Quantification of NOx Reductions for Local Use of Diesel Cetane Additives

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Mobile Source Technical Review Subcommittee
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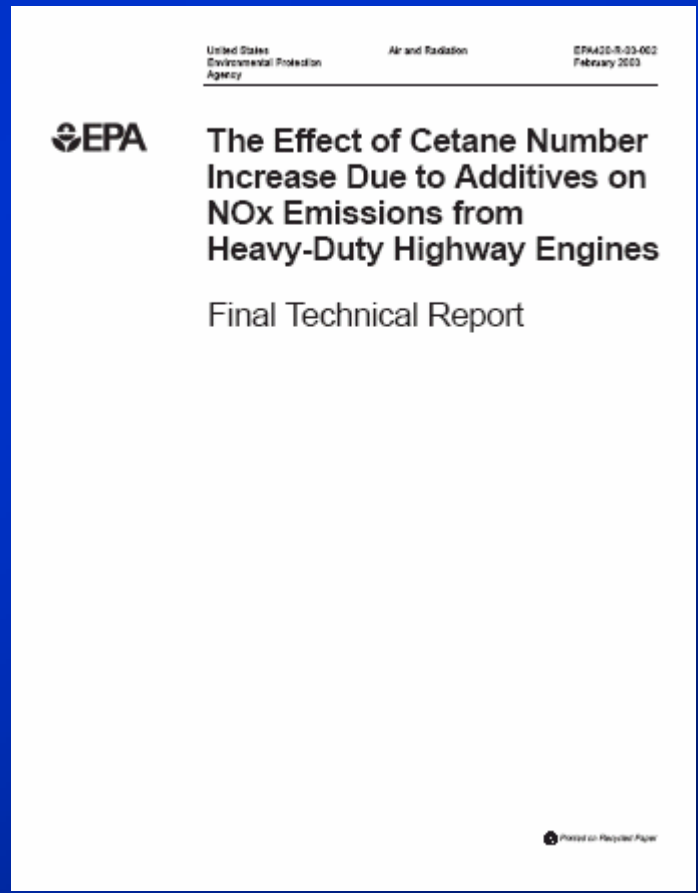
Interest in Cetane Additives

- EPA Technical Report:
- Cetane additive benefits listed as a "verified technology"
- Several areas have expressed interest in cetane additive programs
- Quantification of NOx reductions not necessarily as simple as might be expected


United States Environmental Protection Agency | Air and Radiation | EPA420-R-03-002 February 2003

EPA

The Effect of Cetane Number Increase Due to Additives on NOx Emissions from Heavy-Duty Highway Engines

