



South Coast Air Quality Management District Hydrogen Internal Combustion Engine Program



April 20, 2006

Miguel A. Pulido

Mayor, City of Santa Ana California

SCAQMD Governing Board Member



Santa Ana, CA

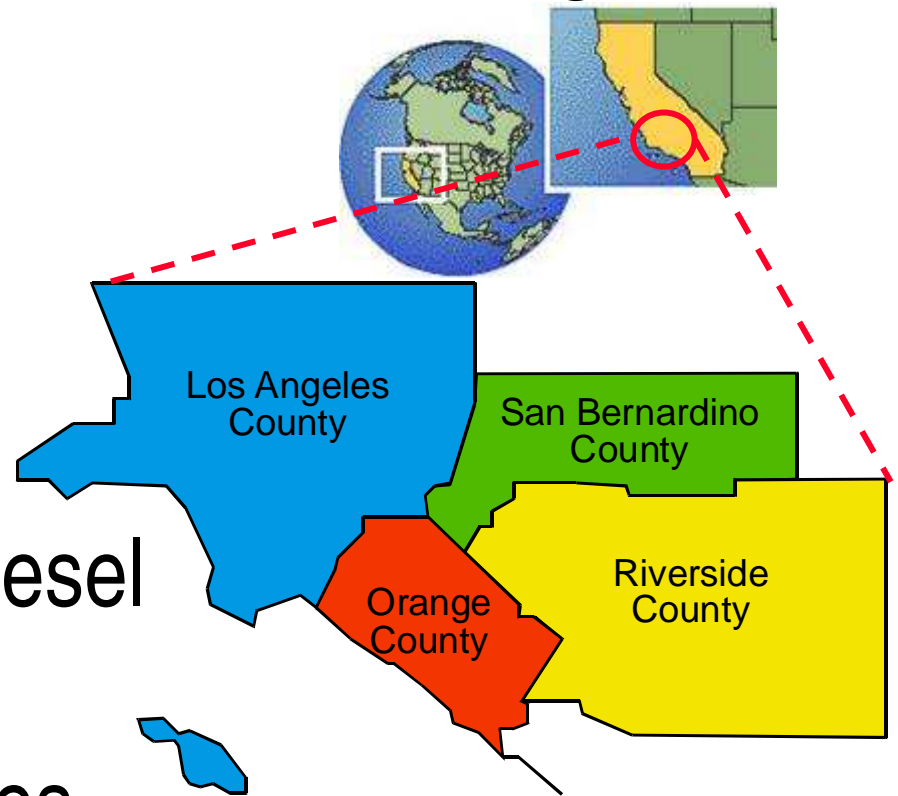


Mexico City

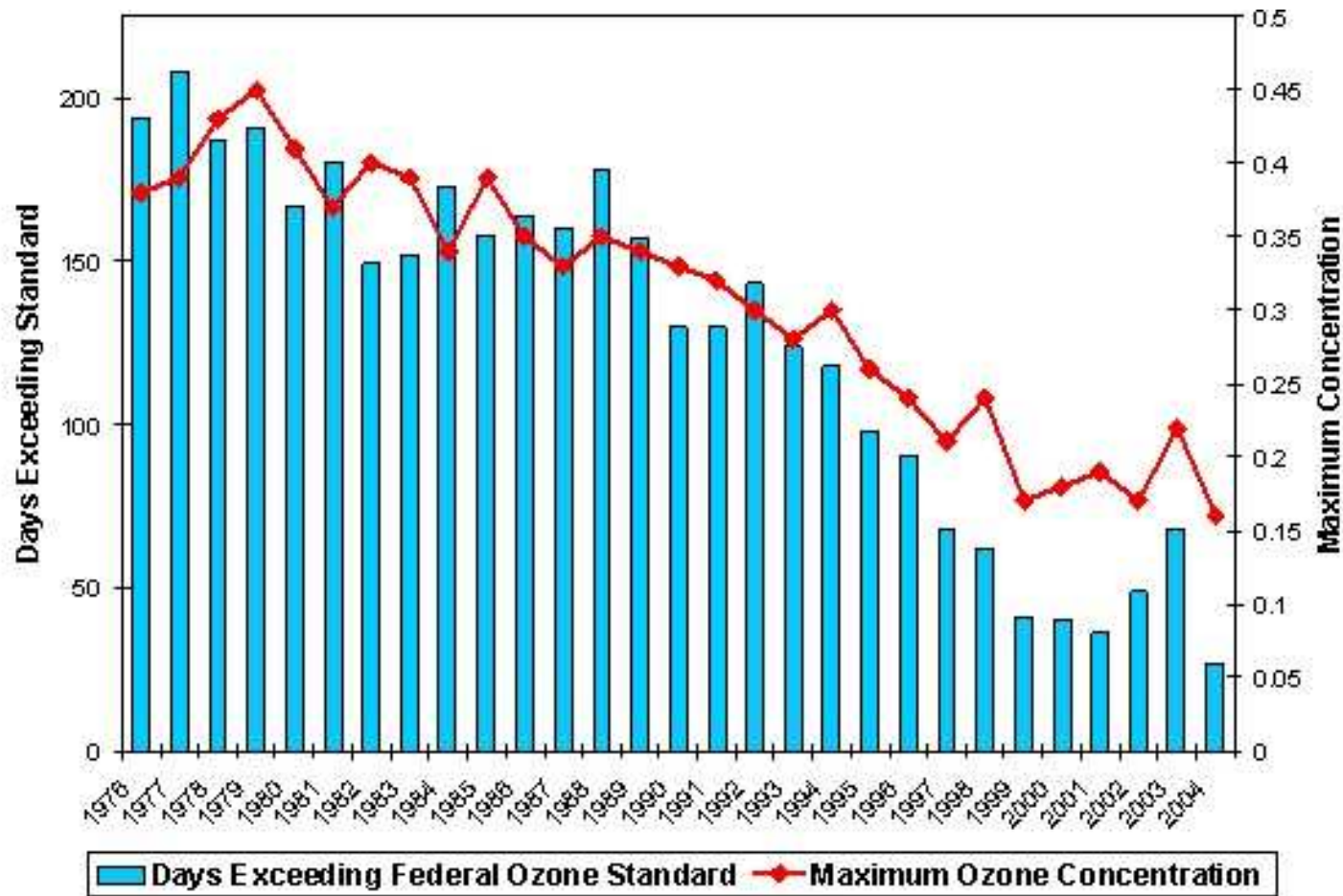
AQMD Background Setting

South Coast Basin:

