Workshop to Discuss Proposed Amendments to Motor Vehicle CNG Fuel Specifications

February 2002

California Environmental Protection Agency

Air Resources Board

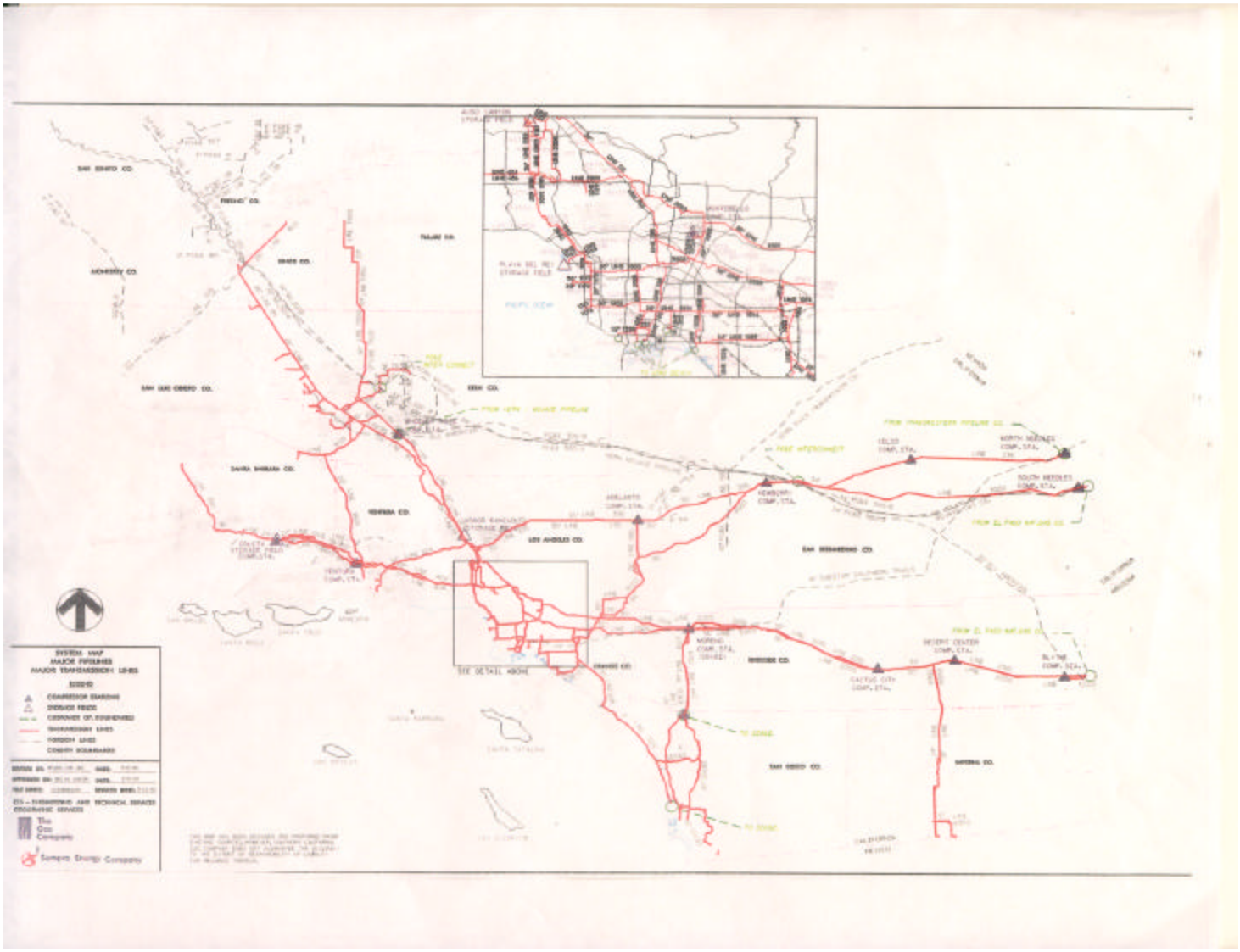
Associated Gas Fuel Quality*

Component	SCC	SSJV	SC	Standard
Methane	88.2	86.2	86.2	88.0 min.
Ethane	4.9	8.8	5.3	6.0 max.
C3+	3.7	2.5	4.8	3.0 max.
Inerts	3.2	2.5	3.7	4.5 max.
CO_2	2.3	1.9	2.8	
N_2	0.9	0.6	0.9	
BTU	1086	1100	1106	970 - 1150 * *

* Volume Weighted Average

* * So. Cal. Gas Co. Requirement

Pipeline Map



Long Term Solution

- Collaborative industry agreement between gas producers and gas suppliers to provide complying CNG
  - Alternative Fuels Regulation that facilitates potential industry options

Objectives of Proposed Amendments

- No significant adverse impact on engine performance or emissions
- Increase flexibility for industry to comply with the regulation

Proposed Amendments to CNG

- Add an alternative statewide CNG fuel specification
  - Methane Number (MN) of 80
- For SCC and SSJV add a limited use option CNG fuel specification
  - MN 73, if all three conditions are met
    - Station cannot economically provide MN80 fuel
    - Fleet vehicles can operate on MN73 fuel
    - Fueling stations have controls to prevent misfueling

Methane Number Index

- Calculated number based on hydrogen to carbon ratio of the hydrocarbon content of the fuel that predicts the likelihood of the fuel to cause engine knock