Final Technical Report

Printed on Recycled Paper

Proposals for Quantification

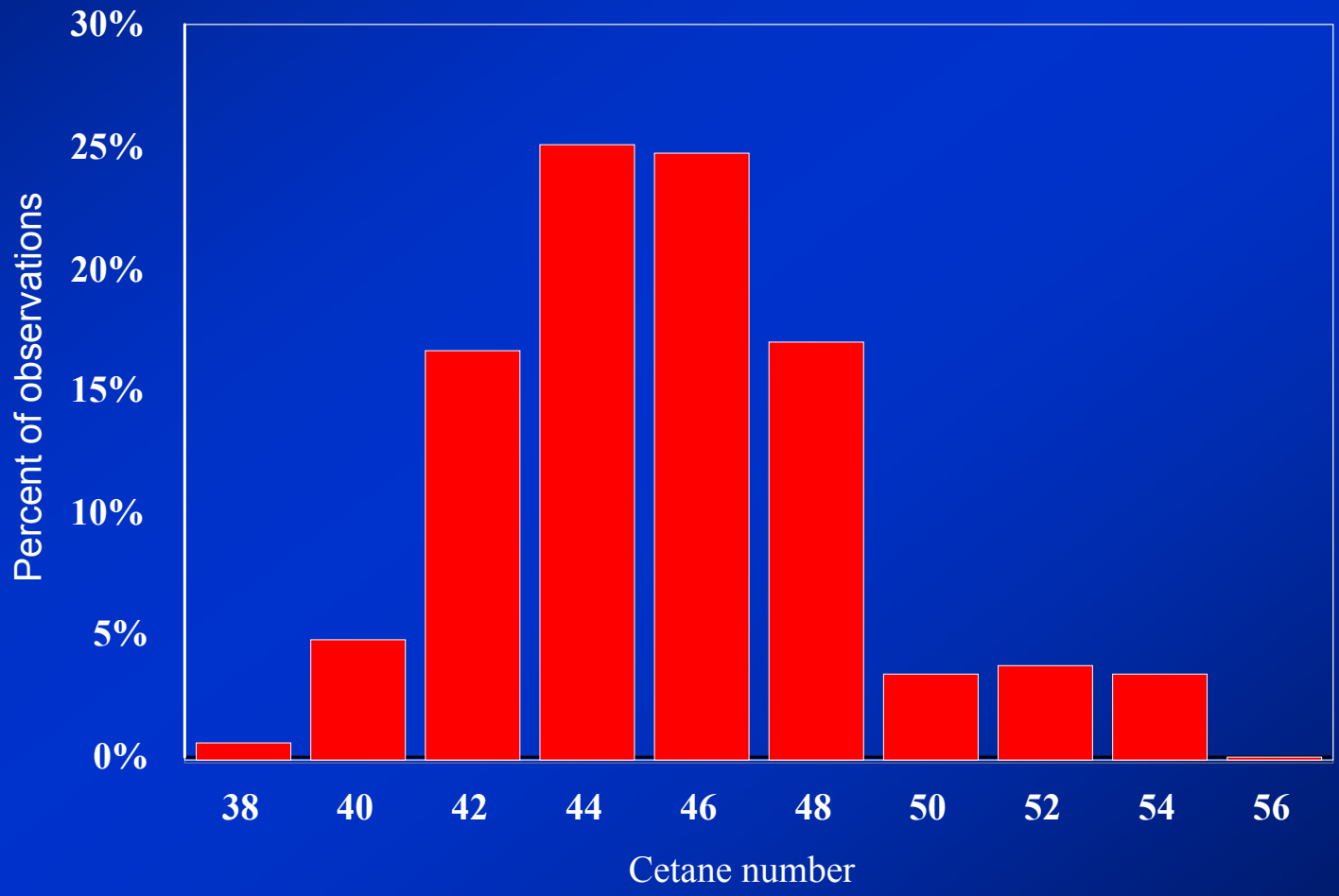
Clean Air Action Corporation

Infineum USA

What Is Cetane?

