Ethanol and Air Quality in Minnesota

Presentation to the Minnesota Senate Environment Committee

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Air Pollution and Ethanol in Minnesota

- Ethanol increases ozone-forming emissions
  - Ethanol worsens ozone by increasing ozone-forming volatile organic compound (VOC) emissions, and possibly nitrogen oxides (NOx)
  - Ethanol reduces CO emissions, but CO is already far below federal standard, and continues to drop
- Minnesota attains all federal air quality standards, but small margin of safety for ozone
  - Hot, sunny summer creates risk of non-attainment over next few years
  - Why risk increasing ozone when ozone non-attainment is so costly?
- Even if ethanol improved air quality, it is far more costly than other options for ozone reduction
- Vast majority of automobile pollution reductions are due to better technology on vehicles and lower sulfur in fuel
  - One year of fleet turnover reduces CO by same amount as entire ethanol CO benefit
- Long-term problem already solved by inherently cleaner cars
  - Average automobile emissions are dropping about 10%/year
  - Fleet will be 80% cleaner in about 15 years (after including growth)

Ozone and CO Trends

- CO: From 1994-2004, CO on worst day at worst site in MN dropped more than 80%
  - Worst location is now 70% below federal standard
- Ozone: Peak ozone levels are declining very slowly
  - Worst location has one or two 8-hour ozone exceedances in most years
  - Averaging four exceedances per year puts you in non-attainment
- What role did oxygenates play
  - CO: Maximum of about 10%-15% of CO improvement is due to ethanol, rest to technology
  - Ozone: would likely have improved more without ethanol, particularly the peak levels responsible for non-attainment
- 21st Century cars will eliminate ozone and CO issues over next decade as old-technology cars are retired

Ethanol and Vehicle Pollution

- Ethanol causes net increases ozone-forming emissions
  - Increases volatile organic compounds (VOC) and possibly nitrogen oxides (NOx)
    - VOC effects: greater tailpipe emissions; greater evaporation; greater permeation
  - Effect is greatest on hot days—the days most favorable for forming ozone
  - Data from Denver:
    - Doubling of average automobile tailpipe VOC emissions on hot days (>90F) due to ethanol
    - Doubling of emission test failure rate on hot days
    - Areas without ethanol do not experience higher emissions on hot days
- Minneapolis-St. Paul averages about 10 days/year above 90F
  - Risk of non-attainment if area gets string of hot summers
  - Lower risk without ethanol in gasoline
  - Non-attainment triggers requirements that would likely cost a few hundred million per year in direct costs, plus indirect costs of process- and administration-heavy requirements like New Source Review, Title V permitting, and transportation conformity
- California has the worst air pollution in the country. CA Air Resources Board is working hard to *remove* ethanol from CA gasoline

Ethanol Would Be A Poor Choice Even If It Reduced Ozone-Forming Emissions

- Ethanol is far more expensive and less efficient than other options for reducing automobile emissions
- Directly addressing high-polluting vehicles would provide more air quality benefits at far lower cost
  - Worst 5% of cars emit 50% of VOC emissions
  - Far more effective and cost effective to fix or scrap these cars

