Control of VOC Emissions in the U.S.

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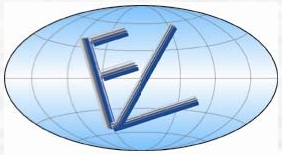
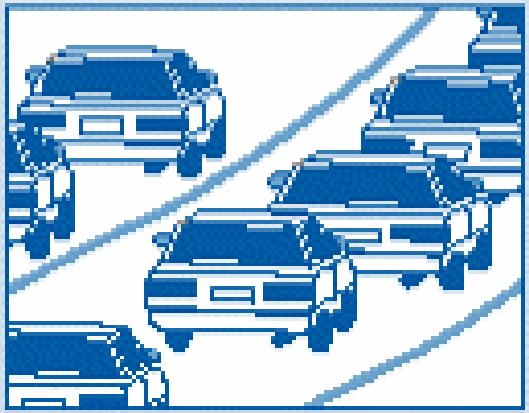


Outline

- Overview of US Clean Air Act (CAA)
- Role of VOC in Air Quality
- U.S. VOC Emissions and Ozone Air Quality Trends
- VOC and Air Toxics Control Strategies
  - Large Stationary Sources
  - Mobile Sources
  - Urban area sources
- California Examples

Routine Emissions From Stationary Sources



Mobile Sources

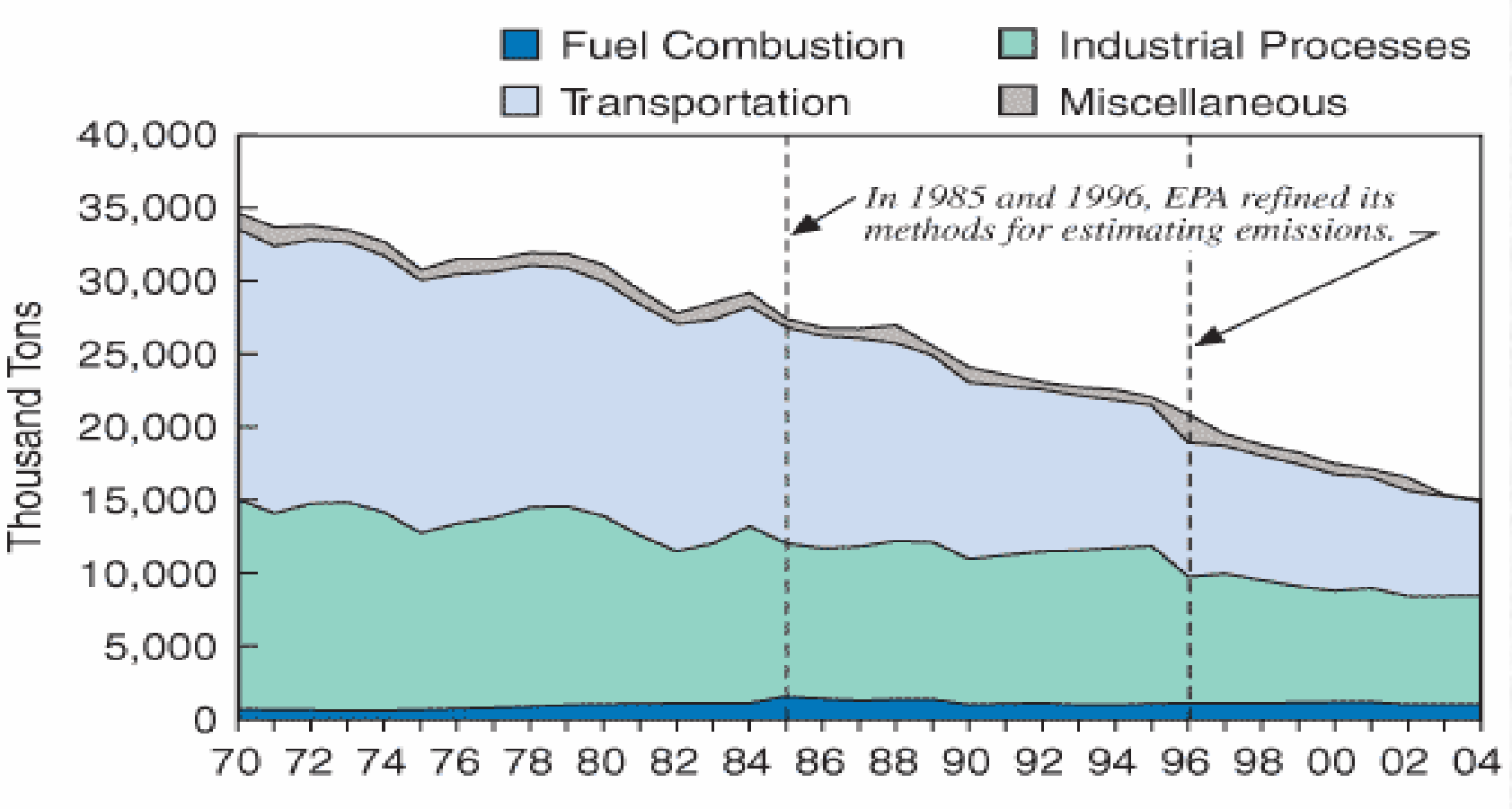
U.S. Clean Air Act: Main Features

- National Ambient Air Quality Standards
  - CO, Ozone, PM_{10}, $PM_{2.5}$, NO_2, SO_2, Pb
- Statutory Deadlines for Attainment by states and affected sources
- State Implementation Plans (SIP) with specific control measures
  - EPA can sanction states for non-compliance
- Enhanced federal 'Air Toxics' program
  - National Emission Standards
  - Assessment of residual health risk
- Comprehensive Air Permits
  - Criminal liabilities
  - Strict enforcement

Why control VOCs

- VOCs are precursors to Ozone formation
  - Ozone is readily formed in the atmosphere by the reaction of VOCs and NOx in the presence of sunlight
- VOCs are emitted from a variety of sources,
  - motor vehicles,
  - chemical plants, refineries, other industries,
  - consumer and commercial products,
  - architectural coatings, and
  - natural (biogenic) sources.
- VOCs are a blend of hundreds of organic compounds some of which have been defined by EPA as Hazardous Air Pollutants (HAPs)