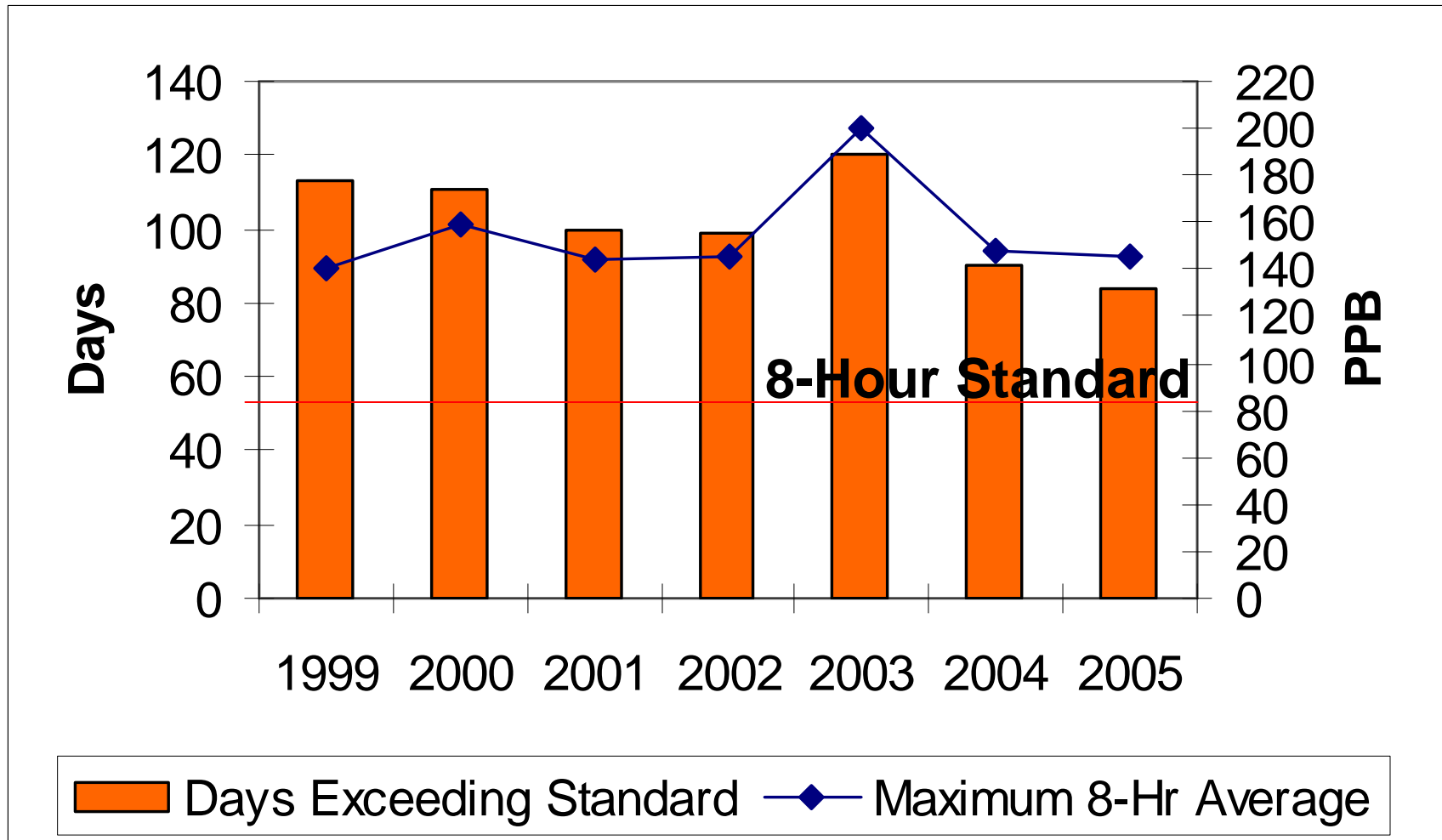
- 4-county region
- 11,000 sq. miles
- 16+ million residents
- Hundreds of thousands diesel vehicles
- Millions of gasoline vehicles
- Combined Ports of Long Beach and Los Angeles are nation's largest cargo gateway