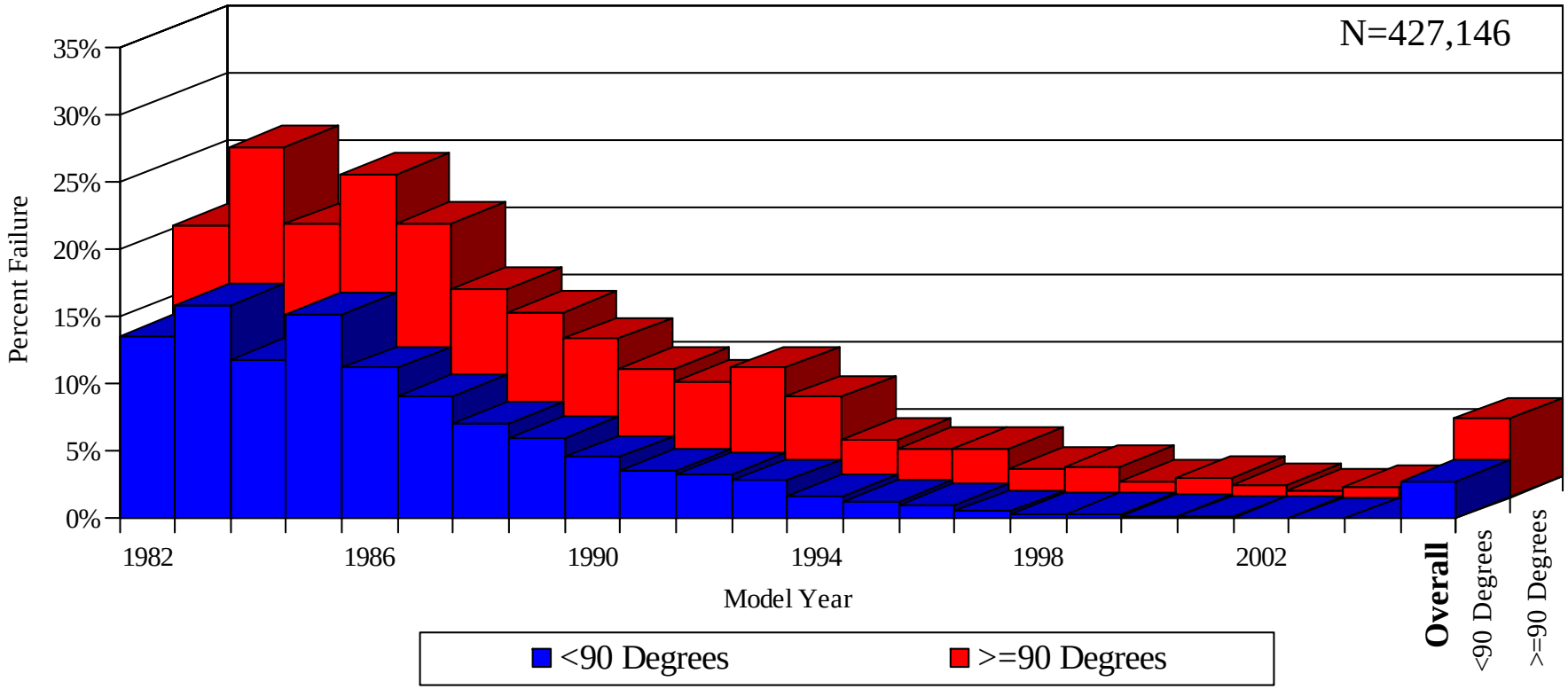
Paying Too Much

- Ethanol receives direct per-gallon subsidy of about $158 million/year due to Minnesota gasohol consumption
  - $21 million of this is from state taxpayer funds
- Fuel economy penalty of about 3% per gallon, costs Minnesotans 5.25¢/gallon, or $140 million per year statewide
  - Going to E20 would double this cost to $280 million per year
- Compare with cost of directly addressing high-polluting cars
  - For $140 million—one year's worth of fuel economy penalty costs—you could pay motorists driving the worst 2% of cars $2,600 each to scrap them
    - Permanent statewide automobile VOC reduction of more than 20%
    - Larger percentage reductions possible regionally, if program focused only on highest-ozone areas of state
  - High polluters can be identified with on-road remote sensing
- Ethanol would never be considered as an air quality measure on a pollution-reduction-per-dollar basis
  - Subsidies and fuel economy loss hide the real cost of ethanol relative to other options

