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Air Pollution and Community Health in Central Long Beach

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ALTHOUGH AIR POLLUTION IN CALIFORNIA HAS DECLINED IN THE PAST FEW DECADES, THERE ARE still areas of the state plagued by hazardous levels of pollution. Poor air quality, or air pollution, has been linked to a wide array of harmful effects on health, including respiratory disease and symptoms, premature birth and birth defects, lung and heart conditions, and even early death. Health problems related to air

Key Issues

- PM2.5, also called *fine particulate matter*, is a harmful pollutant in the air made up of very small particles that are less than 2.5 microns in size (about 1/30th the width of a human hair). Breathing air with high levels of PM2.5 has been linked to a variety of short- and long-term health problems.
- Central Long Beach residents are at particularly high risk for health problems related to high levels of PM2.5 pollution.
- Central Long Beach is affected by higher levels of PM2.5 because of its proximity to various PM2.5-emitting sources of pollution. The area is home to the second busiest port in the country, many rail yards, refineries, and industrial facilities. Ambient levels of PM2.5 have declined as a result of public and private sector pollution control efforts; however, the yearly average is still above the California clean air standard.

Key Findings

Reducing PM2.5 air pollution could yield substantial health and economic benefits for residents of Central Long Beach. If PM2.5 levels were reduced to the California clean air standard, over the next 20 years residents of Central Long Beach would experience:

- 190 fewer deaths
- 39,800 fewer days of work lost due to hazardous PM2.5 pollution on health, accumulating to approximately \$7.6 million in lost wages¹
- 1,600 additional years of life

pollution also have an effect on school attendance, academic and work performance, a person's income and opportunities for advancement as well as overall quality of life.

This Issue Brief examines various air quality scenarios for fine particulate matter, or PM2.5, and the potential to improve health outcomes for Central Long Beach, one of 14 communities in The California Endowment's 10-year Building Healthy Communities plan. Over the course of a 20-year time horizon, we estimate the direct and indirect community-wide impact on health as a result of a reduction in PM2.5 which adequately meets the California clean air standard. We project substantial health gains for residents, lower associated medical care expenditures, increased economic productivity, and improved quality of life for the community of Central Long Beach. (Note: Our analysis does not differentiate between localized variation of fine particulate matter, nor the frequency and duration of exposure of each individual resident.)

Why is PM2.5 an important concern in Central Long Beach?

PM2.5 is a harmful pollutant. Fine particulate matter is one of six air pollutants regulated by the state and federal government because of their harmful effects on human health. Breathing PM2.5 can cause and contribute to health problems in the near term and over the course of a lifetime.²

Many PM2.5 pollutant-emitting sources are found in Central Long Beach. Fine particulate matter pollution is emitted from various sources, but primarily from manufacturing activities, rail yards, and the movement of gas- or diesel-powered vehicles, including boats, tractor trailers, and cars.³ The community of Central Long Beach is within close proximity to many of these sources and has consistently recorded higher than average annual levels of PM2.5.

A high percentage of community members are susceptible to the harmful effects of PM2.5. Fine particulate matter pollution has the potential to harm the health of anyone breathing the pol-

lutant. Some groups, considered *vulnerable populations*, are at even greater risk of being harmed by PM_{2.5} pollution. Children, the elderly, and people living with poor health are especially vulnerable to PM_{2.5}, and the resulting health consequences can be more severe for these groups. Children are particularly susceptible because their respiratory systems are still developing. The elderly are highly susceptible to the effects of PM_{2.5} because they are prone to have more health problems and are less able to fight off and recover from illness. For a person of any age living in poor health, exposure to PM_{2.5} pollution can contribute to and worsen health problems.

