

August 2005

# AIR POLLUTION

## Estimated Emissions from Two New Mexicali Power Plants Are Low, but Health Impacts Are Unknown



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# Highlights

Highlights of [GAO-05-823](#), a report to congressional requesters

## Why GAO Did This Study

Power plants emit pollutants that have been linked to various negative health effects. In 2003, two new power plants, owned by Sempra Energy and Intergen, began operations 3 miles south of the U.S.-Mexico border near Imperial County, California. The county does not meet some federal and state air quality standards and may be further impacted by the emissions from these plants. Although these plants export most of the electricity they produce to the United States, they are not currently required to meet any U.S. or California emissions standards.

GAO was asked to determine (1) how emissions from the two plants compare with emissions from recently permitted plants in California and emissions from sources in Imperial County, and what emissions standards they would be subject to if they were located in Imperial County; (2) the health impacts of emissions from the plants on Imperial County residents; and (3) options available to U.S. policymakers to ensure that emissions from these plants do not adversely affect the health of Imperial County residents.

In commenting on a draft of this report, DOE disagreed with our characterization of the limitations of their assessment of the health impact of pollution from the Sempra and Intergen power plants. We believe we have portrayed the limitations of this assessment accurately.

[www.gao.gov/cgi-bin/getrpt?GAO-05-823](http://www.gao.gov/cgi-bin/getrpt?GAO-05-823).

To view the full product, including the scope and methodology, click on the link above. For more information, contact John B. Stephenson at (202) 512-3841 or [stephensonj@gao.gov](mailto:stephensonj@gao.gov).

## AIR POLLUTION

# Estimated Emissions from Two New Mexicali Power Plants Are Low, but Health Impacts Are Unknown

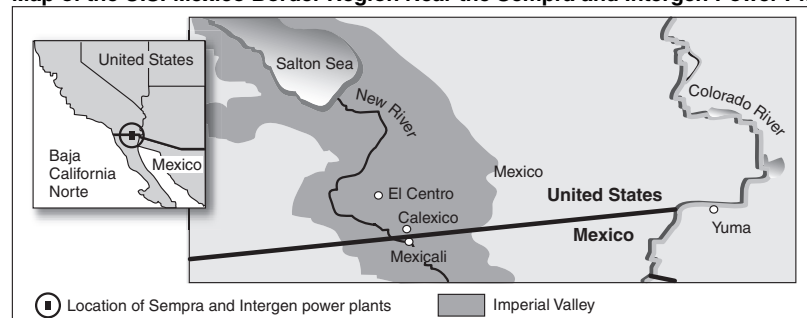
## What GAO Found

The estimated emissions from the Sempra and Intergen power plants near Mexicali are comparable with similar plants recently permitted in California and are low relative to emissions from the primary sources of pollution in Imperial County, California, which are dust and vehicles. However, if the plants were located in Imperial County, they would be required to take steps to improve air quality by reducing emissions from other pollution sources in the region, such as paving dirt roads, because the county is not meeting certain U.S. air quality standards.

Although emissions generated from the Sempra and Intergen plants may contribute to various adverse health impacts in Imperial County, the extent of such impacts is unknown. The Department of Energy (DOE) estimated that emissions from these plants may increase asthma hospitalizations by less than one per year. However, DOE did not quantify any other asthma-related impacts, such as emergency room visits or increased use of medications, which, although less severe, are likely to occur more often. In addition, DOE did not determine whether increased emissions would cause other respiratory or cardiovascular problems and the impact of particulate matter on particularly susceptible populations. Finally, the potential health impacts associated with ozone could be greater than DOE estimated because some important data needed for modeling were not available.

Existing laws and international agreements may not provide adequate mechanisms to address adverse health impacts resulting from power plant emissions. Policymakers could take some actions, such as requiring plants that seek to export electricity to the United States to use specified emission controls. While this action would have benefits, it would also have costs, such as possibly reducing energy supplies available to Southern California. Long-term policy options include the development of a binational pollution reduction program or a trust fund to provide grants and loans to support air quality improvement projects. However, substantial efforts on both sides of the U.S.-Mexico border would be required to establish the legal and management framework necessary for such programs to be effective.

Map of the U.S.-Mexico Border Region Near the Sempra and Intergen Power Plants



Source: GAO presentation of DOE data.

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### Abbreviations

BLM	Bureau of Land Management
CO	carbon monoxide
DOE	Department of Energy
EPA	Environmental Protection Agency
NAAEC	North American Agreement on Environmental Cooperation
NAFTA	North American Free Trade Agreement
NO <sub>x</sub>	nitrogen oxides
NH <sub>3</sub>	ammonia
PM	particulate matter
PPM	parts per million
VOC	volatile organic compounds

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United States Government Accountability Office  
Washington, DC 20548

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August 12, 2005

The Honorable Hilda Solis  
Ranking Member  
Subcommittee on Environment and Hazardous Materials  
Committee on Energy and Commerce  
House of Representatives

The Honorable Bob Filner  
House of Representatives

In 2003, two new power plants owned by American-based corporations, Sempra Energy and Intergen, began operations 3 miles south of the U.S.-Mexico border near Mexicali, Mexico, and Imperial County, California. These modern natural gas-fired plants use advanced pollution control technologies; nevertheless, they emit some pollutants such as nitrogen oxides and airborne particles, known as particulate matter. Some health studies have found that even the smallest incremental increase in the amount of particulate matter in the air corresponds with an increase in adverse health effects.

The U.S.-Mexico border region is experiencing significant economic, industrial, and population growth, and that growth is expected to continue. Imperial County is one of the fastest growing counties in California and is expected to double in population by 2025. The county does not currently meet some federal and state air quality standards and has one of the highest asthma prevalence rates for children ages 1 through 17 in the state. The increased demand for energy to meet the needs of the border region could lead to the construction of additional power plants, with the associated potential for increased air pollution and negative impacts on public health.

In the United States, the Clean Air Act establishes the principal framework for federal, state, and local efforts to protect air quality. Under this act, the Environmental Protection Agency (EPA) establishes health-based air standards that the states must meet.<sup>1</sup> EPA has issued air quality standards

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<sup>1</sup>The standards are known as the National Ambient Air Quality Standards.

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for six primary pollutants—carbon monoxide, lead, nitrogen dioxide,<sup>2</sup> ozone, sulfur dioxide, and two categories of particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>)<sup>3</sup>—that have been linked to a variety of health problems. Agencies collect data on the levels of these pollutants to determine if air quality is meeting the federal standards. Areas that do not meet these federal standards are designated as “nonattainment” areas and are, as a result, generally subject to more stringent emission control requirements. Imperial County is currently designated as a nonattainment area for PM<sub>10</sub> and ozone.<sup>4</sup> New facilities being built within a nonattainment area that are expected to generate emissions above a certain threshold may be required to provide mitigation measures in the form of emission offsets. These offsets are designed to improve air quality in nonattainment areas by reducing emissions from other pollution sources in the region. They could include, for example, providing funds to update diesel engines or to pave dusty dirt roads.

The Sempra power plant has a single power-generating unit with the capacity to produce a total of 650 megawatts of electricity per hour, all of which are designated for export to the United States.<sup>5</sup> The Intergen facility, which has a total capacity of 1,060 megawatts, is composed of two units: one that produces power exclusively for the United States and a second that exports up to one-third of its power to the U.S. market. Because the plants are located in Mexico, Mexican agencies have the exclusive authority to regulate the permitting and construction, as well as the emissions resulting from their operation. Mexico regulates the emissions of several pollutants from its power plants but requires natural gas-fired plants, such as Sempra and Intergen, to report emissions of only nitrogen oxides. In part, because of the advanced technology and control

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<sup>2</sup>Nitrogen dioxide (NO<sub>2</sub>), a common air pollutant, is one of a group of gases collectively known as nitrogen oxides, or NO<sub>x</sub>. The term NO<sub>x</sub> is used commonly in both the United States and Mexico to describe these gases, but NO<sub>2</sub> is sometimes monitored to report on the levels of all nitrogen oxide emissions in general.

<sup>3</sup>PM<sub>2.5</sub> and PM<sub>10</sub>, also known as fine and coarse particulate matter, respectively, refer to the size of the airborne particles measured at the diameter (in micrometers).

<sup>4</sup>Ozone is formed at ground level by a chemical reaction of various air pollutants, including NO<sub>x</sub>, combined with sunlight. Ozone is a key ingredient in urban smog.

<sup>5</sup>Independent of such factors as time of day, time of year, and geographical location, in general, one megawatt of electricity is sufficient to meet the needs of 750 to 1,000 households for 1 hour.

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equipment these plants are using, their estimated emissions of NO<sub>x</sub> are significantly lower than the established emission limit in Mexico.