Ethanol: Expensive and Counterproductive

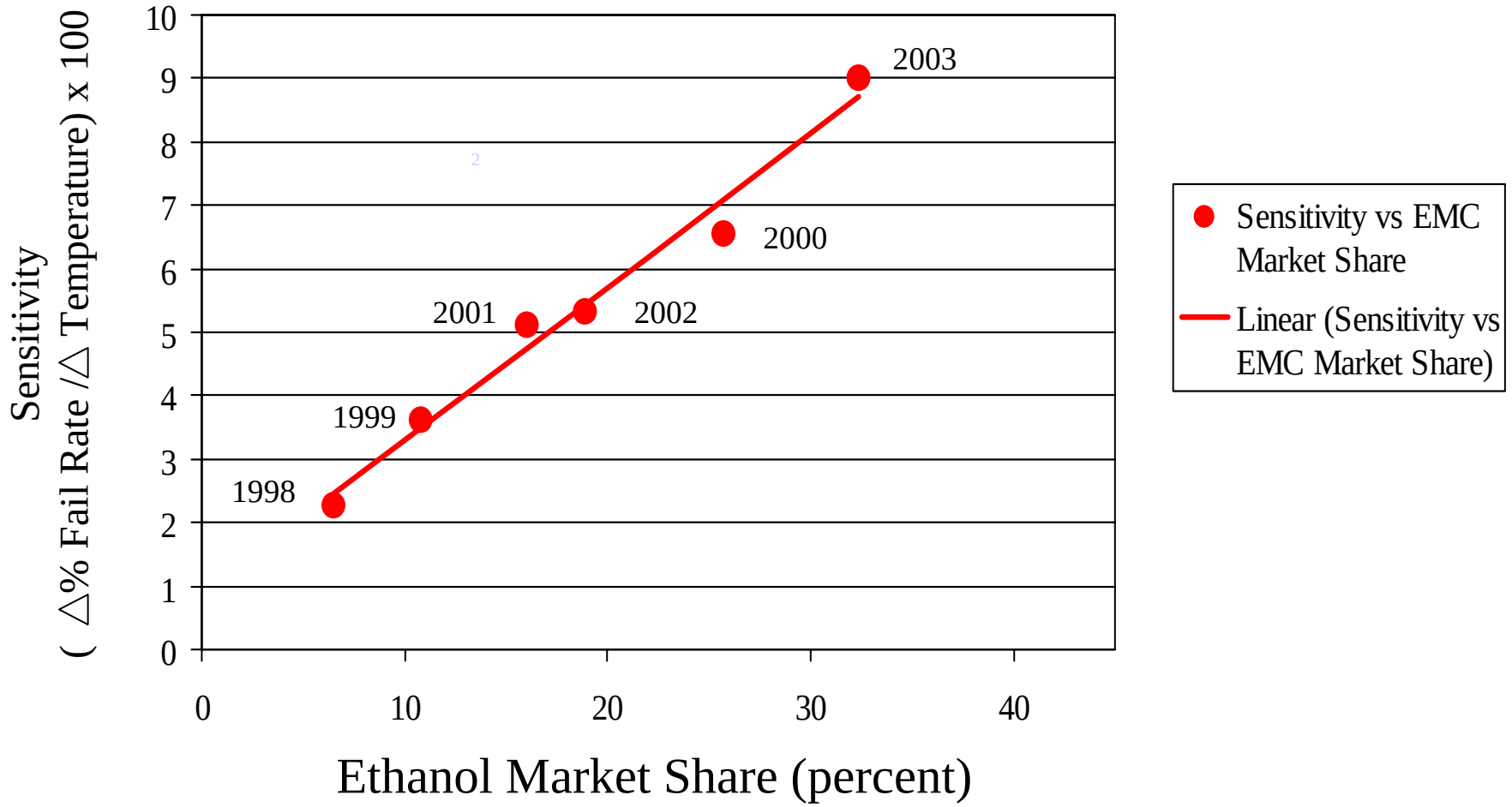
- Ethanol increases ozone-forming emissions
  - Why risk the economic harm from being designated non-attainment
  - VOC and NOx eliminated by fleet turnover
  - Achieve additional near-term reductions with targeted approaches
- Ethanol costs Minnesotans $140 million/year in fuel economy loss, and $21 million/year in state subsidies. Federal subsidies add another $137 million/year.
  - Minnesota could mitigate ozone non-attainment risk virtually permanently by instead spending a fraction of these funds on a one-time basis to address remaining middle-aged and older high-polluting, old-technology automobiles
- Oxygenates are not necessary for Minnesota to stay in CO attainment or to continue reducing CO
  - Fleet turnover has solved the problem and will continue to reduce CO
  - Targeted strategies just as effective and far cheaper should additional CO reductions be desired

