



The Future of Public Transport – In Pursuit of Zero Emissions

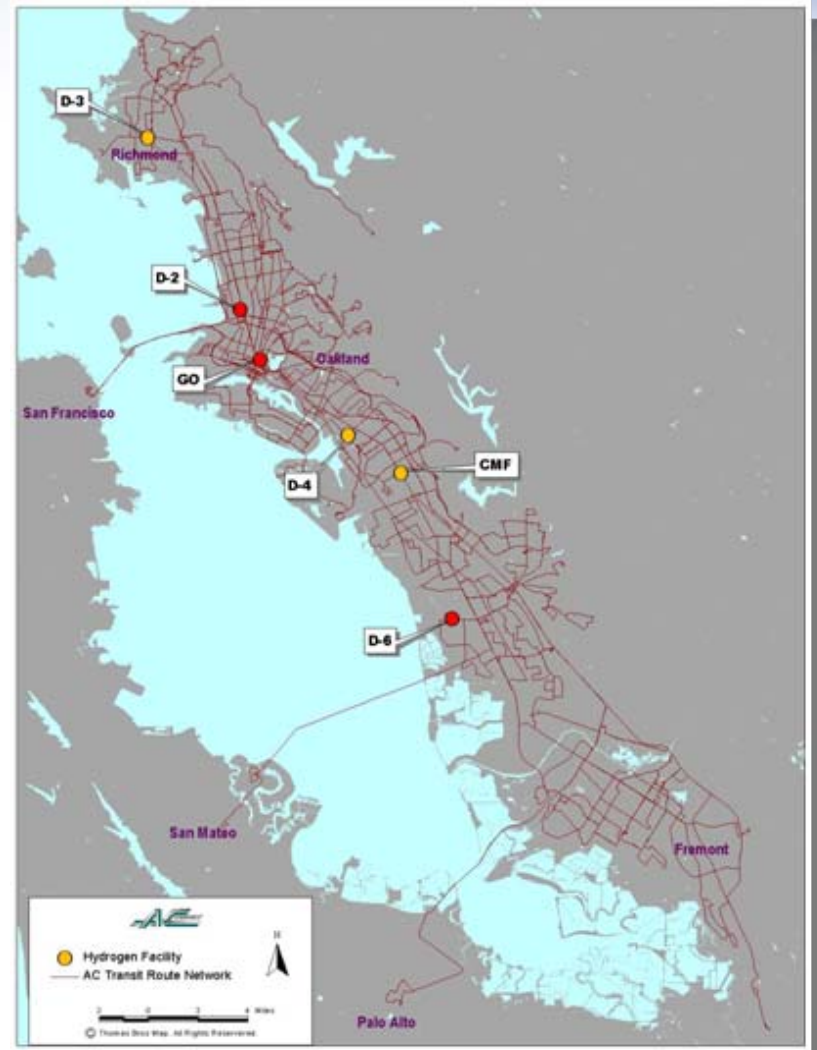
Jaimie Levin





AC Transit

- **Serving 1.5 million people in 13 cities**
- **61 million passengers**
- **600 buses**
- 2,000 employees
- \$325 million budget
- 105 lines (26 transbay)