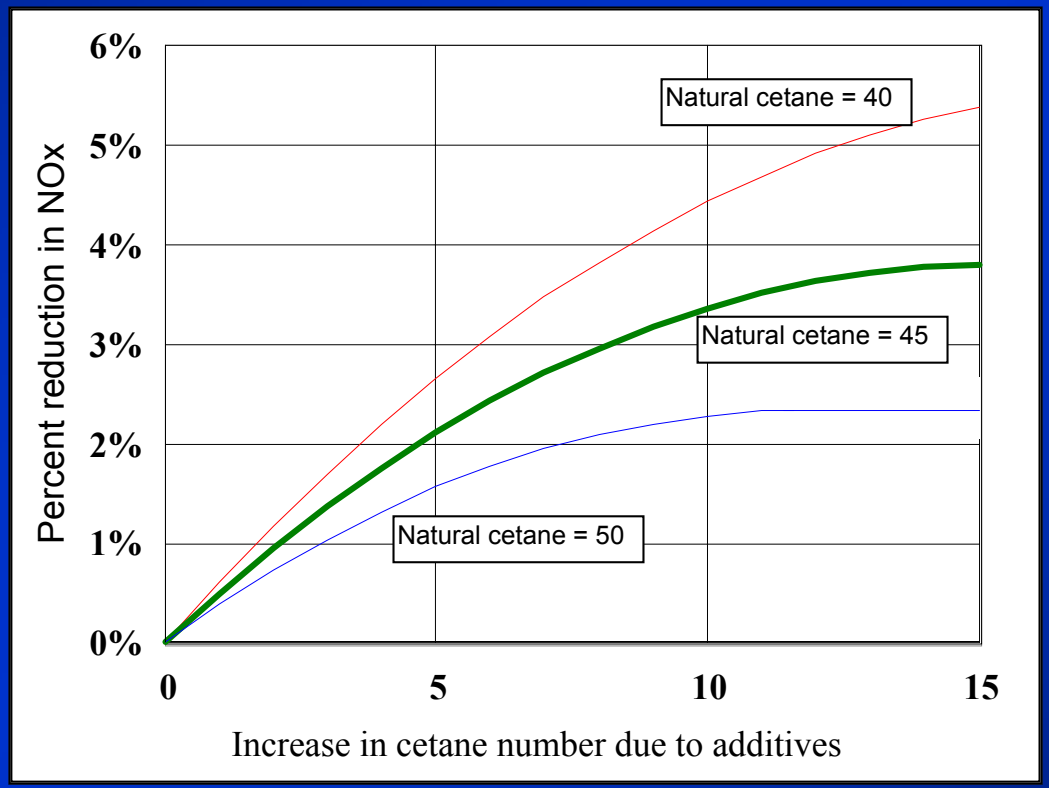
- Measure of diesel fuel ignition quality
  - Scale of autoignitability
- Can be changed "naturally" or via additives
  - Most common additives are 2-ethylhexyl nitrate and di-tertiary butyl peroxide
- Primary test method is ASTM D613

In-Use Cetane Numbers



EPA Technical Report

$$\%\ \text{change in NOx} = \{\exp[\ -0.015151 \times (\text{additized cetane}) + 0.000169 \times (\text{additized cetane})^2 + 0.000223 \times (\text{additized cetane}) \times (\text{natural cetane})\ ] - 1\ \} \times 100\%$$



A "typical" cetane increase of 5 numbers will produce a 2.1% reduction in NOx

Program Purpose and Design Impacts NOx Ton Calculations

- Voluntary versus mandatory programs
- SIP credit versus trading programs

Quantification Issues

- Applicable engine technologies and applications
- Proxy properties
- Price aversion
- Vehicle migration
- Volume tracking

Applicable Engine Technologies and Applications

- Cetane-insensitive engines
  - Short of more/better data, 2003+ MY highway engines are assumed to get no NOx benefit
  - By 2007, only 65% of NOx benefits can be verified
- 2-Stroke engines
  - Negligible fraction of in-use fleet, but
  - No NOx benefit, so specific fleets must be scrutinized
- Nonroad engines
  - No cetane data on nonroad
  - A portion of nonroad fuel ends up in heaters