- Similar to Motor Octane Number

Methane Number Index (cont.)

- Index used by engine manufacturers to design engines and evaluate performance
- MN index allows hydrocarbon component content tradeoff
- MN 80 applicable to existing and new engines
- MN 73 applicable to LD vehicles and HD advanced technology engines

Effect of Proposed CNG Specifications

- Fuel Supply
- Fuel Composition
- Impact on Engines and Emissions

Impact on Fuel Supply

- Complying CNG under Existing Specification

– SCC	11%
– SSJV	<1%
– LAB	99%

- Complying CNG under Proposal

	MN80	MN73
– SCC	21%	89%
– SSJV	24%	99%
– LAB	99%	N/A

Impact on Fuel Composition

- Existing CNG specification equates to about MN 81 but limits ethane, propane, and higher hydrocarbons
- Tradeoff could increase the content of ethane or C3+
- Small changes in reactivity
  - Existing Specification 0.1 MIR
  - Proposed Amendments 0.09 - 0.15 MIR

Quality of CNG Entering SC

Existing Specification

	MN
Volume Wtd. Avg.	88

Proposed MN 80 Specification

	MN
Volume Wtd. Avg.	85

CNG Motor Vehicle Emission Testing

- Two studies conducted to evaluate CNG fuel quality affects
  - Driveability
  - Emissions
  - Fuel economy

Light Duty Testing

- 5 fuels tested
  - Methane content 82% - 94%
  - Ethane content 2% - 8%
  - C3+ content 0% - 10%
  - MN 63 - 103
  - Wobbe Number 1245 - 1425
- 8 vehicles tested
  - Dedicated and Bi-fuel