More Cars Fail Emissions Test on Hot Days



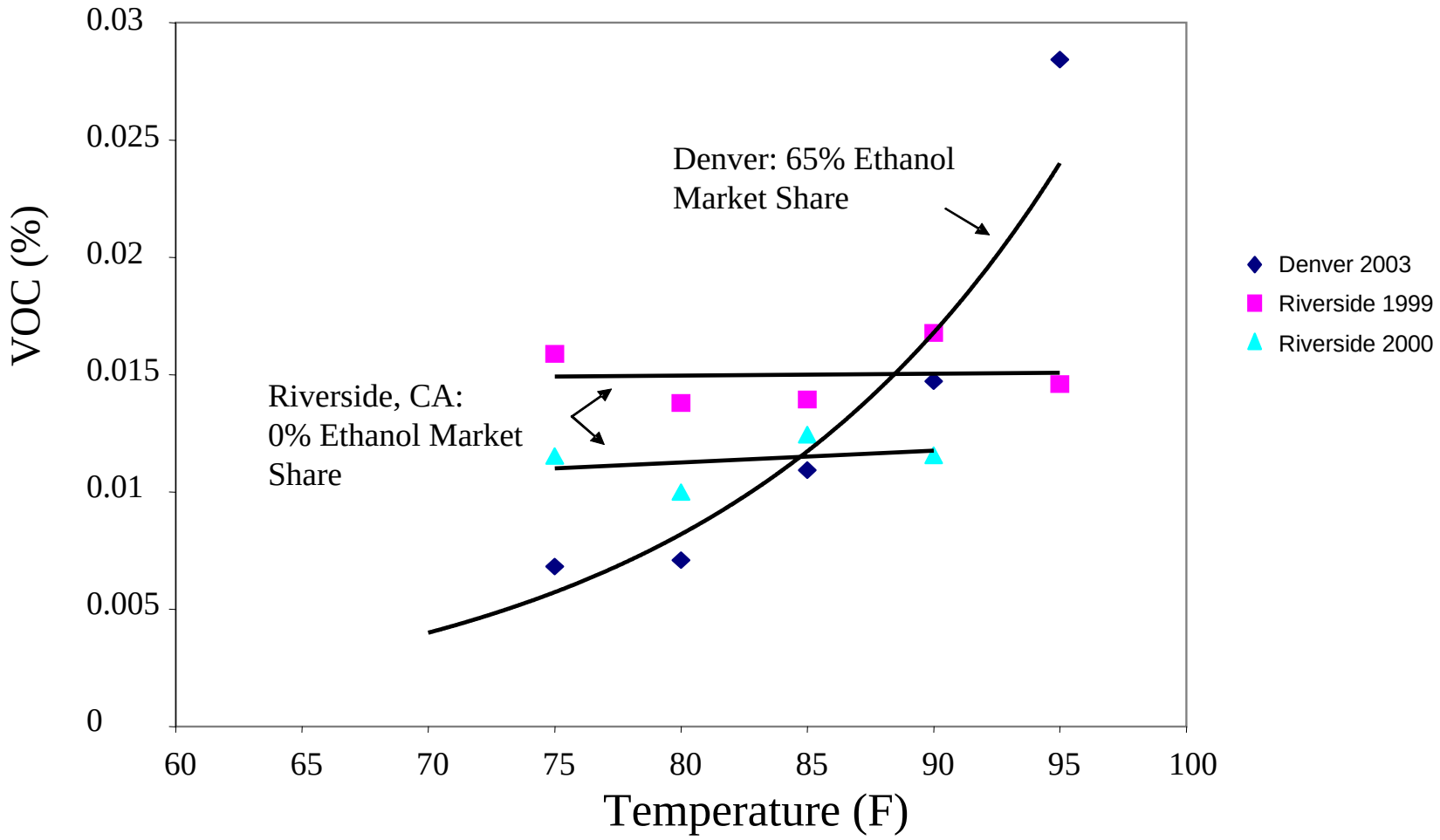
Denver test results, 10/02-9/03. Graph provided by Don Stedman, U of Denver