Air Quality Setting: Days Exceeding 1-Hour Ozone Standard

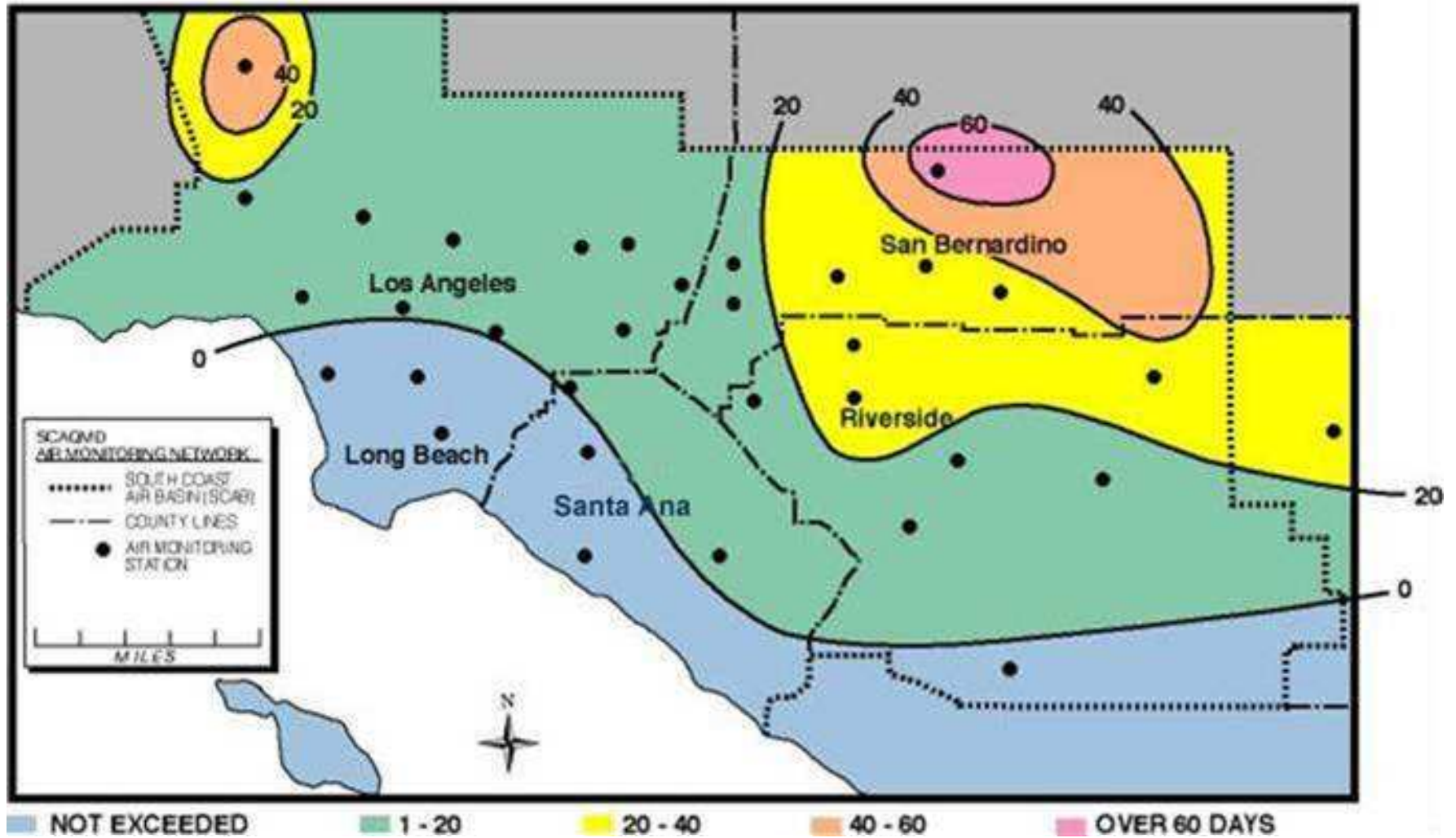


Trends of Basin 8-Hour Ozone



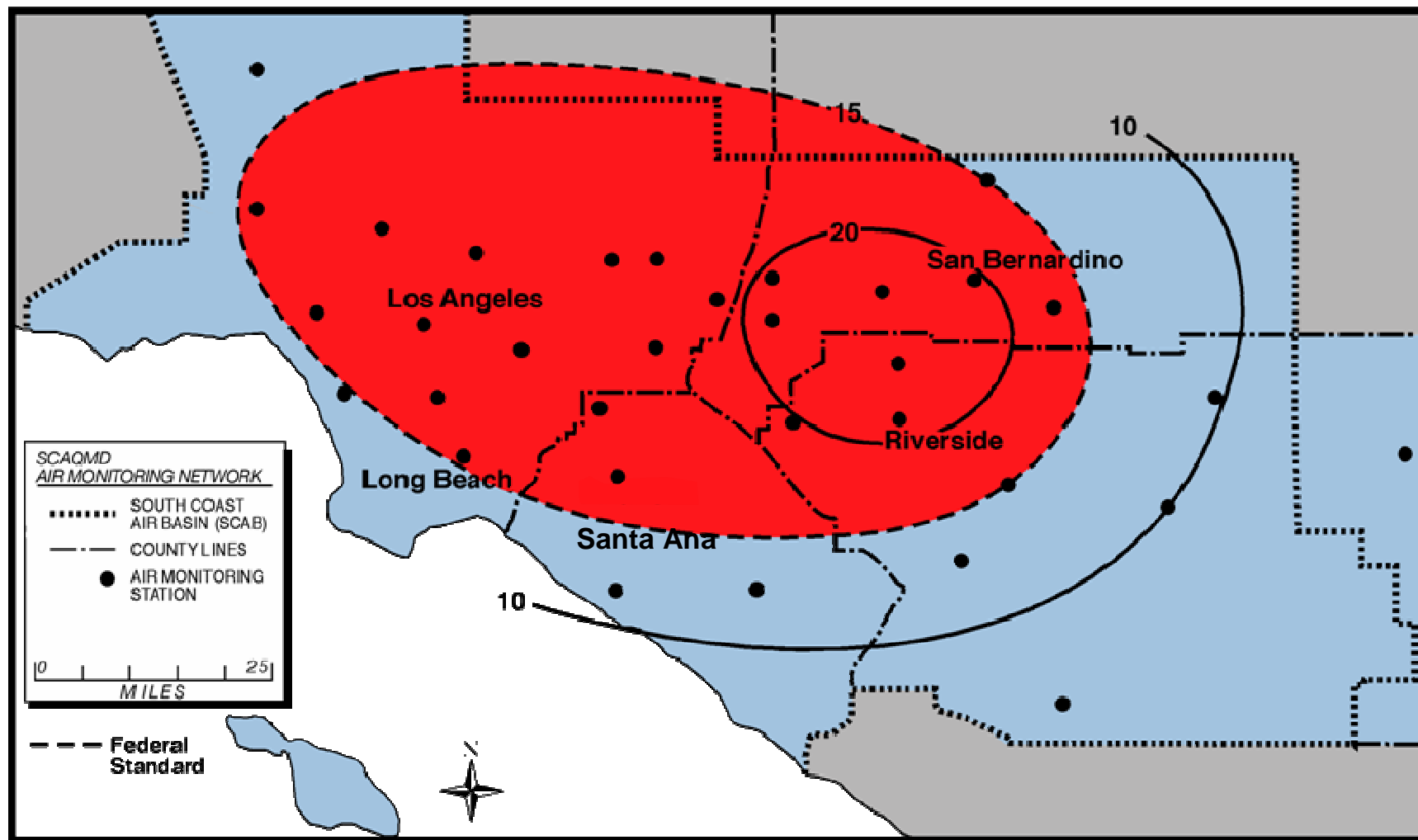
OZONE – 2005

Number of Days Exceeding the Federal Standard
(8-hour average > 0.08 ppm)



PM2.5 – 2004

Annual Arithmetic Mean, $\mu\text{g}/\text{m}^3$
(Federal Standard = $15 \mu\text{g}/\text{m}^3$)



NOT EXCEEDED

Over $15 \mu\text{g}/\text{m}^3$

California Hydrogen Highway Network

- Goal:
 - Up to 100 Stations and 2,000 vehicles by 2010
- AQMD support on implementation
 - Advisory Panel
 - Topic Teams
 - Continued support and opportunities for leveraging



AQMD's Hydrogen & Fuel Cell Technology for Transportation

- Work with US Department of Energy and Energy Companies on vehicle-infrastructure demonstrations
- Coordinating efforts with State and Federal programs
- Focus AQMD resources on
 - *Bridging Technologies/Activities*
 - *Local fueling infrastructure development*

AQMD Technologies Pathway



Fuel Cell Vehicles



Hydrogen ICEs

Natural Gas-H₂ Blends



Natural Gas ICE Vehicles



Hydrogen Fueling



Plug-in Hybrids

Bridging Technologies and Activities

Technologies

- Natural Gas
- Hydrogen/Natural Gas Blends
- Hydrogen-powered Internal Combustion Engines (ICE)
- Plug-in Hybrid Electric Vehicles (PHEVs)