The electricity generated by these plants is transmitted into the United States over electric transmission lines authorized by presidential permits issued by the Department of Energy's (DOE) Office of Fossil Energy.<sup>6</sup> These permits are required before electric transmission facilities are constructed, operated, maintained, or connected at the U.S.-Mexico border.<sup>7</sup> DOE is responsible for reviewing permit applications and conducting an environmental evaluation as part of this review. DOE issued a final environmental impact statement on the Sempra and Intergen transmission lines in December 2004 that included an assessment of the potential health impacts associated with emissions from the power plants.

In this context, you asked us to determine (1) how emissions from the Sempra and Intergen power plants compare to emissions from recently permitted plants in California and emissions from sources in Imperial County, and what emissions standards the plants would be subject to if they were located in Imperial County; (2) the health impacts of emissions from the power plants on Imperial County residents; and (3) what options exist for U.S. policymakers to ensure that emissions from these power plants do not adversely affect the health of Imperial County residents.

To address these objectives, we visited the Sempra and Intergen plants near Mexicali, Mexico; interviewed plant representatives, various federal, state, and local air quality officials, and other key stakeholders; and reviewed relevant documents and studies. To address how emissions from the Sempra and Intergen power plants compare to emissions from recently permitted plants in California, we used data from emissions tests conducted at the plants by third-party contractors. We did this because Mexico does not require the plants to report actual emissions of pollutants other than nitrogen oxides. We assessed the reliability of the data by (1) reviewing documentation of test objectives and quality control procedures provided by the third-party contractors who conducted the tests, (2) talking with Sempra and Intergen officials to determine the scope and

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<sup>6</sup>On April 13, 2005, the Secretary of Energy transferred the authority to grant presidential permits to the Office of Electricity and Energy Assurance. That office has subsequently been renamed the Office of Electricity Delivery and Energy Reliability.

<sup>7</sup>Exec. Order No. 10485, 18 Fed. Reg. 5397 (Sept. 9, 1953) amended by Exec. Order No. 10238, 43 Fed. Reg. 4957 (Feb. 3, 1978).



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generalizability of the tests, and (3) reviewing reports of actual NO<sub>x</sub> emissions submitted to the Mexican government to verify consistency with the test results. We determined that the data were sufficiently reliable for the purposes of this report. We also obtained the permissible emission limits for comparable plants in California. Comparable plants were selected by identifying all natural gas power plants of similar size and specifications to the Sempra and Intergen plants that were permitted in California between 2000 and 2004. Because all California power plants are permitted on a case-by-case basis, emissions limits may vary with each project. Therefore, we used the entire range of emission limits for the 23 plants that were identified during our selection process. To determine how the emissions from the Sempra and Intergen power plants compared to emissions from sources in Imperial County, we utilized the 2004 estimated annual average emissions inventory for the county developed by the California Air Resources Board, among other things. To address what emissions standards the plants would be subject to if they were located in Imperial County, we reviewed federal and California regulations for new power plants, interviewed EPA, state, and Imperial County air quality officials, and reviewed the emission limits and selected permitting conditions for power plants located in California. To identify the potential health impacts from plant emissions, we reviewed the health assessment methodology DOE used in its environmental impact statement, reviewed relevant studies, and met with health experts. To determine available policy options, we reviewed the Clean Air Act; environmental and trade agreements among the United States, Mexico, and Canada; and academic research. See appendix I for additional details on our scope and methodology. We conducted our work between September 2004 and August 2005 in accordance with generally accepted government auditing standards.

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## Results in Brief

The emissions from the Sempra and Intergen power plants near Mexicali are comparable to emissions from similar plants recently permitted in California and are low relative to emissions from the primary sources of pollution in Imperial County—dust and vehicles. However, if the plants were located in Imperial County, they would be required, among other things, to offset their emissions to help improve regional air quality. Our review of emissions test data obtained from Sempra and Intergen indicates that estimated emissions from these plants generally fall within a range of allowable emission limits identified from 23 plants of comparable size and specifications permitted in California between 2000 and 2004. Although the Sempra and Intergen plants will cause some increase in regional emissions of PM<sub>10</sub> and nitrogen oxides (which contribute to ozone

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formation), the primary sources contributing to PM<sub>10</sub> and ozone in Imperial County are various forms of dust and motor vehicles. In addition, based on the amount of energy produced per pound of NO<sub>x</sub> emissions, these plants are cleaner than other major fuel-fired plants operating in Imperial County or the border region of Baja California, Mexico. Nevertheless, if the plants were located in Imperial County, they would be required to offset their emissions because the county is a nonattainment area for PM<sub>10</sub> and ozone. More specifically, Imperial County air quality rules would require that the operators of each plant provide emissions offsets of at least 1.2 tons for every ton of emissions released by the plant that contribute to area nonattainment status.

Emissions generated by the Sempra and Intergen power plants, like any other source of emissions, may contribute to adverse health impacts in Imperial County, but the full extent of such impacts is unknown. In its December 2004 final environmental impact statement, DOE estimated an increase in asthma hospitalizations in Imperial County of less than one per year as the result of increased emissions from the two plants. However, DOE did not fully assess the plants' health impact because it did not quantify other asthma-related health impacts, such as emergency room visits, physician visits, and increased use of asthma medication, which, although less severe than hospitalization, are likely to occur more often, according to health experts. Also, the DOE study did not address the extent to which increased emissions of particulate matter would cause other adverse health impacts, such as other respiratory or cardiovascular conditions. In addition, DOE did not analyze the health impacts from increased power plant emissions on particularly susceptible populations, such as asthmatic children and low-income asthmatic adults. Imperial County is one of the poorest counties in California and low-income asthmatics adults are more susceptible to health problems, in part, because they have less access to health care. Finally, EPA officials are concerned about the accuracy of DOE's modeling of estimated ozone increases for its final environmental impact statement because comprehensive data on some key factors, such as temperature and relative humidity, were not available. According to EPA officials, if the modeled estimates of increased ozone are not correct, the impacts on air quality from these two plants could be significant, resulting in some adverse health impacts that were not reported by DOE.

Policymakers have limited options to ensure that emissions from the Sempra and Intergen power plants do not adversely affect the health of residents in Imperial County. The Sempra and Intergen plants are not subject to the federal Clean Air Act or the California Clean Air Act and,

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therefore, are not required to offset their emissions. In addition, relevant agreements among the United States, Canada, and Mexico may not provide adequate mechanisms to address adverse health impacts resulting from emissions from these plants because they only require the countries to enforce their own environmental laws, not to implement specific pollution control requirements. Nevertheless, policymakers could take some actions. For example, the Congress could enact legislation restricting the importation of electricity generated by these plants if they do not meet certain U.S. emission and offset requirements. While this action would have benefits to air quality and health, it would also have costs, such as possibly reducing energy supplies available to Southern California. Similarly, DOE could modify its regulations to require permit applicants seeking to import electricity into the United States from Mexico to employ specified emission controls and obtain offsets. However, these two policy options may raise trade issues under the North American Free Trade Agreement. A third option would be to develop programs that provide economic incentives to reduce pollution in the U.S.-Mexico border region. Market-based programs, such as EPA's program to reduce emissions that contribute to acid rain, have proven successful elsewhere in the United States in reducing emissions. Finally, another potential option is the development of a binational clean air trust fund that could provide grants and loans to support air quality improvement projects for cities along the U.S.-Mexican border. However, developing the legal and regulatory framework needed to create these binational programs is likely to require substantial time and effort.

DOE commented on a draft of this report and generally disagreed with our characterization of the limitations of the health risk assessment done as a part of the environmental impact statement for the Sempra and Intergen power plants. Specifically, DOE did not agree with our assertion that it did not analyze all of the likely asthma-related and other health impacts of increased pollution from the power plants. However, DOE's environmental impact statement analyzed adverse health effects only for asthma hospitalization, which is just one in a continuum of adverse health impacts. DOE also disagreed with our assertion that it did not analyze the potential health impacts of pollution from the Sempra and Intergen power plants on susceptible populations in Imperial County. Although DOE said that its environmental impact statement included children in its asthma hospitalization estimates, asthmatic children are not the only susceptible population and asthma hospitalization is not the only potential health impact. Finally, DOE did not agree that health impacts from ozone formation may be larger than it estimated in its final environmental impact statement because of limitations in its ozone modeling analysis. However,