Sensitivity of Emissions to Temperature Is Correlated with Ethanol Market Share



Denver test results, 1998-2003. Graph provided by Don Stedman, U of Denver

On-Road Data Show Automobile VOC Emissions Rise on Hot Days Only in Areas with Ethanol

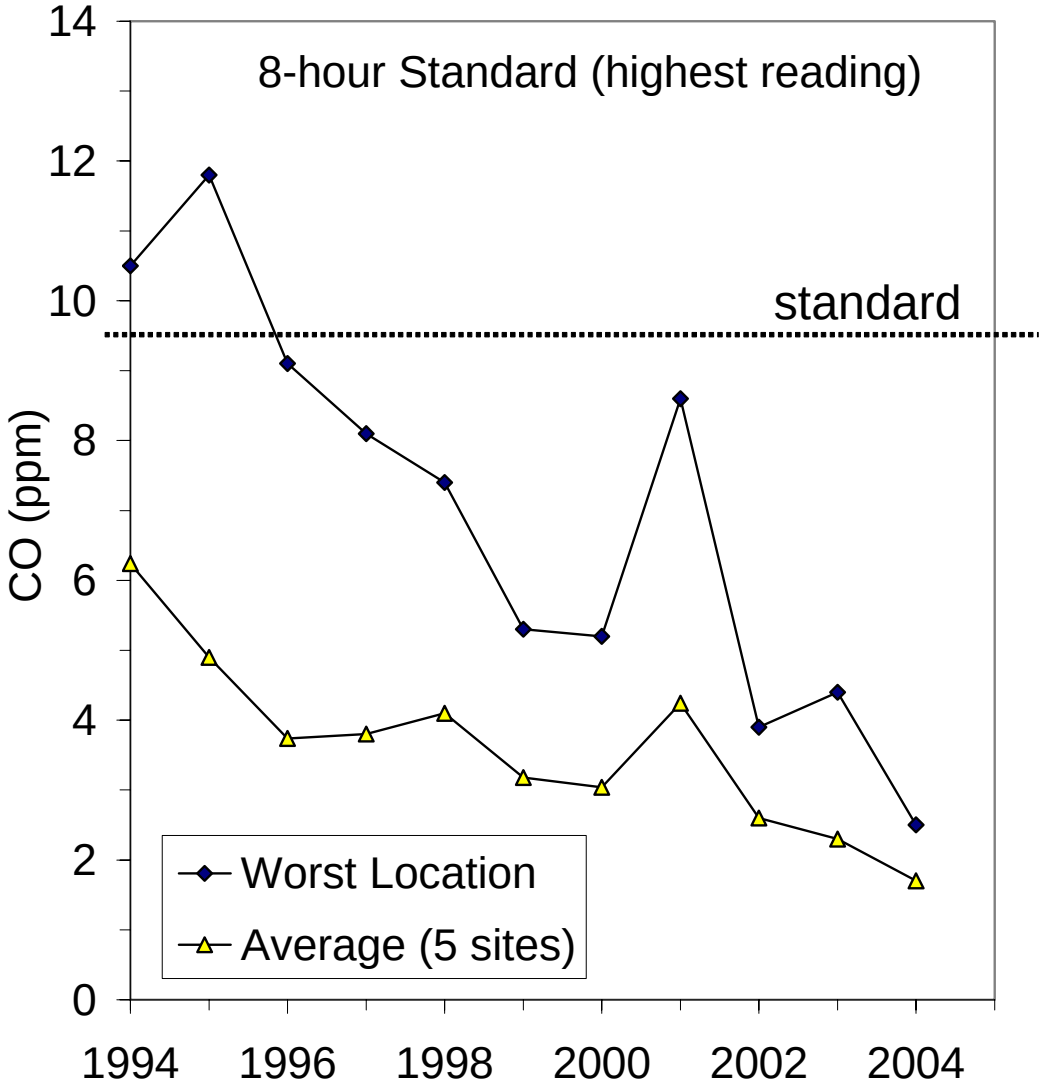


On-road remote sensing data. Graph provided by Don Stedman, U of Denver.

CO: Localized Approaches for A Localized Problem

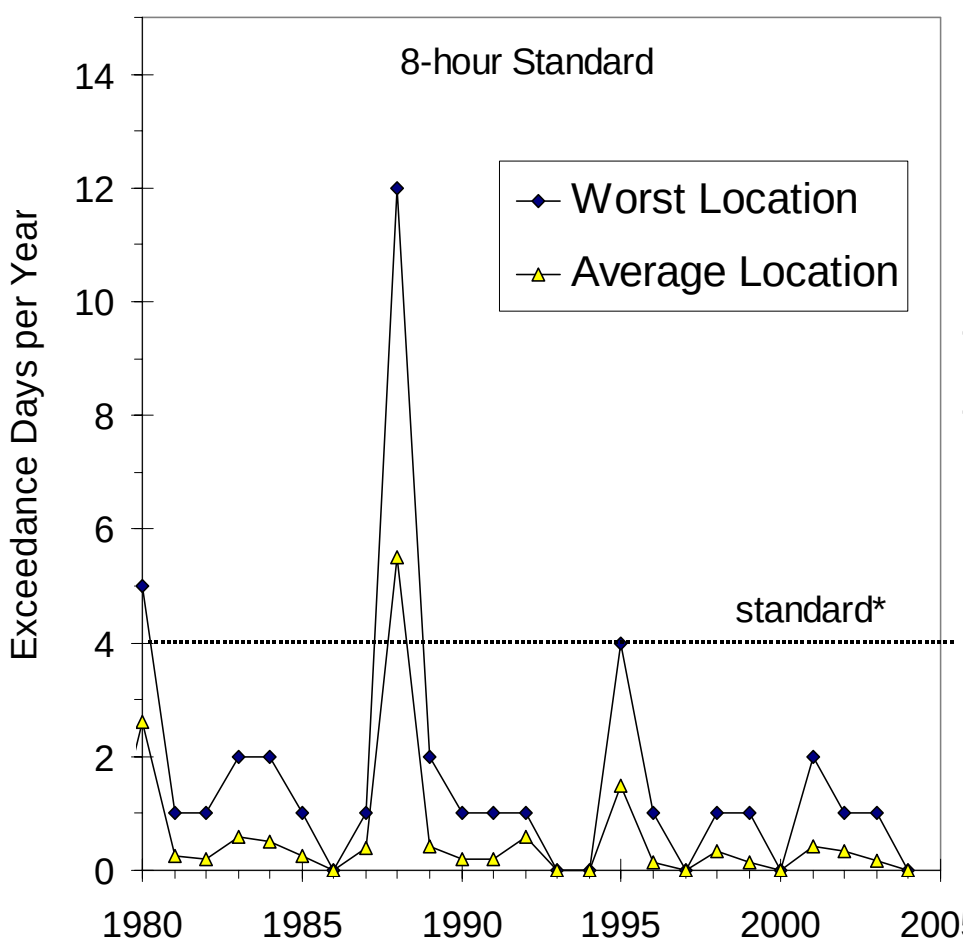
- Almost all CO (90% or more) comes from gasoline engines, mainly automobiles
- High CO levels occur only at localized “hot spots”
- It takes 3 exceedance days in a 2-year period to violate the EPA standard
  - But even the worst location in Minnesota hasn’t had even one exceedance in the last 10 years
- Minnesota will stay in attainment of the CO standard with or without oxygenated fuel
- But even if CO reductions were necessary, they would be necessary in perhaps one or two relatively small areas
- CO emissions are highly skewed—the worst 5% of cars emits 50% of CO emissions
  - Scrapping or repairing a few thousand (at most) high emitters in a CO hot-spot area would solve the problem.