Proxy Properties

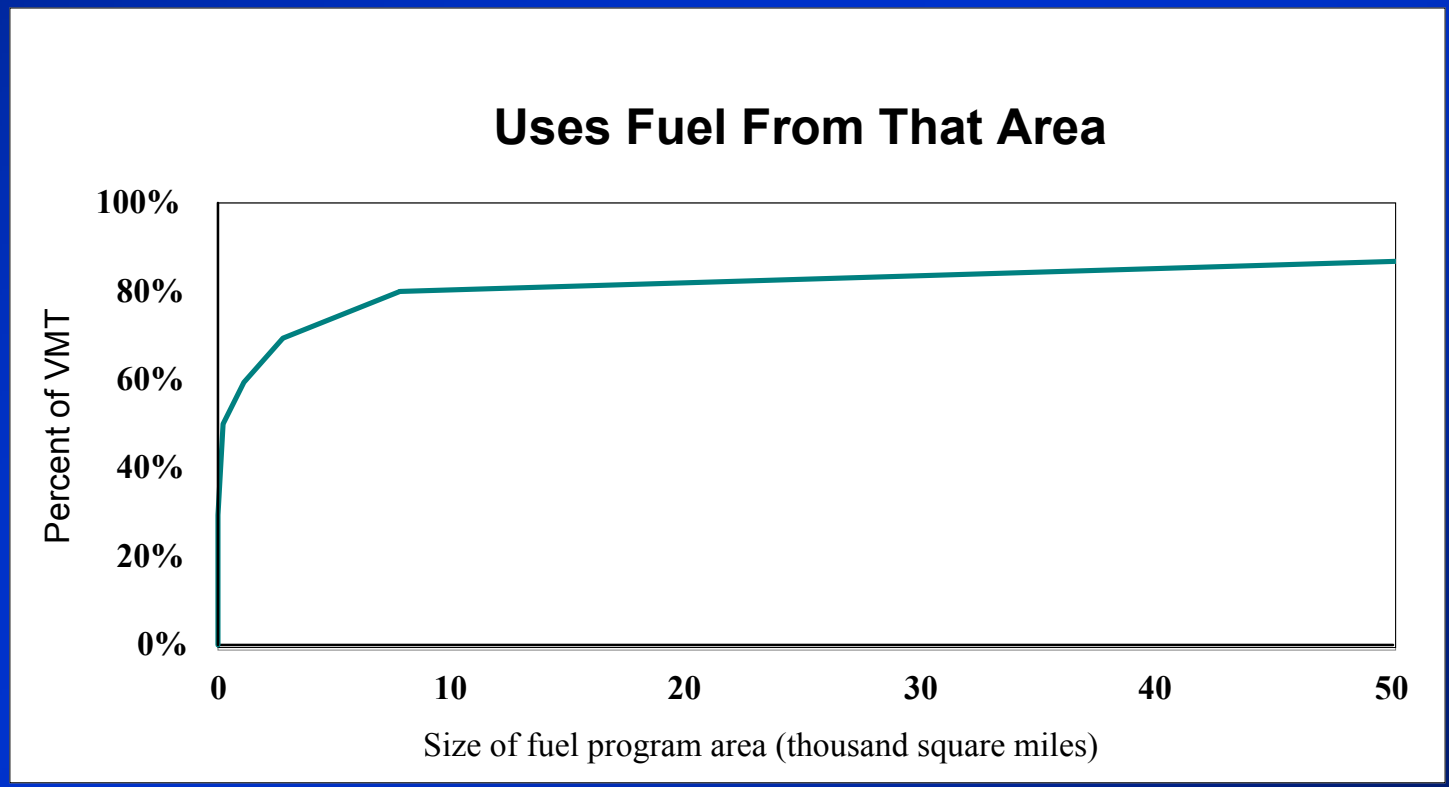
- "Proper" method is to measure cetane number using ASTM D613
- Cetane index may be a valid alternative, but there is a verifiable bias
  - Only relevant for base cetane measurements
- Measuring additive concentration may also be valid, but one must have cetane response function and verify the absence of bias
  - Additive concentration must be measured for actual additized fuel, not a laboratory blend

Price Aversion

- Vehicle owners may avoid higher-priced fuel
- Concept seems reasonable, but quantification is difficult
  - Verifiable but small shift from premium gasoline to regular when prices go up
- Prior work on California diesel fuel showed no obvious impact on consumption rates when their clean diesel regs went into effect
- Attempts to correlate jumps in state fuel taxes with consumption in those states were unsuccessful

Vehicle Migration

- Many diesel trucks travel long distances, so that the NOx benefits of cetane additives may not occur in or near the area where the additized fuel was dispensed



Volume Tracking

- Need to verify that the additized fuel is delivered to the area that needs the NOx benefits
  - More difficult in a voluntary program than in a mandatory program
- Location of cetane improver additive injection equipment is a factor in determining whether the additized fuel is being dispensed where the NOx benefits are needed

Tons Calculations

- States generate inventories by vehicle type/class for specific areas
- Tons of NOx reduced can be calculated by applying the % reduction in NOx to these inventories
  - Need to account for volume fraction of the fuel that is additized for the area in question

Thank you

Questions or comments?