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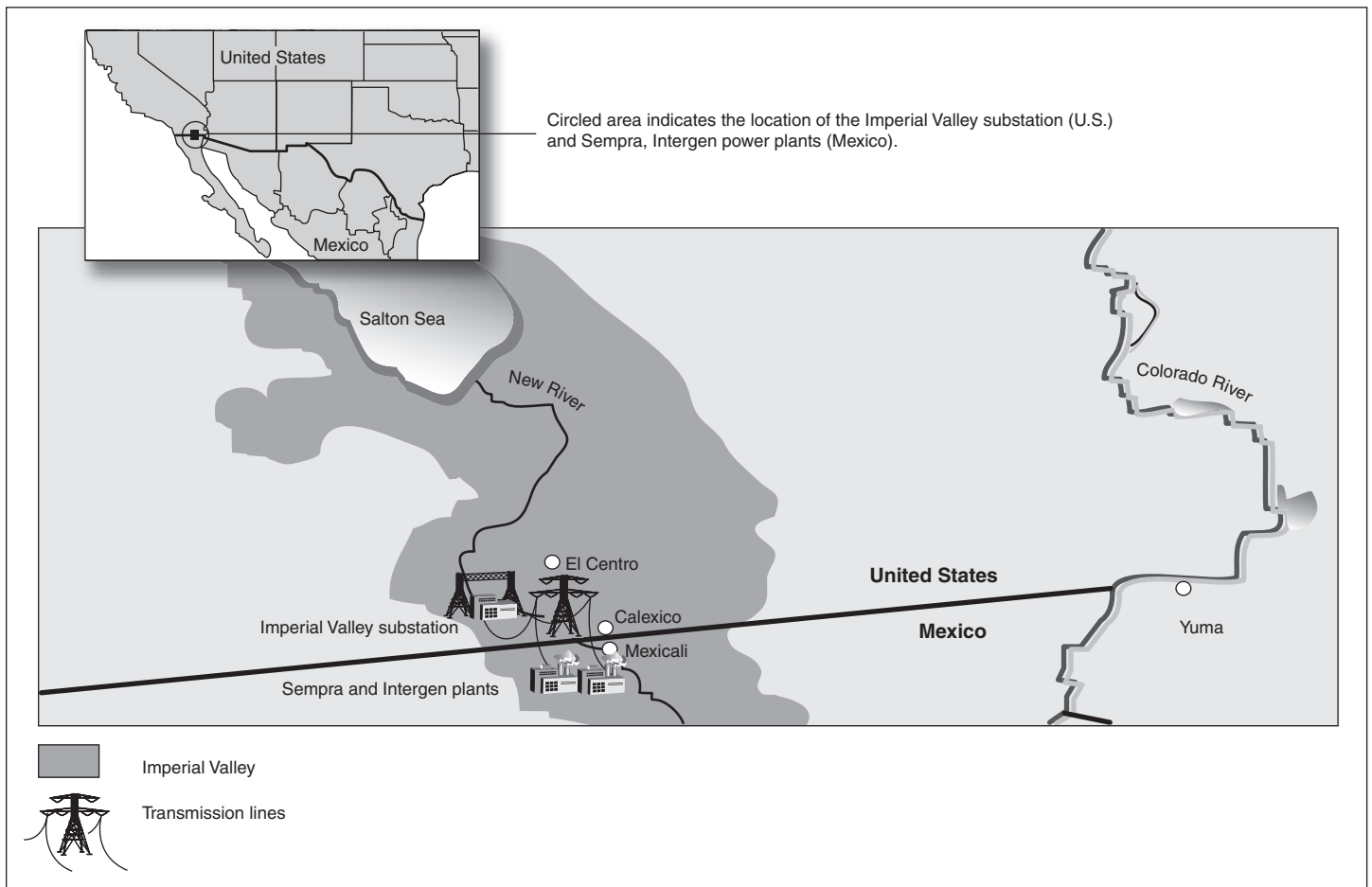
in its comments on the final environmental impact statement, EPA said that it continues to support off-site mitigation efforts to ensure that there is no net increase in air pollution in Imperial County because of the ozone modeling limitations. For these reasons, we believe the report accurately characterizes the limitations of DOE's health assessment and have made no changes to the report in response to these comments. DOE's specific comments and our detailed responses are presented in appendix II of this report.

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## Background

The Sempra and Intergen plants are located in close proximity to each other near Mexicali, Mexico—an area 3 miles south of the U.S.-Mexican border and Imperial County, California (see fig. 1). Final permitting and construction for both of the plants and the associated transmission lines to the United States began in 2001, and commercial operations commenced in July 2003. Fuel for the plants is provided by a 145-mile cross-border natural gas pipeline built by Sempra Energy, which began operating in September 2002.

**Figure 1: Map of the Sempra and Intergen Power Plants and the Associated Transmission Lines**



Source: GAO presentation of DOE data.

The Sempra plant, known as Termoelectrica de Mexicali, consists of one natural gas-fired, combined-cycle power-generating unit with a total capacity of 650 megawatts. In this type of plant, electricity is produced by a combination of gas turbines and steam turbines. Heat from the gas turbine exhaust, which would otherwise be released to the atmosphere with exhaust gases, is captured and used by a heat recovery steam generator to produce steam, which in turn is used by the steam turbine to generate additional electricity. The Sempra plant operates with an export permit from the Mexican government and produces electricity exclusively for export to the United States. The facility is equipped with the latest pollution control technologies, including selective catalytic reduction

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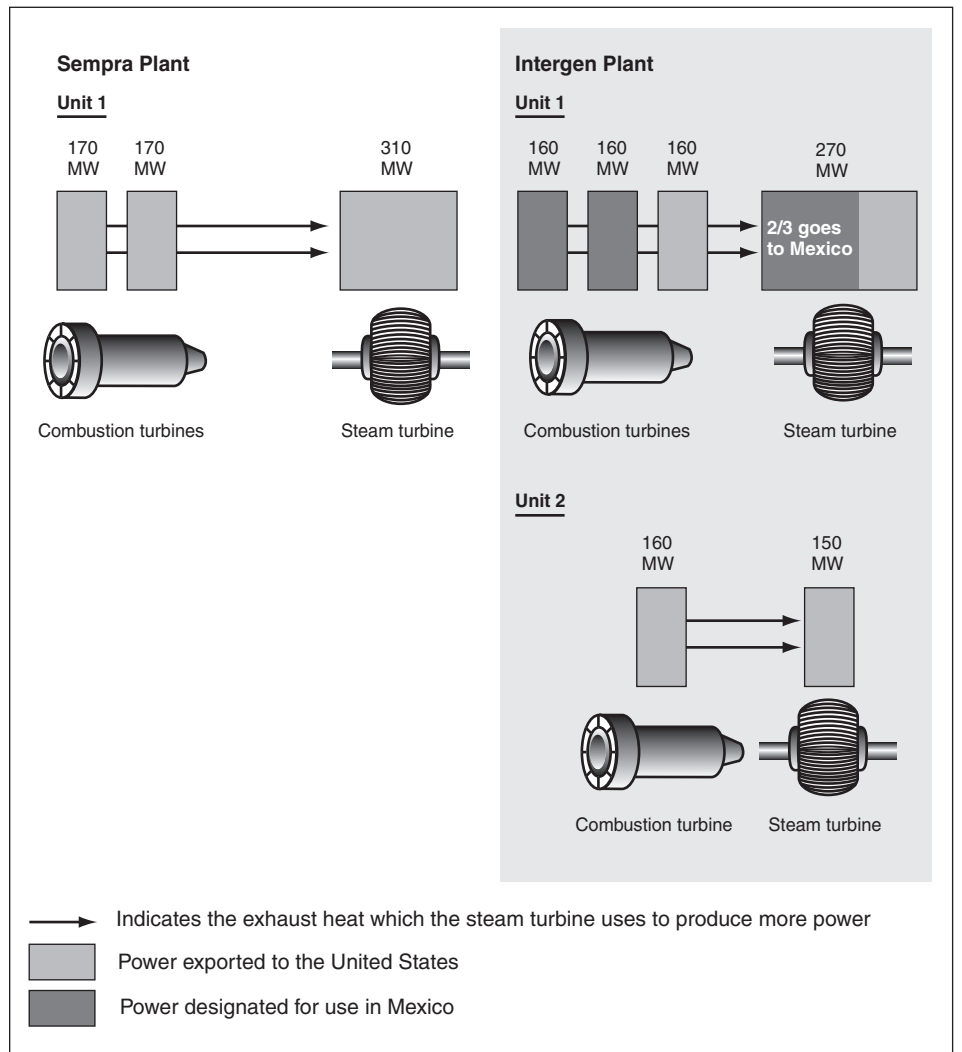
systems to reduce NO<sub>x</sub> emissions and an oxidizing catalyst system to reduce carbon monoxide (CO) emissions.<sup>8</sup>

The Intergen plant, which consists of two natural gas-fired combined-cycle units (collectively known as the La Rosita Power Complex), has a total capacity of 1,060 megawatts. The first unit provides two-thirds of its 750 megawatt capacity to Mexico, with the remaining one-third available for export to the United States. The second unit has a generating capacity of 310 megawatts, all of which is designated for export to the U.S. market. (See fig. 2.) Originally, only the second unit was designed to include a selective catalytic reduction system, but as of April 7, 2005, all four of the combustion turbines within the two units have been equipped with these systems to control NO<sub>x</sub> emissions.