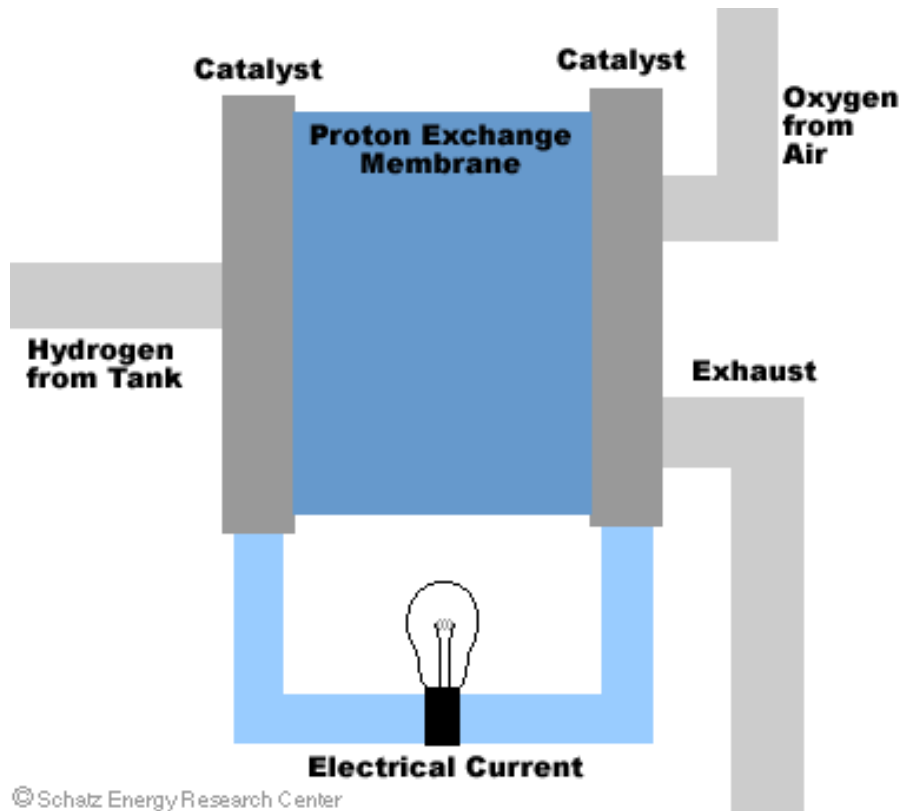
AC Transit Regional Role

One of 27 Transit Operators

- San Francisco MUNI
- BART (Capitol Corridor)
- **AC Transit**
- VTA
- Samtrans
- Caltrain
- Golden Gate
- County Connection
- ACE
- Wheels, Tri Delta, Vallejo, WestCAT
- 14 Smaller Operators



What's A Fuel Cell?



© Schatz Energy Research Center

- An electrical generator
- **NOT** a battery
- A chemical reaction between hydrogen and oxygen
- Emits only water vapor and heat
- 120 kW to 200 kW of output



Phase 1 – 26 Partners – \$21 Million





1st Generation Bus

- >267,000 Miles (as of OCT 2010)
- >700,000 Passengers
- 60% Better Fuel Economy
- 43% GHG Reductions
(Reforming Natural Gas;
100% reduction with solar or wind hydrogen)





