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Ozone Exposure and Health

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Purpose of this Testimony

- Establish that O_3 exposure has significant adverse effects on health even at low levels.
  - Effects are clinically significant.
  - Evidence is provided by laboratory studies with rodents, non-human primates and humans.
  - Supporting evidence is provided by epidemiological studies.
- Health outcomes were improved in cities where ambient O_3 concentrations were reduced.

Quote from Prozone's Response to the Proposed Regulation

"Pure ozone, in of itself, is a non-toxic irritant…even high levels of pure ozone that can possibly be produced by a household rated machine have biological symptoms that reverse within 24 hours of exposure."

This is not true!

O_3-induced effects are not all fully reversible.

- Near life-long exposure to O_3 causes functionally restrictive, i.e. "stiffened," lung and progressive loss of respiratory system compliance in rodents.
- Long-term exposure to relatively low levels of ozone caused irreversible changes in lung collagen structure consistent with fibrosis in non-human primates.
- When infant monkeys were episodically exposed to 0.5 ppm O_3 for 5 months, their lung development was abnormal.
- These changes are likely to be permanent!

Human Clinical Studies Show Adverse Effects of O3 at Levels Below the Current Air Quality Standard

- Acute and subacute exposure to O_3 induces lung inflammation and injures both upper (nasal) and lower airways.
- These inflammatory processes are linked to the pathogenesis of many airway diseases.
- Exposures of human volunteers for 1-h to 6-h durations caused respiratory symptoms, lung function decrements, increased airway responsiveness, and inflammatory reactions.
- Effects occurred at concentrations below 0.080 ppm for 6-h.
- At levels as low as 0.04 ppm, a small number of sensitive individuals had clinically significant lung function losses.

While some acute effects of O_3 are somewhat reversible, this does not mean that they are not harmful!

- Acute exposure to O_3 is associated with increased respiratory symptoms and decreases in lung function in children with asthma.
  - Symptoms of lower respiratory tract disease and use of bronchodilators may be increased by about one third.
  - Hospital and outpatient admissions for children with preexisting asthma may be increased in the range of 20% with acute exposure to ambient O_3 peaks (Nicolai, 1999).
- There are laboratory findings that support the biological plausibility of the epidemiology.
  - Ozone opens junctions in the lung allowing mediators to leak in. These mediators like histamine make bronchial airways hyperresponse and can provoke asthma-like symptoms.

Experimental Studies are Supported by Epidemiological Results

- Daily mortality is consistently associated with O_3 exposure.
  - The relative risk of daily mortality is increased 6% for a rise in 24-hr average O_3 concentration of 0.031 ppm.
- The relative risks of ozone are higher for subjects older than 78 y.
- The relationship between mortality and ozone did not deviate significantly from linear.
- If a threshold exists for the effects of O_3 on mortality, it exists at very low levels (Hoek *et al.*, 1997).
- O_3 exposure effects on daily mortality is strong in the summer.
- The number of daily deaths increases linearly with 24-hr ozone concentration within the range 0.010 to 0.041 ppm ($P \leq 0.01$) (Sartor *et al.*, 1997).

Lower O_3 levels promote improved health!

- Reducing ambient O_3 levels in Barcelona by 0.022 ppm resulted in a 4% reduction in emergency-room visits for COPD and asthma ($p < 0.05$).
- These results were consistent with the findings of similar studies in other European and American cities. (Tobias Garces *et al.*, 1998).

Conclusion

- Ozone is toxic
- Ozone causes irreversible and clinically significant health effects.
- Reversible effects can be life threatening for sensitive individuals.
- For these reasons, I support the proposed regulation.