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<sup>8</sup>Selective catalytic reduction is a post-combustion cleaning technology whereby NO<sub>x</sub> emissions chemically react with ammonia (NH<sub>3</sub>) to produce ordinary nitrogen and water vapor. An oxidizing catalyst is similar in concept to catalytic converters used in automobiles. The catalyst, normally coated with a metal, such as platinum, is used to promote a chemical reaction with the oxygen present to convert carbon monoxide into carbon dioxide and water vapor.

**Figure 2: Electrical Production at the Sempra and Intergen Power Plants**



Source: DOE.

Although no U.S. emissions requirements apply to these plants, Sempra and Intergen required a presidential permit to construct and connect the new transmission lines needed at the U.S.-Mexican border to export electricity into the United States. Because of the similarities of the proposals submitted by the companies, DOE decided to consider them together in a single environmental assessment, required as part of the

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permitting process.<sup>9</sup> In December 2001, DOE completed the environmental assessment and issued a finding of no significant impact and presidential permits for both of the proposed projects. Following these decisions, Semptra and Intergen constructed the transmission lines and began commercial operations. However, as a result of subsequent litigation, on July 8, 2003, the U.S. District Court for the Southern District of California instructed DOE to prepare a more comprehensive environmental review, which included an assessment of the health impacts from the power plants as part of its analysis. DOE's environmental impact statement was issued in final form in December 2004. DOE found that the proposed power plants presented a low potential for environmental impacts and published a record of decision in the Federal Register on April 25, 2005, authorizing presidential permits to be granted for both transmission lines to the respective power plants as presently designed.

The operation of any fuel-fired power plant results in a variety of air pollutants. However, because natural gas is a relatively clean fuel, the primary emissions of concern from these plants are generally limited to nitrogen oxides (which contribute to ozone formation); particulate matter; and, in some cases, carbon monoxide. Nitrogen oxide, or NO<sub>x</sub>, is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Ground level ozone, another primary pollutant, is not emitted from the plants directly but is formed in the presence of sunlight by a chemical reaction between NO<sub>x</sub> and various air pollutants known as volatile organic compounds (VOC). Particulate matter refers to dust, dirt, soot, smoke, and liquid droplets directly emitted into the air by various sources. Secondary formation of PM can also take place by the combination of NO<sub>x</sub> and ammonia (NH<sub>3</sub>).<sup>10</sup> Carbon monoxide is a colorless and odorless gas that is formed when carbon in fuel is not burned completely. These four pollutants have been linked to a variety of negative health effects, including, but not limited to, aggravated asthma, reduced lung function and other respiratory illnesses, and aggravation of heart disease, as well as premature deaths (see table 1). While emissions of sulfur dioxide are also a significant concern at some power plants, the

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<sup>9</sup>Because the proposed lines traverse land managed by the U.S. Department of the Interior, Bureau of Land Management, they also participated in the environmental assessment.

<sup>10</sup>For this reason, ammonia (NH<sub>3</sub>) is often included in the review of potential impacts from power plants and is subject to emission limits as part of the permitting process conducted in California. NH<sub>3</sub> emissions, typically referred to as ammonia-slip, are released from power plants as a byproduct of selective catalytic reduction control technology.



use of natural gas at the Sempra and Intergen facilities greatly reduces sulfur dioxide emissions compared with other fuels such as coal or oil. For example, U.S. coal contains an average of 1.6 percent sulfur, and oil burned at electric utility power plants ranges from 0.5 percent to 1.4 percent sulfur; comparatively, natural gas has less than 0.0005 percent sulfur.

**Table 1: Key Power Plant Pollutants and Potential Health Impacts**

Pollutant	Potential health impact
Nitrogen oxides	<ul style="list-style-type: none"> <li>• Can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections</li> <li>• Contribute to the formation of ozone</li> </ul>
Ozone	<ul style="list-style-type: none"> <li>• Triggers a variety of health problems, including aggravated asthma, even at very low levels</li> <li>• Can cause permanent lung damage after long-term exposure</li> <li>• Can contribute to premature death</li> </ul>
Particulate matter	<ul style="list-style-type: none"> <li>• Can aggravate asthma</li> <li>• Can cause increases in respiratory problems like coughing and difficult or painful breathing</li> <li>• Can lead to chronic bronchitis or decreased lung function</li> <li>• Can contribute to premature death</li> </ul>
Carbon monoxide	<ul style="list-style-type: none"> <li>• Can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues</li> <li>• Can cause chest pains in those with heart disease and other cardiovascular effects after repeated exposures</li> <li>• High levels can lead to vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks.</li> </ul>

Sources: EPA and the Southwest Consortium for Environmental Research and Policy.

## Emissions from the Mexicali Plants Are Comparable to New Plants in California, but Offset Requirements Would Apply in Imperial County

The emissions from the Sempra and Intergen power plants in Mexicali are comparable to emissions from similar plants recently permitted in California and are low relative to emissions from the primary sources of pollution in Imperial County, which are various forms of dust and motor vehicles. However, if the plants were located in Imperial County, they would be required, among other things, to offset their emissions by reducing emissions from other pollution sources in the region.

## Estimated Emissions from the Sempra and Intergen Plants Are Comparable to Emissions from New California Plants

Power plants in Mexico are not required to report to federal agencies in the United States on actual emissions of key pollutants generated during plant operations. Therefore, we believe that the best data available to estimate emissions from the Sempra and Intergen power plants comes from emission performance tests conducted by independent third-party contractors hired by the power plants. The average emissions from the Sempra and Intergen plants based on the results of the third-party testing are presented in table 2.

**Table 2: Average Emissions from the Sempra and Intergen Power Plants Based on Third-party Testing**

Pollutant	Sempra results <sup>a</sup>		Intergen results <sup>b</sup>			
	Unit 1		Unit 1		Unit 2	
	Turbine 1	Turbine 2	Turbine 1	Turbine 2	Turbine 3	
NO <sub>x</sub> (ppm)	2.33	2.08	15.33 <sup>c</sup>	13.37 <sup>c</sup>	2.41	3.14
PM <sub>10</sub> (lbs/hr)	12.80	11.86	7.73	3.18	3.09	7.10
CO (ppm)	0.00	0.00	0.71	1.24	0.86	0.73
NH <sub>3</sub> (ppm)	0.45	0.41	<sup>d</sup>	<sup>d</sup>	1.24	1.73
VOC (lbs/hr)	<sup>e</sup>	<sup>e</sup>	0.07	0.11	0.83	0.86

Legend: NO<sub>x</sub> = nitrogen oxides; ppm = parts per million; PM<sub>10</sub> = particulate matter; lbs/hr = pounds per hour; CO = carbon monoxide; NH<sub>3</sub> = ammonia; VOC = volatile organic compounds.

Sources: Sempra and Intergen.

<sup>a</sup>These tests were conducted on June 4-6, 2003, and July 8-9, 2003.

<sup>b</sup>These tests were conducted between September 20 and September 28, 2004.

<sup>c</sup>Selective catalytic reduction systems were installed on these turbines in March and April 2005, after these tests had been completed. These turbines have been emitting NO<sub>x</sub> at a level below 2.5 ppm since the installation of the new equipment.

<sup>d</sup>NH<sub>3</sub> is a by-product of selective catalytic reduction control technology and was not emitted by these turbines at the time the tests were conducted because the control technology had not yet been installed.

<sup>e</sup>VOC emissions were undetectable at the plant during these tests.

We were not able to compare emissions data from the Sempra and Intergen plants with emissions data from an individual plant in Imperial County to determine whether the plants would likely meet emissions requirements because no similar natural gas-fired power plant has recently been permitted for construction in the county. Therefore, we evaluated the

Sempra and Intergen data against a range of allowable emission limits from the 23 natural gas-fired power plants of similar size and specifications that were given permits to operate elsewhere in California by the California Energy Commission between 2000 and 2004. These 23 plants are among the cleanest fuel-fired plants in the United States. We found that the levels of emissions for major pollutants (NO<sub>x</sub>, PM<sub>10</sub>, CO, NH<sub>3</sub>, and VOC) from the Sempra and Intergen plants are generally comparable to the range of emissions limits for the recently permitted California plants (see table 3).

**Table 3: Comparison of Estimated Sempra and Intergen Plant Emissions and the Emission Limits of Recently Permitted Power Plants in California**

Pollutant	Range of CA emission limits <sup>a</sup>	Sempra average <sup>b</sup>	Intergen average <sup>b</sup> (US export)	Intergen average (Mexico)
NO <sub>x</sub> (ppm) <sup>c</sup>	2.0 – 2.5	2.2	2.8	14.4
PM <sub>10</sub> (lbs/hr)	3.0 – 18.5	12.3	5.1	5.5
CO (ppm)	2.0 – 10.0	0.0	0.8	1.0
NH <sub>3</sub> (ppm)	5.0 – 10.0	0.4	1.5	<sup>d</sup>
VOC (lbs/hr)	1.6 – 6.6	<sup>e</sup>	0.8	0.1

Legend: NO<sub>x</sub> = nitrogen oxides; ppm = parts per million; PM<sub>10</sub> = particulate matter; lbs/hr = pounds per hour; CO = carbon monoxide; NH<sub>3</sub> = ammonia; VOC = volatile organic compounds.

