48,360	68,012	101,420	158,215	254,765	418,900	697,931	1,172,282	1,978,680	3,349,556	5,680,045	9,641,876
FC Buses			3,500	3,500	5,000	7,100	10,040	14,156	19,095	25,022	32,135	40,670	50,912	63,202	77,950	95,648	116,886	142,371	172,953
HICE buses & shuttles			1,500	2,500	3,500	4,500	6,200	9,090	14,003	22,355	36,554	60,691	101,725	134,552	160,814	181,823	198,631	212,077	222,833
HCNG			0	2,000	4,800	8,720	14,208	21,891	32,648	47,707	68,789	98,305	139,627	189,627	239,627	289,627	339,627	389,627	439,627
FC Class 4 and larger truck/van			0	0	500	1,200	2,180	3,552	5,473	8,162	11,927	17,197	24,576	34,907	49,370	69,617	97,964	137,650	193,210
Small Specialty & Motorcycle			0	0	500	1,200	2,180	3,552	5,473	8,162	11,927	17,197	24,576	34,907	49,370	69,617	97,964	137,650	193,210
Military Medium, Heavy, Tactical			0	1,000	2,700	5,590	10,503	18,855	33,054	57,191	98,225	167,983	286,571	488,170	830,889	1,413,511	2,403,969	4,087,747	6,950,170
Truck H2 APUs			0	0	500	1,200	2,180	3,552	5,473	8,162	11,927	17,197	24,576	34,907	49,370	69,617	97,964	137,650	193,210
Forklifts/goods move			0	0	2,000	5,400	11,180	21,006	37,710	66,107	114,382	196,450	335,965	573,141	976,340	1,661,778	2,827,022	4,807,938	8,175,494
<b>Total Annual H2 Consumption kg</b>			<b>98,000</b>	<b>141,000</b>	<b>190,500</b>	<b>226,910</b>	<b>320,471</b>	<b>495,014</b>	<b>823,940</b>	<b>1,328,289</b>	<b>2,424,080</b>	<b>4,542,456</b>	<b>7,756,429</b>	<b>14,872,344</b>	<b>28,771,011</b>	<b>56,082,920</b>	<b>95,611,584</b>	<b>187,830,755</b>	<b>370,312,585</b>
<b>Gasoline Displaced (gge/yr)</b>			<b>73,500</b>	<b>105,750</b>	<b>142,875</b>	<b>170,183</b>	<b>240,353</b>	<b>371,261</b>	<b>617,955</b>	<b>996,217</b>	<b>1,818,060</b>	<b>3,406,842</b>	<b>5,817,322</b>	<b>11,154,258</b>	<b>21,578,258</b>	<b>42,062,190</b>	<b>71,708,688</b>	<b>140,873,066</b>	<b>277,734,439</b>

# Hydrogen Displaces Millions of Gallons of Gasoline



## Optimistic Scenario Assumptions

There are several assumptions supporting this Optimistic Scenario for Hydrogen Growth. The Zero Emission Bus regulations will stay on track. Major auto companies will stay on track in selling limited production vehicles, starting for some in 2010.

Most early sales will continue to be to government fleets which are looking beyond short-term cost per mile to meet energy independence and environmental goals.

Total ridership includes fuel cell, HICE, and HCNG vehicles. Currently most vehicles are fuel cell. This is expected to continue with fuel cell prices dropping and warranties extending for years, lowering lifecycle costs.

This scenario assumes that vehicle growth will slow to 40 to 70% annually in various categories of vehicles. Major early fleets are like anchor tenants in a shopping center. SunLine started with one bus. Soon other hydrogen vehicles were using the same fueling station. CNG vehicles then started using hydrogen-CNG blends, increasing fuel efficiency and reducing damaging emissions. Stations are being expanded in capacity to support larger fleets.

The cost of hydrogen will continue to fall. In 2007, two California stations are expected to sell hydrogen for under \$4 per kilogram. The hydrogen will be used in fuel cells that get over twice the mileage of convention gasoline engines. At these two locations, hydrogen fuel will be less expensive than gasoline. Costs will fall for several reasons: volume production, increase use of pipelines instead of expensive diesel trucks to transport the fuel, more capturing of waste hydrogen. By 2012, BP may even have a large-scale power plant in Carson that also creates volumes of hydrogen.

## Clean Fleet Report

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The Clean Fleet Report now provides the latest news about fleets using hydrogen, alt-fuels and battery-electric in California. California fleets now have over 2,000 average daily riders on hydrogen vehicles. Current H2 fleet news, profiles, forecasts, and links are included.

OPTIMARK inc. is the publisher of the California Hydrogen Report. Since 1992, OPTIMARK has provided market intelligence, reports, education, outreach, market and partner development.

## 1,000,000 Hydrogen Riders for California (continued)

What about other technology and fuels? Ethanol and biodiesel will displace even more gasoline than hydrogen because they can be used in many vehicles currently on the road. Of all the alternative fuels, hydrogen is the only zero emission alternative.

Hybrid and plug-in hybrid technology will grow faster than hydrogen and create significant savings of gasoline. Hybrid technology compliments hydrogen, lowering the size of expensive fuel cells that are required. Currently almost all hydrogen vehicles are hybrid. AC Transit currently uses plug-in hybrid hydrogen buses that transport 800 people daily.

Vehicle costs will continue to fall from the present \$1 million fuel cell prototypes. Quantum Technologies delivered Toyota Priuses modified to run on hydrogen for about \$80,000. These hydrogen internal combustion engine (HICE) vehicles will continue to be part of lowering the cost of hydrogen transportation. HICE and fuel cell vehicle costs will continue to drop.

If these assumptions do not hold, then the hydrogen growth will be slower. Toyota presented a scenario where it could reduce cost 10X in its \$1 million fuel cell vehicles through improved technology and another 10X through manufacturing volume. Should this happen before 2022, then this Optimistic Scenario will go down in history as a pessimistic scenario, because it will be too low.

California plans to reduce petroleum use by 30% by 2022. This is ambitious given the continued growth in population (and population of vehicles). 30% is achievable if we are smart enough to do more riding together, riding less, and more riding cleanly. Hybrids, biofuels and hydrogen are all part of the solution. California Hydrogen Report's Optimistic Scenario projects hydrogen saving California 3% of its total gasoline consumption by 2022.

A sage said that we tend to over estimate success in the short term and under estimate it in the long term. The same growth may happen with hydrogen

transportation. As fleets expand and as the hydrogen stations expand in capacity, costs will diminish and ridership will continue to grow.

## Will Hydrogen Succeed?

### Pro

**50,000,000 tons sold annually**

**Energy independence need**

**Zero emissions**

**Oil cost increases**

**Early success**

**Billions invested in H2 by vehicle makers**

**Billions invested in H2 by oil producers**

**Safety**

### Con

**Hybrid alternatives**

**Biofuel alternatives**

**New diesel engines**

**Little infrastructure**

**Few vehicles**

**Fuel too expensive**

**Fuel cells too expensive**

**Storage & range**

**Warranty**

**Safety**