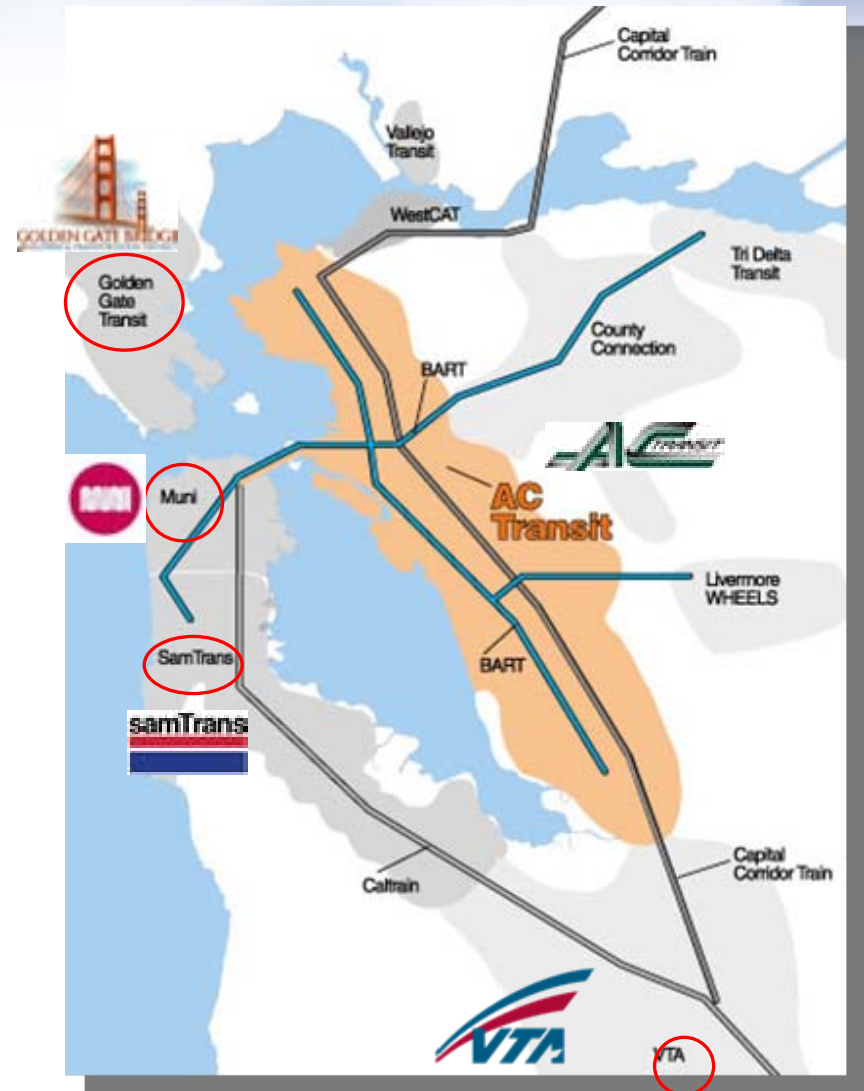
Passenger Survey – 493 Passengers

- Funded by Federal Transit Administration
- **ACT's Fuel Cell Program – 84% Positive**
- Program's Effect on Opinion of Local Government – **70% Improved**
- Importance of Considering Alternative Fuels – **90% Yes**
- Support **Expanded Fuel Cell Bus Program** at AC Transit – **81% Yes**



Phase 2 – Bay Area Demo

- \$60 Million
- 12 New Buses in 2010
- 5 Transit Agencies (>2,500 vehicles)
- Shared Service
- Shared Training





1st Generation Design





2nd Generation Design





3rd Generation Design – 28,000 Mi



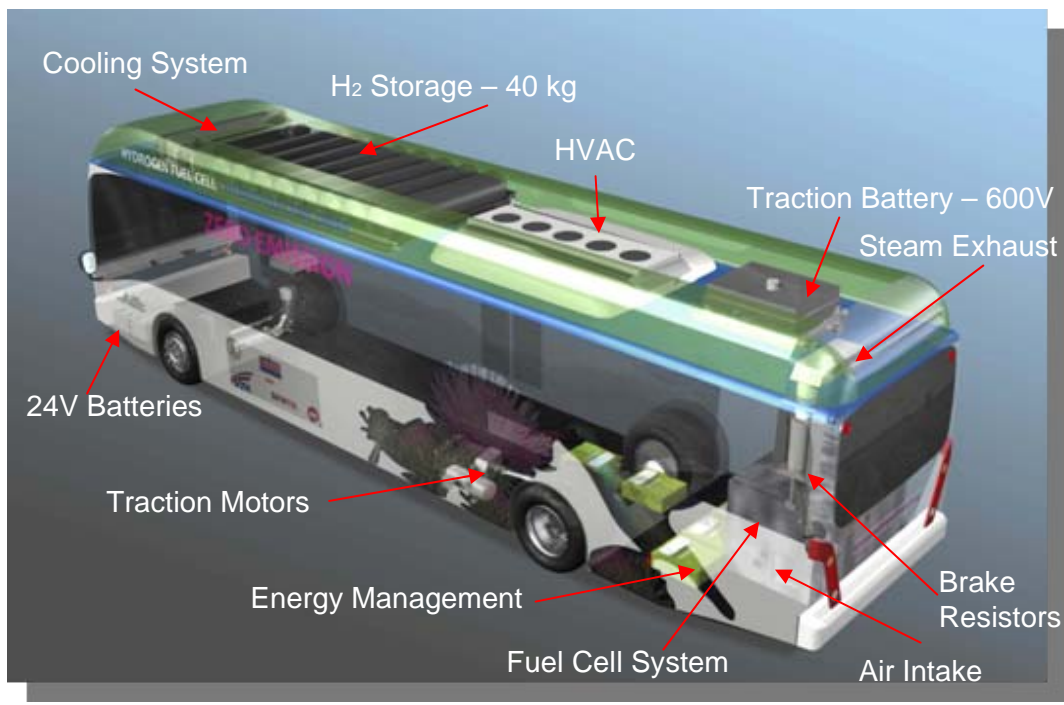
“Disneyland in The Real World.”