Many studies have strongly linked low socioeconomic status, such as educational attainment and household income and poverty, with a higher probability of living in poor health.⁴ People who live in low-income areas tend to have less access to adequate health care services and fewer opportunities to live a healthy, physically-fit lifestyle. Demographic data for Central Long Beach reveal numerous socioeconomic challenges faced by members of this community. When compared to the rest of the City of Long Beach and Los Angeles County, the negative

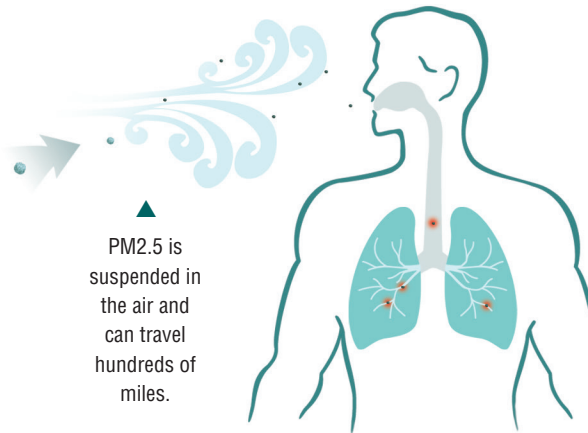
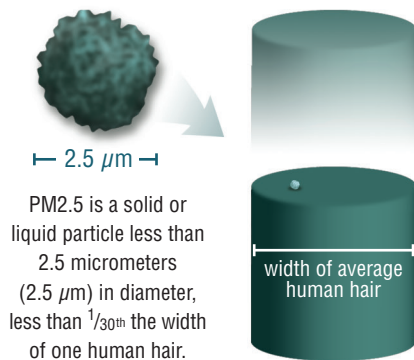
health consequences associated with exposure to high levels of PM_{2.5} are even greater because of the likelihood of existing poor health. The median household income in Central Long Beach is \$20,000, approximately half of the median household income in Los Angeles County and \$17,000 less than the entire City of Long Beach.⁵ Central Long Beach also has a higher rate of poverty. Approximately 44% of families in Central Long Beach live in poverty, more than double the rate of 19.3% for the City of Long Beach as a whole.⁶

Why is it important to reduce PM_{2.5} pollution?

There are a growing number of reports and studies which have found PM_{2.5} to have harmful effects on health. A 2010 report by the California Air Resources Board estimates 9,200 premature deaths occur annually as a result of high PM_{2.5} pollution levels.⁷ The findings of a 16-year follow-up investigation⁸ of exposure to fine particulate matter among adults age 30 years and older found that for each 10 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) increase in PM_{2.5}, the risk of death from all causes increased by 4%, and thus for every reduction of 10 $\mu\text{g}/\text{m}^3$ PM_{2.5} in the general population, there was an estimated increase in life

Fine Particulate Matter and Health

What is PM_{2.5}?



Why is PM_{2.5} dangerous?

- ▶ PM_{2.5} poses a health risk because the fine particles travel deeper into the lungs and are made of toxic materials which can cause:
 - chronic bronchitis or asthma
 - respiratory infections
 - lung cancer or decreased lung function
 - heart disease or irregular heartbeat
 - pre-term birth and low birth weight
 - premature death

Who is most vulnerable?

- **Children:** Their bodies are still developing and they breathe in more air and particulates in proportion to their body size.
- **Elderly or People with pre-existing respiratory conditions:** They have weaker immune systems.
- **Low-Income Groups:** They are more commonly exposed to high levels of PM_{2.5}.

What can you do to reduce your health risks?

While there is much more work that can be done to improve air quality, there are everyday contributions you and members of your community can make to help reduce the risks to your health caused by PM_{2.5} pollution.

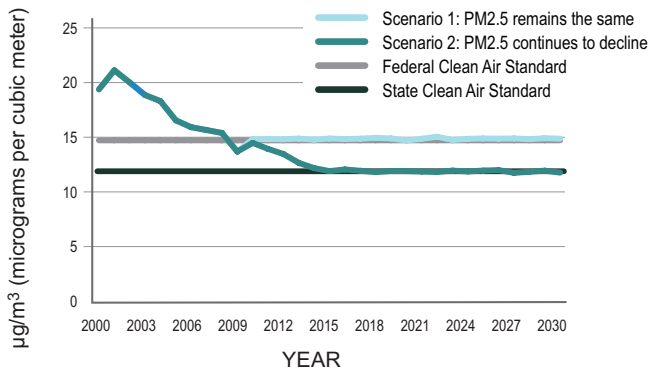
- Check your neighborhood's air quality every day at www.airnow.org and encourage others to do the same.
- Minimize your outdoor exposure and limit your outdoor physical activities when levels of pollution are high. Breathing in pollutants while exercising may cause more damage to your health than you think.
- Limit children's exposure to pollution. If you have kids, talk to their teacher and other school officials about measures they set into action when air pollution levels are high.