Activities

- Outreach & Education
- Seeding/Initiating Market
- Leveraging/Catalyzing Automakers

Technology and Market Preparedness

AQMD Technologies Pathway

- Very expensive
- Limited H2 storage capability
- No commercial product yet



Fuel Cell Vehicles

- Less \$ than FCVs but
- Storage is still an issue
- H2 is expensive
- Low but measurable emissions



Hydrogen ICEs



H2 PHEVs

- Increased range
- Reduced H2 components
- More mature battery tech
- Even lower emissions

Five Cities Hydrogen ICE Vehicle and Fueling Infrastructure Project

- Partner with:
 - Burbank
 - Ontario
 - Riverside
 - Santa Ana
 - Santa Monica
- Develop and demonstrate hydrogen ICE vehicles
- Installation of hydrogen fueling stations by Air Products
- Vehicle conversions by Quantum Technologies



Santa Ana Opening Jan. 22



Riverside Opening Feb. 1

5 Cities Hydrogen Stations

Station	Date Open	Technology
Santa Ana	January 11, 2006	Mobile
Ontario	January 11, 2006	Mobile
Riverside	January 17, 2006	Electrolyzer
Burbank	January 31, 2006	Electrolyzer
Santa Monica	May 2006 *	Electrolyzer

* Scheduled



HF-150
150 kg @ 6600 psi

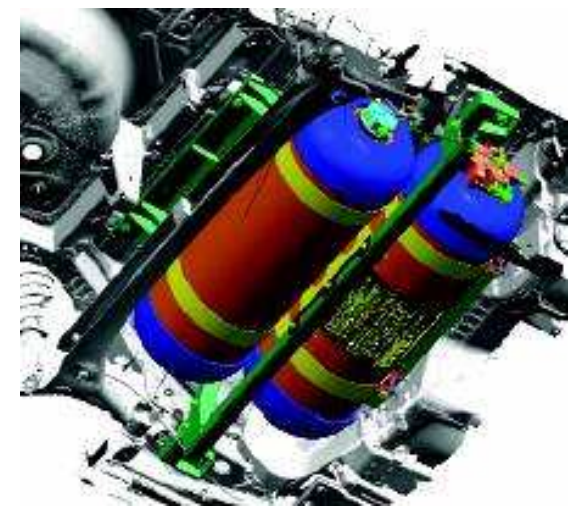


Proton Electrolyzer
0.5 kg/hr
52 kg @ 6250 psi



Hydrogen ICE Vehicles

- Toyota Prius – base platform
- Range ~ 70 miles
- 5 Year State experimental permit
- Lowest State emissions levels
 - Zero CO, HC, or CO₂ Emissions
- Similar driving characteristics as gasoline Prius
- 30 vehicles converted –
 - 5 for each city, 5 for AQMD



Vehicle Modifications

- Dedicated Hydrogen fuel system designed for high pressure hydrogen exposure
 - Major fuel components: fill valve, filter, storage tanks, valves, regulators, injectors and sensors.
- Other major changes:
 - New Turbo system added requiring altered air intake, routing and charge air intercooler
 - Exhaust system altered rear of resonator
 - Fuel level indication now on video screen display
 - Multiple electronic controllers