Next-Generation Enhancements

- 5,000 Pounds Lighter/Lower Profile
- OEM Integration/EnerDel Li-ion Batteries
- Hybrid-drive Components
- FC Cooling
- H₂ Storage
- Performance
- FC Durability
- Reliability



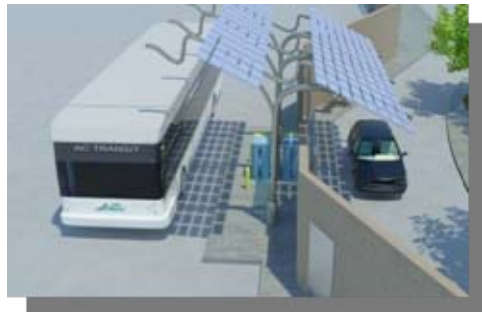
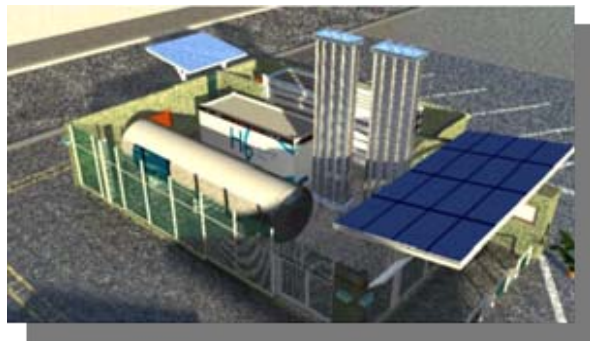


Oakland Temporary Fueling





New Emeryville Energy Station



- **Solar Electrolysis and H₂ Delivery**
- **6 to 12 buses daily**
- **Fast Fueling 5-6 kg/minute**
- **20 cars per day**
- **Toyota, Daimler, Hyundai**
- **Startup – April 2011**





Seminary Station – 180/360 kg/Day





ACT Solar Power – 1.3 Megawatts

AC Transit solar system will provide renewable power to Emeryville station

**\$6.4 Million FTA
TIGGER I Grant for
new solar system**



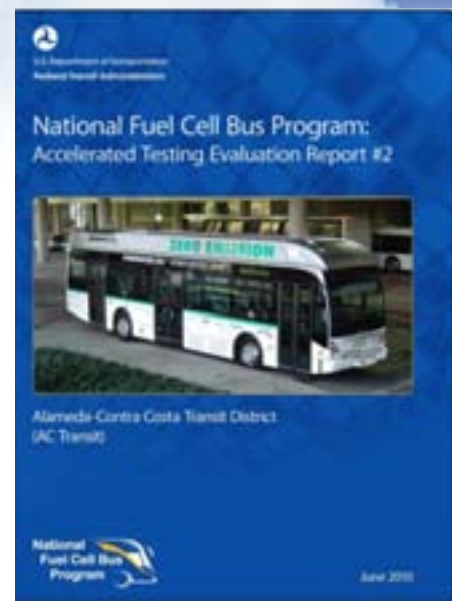
Existing solar at AC Transit Oakland Division





Evaluation

- In Partnership with NREL, FTA, and DoE
- **DoE has approved continued data collection and analysis of 12 buses and new stations through 2011.**
- Monthly and Semi-annual Performance Reports



