Thank you, Ms. Witherspoon. Good morning, Dr. Lloyd and members of the Board.

This morning’s presentation focuses on results from several recent studies that provide evidence for the health benefits of air pollution control.
One of our roles at the ARB is to evaluate the scientific literature regarding air pollution’s effects on human health. Clear examples of how elevated levels of particulate matter, ozone and other pollutants adversely affect the health of the public have been presented to the Board in several recent Health Updates.

Today, the focus is on the inverse -- that improving air quality has a positive effect on health. This issue is at the heart of the current interest in accountability, which is defined as the process of measuring the health benefits of environmental regulation, in this case, air pollution controls.

To this end, I will summarize 5 studies that show evidence for health benefits due to reducing air pollution.
The five studies come from Europe and Asia as well as the United States.

One study examined death rates resulting from PM reductions due to a ban of coal sales in Dublin, Ireland.

The second study, performed in the Utah Valley, examined the effects of the temporary closure of a steel mill, which was the main source of particulate pollution in the region.

The summer Olympic Games of 1996 presented a good opportunity to study the health effects of ozone reductions from changed traffic patterns in Atlanta, Georgia.

In Hong Kong, the health effects of reducing the sulfur content of fuel were assessed.

I will conclude my presentation with an update on relevant findings from ARB’s Children’s Health Study conducted in southern California.
I begin with the study in Dublin, Ireland.

On Sept 1, 1990, the Irish government banned the marketing, sales and distribution of soft coal within the city of Dublin. Luke Clancy et al examined the effect of this intervention on the association between ambient air quality and death rates.

The investigators analyzed data from 6 years prior and 6 years after the ban.
In this study, black smoke and sulfur dioxide were measured at six stations. The researchers found that the ban of coal sales resulted in a substantial reduction in black smoke, which is a measure of fine particles. Overall, the average black smoke level fell by about 2/3 after the ban.

Similarly, sulfur dioxide levels decreased by about 1/3 after the ban.

The pollutant levels shown in this slide represent an average across all months. However, these pollutants typically peak during the winter season, and in this study, the largest declines had occurred in the winter.
After adjusting for factors known to influence mortality, which include temperature, relative humidity, respiratory epidemics, age and changes in personal habits such as smoking, the investigators found statistically significant decreases in death rates. They found a 6% decrease in non-trauma deaths. This decrease was primarily driven by an estimated 10% and 16% decrease in the rates of death from heart and lung diseases, respectively. This finding is consistent with our understanding of air pollution effects on the cardiovascular and respiratory systems.

Moreover, the reduction in death rates was 2 to 3 times greater than had been predicted from previous PM mortality studies.

Note that deaths from all other non-trauma causes were estimated to increase slightly. However, this increase was not statistically significant.
To summarize the results of this study, the ban on coal sales within Dublin led to a substantial improvement in air quality. The investigators found significant reductions in death rates, especially for cardiovascular and respiratory causes.

Compared to previous studies, this research shows greater health benefits of reducing daily exposures to PM.

These findings suggest that control of particulate air pollution can lead to immediate and significant reductions in death rates.
Let me move on to the second study, which was conducted by Dr. Arden Pope in Utah Valley, located in central Utah.

During the period of August 1986 to Sept 1987, a steel mill, which was the primary source of particulate pollution in Utah Valley, was closed due to a workers’ strike. Dr. Pope studied the effects of the closure and subsequent re-opening of this mill on air quality and hospital admissions for respiratory diseases among children.

The study period covered 12 months before and 12 months after the closure period.
During winter seasons when mill was open, federal PM10 standard* was exceeded:
- 13 days in 1985/86
- 10 days in 1987/88

*Federal 24-hour standard for PM10 is 150 \(\mu g/m^3\).

The PM10 standard was not exceeded when the mill was closed (winter 1986/87)

This study focused on the results from the winter seasons since PM10 levels are typically highest during the winter.

Dr. Pope found that particulate levels were lower during the closure period.