Do children play and exercise indoors when pollution levels are hazardous?

- Whenever you can, drive less. Get to know your neighbors by carpooling, biking, or walking. Public transportation is another good option since many of the local bus lines operate cleaner emission vehicles.
- Call your local air pollution control agency to report smoking vehicles or factories, dust, excessive odors, or other air contaminants at 1-800-CUT-SMOG (1-800-288-7664). Phone lines are open 24 hours a day.
- Learn more about Community Asthma Air Quality Resource Education (CAARE) Program operated by the City of Long Beach to help reduce the negative health effects of air pollution.

Source: U.S. Environmental Protection Agency

Figure 1. Central Long Beach PM_{2.5} Air Quality Trends and Clean Air Standards, Years 2000–2030



expectancy of about half a year.⁹ Long-term exposure to PM_{2.5} also increased hospital admissions for all respiratory issues (4%), heart disease (3%), stroke (3.5%), and even diabetes (6.3%).¹⁰

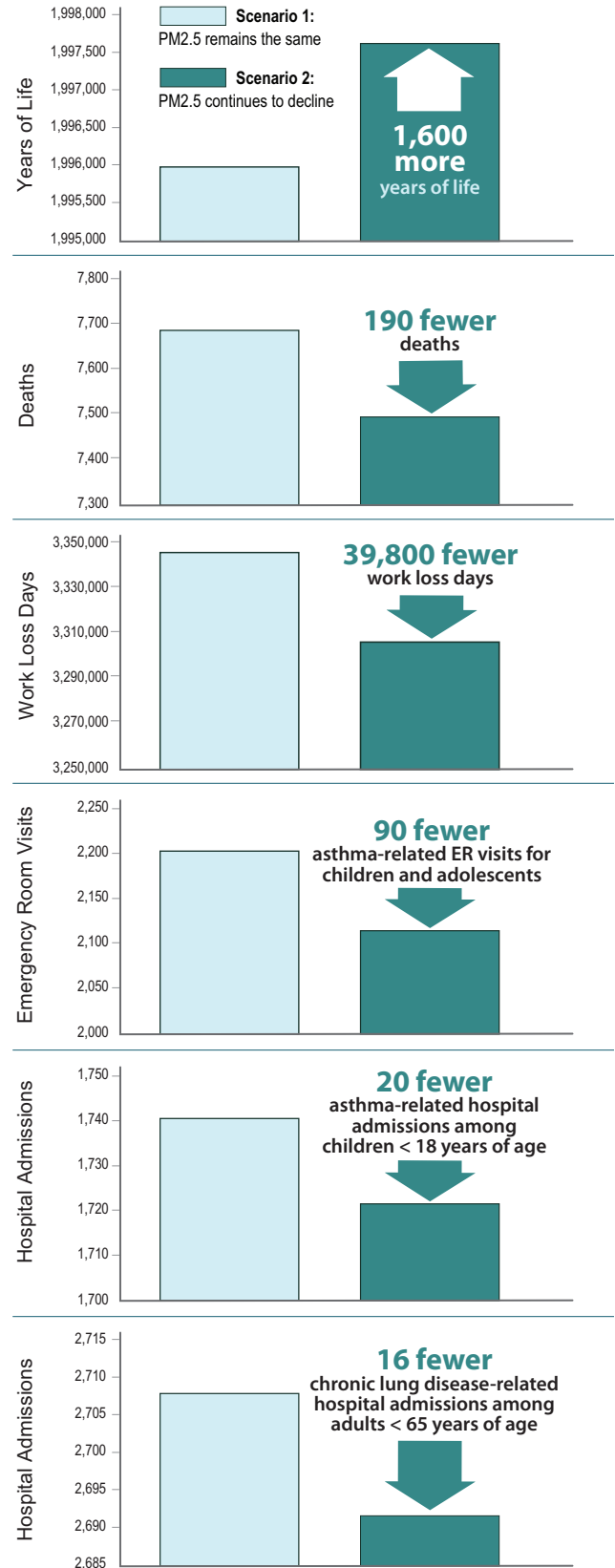
Because of the risks it poses, PM_{2.5} is regulated through air quality standards established by the state and federal government. The national standard limits PM_{2.5} to an annual mean of 15 µg/m³.¹¹ The state standard allows even less PM_{2.5} to be present in the air, at 12 µg/m³. A combination of policies and programs enacted by the government, increased community awareness and engagement, efforts by local industries such as the port's adoption of the San Pedro Bay Ports Clean Air Action Plan to reduce emissions that lead to the formation of PM_{2.5}, and the economic recession, have all led to a substantial reduction in PM_{2.5} levels in Long Beach since 2001. However, the annual average is still above the state standard, and increasing economic activity may contribute to higher PM_{2.5} emissions in coming years.