ENERGY Department of Energy Fuel Cell Technologies Program

Bay Area Transit Agencies Propel Fuel Cell Buses Toward Commercialization

Participating Agencies and Parts of a System

Agency	Vehicle	Capacity	Power	Range	Cost
Alameda-Contra Costa Transit District (AC Transit)	FCM1	100	100 kW	100 miles	\$1.5 million
	FCM2	100	100 kW	100 miles	\$1.5 million
Alameda-Contra Costa Transit District (AC Transit)	FCM3	100	100 kW	100 miles	\$1.5 million
	FCM4	100	100 kW	100 miles	\$1.5 million
Alameda-Contra Costa Transit District (AC Transit)	FCM5	100	100 kW	100 miles	\$1.5 million
	FCM6	100	100 kW	100 miles	\$1.5 million





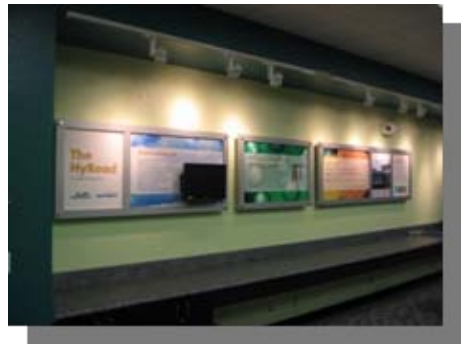
Education – \$1.1 million

HyTEC
Hydrogen Technology & Energy Curriculum
Integrating Hydrogen and Fuel Cells into a Standard High School Chemistry Curriculum

PROGRAM PARTNERS
LHS, Lawrence Hall of Science, ACTransit, and a green circular logo.

PROGRAM ADVISORS
National Hydrogen Association (NHA), Chobot Space & Science Center, California schools and teachers.

- In Partnership with **Lawrence Hall of Science at UC Berkeley**
- Curriculum Development for Middle- and Secondary Schools





Proof of Concept: Performance

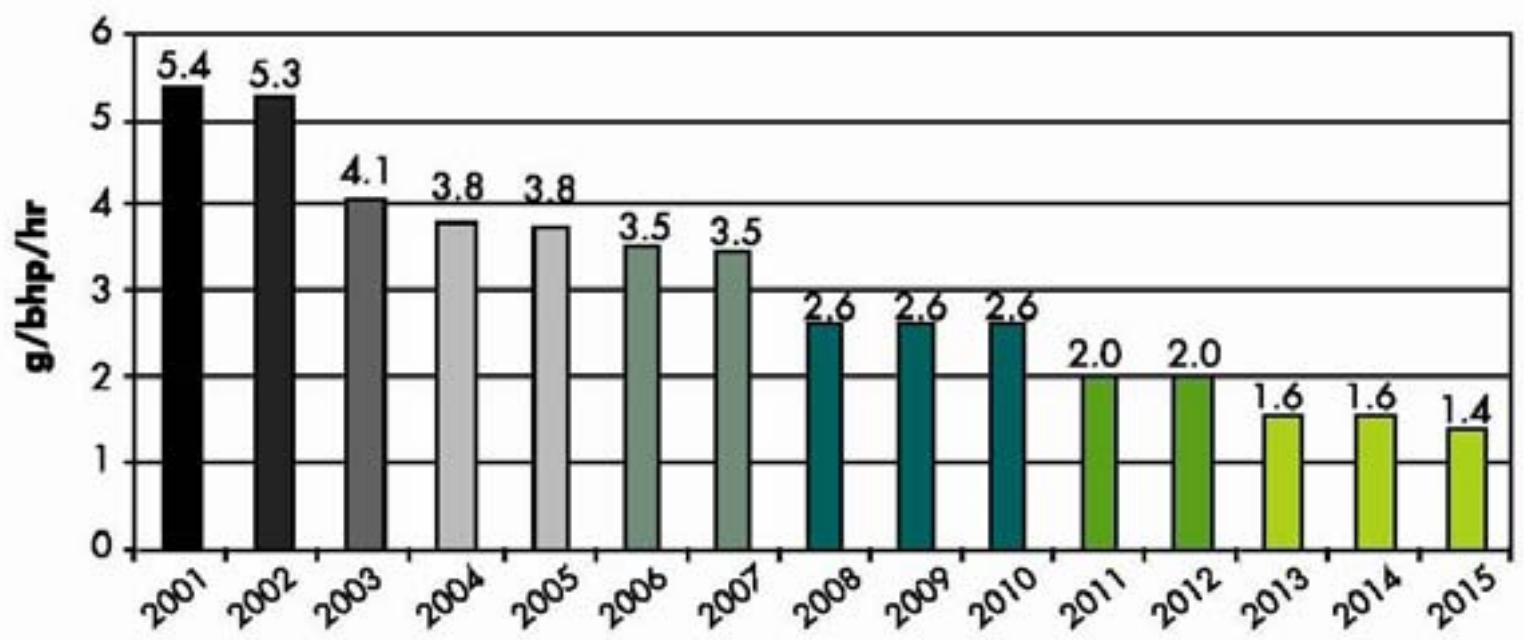
Next Steps	Evaluation Criteria
12 Next-Generation Buses in Service by November 2010	<ol style="list-style-type: none"> 1. Performance by different operators 2. Fuel economy 3. RELIABILITY 4. HYDROGEN SUPPLY
Four or Five Regional Centers of Excellence : Demo 25 to 50 Buses	<ol style="list-style-type: none"> 1. Reliability 2. DURABILITY 3. HYDROGEN SUPPLY