For example, the two winter seasons before closure and after re-opening experienced 13 and 10 exceedances, respectively, of the federal 24-hour PM10 standard. In contrast, during the closure period, the standard was not exceeded.
When hospital admissions were analyzed for the same time periods, striking differences were observed.

This graph shows the number of children less than 18 years of age admitted to the regional hospitals for respiratory causes during the winter months between 1985 and 1988. During the 1986/87 winter season, when the mill was closed, hospital admissions for children were approximately 3 times lower than when it was open -- as indicated by the dark red bars. Statistical analyses showed that this decrease was associated with the decrease in PM10 levels.

Not shown in this slide are results from the mortality study that Dr. Pope also conducted in the Utah Valley. It is noteworthy that Dr. Pope's estimates of death reductions among adults and children from decreased PM in this study are very similar to those of the Dublin Study.
The third study I'll summarize today took advantage of the decreased motor vehicle traffic in Atlanta during the 1996 Summer Olympic Games.

During the 17 days of the Games, traffic patterns changed due to the alternative transportation strategy that was implemented to relieve traffic congestion.

For this study, the researchers analyzed the effects of these changes on air quality and acute asthma events among children by examining the air quality and hospital records 4 weeks before and 4 weeks after the Games.
As shown in this slide, the ambient ozone levels calculated from 3 monitoring sites decreased about 13% during the Games -- which is indicated by the dark red bars.

Correspondingly, there were fewer children admitted to the hospitals for acute asthma, an average of 2.5 cases per day during the Games compared to 4.2 cases per day in the baseline period (before and after the Games).

The study determined that there were no significant changes in weather conditions or emissions from stationary sources. Also, hospital admissions for other causes among children did not change during this period.
The next study takes us to Hong Kong, where authorities regulated the sulfur content of fuel oil to be not greater than 0.5% by weight, starting in 1990.

Researchers at the University of Hong Kong studied the impacts of this regulatory action on ambient air quality and several health endpoints in the years following the change.

The regulation produced large reductions in concentrations of several pollutants directly derived from fuel combustion. Specifically, sulfur dioxide measured at multiple sites fell an average of 53% over the following year compared to the baseline levels measured 2 years prior.

However, it should be noted that ozone levels rose in the 5 years following the regulation, and no major changes in levels of PM10 or nitrogen dioxide were observed.
The researchers estimated the impact of the regulation on mortality by examining death rates among 2 age groups for the period 1985 through 1995 -- which includes a 5-year period before and 5-year period after the restriction of sulfur content.

As shown in this slide, the annual average mortality rates for all causes, cardiovascular and respiratory diseases declined after the regulation. It is noteworthy that no significant change was observed for other causes.
Now, I would like to point out that California has its own study which relates to this health benefits issue. Within the Children’s Health Study, investigators studied the health effects of relocating to areas of differing levels of air pollution.

They followed 110 children from the larger Children's Health Study who moved to 6 western states at least one year before follow-up and to areas of either higher or lower pollution.

They found that children moving to areas with lower PM10 levels experienced an increase in lung function growth rates. Conversely, moving to areas of higher PM10 resulted in a decrease in lung function growth rate.
Finally, I’d like to mention that ARB is currently funding a pilot study to determine whether we can quantify the health benefits resulting from incremental improvements in air quality in the South Coast Air Basin. This study is being conducted by UC Berkeley, and the technical work is being peer-reviewed by an external advisory committee consisting of 6 experts in the fields of epidemiology, statistics, public health, and exposure modeling. Results are expected in 2005.

We are also coordinating with the Health Effects Institute, which has its own proposal to assess the effectiveness of regulatory interventions directed toward improving air quality for public health.
In conclusion, there is a growing and substantial body of evidence that suggests immediate health benefits from air pollution controls. These improvements include reductions in both illness and death, in children as well as in adults.

All of the studies discussed today were in populated metropolitan areas -- one indication of their relevance to our situation in California. In addition, while some of the pollution sources are not common to California, the pollutants studied are those of great concern to the ARB.

This concludes my presentation. I will be happy to answer any of your questions. Thank you for your attention.