Sources: GAO analysis of data from the California Energy Commission, Sempra, and Intergen.

<sup>a</sup>The range of emission limits is based on best available control technology requirements for 23 similar plants permitted in CA between 2000 and 2004. Although these limits are based primarily on the use of modern emissions control equipment, best available control technology is determined on a case-by-case basis and may take into consideration factors such as potential economic impacts, as well as design or operational standards.

<sup>b</sup>Sempra and Intergen emissions data are based on the average of emissions from the individual turbines recorded during testing.

<sup>c</sup>ppm for the California plants are based on a 1 or 3-hour average, depending on the testing method required by the local air pollution control agency. NH<sub>3</sub> levels are computed based on a 1, 3, or 24-hour average.

<sup>d</sup>NH<sub>3</sub>, or ammonia, is a by-product of selective catalytic reduction control technology and was not being emitted at this unit at the time of the tests because the control technology had not yet been installed.

<sup>e</sup>VOC emissions were undetectable during tests conducted at the plant.

As shown in table 3, the average NO<sub>x</sub> emissions from the Intergen power plant were the only emissions that exceeded the range of emissions from recently permitted plants in California. This was the case, in part, because the plant was not originally designed to meet California requirements. However, as of April 7, 2005, all combustion turbines at the Intergen plant

had been equipped with the selective catalytic reduction control technology for nitrogen oxide that is common in the newer California plants. With the exception of one turbine, which will continue to operate at a maximum NO<sub>x</sub> limit of 3.5 ppm, all other turbines are expected to emit NO<sub>x</sub> at a level below 2.5 ppm. According to Intergen plant officials, the last two turbines to be equipped with selective catalytic reduction systems have been meeting these levels since the systems became operational in March and April 2005, respectively. Data provided by plant officials, based on continuous monitoring of all emissions from these turbines over a 1 week period, also indicate that both turbines are achieving the expected NO<sub>x</sub> reductions.

### Estimated Annual Emissions from the Sempra and Intergen Plants Are Low Relative to Emissions from Sources in Imperial County

One way to assess the environmental impact of emissions from power plants is to examine the tons of pollutants they emit on an annual basis. The third-party performance tests discussed above provide the best available data to estimate annual emissions likely to occur during actual operations at the Sempra and Intergen plants because the data are based on observations of the actual equipment in operation. Other options for estimating annual emissions from these plants include using (1) the maximum allowable emissions levels for similar plants in California and (2) the emissions estimates that DOE developed during its environmental impact assessment of the Sempra and Intergen plants. Table 4 presents annual emissions estimates based on each of these three alternative operating assumptions.

**Table 4: Summary of Annual Emission Estimates for the Sempra and Intergen Power Plants Using Three Alternative Operating Assumptions (Tons per Year)**

Pollutant	Third-party testing	Maximum allowable emissions levels in California	DOE's environmental impact statement
NO <sub>x</sub>	374	610	610
PM <sub>10</sub>	200	352	1,210
CO	919	1,897	3,089
NH <sub>3</sub>	86	518	646
VOC	57	105	1,026

Source: GAO analysis of data from Sempra, Intergen, the California Energy Commission, and DOE.

Under the first scenario, annual emissions levels were estimated using the values determined by third-party contractors during turbine performance tests at the Sempra and Intergen plants. For the two Intergen turbines that

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did not have selective catalytic reduction systems installed when the testing was conducted, we estimated annual NO<sub>x</sub> emissions using the testing values recorded for the similar turbine that was operating with such equipment. We did so because these two turbines are now equipped with selective catalytic reduction systems and their future emissions are likely to be similar to those from the turbine that was using this technology during the tests. These estimates do not take into account start-up and shutdown operations of the plant, which may contribute to increased plant emissions for approximately 1 to 2 hours. However, the total annual estimate is based on the conservative assumption that the plants are operating at maximum emission levels, 24 hours a day, 365 days a year. The actual operation of the plants, and the resulting emissions, would be less than this because of scheduled maintenance, forced outages, and varying electrical demand in California.

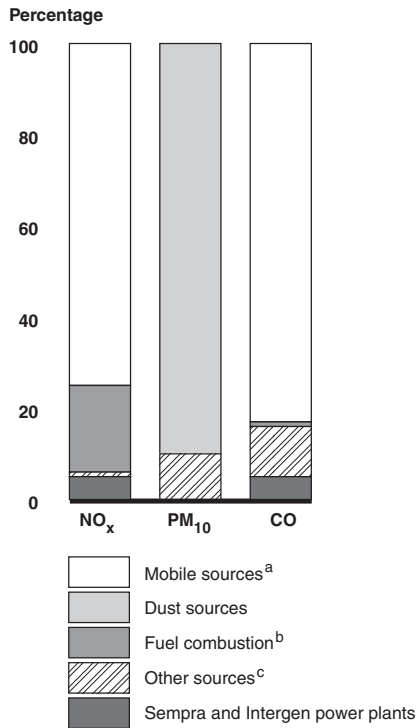
The second estimates of annual emissions were based on maximum allowable emissions determined during the permitting process for similar California plants. These maximum allowable emissions are higher than the estimates based on third-party testing data. California grants permits to construct power plants on a case-by-case basis. As a condition of receiving a permit, the state places limits on emissions of individual pollutants. These limits are based on the use of best available control technology and take into consideration energy, environmental, and economic impacts. Under this estimating scenario, the annual estimates also account for short term variations in emissions levels that may occur during start-up and shutdown operations and are based on the conservative assumption that the plants are operating at maximum emissions levels, 24 hours a day, and 365 days a year.

The final, and highest, emissions estimates are based on the values DOE used in its environmental impact statement. DOE's estimates are based on either the maximum emissions allowable by permit from the Mexican government or the vendor guarantee limits, which are the maximum emissions levels specified by the manufacturer that a piece of equipment is likely to produce. These values tend to be much higher than the levels that typically occur during normal power plant operations. For example, the vendor guarantee limit of PM<sub>10</sub> for turbines at the Intergen plant is 52.3 pounds per hour. However, the actual emissions of PM<sub>10</sub> at plants using similar equipment are typically below 10 pounds per hour. In addition, DOE's estimates also assume that the Sempra and Intergen plants are operating at these levels 100 percent of the time, 365 days per year. Averaged on an annual basis, these estimates are likely to be significantly higher than the actual emissions resulting from operations at these plants.

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According to DOE's environmental impact statement, emissions from the Sempra and Intergen power plant would result in increases of ambient concentrations of NO<sub>x</sub>, PM<sub>10</sub>, and CO in Imperial County. However, it is difficult to determine the actual percentage of plant emissions that will reach Imperial County annually. For most of the year, the winds in the vicinity of the Sempra and Intergen plants travel predominantly from the United States to Mexico. However, during the months of June, July, and August, this trend reverses and the winds travel predominantly from Mexico to the United States. Even assuming the plants operate at the maximum emissions levels allowed in California, and that all of those emissions reach Imperial County, annual emissions from the plants are low compared with various forms of dust and emissions from motor vehicles—the primary sources contributing to nonattainment of the standards for PM<sub>10</sub> and ozone in Imperial County (see fig. 3).

**Figure 3: Relative Emissions Contributions by Source Assuming the Sempra and Intergen Plants Operated at Maximum Allowable Emissions and All Emissions Reached Imperial County**



Source: GAO analysis of data from Sempra, Intergen, and the California Air Resources Board.

**Note:**

Emissions contributions of less than 0.5 percent were not included in this figure. In the PM<sub>10</sub> category, mobile sources (0.5 percent), the Sempra and Intergen power plants (0.4 percent), and fuel combustion (0.2 percent) emissions were omitted.

<sup>a</sup>The “mobile sources” category includes emissions from sources such as on and off-road motor vehicles, airplanes, trains, boats, and farm equipment.

<sup>b</sup>The “fuel combustion” category includes other stationary sources, such as electric utilities, manufacturing, food and agricultural processing, and service and commercial operations.

<sup>c</sup>The “other sources” category includes all subcategories identified by the California Air Resources Board, such as farming, fires, waste burning, and mineral processing that contribute emissions not included in the other categories listed.