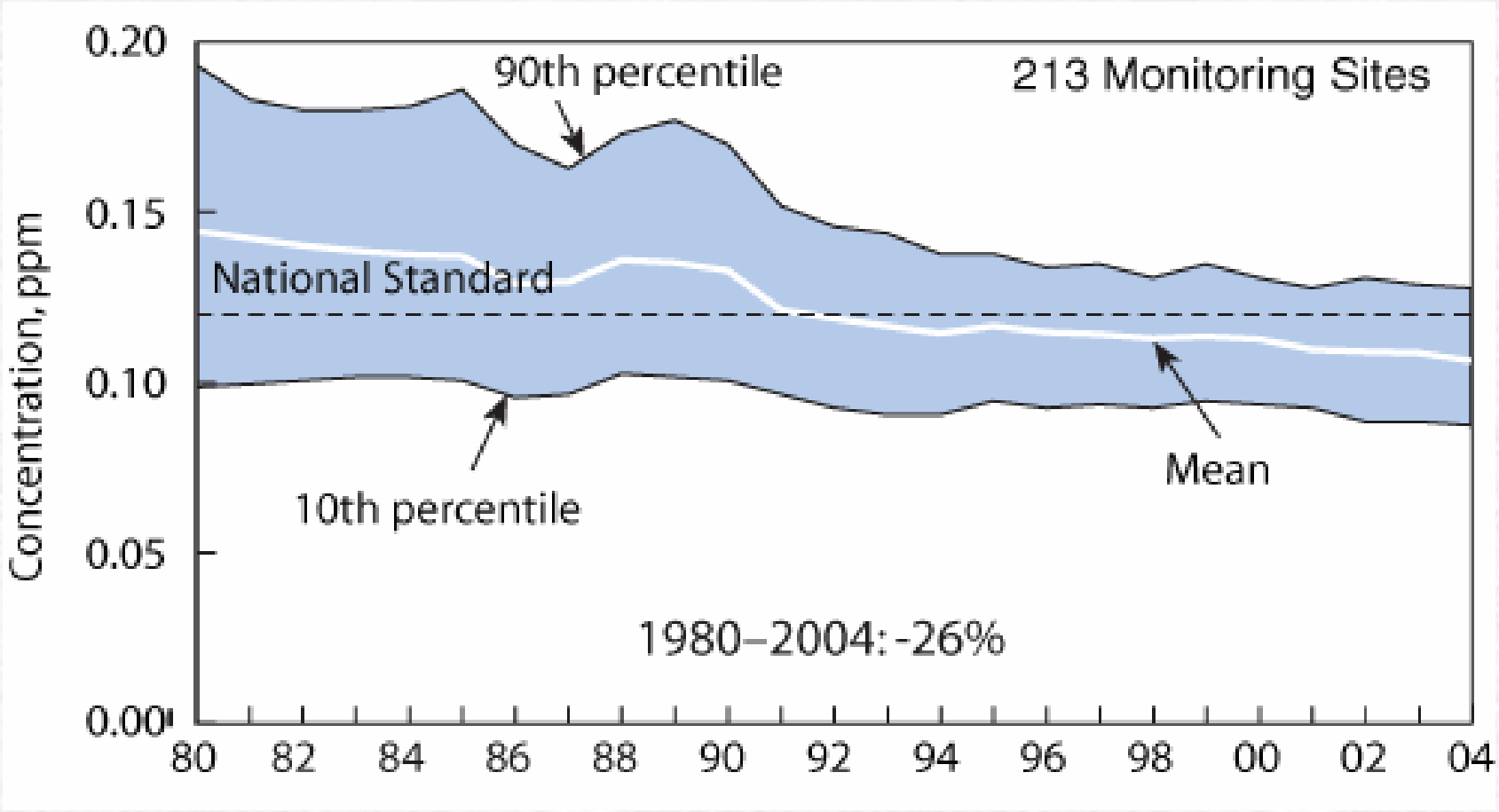
U.S. VOC Emissions Trend
1970-2004



Source: **USEPA Trends Report, 2005**

Ozone Air Quality Trends

1-hour standard



Source: **USEPA Trends Report, 2005**

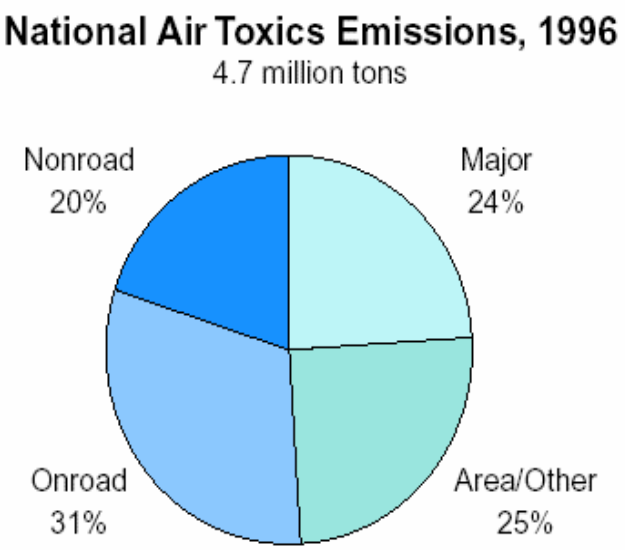
National Air Toxics Program: Major Sources

- Mandatory control of 188 hazardous air pollutants from categories of stationary sources
  - E.g. benzene, toluene, perchlorethlyene, methylene chloride, etc.
- Definition of “Major” sources
  - "Major" sources emit 10 tons per year of a single toxic compound, or 25 tons of a mixture

    (E.g. refineries, organic chemical manufacturing, pharmaceutical, combustion devices, etc.)
- All major sources are required to install Maximum Achievable Control Technology (MACT)