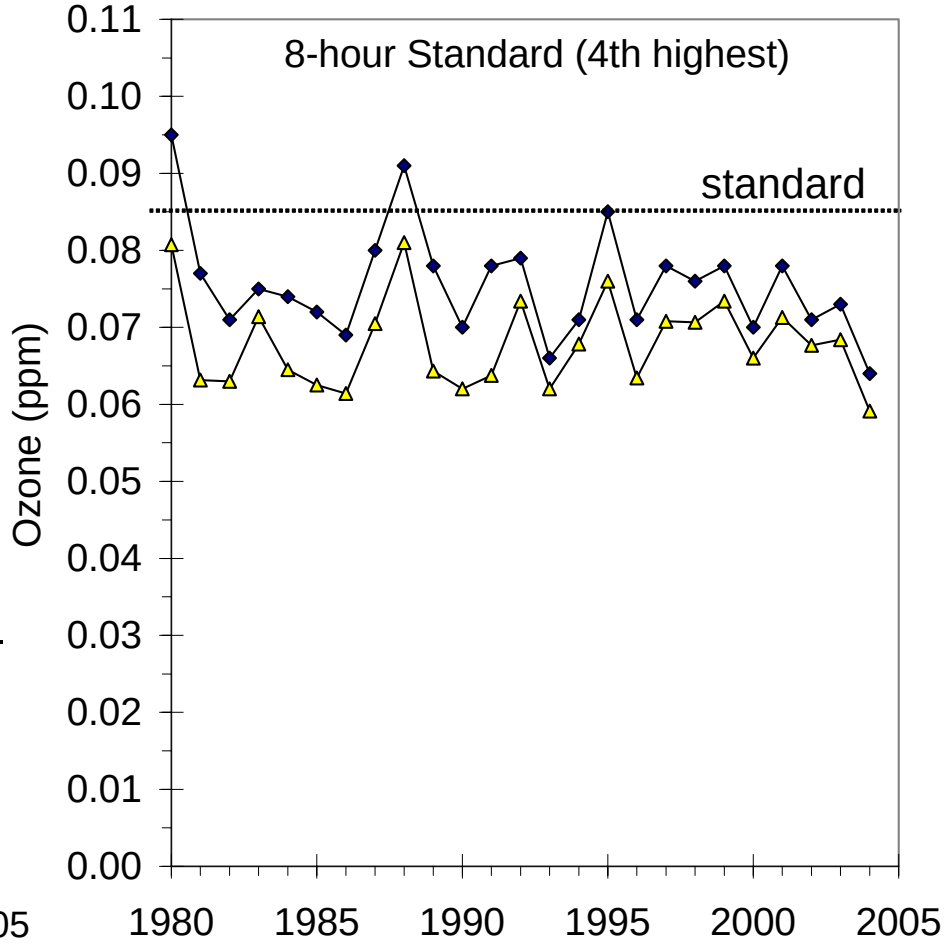
Carbon Monoxide Trend



Notes: “Worst location” is Minnesota site with highest value in any given year. “Average” is average for all Minnesota sites with continuous data for entire time period. All data downloaded from EPA’s AIRdata system.