According to 2004 California emissions inventory estimates, road and windblown dust constituted almost 89 percent of total PM<sub>10</sub> emissions within Imperial County. Mobile sources, which include both personal and commercial vehicles, accounted for 79 percent of total NO<sub>x</sub> emissions in the county. Even if they were located in Imperial County and operated at maximum allowable California emissions levels 24 hours per day, the

plants would emit 352 tons per year of PM<sub>10</sub>, compared with nearly 77,000 tons per year from road and windblown dust, and 610 tons per year of NO<sub>x</sub>, compared with almost 10,000 tons per year from mobile sources (see table 5).

**Table 5: Estimated Annual Average Emissions in 2004 for Imperial County, California (Tons per Year)**

<b>Emissions sources</b>	<b>NO<sub>x</sub></b>	<b>PM<sub>10</sub></b>	<b>CO</b>
<b>Stationary sources</b>			
Fuel combustion <sup>a</sup>	2,537	150	325
Other stationary sources	11	1,011	22
<b>Subtotal</b>	<b>2,548</b>	<b>1,161</b>	<b>347</b>
<b>Area-wide sources</b>			
Paved and unpaved road dust	0	13,647	0
Fugitive windblown dust	0	63,068	0
Waste burning and disposal	106	799	4,395
Other miscellaneous	37	7,194	252
<b>Subtotal</b>	<b>142</b>	<b>84,709</b>	<b>4,647</b>
<b>Mobile sources</b>			
On-road motor vehicles	5,143	139	25,831
Other mobile sources	4,847	252	8,629
<b>Subtotal</b>	<b>9,990</b>	<b>391</b>	<b>34,460</b>
<b>Total</b>	<b>12,680</b>	<b>86,260</b>	<b>39,454</b>

Legend: NO<sub>x</sub> = nitrogen oxides; PM<sub>10</sub> = particulate matter; CO = carbon monoxide.

Source: GAO analysis of California Air Resources Board data.

<sup>a</sup>The Fuel Combustion subcategory includes stationary sources such as existing electric utilities, manufacturing, food and agricultural processing, and service and commercial operations.

Another way to examine the environmental impact of a power plant is to evaluate the amount of pollution emitted per unit of electricity produced. This calculation has been used within the energy industry to measure how efficiently power plants produce electricity. As illustrated in table 6, the Sempra and Intergen plants produce much lower emissions of NO<sub>x</sub> for each megawatt of energy generated than do other power plants operating in Imperial County and the border region of Baja California, Mexico. For example, Sempra's estimated emission rate for NO<sub>x</sub> of .04 pounds per



megawatt of electricity is over 35 times lower than that rate at El Centro, the only major fuel-fired plant operating in Imperial County in 2002.<sup>11</sup>

**Table 6: Comparison of NO<sub>x</sub> Emission Rates from the Sempra and Intergen Plants and Power Plants in Imperial County and Baja California**

Power plants	NO <sub>x</sub> emissions rate (lbs/MW)	Annual NO <sub>x</sub> emissions (lbs)	Net annual energy generation (MW)
<b>Mexicali plants (2004)</b>			
Sempra	0.04	89,668	2,389,549
Intergen	0.30 <sup>a</sup>	1,309,422	4,306,690
<b>Imperial County (2002)</b>			
El Centro	1.45	610,674	421,736
<b>Baja California (2002)</b>			
C.C.C. Presidente Juarez (Rosarito)	2.38	4,942,713	2,077,250
C.TG. Presidente Juarez (Tijuana)	4.15	2,694,021	648,420

Legend: NO<sub>x</sub> = nitrogen oxides; lbs/MW = pounds per megawatt.

Sources: GAO analysis of data from Sempra, Intergen, and the Commission for Environmental Cooperation.

<sup>a</sup>Intergen's values represent emissions produced in 2004 before the installation of selective catalytic reduction technology on two of the four units. Future NO<sub>x</sub> emissions rates will likely be comparable to those at the Sempra plant.

**If the Plants Were Located in Imperial County, California, among Other Things, Standards Would Require Them to Offset Their Emissions**

If the Sempra and Intergen plants were located in Imperial County, to help improve air quality, California regulations would require, among other things, offsets for all emissions from the plants that contribute to nonattainment of the PM<sub>10</sub> and ozone standards in the county. Under the specific offsetting rules established by the Imperial County Air Pollution Control District, the operators of each plant would be required to reduce emissions from other pollution sources in Imperial County by at least 1.2 tons for every ton of emissions the plants released.<sup>12</sup> In addition to offsetting emissions of PM<sub>10</sub> and NO<sub>x</sub> generated by the plant, Sempra and

<sup>11</sup>North American Power Plant Air Emissions, Commission for Environmental Cooperation of North America, 2004.

<sup>12</sup>Imperial County Air Pollution Control District, Rule 207, Section C.3 (Revised Sept. 14, 1999).

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Intergen would also be required to offset all emissions of VOC, which, in combination with NO<sub>x</sub>, contribute to the formation of ozone.<sup>13</sup>

As shown in table 7, potential offsets identified by the Imperial County Air Pollution Control District in DOE's environmental impact statement include (1) paving roads, (2) retrofitting emission controls on existing power plants in Imperial County, (3) funding projects designed to increase the use of natural gas in motor vehicles, (4) controlling Imperial County airport dust, and (5) retrofitting diesel engines for off-road heavy duty vehicles. According to the Air Pollution Control District, repaving approximately 23 miles of roads could reduce PM<sub>10</sub> emissions in Imperial County by about 650 tons per year—more than the estimated annual PM<sub>10</sub> emissions from both plants based on the maximum allowable emissions levels in California. The District estimated the paving project would cost approximately \$430,000 per mile for a two-lane road, bringing the total cost to about \$9.9 million.

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<sup>13</sup>The border city of Calexico, California, is also in violation of the state ambient air quality standard for CO. Therefore, if the plants were located in Imperial County close enough to Calexico to impact the city's air quality, the plants would also be required to offset their emissions of CO.

**Table 7: Potential Offsets in Imperial County, California, Identified by the Imperial County Air Pollution Control District**

Potential offset	Description of project	Estimated cost	Estimated emission reduction
Paving roads	<ul style="list-style-type: none"> <li>Pave 50 road segments in Imperial County, totaling 23 miles.</li> </ul>	\$9,890,000	650 tons per year (PM <sub>10</sub> )
Enhancing use of natural gas in motor vehicles	<ul style="list-style-type: none"> <li>Fund maintenance of El Centro natural gas facility.</li> <li>Fund natural gas facility to be constructed at the Calexico Unified School District.</li> <li>Acquire land in Brawley, California, for construction of a new natural gas facility.</li> <li>Replace/update fleet of fifteen Imperial Valley buses.</li> </ul>	\$150,000 \$250,000 \$250,000 to \$500,000 \$4 million to \$5 million	0.1 tons per year <sup>a</sup> (PM <sub>10</sub> )
Controlling Imperial County Airport dust	<ul style="list-style-type: none"> <li>Begin treatment of bare desert soil with chemical dust retardants or cover soil with crushed rock in the most sensitive areas.</li> </ul>	\$150,000	15 tons per year (PM <sub>10</sub> )
Retrofitting diesel engines	<ul style="list-style-type: none"> <li>Update the diesel engines of off-road vehicles used in agriculture, earthmoving, or construction.</li> </ul>	\$250,000	3.3 tons per year (PM <sub>10</sub> )
Retrofitting emission controls on existing power plants	<ul style="list-style-type: none"> <li>Install selective catalytic reduction technology on one main unit of the existing steam plant at the Imperial Irrigation District, as well as all of the smaller units used only during periods of peak electricity demand.</li> </ul>	Not Estimated	The main unit is already scheduled to be retrofitted in 2007-2008 (NO <sub>x</sub> )

Legend: NO<sub>x</sub> = nitrogen oxides; PM<sub>10</sub> = particulate matter.

Source: DOE.

<sup>a</sup>Estimated emission reduction applies only to the bus replacement project. Emission reductions from the other projects were not quantified.

In addition to the potential offsets identified above for Imperial County, according to DOE, mitigation measures may be even more abundant and cost-effective if applied on the Mexican side of the border. Some potential projects include paving roads in Mexicali, Mexico; replacing older automobiles and buses with newer, less polluting ones; and converting brick kilns to run on natural gas. However, according to DOE, it does not have the authority to impose or enforce offsets in Mexico.

Finally, if the power plants were located in California, the Intergen plant would likely be required to make additional equipment modifications to be consistent with other plants recently constructed in California. These modifications would include installing additional carbon monoxide control equipment and achieving a small reduction in NO<sub>x</sub> emissions in one of the plant's four combustion turbines. Although emissions testing data indicate that Intergen's carbon monoxide levels are generally comparable to those of California plants without this equipment, nearly all of the plants

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recently permitted in California have installed oxidizing catalyst systems to control carbon monoxide emissions. In addition, the Intergen plant would likely be required to lower the maximum NO<sub>x</sub> emissions in one turbine by 1.0 ppm—from 3.5 ppm to 2.5 ppm. Although this turbine is currently equipped with a selective catalytic reduction system to control NO<sub>x</sub> emissions, Intergen has stated that certain technical aspects of the design of the turbine prevent it from attaining emissions levels of 2.5 ppm.