National Air Toxics Program: Area and Mobile Sources

- Definition of "Area" sources
  - Smaller, non-major facilities
    (E.g. Polyurethane Foam, Hospital Sterilizers, Gasoline Distribution, Dry Cleaning, Paint Stripping, Automobile Paint Refinishing, etc.)
- Control of mobile source air toxics
  - Law lists five pollutants
    (E.g. benzene, formaldehyde, acreolin, 1,3-butadiene, etc.)
  - POM = Polycyclic Organic Matter



Source: USEPA National Air Toxics Assessment Report, 2003

Emission Reduction Strategies

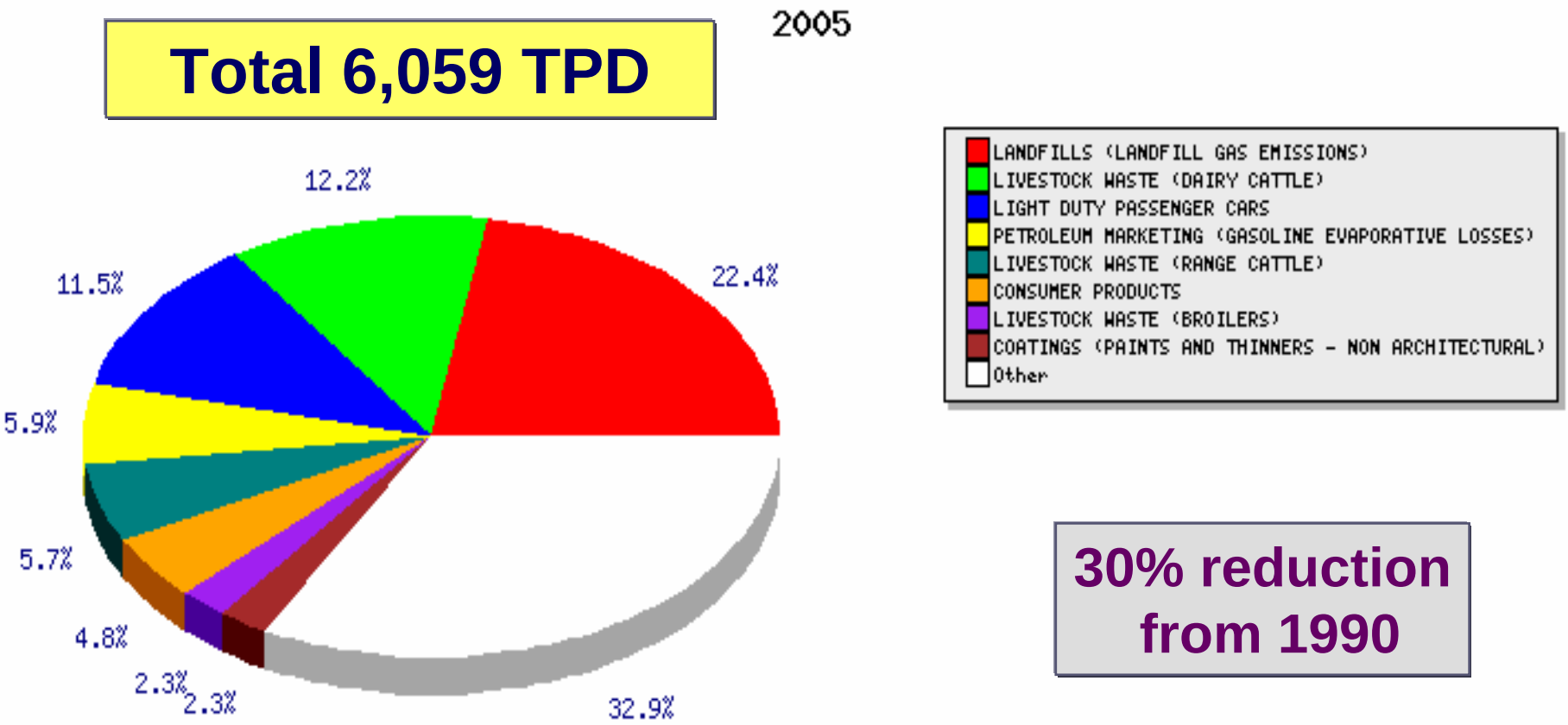
- Reduce the volume, or eliminate emissions, of volatile organics including toxics by
  - process changes, substitution of materials, or other modifications;
- Enclose systems or processes to eliminate emissions;
- Collect, capture, or treat these pollutants when released from a process vent, stack, storage, or fugitive emissions point;
- Design equipment, implement work practice, or operational standards
  - including requirements for operator training or certification