Our Work

We developed a quantitative model to assess the health impacts of fine particulate matter in Central Long Beach over a 20-year time frame and examined how this community would be affected if the California clean air standard for PM_{2.5} was reached. This *micro-simulation computer model* incorporates specific demographic profiles, risk factor information, and the epidemiologic information that links the risk profile to outcomes over a simulated time horizon.¹² Data inputs for the model were drawn from various sources. Demographic data were retrieved from the U.S. Census, and population estimates were downloaded from the Demographic Research Unit of the California Department of Finance. Air quality data were obtained from the California Air Resources Board, using all available data for air quality monitoring stations throughout Los Angeles County to calculate levels of ambient PM_{2.5} in Central Long Beach. We included health risk function information on the relationship between PM_{2.5} air pollution and a number of health outcomes developed by the United States Environmental Protection Agency Environmental Benefits Mapping and Analysis Program (BenMAP).

Figure 2. Cumulative Direct and Indirect Health Outcomes: Central Long Beach, Years 2010–2030

A comparison of Scenarios 1 and 2 show that residents of Central Long Beach would benefit greatly if levels of PM_{2.5} decreased to the federal standard by 2015.



We found that annual averages for ambient PM_{2.5} in Central Long Beach have declined in the past decade, and in 2009 fell below the federal clean air standard (Figure 1). The annual mean for PM_{2.5} decreased from a high of 21 µg/m³ in 2001, or roughly double the acceptable state standard, to 13.6 µg/m³ in 2009, an annual average still above the state standard. During the same time the number of days per year during which ambient PM_{2.5} exceeded the federally-established daily limit of 35 µg/m³ (considered hazardous in our Health Forecasting Tool) also improved. The number of hazardous days decreased, from a high of 41 days in 2001 to 4 in 2009.

Scenarios

The Health Forecasting Tool compares two “*What would happen in Central Long Beach if*” scenarios using historical data¹³ to forecast trends in the future.

Scenario 1: *What if levels of PM_{2.5} pollution remain the same?*

In the past decade, Central Long Beach experienced a 35% decline in PM_{2.5}. However, the annual average still exceeds the California clean air standard. Some of this decline may be attributed to pollution control measures, such as the Clean Air Action Plan diesel truck replacement program which requires new commercial vehicles to meet more stringent emission standards. The economic recession has also played a role, reducing commercial and personal vehicle use as the price of gas rose and jobs were lost. For Scenario 1, we assume that PM_{2.5} levels will stabilize, with growing economic activity counteracting the impact of past pollution control efforts. We thus use the average ambient level of PM_{2.5} from 2007 to 2009, which averages to 14.9 µg/m³. This level is applied to ambient air quality levels in Central Long Beach beginning in the year 2010 through 2030.

