

CARB Fuels Workshop

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Outline

- Introduction
- Statement of principles
- Review Predictive Model responses
 - Sulfur
 - T50
 - T90
- Oxygen flat spot
- Random Balance Method
- Next steps to finalize model

Introduction

- Workshop and Expert Group process has worked well and led to considerable progress in modeling
 - Ethanol permeation
 - Updated emissions inventory
 - Reactivity of exhaust and evaporative emissions
 - CO impacts
 - Incorporation of new vehicle data
- WSPA providing comments on draft of Predictive Model issued December 2006
 - Only a few remaining issues to be addressed

Principles for Evaluation

- Sound science should be basis for evaluating Predictive Model
- Responses in the Predictive Model should be consistent with results from designed studies
- If not, need to understand
 - What data are driving the responses?
 - Does statistical approach need to be modified?
- Check for terms in the model that cause kinks in the response surfaces

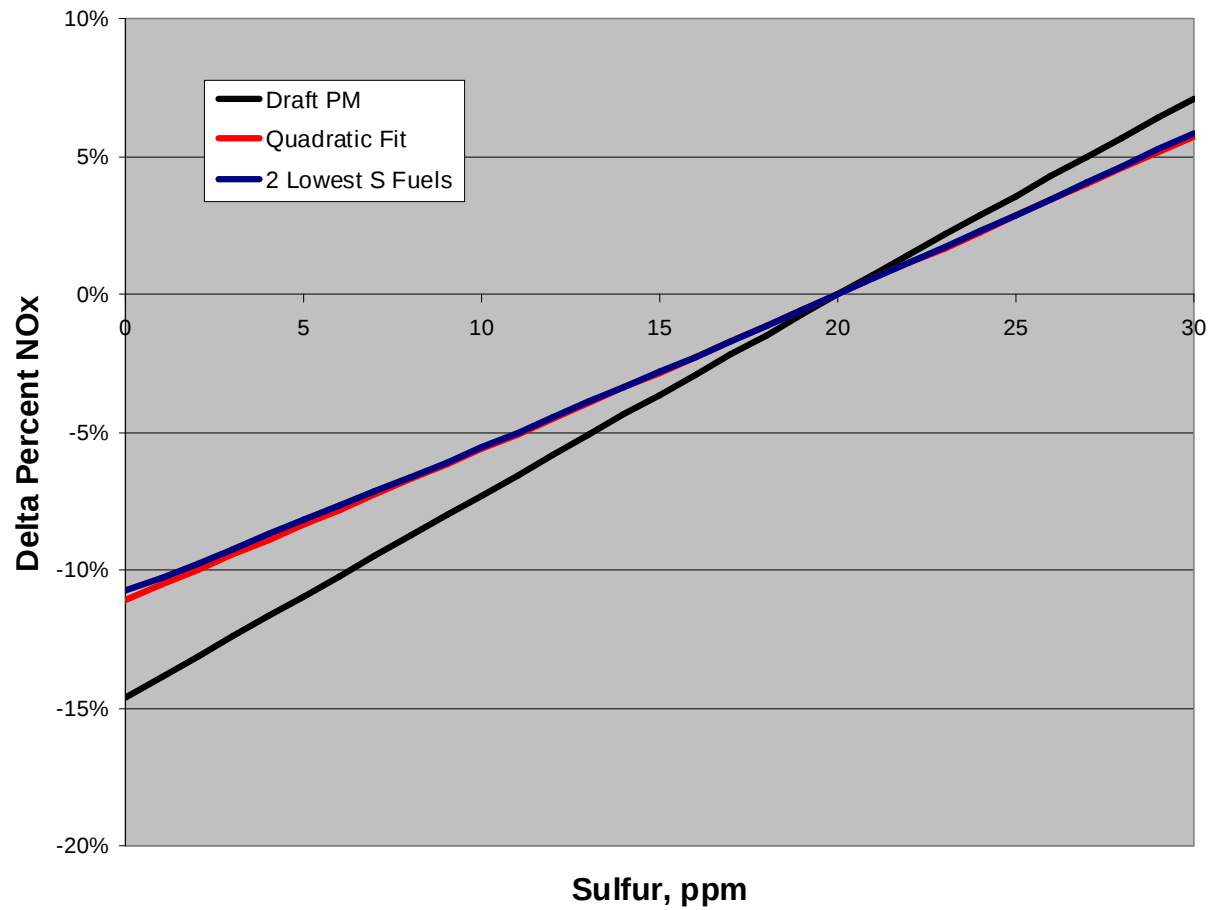
Tech 5 Sulfur-NOx Response

- Four studies evaluated sulfur response in Tech 5 vehicles
 - AAM
 - + 3 sulfur levels, 3 oxygen levels (no interaction)
 - AAMA
 - + 5 sulfur levels (non-oxy)
 - CRC LEV program
 - + As-received and aged catalysts
 - + 5 sulfur levels (non-oxy), 2 sulfur levels (oxygenated)
 - CRC E-60
 - + As-received and aged catalysts
 - + 3 sulfur levels (non-oxy)

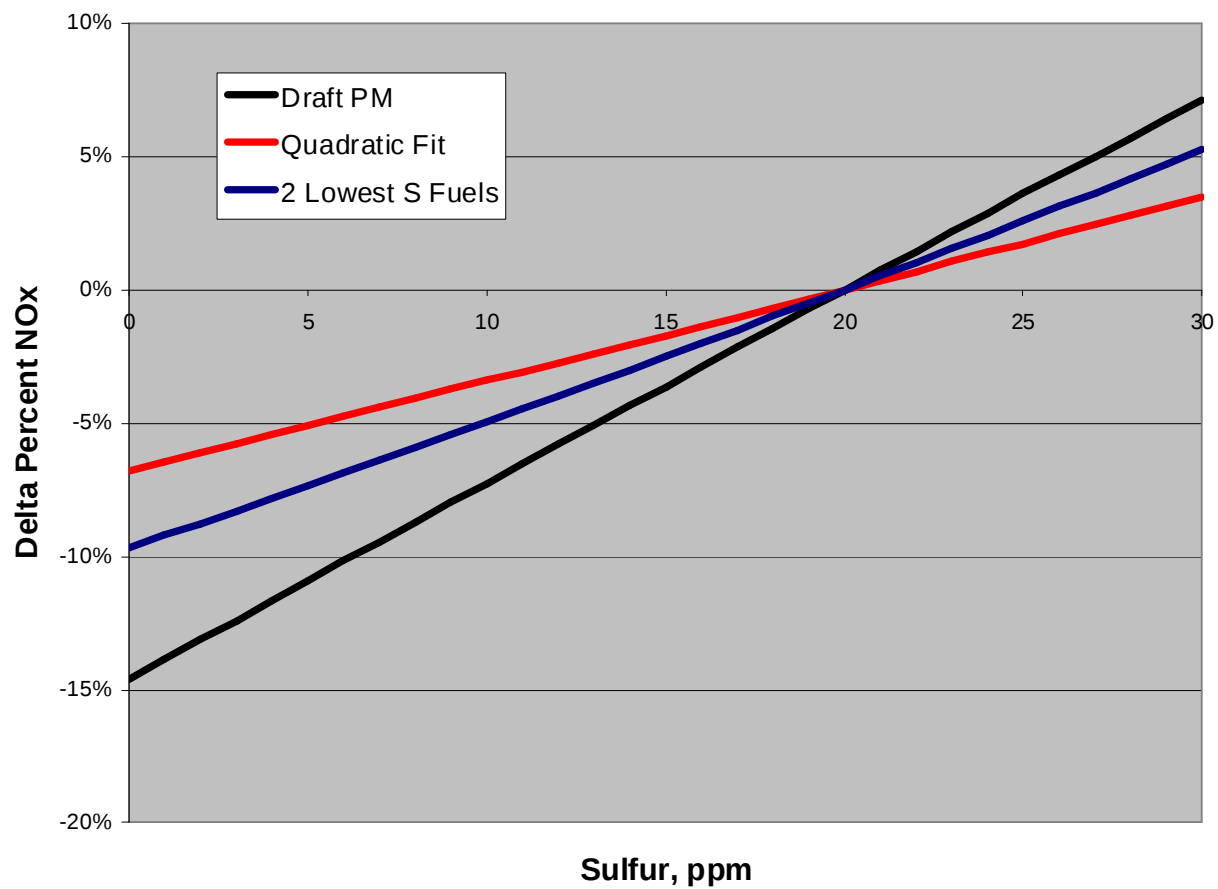
Tech 5 Sulfur-NOx Response (Cont'd)