Stationary Source Controls

- Storage vessel and loading
  - Roofs: fixed, internal floating, or external floating,
  - Closed Vents routing vapors to a fuel gas system
  - Vapor balancing system for loading
- Fugitive Emissions from Process Equipment Leaks
  - Leak Detection and Repair (LDAR) work practice
- Process Vents
  - Reduce volatiles by 98% or below 20ppm VOC
- Wastewater collection and Treatment

VOC Emissions in California

Total 6,059 TPD



30% reduction from 1990

Source: **California Air Resources Board Database**

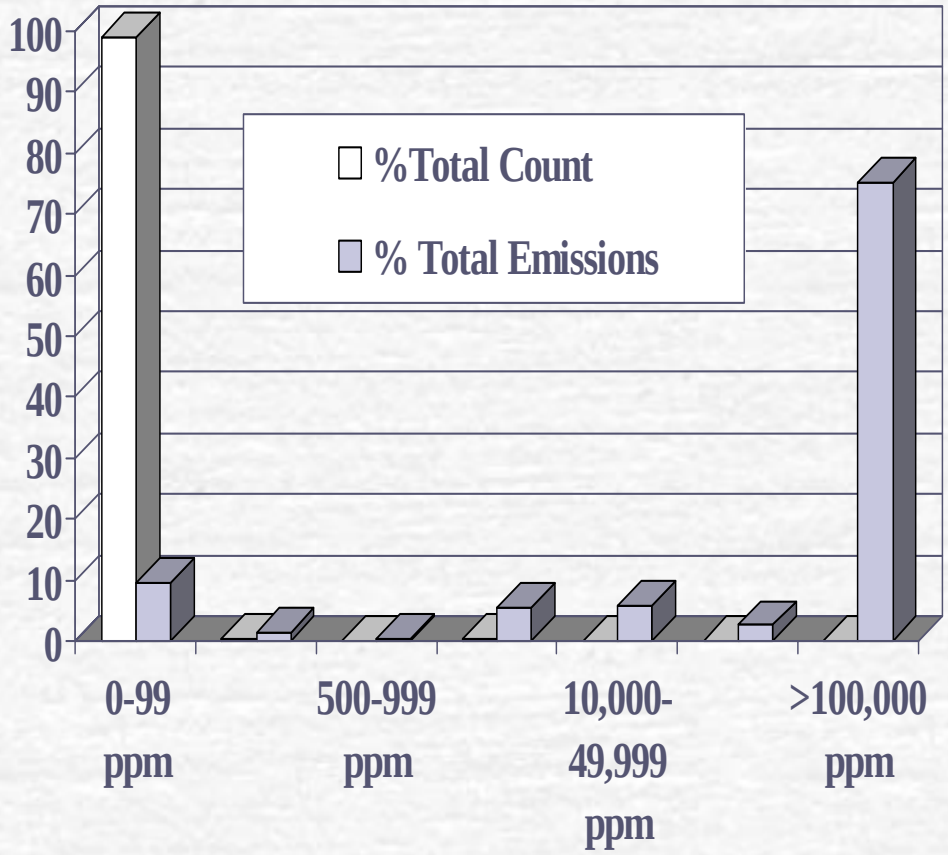
Focus on Southern California

- Emission fees mandatory by federal law
  - In California they range from $50-950/ton/year
- Outcome of emissions control
  - *In 1990*: ~ $ 20 Million/year paid by the six large refineries in southern California
  - *By 1999*: VOC emissions (and fees) have declined by 40-70%

- Reformulated gasoline introduced in 1994
  - Improved air quality in the region to the best levels in 30 years