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## Emissions Generated by the Sempra and Intergen Power Plants May Contribute to Various Adverse Health Impacts in Imperial County, but the Extent of Such Impacts Is Unknown

Emissions from the Sempra and Intergen power plants may contribute to adverse health impacts in Imperial County, but the extent of those impacts is unknown for several reasons. First, in its environmental impact statement, DOE did not calculate the total health impacts in the county because it did not analyze all the likely asthma-related or other health impacts from the increased pollution caused by the Sempra and Intergen plants. Second, DOE did not analyze the health impacts from increased power plant emissions on particularly susceptible populations, such as asthmatic children and low-income populations. Finally, because of uncertainty in DOE's modeling of ozone increases due to emissions from the power plants, the health impacts related to ozone may be larger than DOE estimated.

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## DOE Did Not Analyze All the Likely Asthma-Related and Other Health Impacts of Increased Pollution from the Sempra and Intergen Power Plants

In its December 2004 final environmental impact statement, DOE estimated that emissions from the Sempra and Intergen power plants would result in increased concentrations of NO<sub>x</sub>, PM<sub>10</sub>, and CO in Imperial County. DOE used EPA's "significant impact levels" to help assess the impact of these emissions increases on the residents of Imperial County. Generally, significant impact levels are thresholds below which the environmental and health impacts of air pollution are not viewed as significant; however, EPA designed them to be used only in areas that meet air quality standards.<sup>14</sup> Although the plants will add more pollution to an area already violating the national standards for PM<sub>10</sub> and ozone, DOE reported that because all pollution increases would be below EPA's significant impact levels, emissions from the plants would not produce any significant air quality impacts in Imperial County. Specifically, DOE

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<sup>14</sup>EPA has established significant impact levels for NO<sub>2</sub>, SO<sub>2</sub>, CO, and PM<sub>10</sub> in the context of permitting a major source or major modification to an existing pollution source in the United States. 40 C.F.R. § 51.165(b)(2).

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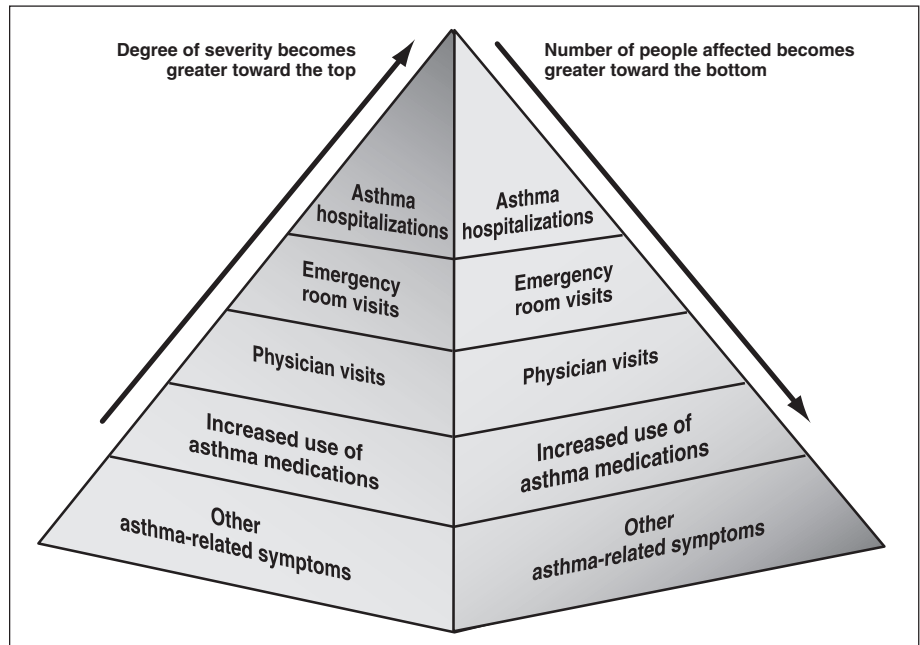
calculated that emissions from the power plants would be expected to increase asthma hospitalizations in the county by less than one case per year. However, DOE's analysis did not quantify all of the health impacts from the increase in PM<sub>10</sub> emissions.

Health experts told us that the potential impact on asthmatics would be broader than the minimal increase in hospitalizations described in the environmental impact statement because hospitalization occurs only in the most acute asthma cases. According to these experts, an increase in PM<sub>10</sub> pollution could exacerbate the underlying condition of anyone suffering from asthma. According to data from the 2003 California Health Interview Survey, 21,000 Imperial County residents, or 14 percent of the county's population, have been diagnosed with asthma.<sup>15</sup> Approximately 13,000 of these asthmatics experienced asthma symptoms during the previous year. The health experts we spoke with agreed that hospitalizations and other adverse health effects are part of a pyramid of potential adverse health effects. While the number of hospitalizations is represented at the top of the pyramid, other adverse health impacts such as emergency room visits, physician visits, asthma medication use, and increased asthma symptoms are layered vertically downward, with the number of people increasing in each subsequent group as you move to the bottom of the pyramid (see fig. 4).

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<sup>15</sup>The California Health Interview Survey—maintained at the UCLA Center for Health Policy Research in Los Angeles, California—is the state's largest health survey. The telephone survey of adults, adolescents, and children is a collaborative project of the UCLA Center for Health Policy Research, the California Department of Health Services, and the Public Health Institute, and is conducted every 2 years.

**Figure 4: Pyramid of Potential Health Impacts for Asthmatics**



Source: GAO.

In addition, the DOE study did not address the extent to which increased emissions of particulate matter would cause other adverse health impacts, such as other respiratory or cardiovascular problems. These impacts could include chronic obstructive pulmonary disease, pneumonia, cardiovascular disease, as well as increased symptoms of upper and lower respiratory disease, decreased lung function, or premature death. According to the project manager of DOE's analysis, the expected incidence of other adverse health effects resulting from PM<sub>10</sub> exposure has not been quantified because of a lack of data.

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## DOE Did Not Analyze the Health Impacts on Particularly Susceptible Populations in Imperial County

Studies funded by EPA, the Health Effects Institute,<sup>16</sup> and others have concluded that certain groups are likely to be more susceptible to particulate matter than others, and therefore experience more adverse health effects. For example, these studies identified asthmatics, especially children, as a potentially susceptible subpopulation. According to data from the 2003 California Health Interview Survey, approximately 19 percent of Imperial County children ages 1 through 17 have been diagnosed with asthma, or about 9,000 children. In addition, the relationship between socioeconomic factors and asthma exacerbation has been documented in various studies. Imperial County is ranked as one of the poorest counties in California, with some of the highest poverty and unemployment rates in the state. An estimated 22 percent of the overall population lives below the national poverty level, in comparison with 13 percent statewide. Results from a 2001 California asthma report indicate that asthmatic adults with family incomes below the national poverty level are nearly twice as likely to experience symptoms every day or every week as those with incomes three times the poverty level, in part, because they have less access to health care.<sup>17</sup>

Finally, residents of Imperial County are currently exposed to airborne particulate pollution exceeding the Clean Air Act's health-based National Ambient Air Quality Standard for PM<sub>10</sub>. For instance, in 2003, Imperial County residents were exposed to an annual average concentration of PM<sub>10</sub> that was 30 micrograms, or 63 percent higher, than the national standard of 50 micrograms per cubic meter of air, as shown in table 8. As a result, Imperial County residents can be expected to have higher incidence of adverse health effects caused by airborne particulate pollution than residents living in areas with less of that contaminant.

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<sup>16</sup>The Health Effects Institute (HEI) is an independent, nonprofit corporation chartered in 1980 to provide impartial research on the health effects of air pollution. Supported jointly by the U.S. Environmental Protection Agency and industry, HEI has funded over 170 studies and published over 100 research reports. HEI supported research has produced findings on the health effects of a variety of pollutants, such as carbon monoxide, nitrogen oxides, ozone, and most recently, particulate air pollution.

<sup>17</sup>UCLA Center for Health Policy Research, *Asthma in California: Findings from the 2001 California Interview Health Survey*, November 2003.

**Table 8: Imperial County Air Quality Compared with National Standard for PM<sub>10</sub> (1997-2003)**

Micrograms per cubic meter of air								
PM <sub>10</sub>	National standard	Imperial County						
		1997	1998	1999	2000	2001	2002	2003
Maximum 24 hour concentration	150	532	176	227	268	647	373	840
Calculated days over national standard		12	12	32	38	18	21	25
Annual average	50	77.7	66.1	77.8	95.2	86.2	81.3	80

Legend: PM<sub>10</sub> = particulate matter.

Source: DOE.