NO_x Emissions

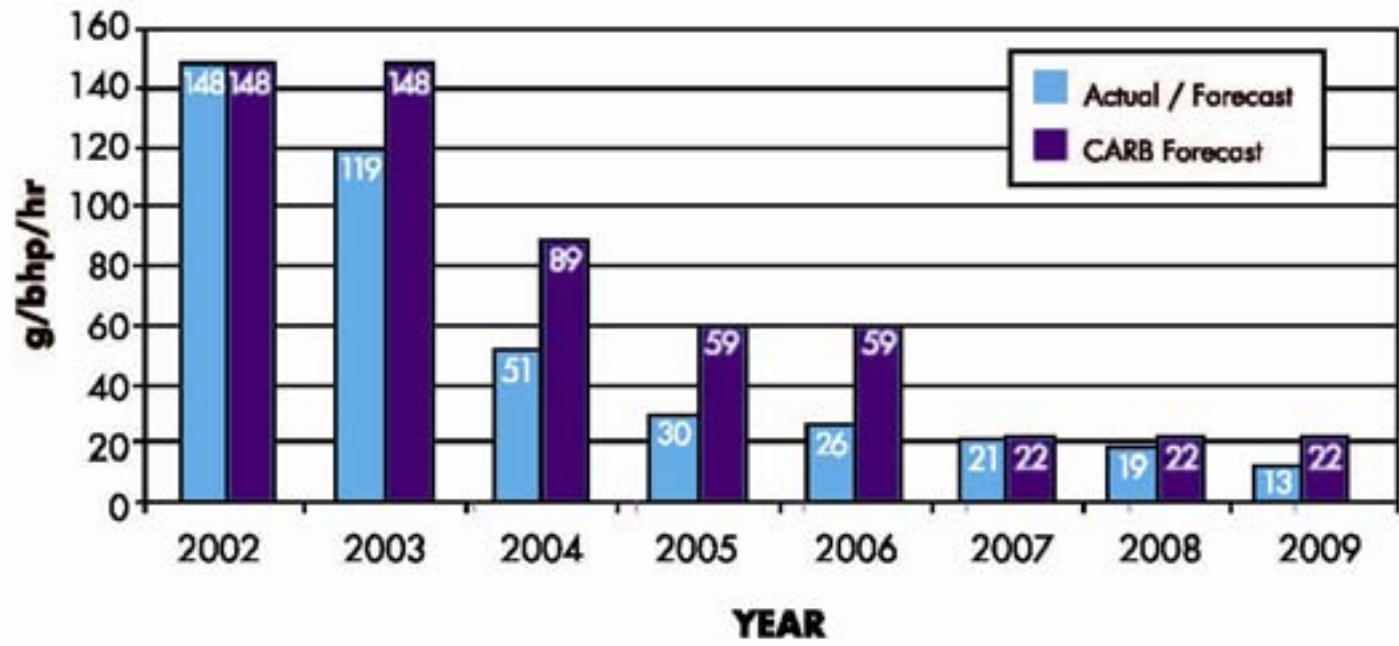
NO_x Fleet Average over 15-year Period AC Transit Urban Bus Fleet