- Conducted regression for each study and compared to the Draft PM Tech 5 response. Used 2 approaches
 - All fuels, allowing quadratic term
 - Only two lowest sulfur fuels
- In each case, Draft PM response was larger than the program results
 - If PM is correct, would have expected individual study results to be both above and below PM value
- Compared overall average response to Draft PM for 10 ppm sulfur

AAM Study

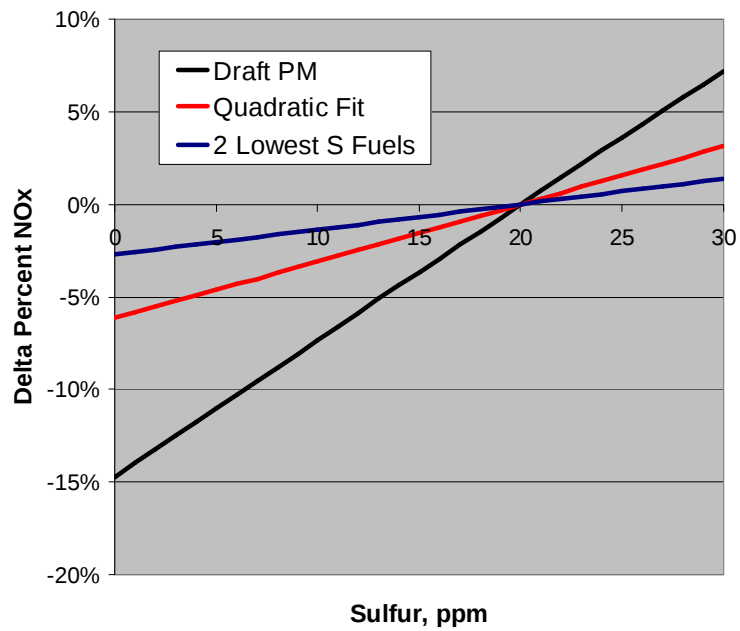


AAMA Low Sulfur Study

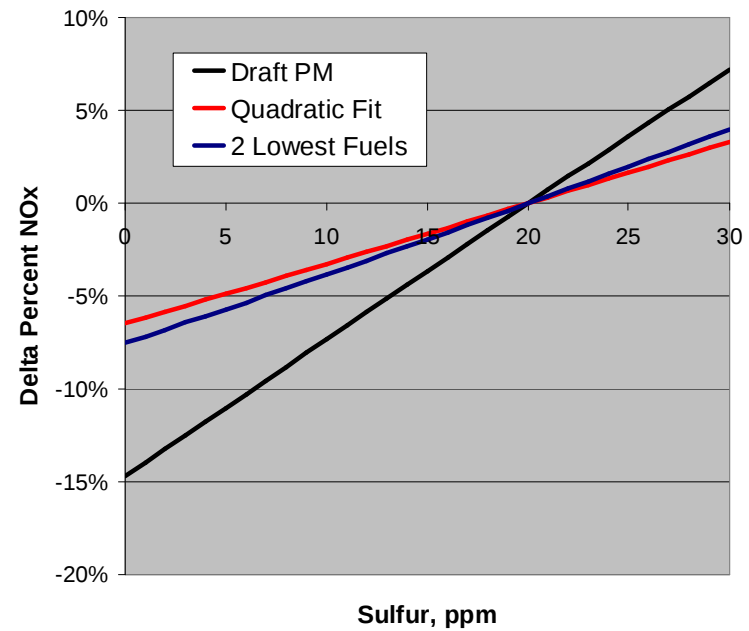


CRC LEV

As-Received Catalysts
Non-Oxygenated Fuel

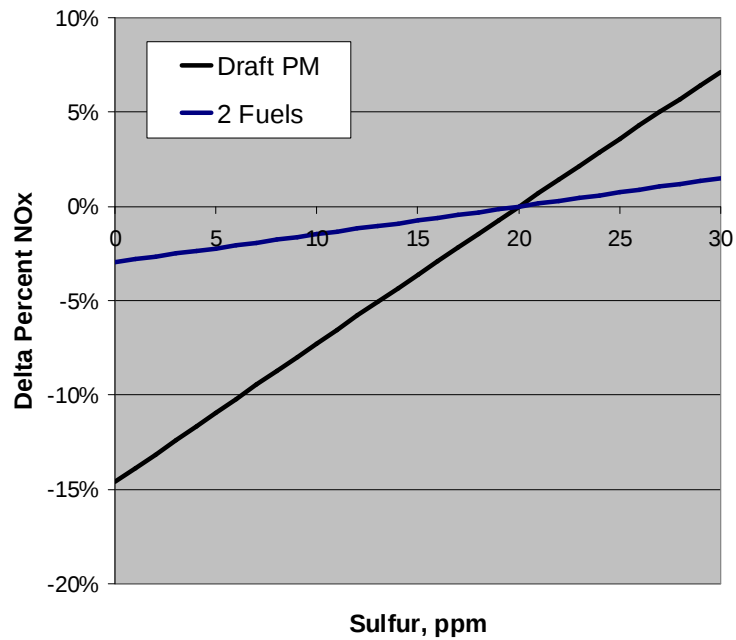


Aged Catalysts
Non-Oxygenated Fuel

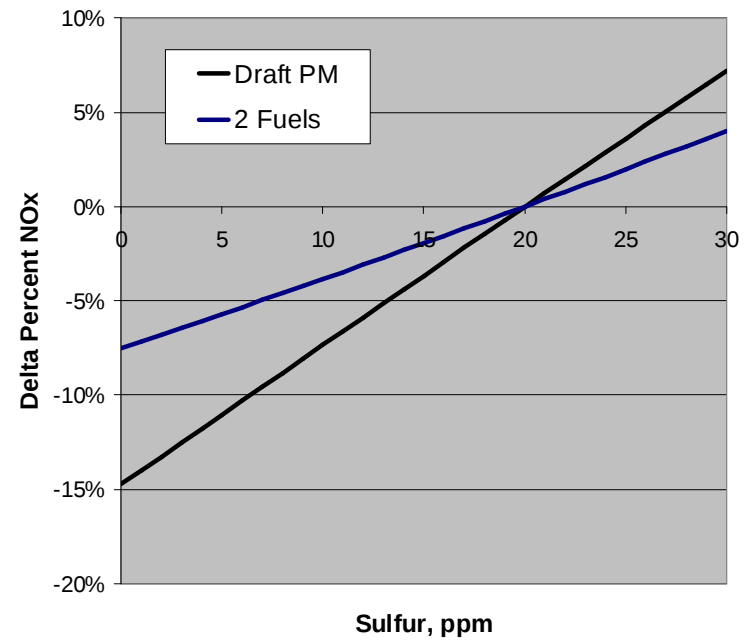


CRC LEV

As-Received Catalysts
Oxygenated Fuel

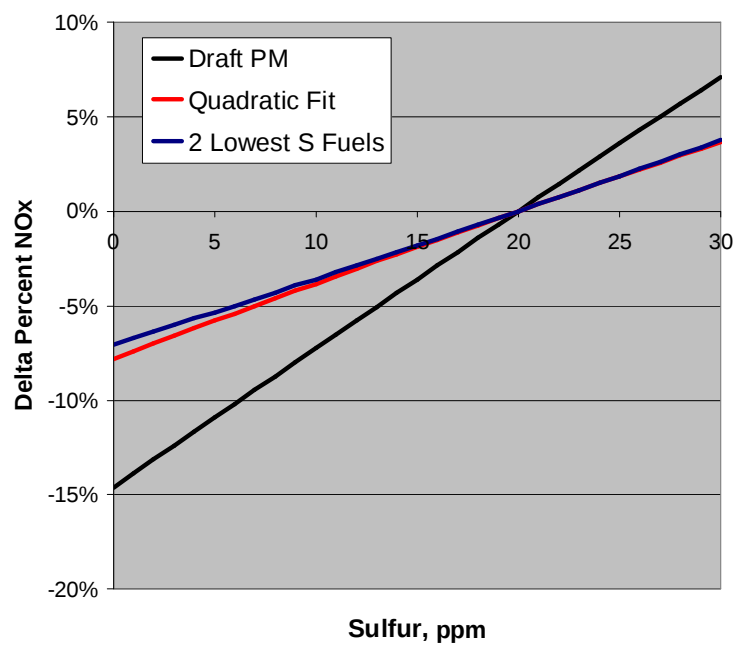