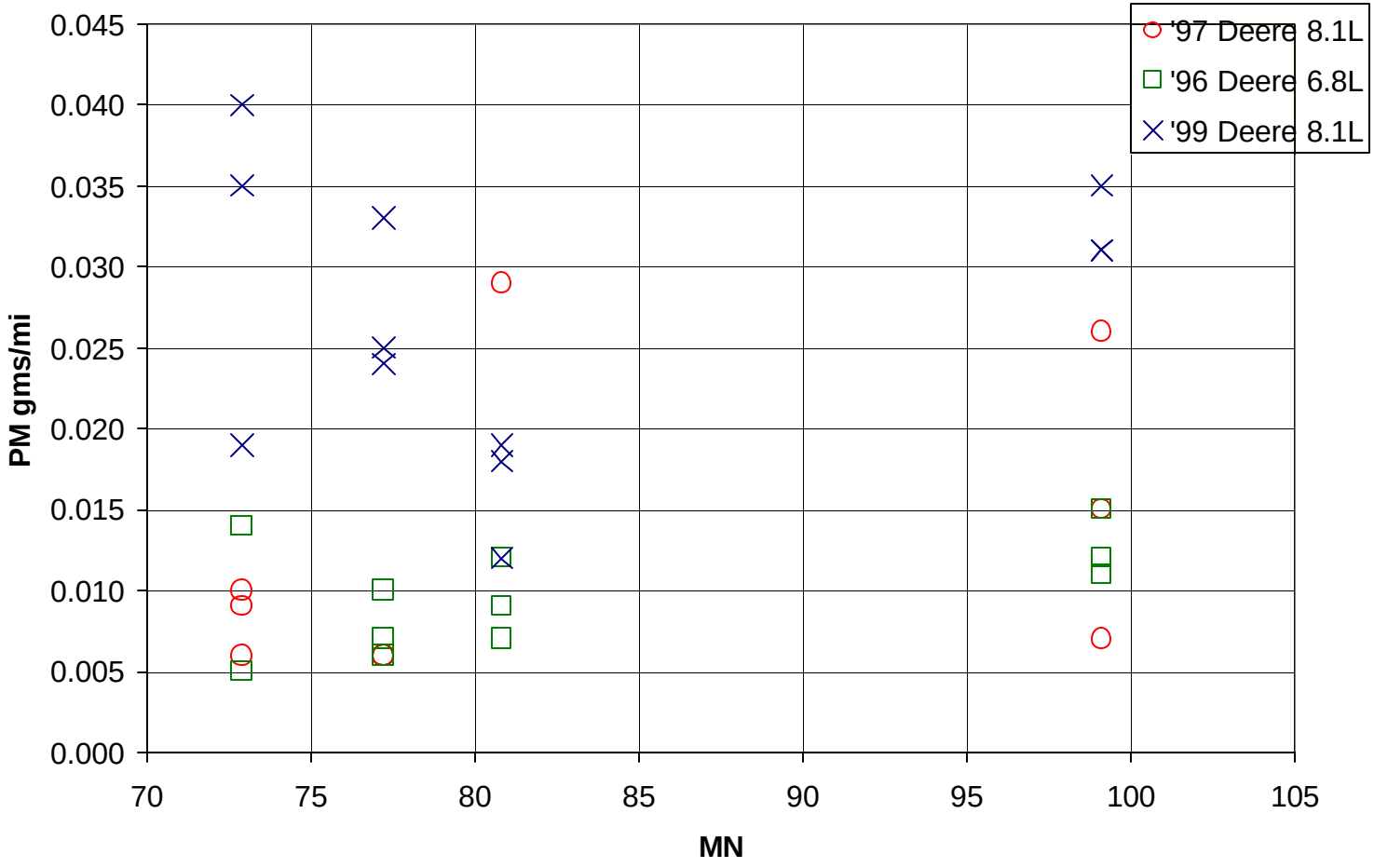
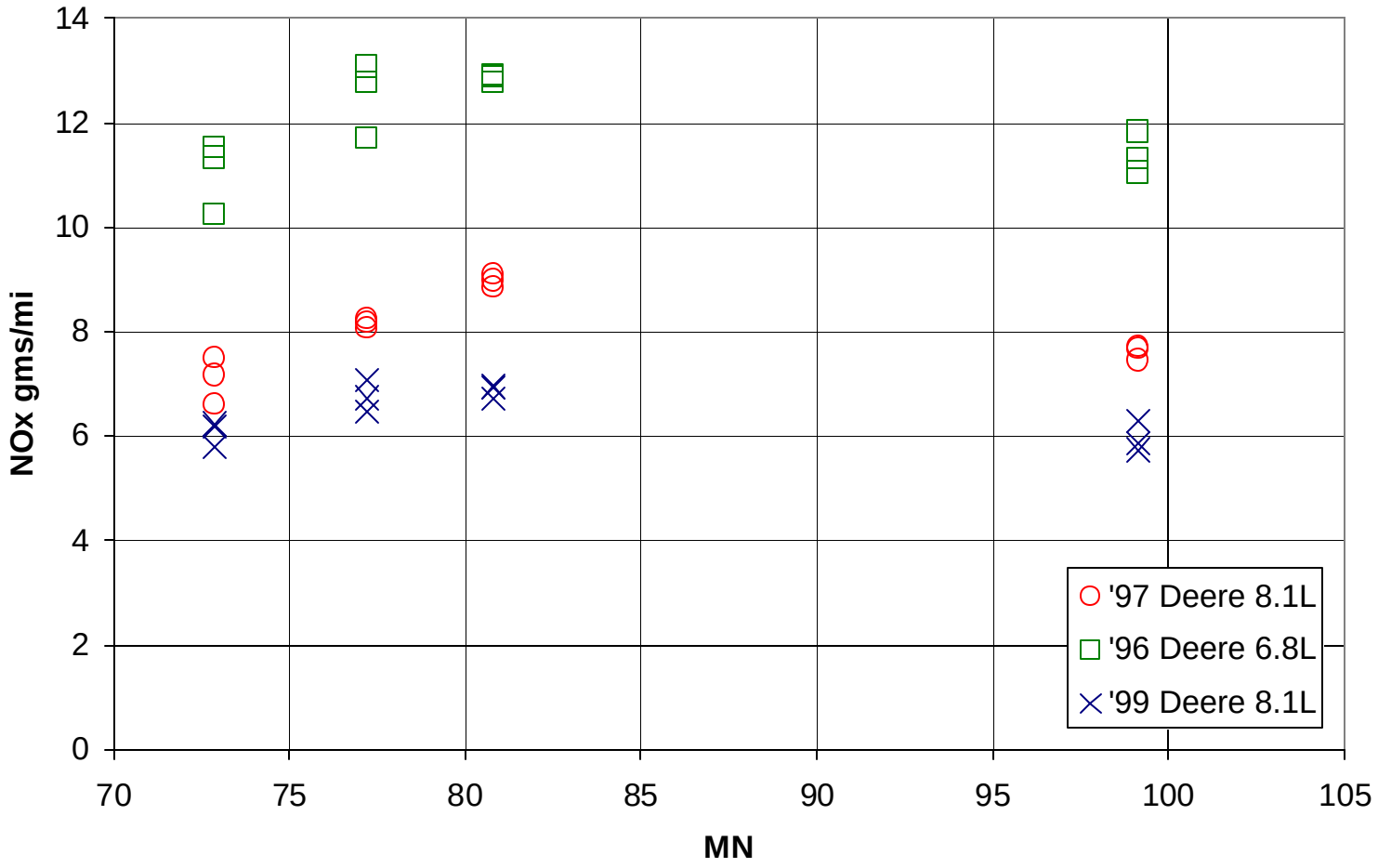
Light Duty Test Results

- Emissions from all dedicated OEM vehicles
  - Below applicable ULEV standards
  - Slight variations in all emissions, both increases and decreases, but no correlation to fuel quality
  - No change in performance

Heavy Duty Testing

- 4 fuels tested
  - Methane content 82% - 95%
  - Ethane content 3% - 8%
  - C3+ content 0% -5%
  - MN 73 - 99
  - Wobbe Number 1310 - 1363
- 7 vehicles tested
  - 3 advanced closed loop technology (ACL)
  - 2 first generation closed loop technology (1CL)
  - 2 open loop technology (OL)

PM data for ACL Vehicles, UDDS Cycle



NOx data for ACL Vehicles, UDDS Cycle