Refinery Fugitive Emissions

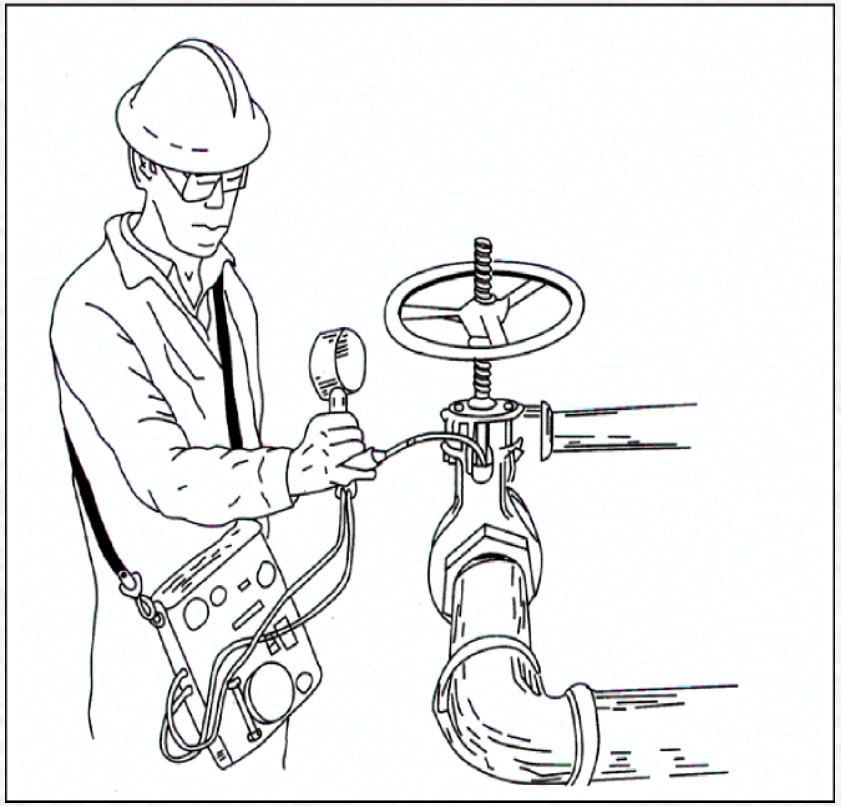
- American Petroleum Institute (API) Study
  - 7 refineries in Southern California
  - 5 years of data
- 92% of reducible emissions come from <0.2% of components
  - Leaks occur randomly
  - Few repeat leakers
- Need a cost-effective method to find large leaks and repair them



Source: API Publication 310, November 1997

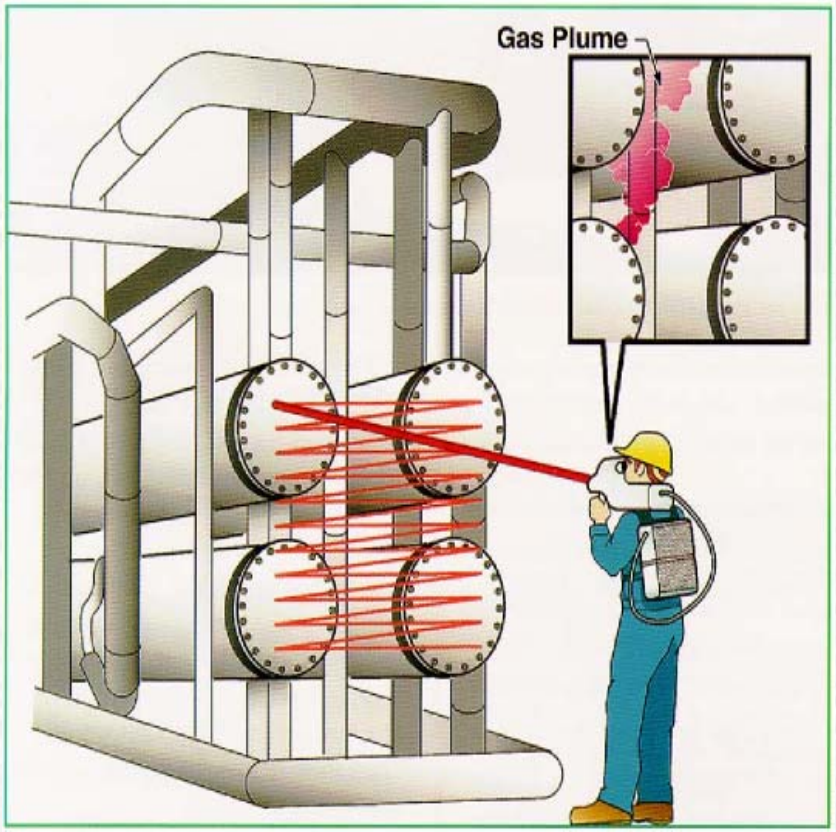
Leak Detection and Repair (LDAR)