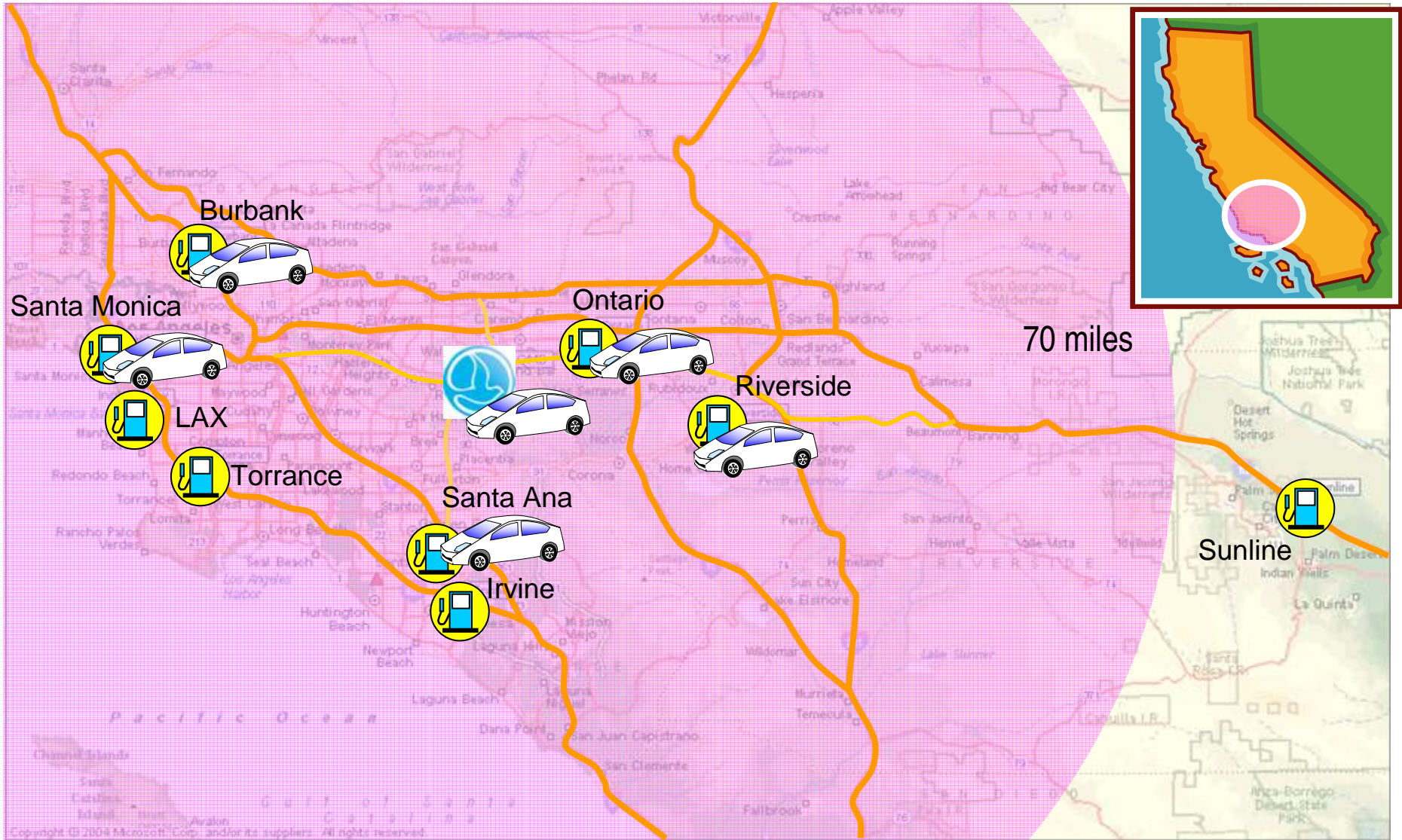


Hydrogen ICE Prius Fleet

- AQMD Testing Completed
 - Over 4,000 miles accumulated
- Santa Ana, Ontario, Riverside, & Burbank
 - Each city testing vehicles
 - Placed in city fleets for
 - Building & Safety
 - Parking Enforcement
 - Carpool Vehicles
- Santa Monica – currently testing one



Hydrogen Demonstration Stations



General Challenges

- Public perception of hydrogen – Hindenburg & explosive
- Codes and Standards not fully developed
- High costs – new technology in demonstration phase