Scenario 2: *What if levels of PM_{2.5} pollution fall below California’s clean air standard by the year 2015?*

Given its location near the ocean, as well as recent collaborative efforts by the government and private sector to reduce emissions that lead to the formation of PM_{2.5}, Central Long Beach reached the federal PM_{2.5} clean air standard in 2009. There is, however, room for improvement. We thus model a continued effort to reduce ambient PM_{2.5} in Central Long Beach using the anticipated decline for PM_{2.5} of 20% from our baseline of 14.9 µg/m³ (average of 2007–2009) through the year 2030. This will bring the annual average PM_{2.5} level below the state target of 12 µg/m³ by the year 2015.

Summary of Results

We project significant improvements on health and work-related outcomes over 20 years following a reduction of PM_{2.5} in Central Long Beach (Figure 2). Further reductions in PM_{2.5}

pollution, enough to reach the state standard for clean air by 2015 (Scenario 2) would provide substantial health gains for residents. These health gains can translate into lower medical care expenditures, improved quality of life, and higher economic productivity for members of the community. We also find an impressive reduction in the number of days lost from work, which has important economic benefits to individual households and the community as a whole.

Our findings can be used to mobilize community members to find solutions to promote cleaner air. While improving air quality is the primary goal of federal and state air quality agencies in charge of setting standards for pollutants such as PM_{2.5}, community members can play an important role in meeting or exceeding the decline in particulate matter to improve air quality. Community-wide approaches to air quality improvement involves decreasing auto emissions, expanding public transportation, improving and maintaining road infrastructure, and encouraging walking and biking to destinations.

Results of this analysis and more information regarding the UCLA Health Forecasting Tool are available on our website: <http://www.health-forecasting.org>.

- 1 The value of a work loss day was calculated using California Air Resources Board methodology found in the Public Health Analysis Supplement: Attachment D: Method used to quantify health benefits of draft scoping plan co-pollutant emission reductions, 2006.
- 2 U.S. Environmental Protection Agency. *PM_{2.5} objectives and history*.
- 3 U.S. Environmental Protection Agency. (2011). Fine particle (PM_{2.5}) designations. Retrieved February 29, 2012, from <http://www.epa.gov/pmdesignations/>
- 4 Eisner MD, et al. Socioeconomic status, race, and COPD health outcomes. *J Epidemiol Community Health*. 2011;65(1):26–34.
- 5 American FactFinder 2. Census: DP-3: Profile of Selected Economic Characteristics: 2000.
- 6 *ibid*.
- 7 California Air Resources Board. (2010). *Estimate of premature deaths associated with fine particle pollution (PM_{2.5}) in California using a U.S. Environmental Protection Agency methodology*.
- 8 Arden Pope III C, et al. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA*. 2002;287(9):1132–41.
- 9 Arden Pope III C, et al. Fine particulate air pollution and life expectancy in the United States. *N Engl J Med*. 2009;360(4):376–86.
- 10 Kloog I, et al. Acute and chronic effects of particles on hospital admissions in New England. *PLoS ONE*. 7(4):e34664.
- 11 According to the U.S. Environmental Protection Agency, the annual mean is derived by calculating the arithmetic annual average concentrations for the previous three years. South Coast Air Quality Management District.
- 12 UCLA Fielding School of Public Health, Health Forecasting Tool www.health-forecasting.org
- 13 [California Air Resources Board](http://www.airresourcesboard.org)

Acknowledgments

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Health Forecasting

The mission of the Health Forecasting Project is to improve population health and reduce or eliminate health disparities. The development and communication of sound, credible forecasts show how the future health of populations and sub-populations can be improved by implementation of effective evidence-based public health policies and programmatic interventions. More information about the project and access to Health Forecasting Tools can be obtained at www.health-forecasting.org. Health Forecasting is based at the [UCLA Fielding School of Public Health](http://www.ucla.edu/fielding), and is a collaborative effort with the [California Department of Public Health](http://www.cdph.ca) and the [Los Angeles County Department of Public Health](http://www.lacounty.gov).

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