Ozone Trend

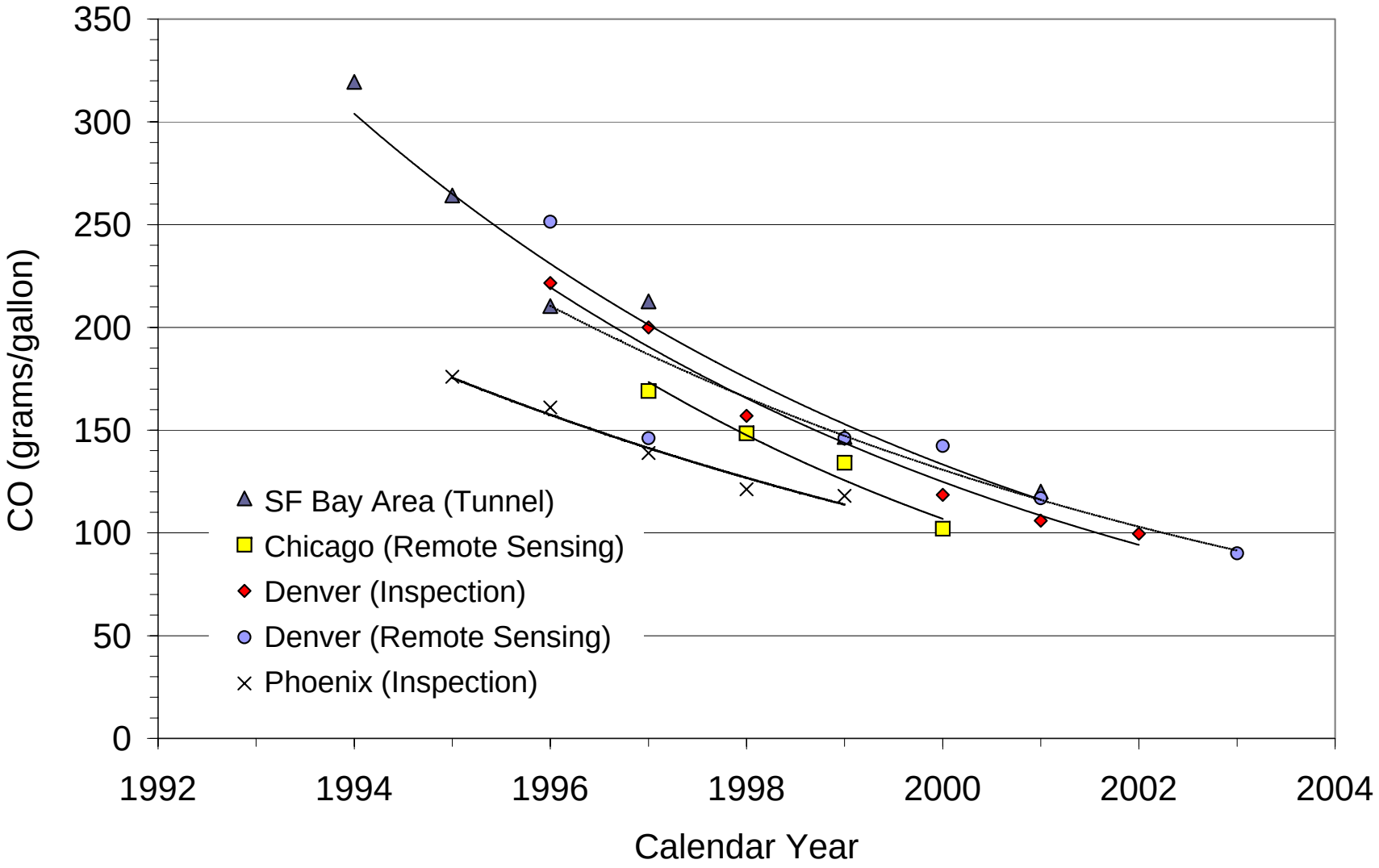




Notes: “Worst location” is Minnesota site with highest value in any given year. “Average” is average for all Minnesota sites operating in any given year. 8-hour standard is exceeded of any monitoring site’s 4th-highest annual reading averages at least 0.085 ppm in any consecutive 3-year period. All data downloaded from EPA’s AIRdata system.

* 8-hour standard is based on 4th-highest concentration each year (right graph), but this is roughly equivalent to averaging less than 4 exceedance days per year.

Automobile CO Emission Trend



Automobile VOC Emission Trend