- Current LDAR Program is Very Costly
  - Most effort seems to be wasted;
  - ~ 98% of components don't leak
- Costs estimated at $1 per component per event
  - ~ $1MM annually at large refineries
- Repairs within 14 days or less depending on leak rates
- Persistent leakers require replacement at turnaround



NEW: Smart-LDAR

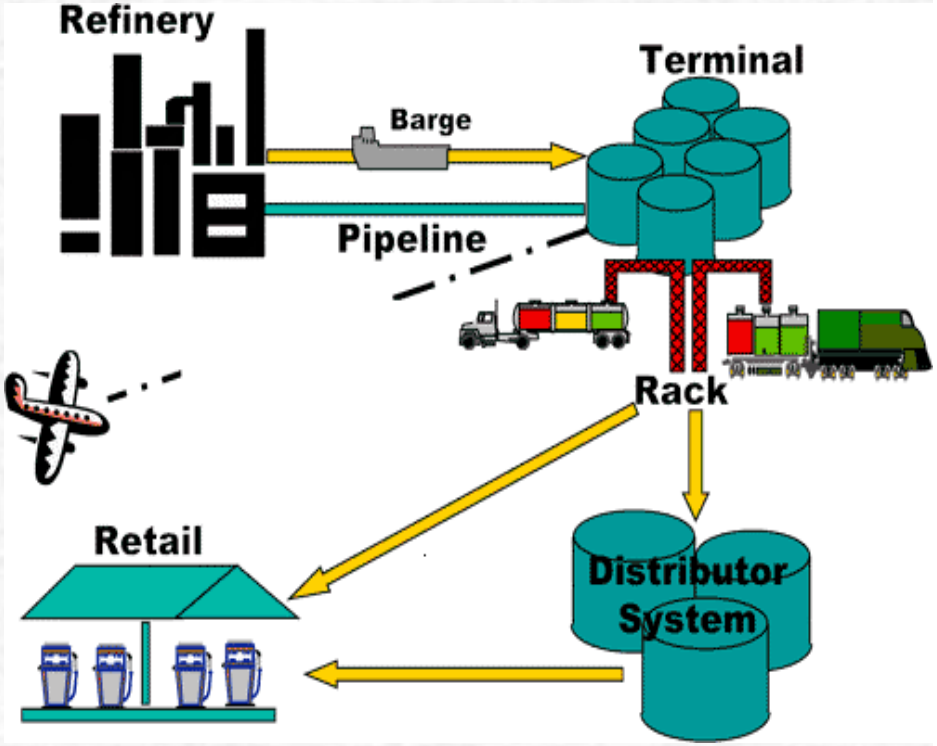
- 'Work Practice' developed and tested jointly by API, EPA and instrument vendors
- Main Features
  - Remote optical imaging
  - View multiple leaking components simultaneously
  - Monitoring more frequently
  - Repair all large leaks quickly
- New EPA rule for this alternative practice expected in April 2006



Gasoline Terminals and Distribution

- A combination of “Major” and “Area” sources
- Emission sources controlled
  - Storage tanks,
  - equipment leaks from the piping system,
  - Gasoline loading racks into tank trucks,
  - Gasoline vapor leakage from fuel distribution

    (Stage I and Stage II controls)



Key Factors for Success

- Integrated Air Quality Management dealing with pollutants and sources
- Specific targets, timelines and enforcement
- Science based air quality planning and assessment process
- Cost-Benefit analyses and prioritization of control measures
- Engagement of all stakeholders to create the political will to tackle tough issues

More Information

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