Aged Catalysts
Oxygenated Fuel

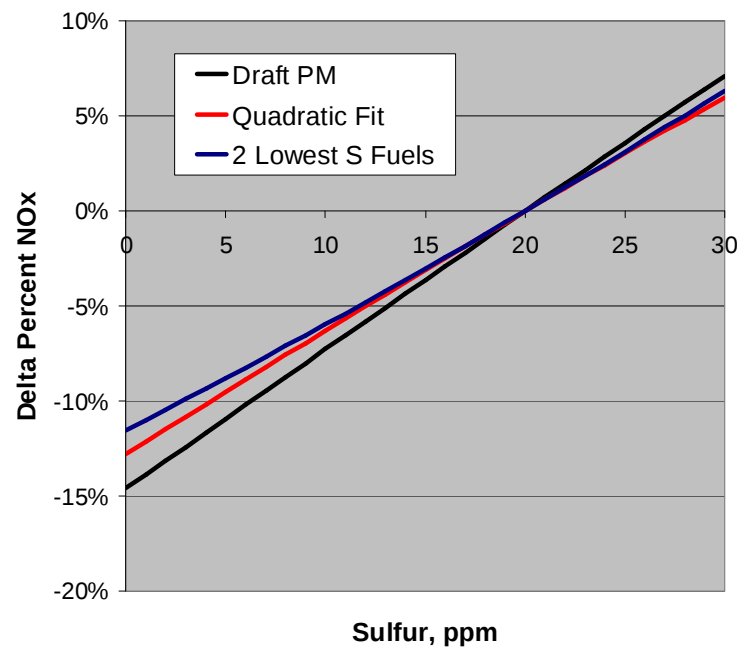


CRC E-60

As Received Catalysts

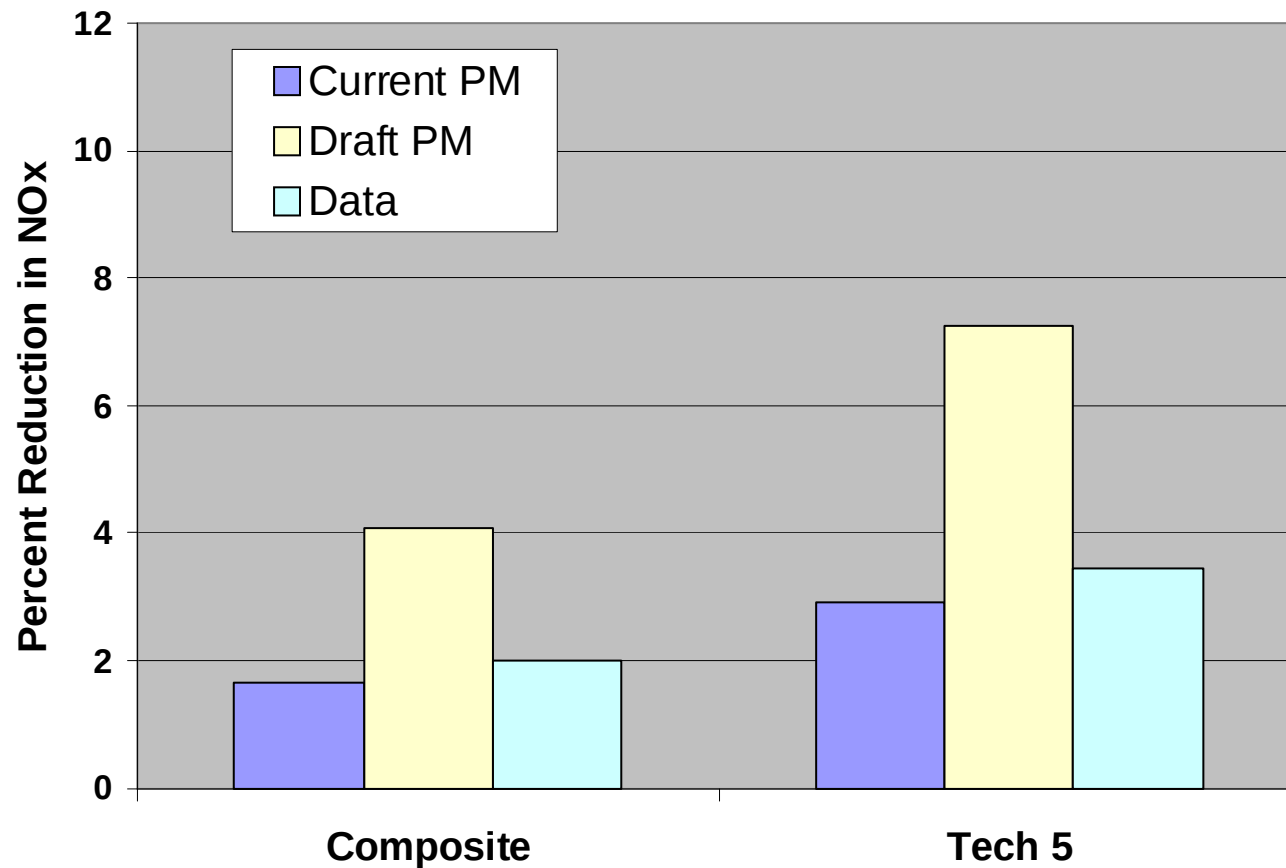


Aged Catalysts

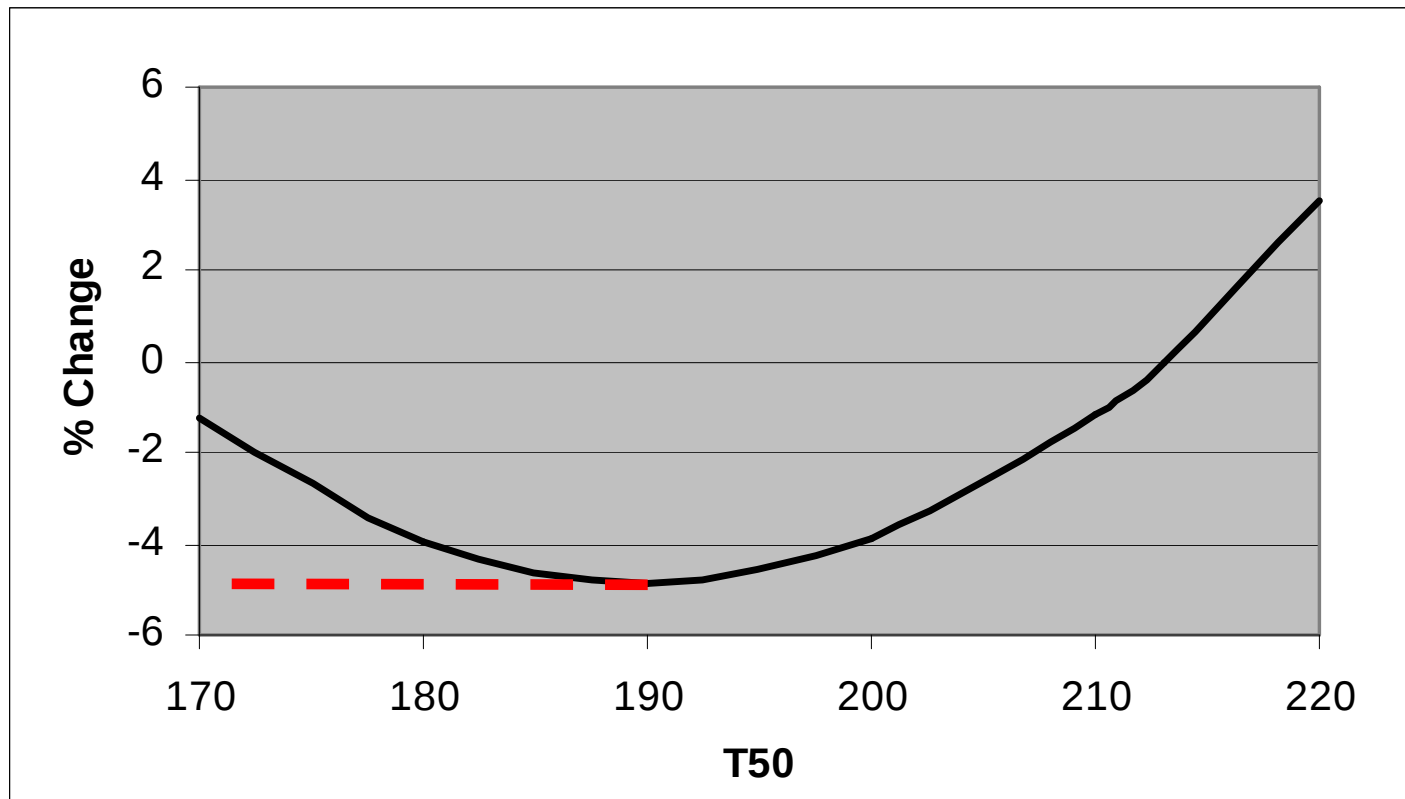


Comparison of Models with Data

NO_x Reduction: 20→10 ppm Sulfur

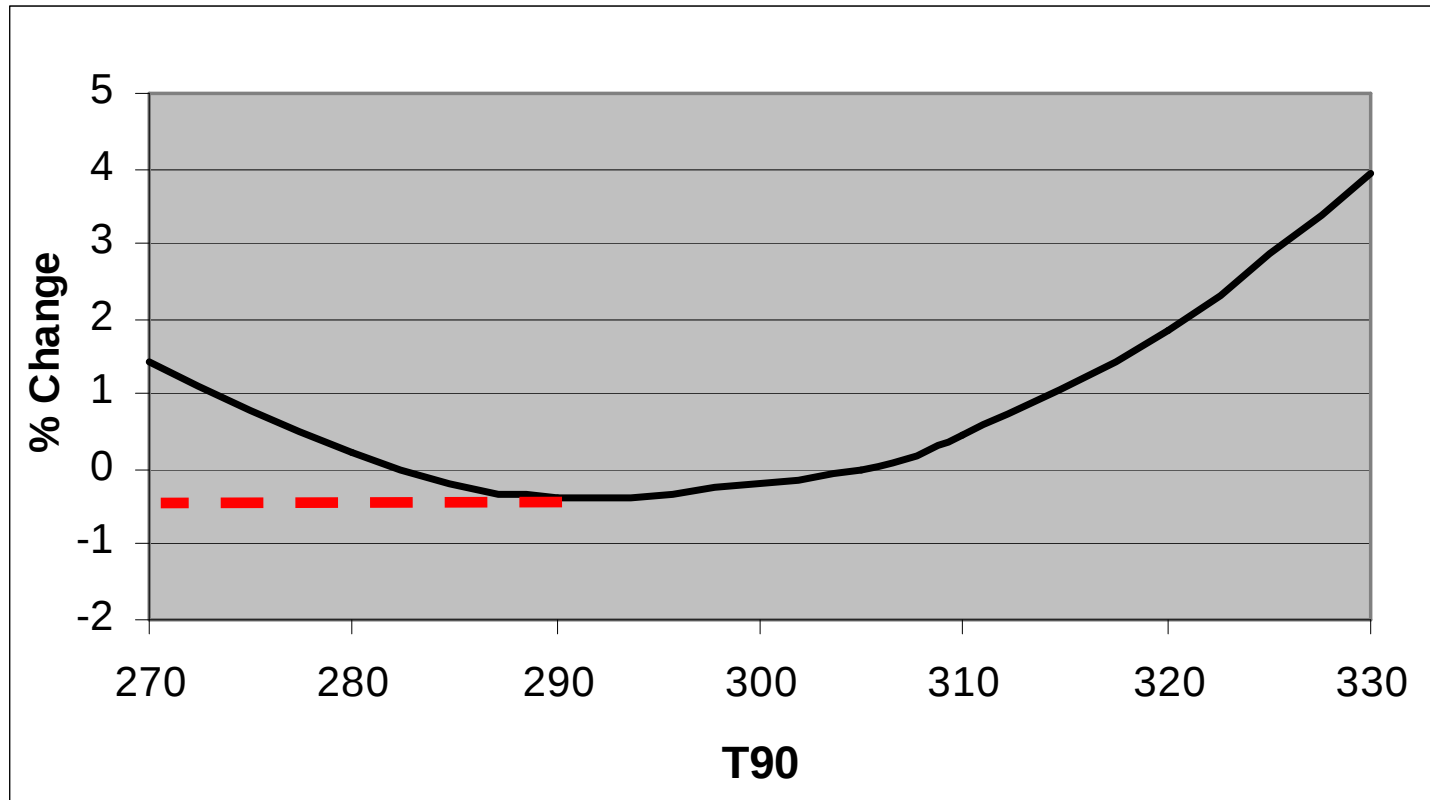


Tech 5 T50-Exhaust TOG



- Response should be flat below 190 °F

Tech 5 T90-Exhaust TOG



- Response should be flat below 290 °F

Oxygen Flat Spot

- Model has flat spot in Oxygen-NO_x response
 - 1.8 – 2.2 wt.% oxygen
 - 2.5 – 2.9 wt. % oxygen
- Flat spot should cover all oxygen levels and should be as wide as possible considering
 - Emissions
 - Product quality (octane, volatility)
 - Ease of enforcement
 - Advantages of system fungibility
- Flat spot should include CO response as well as TOG response

Random Balance Technique

- Random Balance technique should be applied to regression equations
- Simplifies equations
- Avoids kinks in response surfaces
- Helps ensure optimum refinery blends

Next Steps to Finalize Model

- Predictive Model should be based on sound science
 - Best estimate of fuel-emissions relationship based on and consistent with all existing data for Sulfur-NOx response
 - Examine the statistical methodology
- Other model issues easier to address

Next Steps on Reg Package

- WSPA has many questions relative to the proposed Alternative Compliance Plan concept released today.
- WSPA commits to work with ARB to develop a comprehensive plan that addresses state renewable fuels initiatives and their emissions impacts.