PM Emissions

Total PM Emissions AC Transit Urban Bus Fleet





CO₂ Emissions

AC Transit CO₂ Emissions (metric tons)

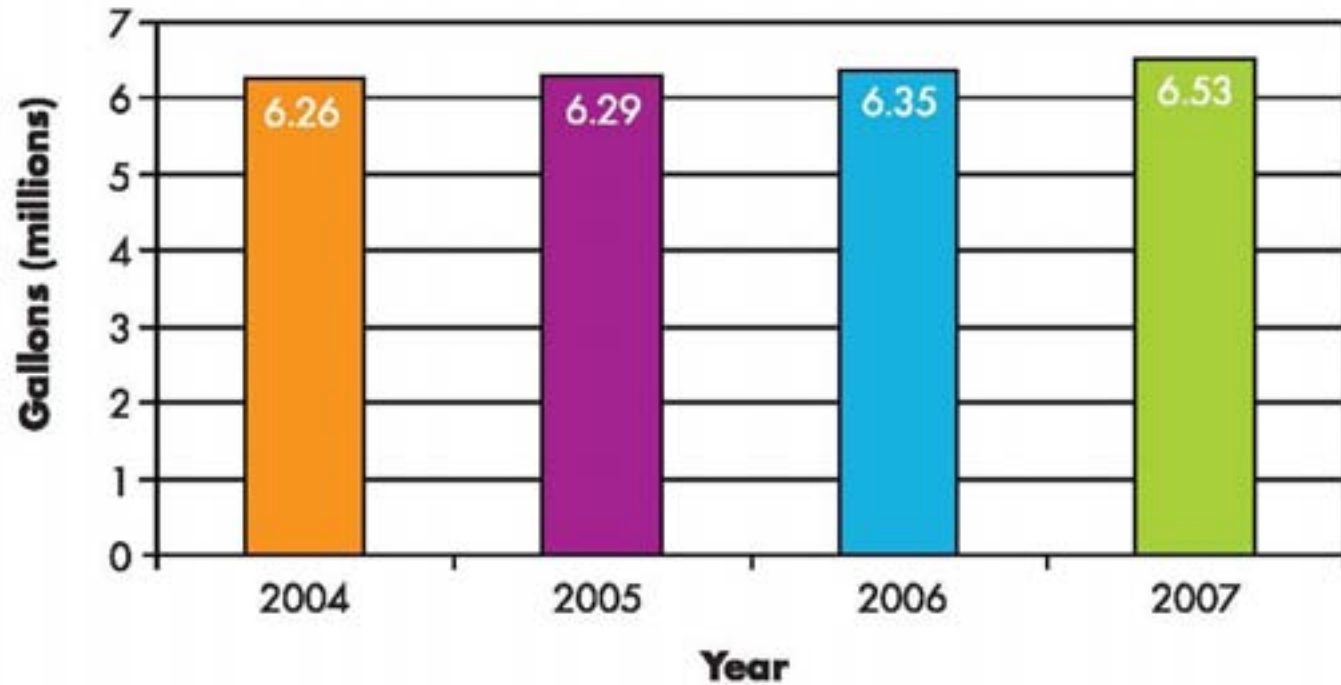
Source	2004	2005	2006	2007
Imported Natural Gas	2,047	1,830	1,965	2,131
Purchased Electricity	2,565	2,415	2,438	2,289
Fleet Diesel Consumption	62,384	62,631	63,108	66,015
Fleet Gasoline Consumption	1,299	1,372	1,138	1,322
Clean Fuel Test Program	—	—	—	356*
De minimis sources	NA	NA	152	62
Total CO₂	68,295	68,248	68,801	72,175*

**Does not include 2007 biodiesel emissions (25 metric tons) as they are considered biogenic.*



Diesel Consumption

Total Annual Diesel Consumption





Hybrids – 30% Fuel Reduction