*Need local champions
to ensure project success*

Station Specific Issues

- City and fuel provider worked closely with Fire Department to acquire permits
- Station location
 - Physical access to site
 - Assessing vehicle travel patterns
- Training City Personnel
 - Fueling
 - Emergency Response
- Coordinating vehicle delivery
- Public Access

Outreach and Education

- Orange County Auto Show
- Five Cities Station Openings
- National Hydrogen Association
- Fire Department Safety Training



Next Steps:

Plug-in Hybrid Electric Vehicles

- AQMD expanded PHEV program
 - Technical Working Group to address barriers
 - Outreach Plan to educate and establish initial market
- Alternative fuel, including hydrogen, PHEVs

Road to Success

- Need For Long-term and Near-term Solutions
- Need To Invest Now In Research-Demonstration Technologies
- Public-private Partnership – Most Important
- Sustained Funding Incentives

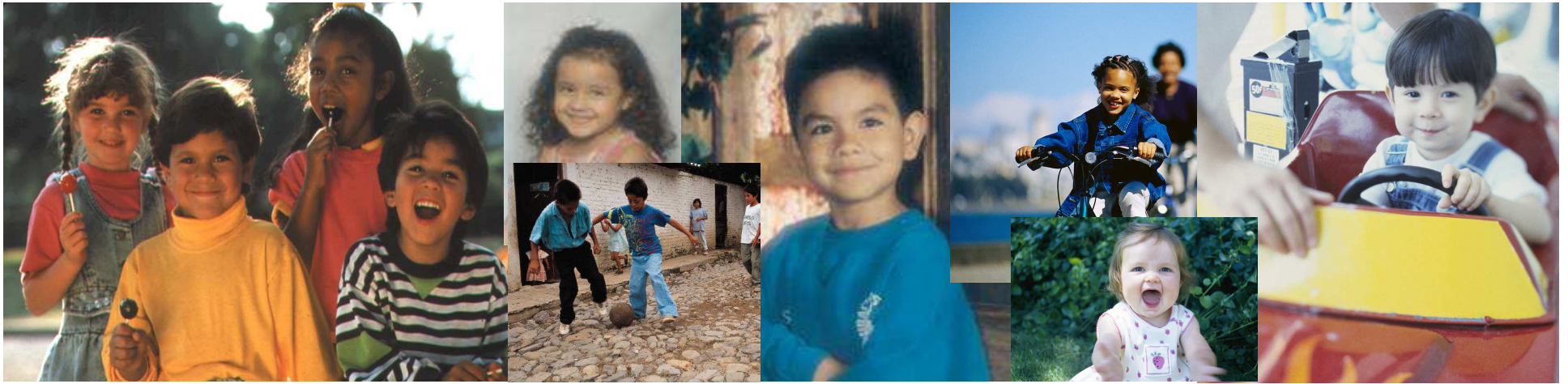


For More Information

www.aqmd.gov

- Air Quality Data
- Permitting Assistance
- Technologies
- Regulations
- Education Materials

The screenshot shows the AQMD website homepage. At the top left is the AQMD logo with the text "SOUTH COAST AQMD". To the right is a search bar with the text "SEARCH" and "GO", and a link "Can't find it? - Click Here". Below the search bar are navigation links: "Inside AQMD", "Community", "Business", "Technology", and "Health & Education". A banner below the navigation links reads "Cleaning the air that we breathe..." and "Welcome to South Coast Air Quality Management District". On the right side, there are language options: "Español | 中文 | 한국어". Below the banner is a carousel of images showing various scenes: a city skyline, a building, a street scene, and a landscape with the word "RIVERSIDE". To the right of the carousel are three buttons: "Alert! ▶", "Governing Board", and "Quick Links ▶". At the bottom, there is a banner for "ULTRAFINE PARTICLES" with the dates "April 30 - May 2, 2006" and the subtitle "The Science, Technology, and Policy Issues". A link "Click Here for Information On Any of These Items" is positioned above the banner.



Clean Air Can't Wait!

<http://www.aqmd.gov/tao/Demonstration/OtherActivities.htm>