In its environmental impact statement, DOE acknowledges that there are preexisting conditions of concern in Imperial County, such as asthmatic children and low-income populations, both of whom are particularly susceptible to health problems from pollution, and the fact that the county is a Clean Air Act nonattainment area for PM<sub>10</sub>. However, DOE did not fully explore these conditions to determine their potential health impacts. DOE believes that because the increases in emissions from the plants are below EPA's significant impact levels any health impacts will be negligible. However, some health studies have found that even the smallest incremental increase in particulate matter air pollution increases the incidence of adverse health effects.

### Health Impacts from Ozone Formation May Be Larger Than Estimated by DOE

DOE conducted air dispersion ozone modeling for the Imperial Valley-Mexicali air basin to determine what impact emissions from the Sempra and Intergen plants would have on the formation of ozone. DOE concluded, based on its modeling, that there would be no meaningful change in ozone levels as a result of the operation of the Sempra and Intergen power plants. Consequently, DOE concluded that the health impacts from ozone formation as a result of plant emissions would be minimal. However, if the modeling is not accurate, then the health impacts could be larger than DOE estimated.

EPA officials have raised concerns about the accuracy of DOE's modeling of estimated ozone increases. In its comments on DOE's draft environmental impact statement, EPA stated that it is difficult to quantify the impact of a small number of facilities (i.e., the two power plants) on



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the maximum ozone concentration in an air basin. The lack of area-specific information, such as temperature, relative humidity, and levels of volatile organic compounds (an ozone precursor), in the Imperial County-Mexicali air basin makes modeling ozone formation particularly difficult. Because these data were not available, DOE used surrogate values from Phoenix, Arizona.<sup>18</sup> Furthermore, DOE's analysis relied on air monitoring data and the EPA ozone model to determine the potential influence of NO<sub>2</sub> emissions—the primary pollutant emitted from the Sempra and Intergen power plants—on ozone concentrations in Imperial Valley. DOE concluded that increased NO<sub>x</sub> emissions from the plants could produce a decrease in ozone concentrations. In its comments on the draft environmental impact statement, EPA stated that peak ozone concentrations generally occur in areas away from sources of high NO<sub>x</sub> emissions, not at the monitor where high NO<sub>2</sub> concentrations are measured. They emphasized that if modeled ozone projections are not correct, impacts to air quality from the plants' emissions could be significant. Recent research funded by EPA and others has found that increases in ozone pollution raise the risk of premature death. Finally, EPA recommended that DOE require Sempra and Intergen to implement mitigation measures to ensure that increased concentrations of ozone do not occur in the air basin.

In response to EPA's comments, in its December 2004 final environmental impact statement, DOE presented a sensitivity analysis that indicated that power plant emissions could result in either increases or decreases in peak ozone concentrations depending on model input assumptions. However, DOE again concluded that its modeling of ozone formation did not indicate any meaningful change in ozone levels as a result of the operation of the Sempra and Intergen power plants and therefore chose not to require any mitigation requirements in its record of decision. According to DOE officials, although the record of decision states that mitigation of emissions is the preferred option, the sum total of emissions from the plants is so minimal that it is not cost-effective to require mitigation measures in the United States. However, DOE has not conducted any analysis to support its claim that mitigation measures are not cost-effective. Furthermore, DOE said that it does not have the resources needed to conduct a comprehensive monitoring program to

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<sup>18</sup>DOE used data from Phoenix, Arizona because it is one of the 10 cities that was already built into the EPA ozone model (OZIPR) database, and they believe Phoenix, Arizona is the most representative proximate city in terms of climate, latitude, and physiography.

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ensure that mitigation projects are completed satisfactorily. Finally, DOE acknowledged in the environmental impact statement that mitigation measures may be more abundant and cost-effective in Mexico. However, DOE told us that while it has the authority to require the plants to take mitigation measures in the United States, it does not have the authority to require or enforce such measures in Mexico.

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## **Policymakers Have Limited Options to Ensure That Emissions from the Sempra and Intergen Power Plants Do Not Adversely Affect the Health of Residents in Imperial County**

Because the Sempra and Intergen power plants are not subject to either the federal Clean Air Act or the California Clean Air Act, they are not required to provide offsets for their emissions. In addition, relevant agreements among the United States, Canada, and Mexico may not provide adequate mechanisms to address adverse health impacts resulting from emissions from these plants. As a result, policymakers have limited options to ensure that emissions from these plants do not adversely affect the health of residents in Imperial County.

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## **Existing Laws and Agreements May Not Provide Effective Mechanisms to Address Adverse Health Impacts**

Existing U.S. law provides few options to ensure that emissions from the Intergen and Sempra plants do not adversely affect the health of residents in Imperial County. Because the Intergen and Sempra plants are not located in the United States, federal and California environmental agencies do not have authority over the plants. The federal Clean Air Act contains no language extending the statute's coverage to pollution sources that are located outside of the United States. Similarly, the text of the California Clean Air Act limits its application to pollution sources that are located in California. Because neither of these laws applies to the Sempra or Intergen plants, U.S. environmental agencies have no authority under existing law to require the plants to implement pollution control measures.

Similarly, existing international agreements provide few options to ensure that emissions from the Sempra and Intergen plants do not adversely affect the health of residents of Imperial County. The governments of the United States and Mexico have ratified two agreements that are of particular importance to environmental conditions in the border region. The first was signed at La Paz, Mexico, in 1983. The La Paz Agreement creates a framework for promoting cooperation between the United States and Mexico on issues of environmental protection in the border region.

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For example, the agreement states that the United States and Mexico will “cooperate in the solution of the environmental problems of mutual concern in the border area,” and that high officials from the two countries will meet annually to review the agreement’s implementation. The agreement does not require either government to implement specific pollution control requirements or provide a course of action for either country to pursue if a particular project in the border region harms the health of border region inhabitants.

The other environmental agreement, the North American Agreement on Environmental Cooperation (NAAEC), also provides few options to ensure that emissions from the Sempra and Intergen plants do not adversely affect the health of residents of Imperial County. The United States, Canada, and Mexico signed the NAAEC in 1993 to supplement the provisions of the North American Free Trade Agreement. The NAAEC provides a dispute resolution procedure under which the United States, Mexico, or Canada may request consultation with another party to the agreement regarding whether there has been a persistent pattern of failure by that other party to effectively enforce its environmental law. The parties must make every attempt to resolve the matter through the consultative process. However, if consultation fails to lead to a satisfactory resolution, then either party may take a series of steps that may culminate in the meeting of an impartial, five-member arbitration panel. This panel can determine whether the party complained against has persistently failed to enforce its environmental law. If the panel issues a decision finding such a persistent failure, it may formulate an action plan to remedy the enforcement failure and may ultimately impose monetary penalties if the enforcement failure persists. Thus, the NAAEC dispute resolution procedure provides an option for U.S. policymakers, but only if the Mexican government persistently fails to enforce the Mexican environmental laws that apply to the two plants. The NAAEC dispute resolution procedure does not provide a useful option for U.S. policymakers if the Intergen and Sempra plants comply with Mexican law, even if the plants adversely affect the health of the residents of Imperial County.

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## Policymakers Have Limited Options to Protect Imperial County Residents from Adverse Health Impacts

There are some actions policymakers could take to protect Imperial County from increased emissions from the Sempra and Intergen power plants. For example, the Congress could enact legislation restricting the importation of electricity generated by power plants whose electrical output is dedicated exclusively to the United States if they do not meet certain U.S. emission and offset requirements. While this action would

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have benefits to air quality and health, it would also have costs, such as possibly reducing energy supplies available to southern California. In 2003 a bill was introduced in the Senate and House that would have prohibited the exportation of natural gas from the United States to Mexico for use in power plants near the U.S. border if the plants do not provide air quality protection that is at least equivalent to the protection provided by air quality requirements applicable in the United States. Each chamber referred the bill to committee; neither the Senate nor the House committee reported the bill to the full chamber for consideration.

Similarly, DOE could modify its regulations that apply to applicants for presidential permit seeking to build new international transmission lines to import electricity into the United States from Mexico. The modified regulations could require that the lines connect to plants that employ specified emissions controls and obtain offsets in the United States. However, limiting the import of electricity from Mexico into California could jeopardize some electricity supplies for parts of southern California, which could be problematic especially during peak consumption periods. According to the California Independent System Operator, the demand for energy in California is growing at nearly 4 percent annually. During the summer of 2004, the peak demand record set in 1999 was broken seven times, and the California Independent System Operator believes that the record will likely fall again during the summer of 2005.

Moreover, both of the above options would need to be assessed to determine if they are compliant with the North American Free Trade Agreement (NAFTA). The agreement allows either the U.S. or Mexico to restrict energy imports for a range of reasons, including protection of human life or health. However, such import restrictions must meet a variety of conditions. For example, though NAFTA recognizes a country's right to license imports and exports of energy, any such licensing system must be consistent with NAFTA and not frustrate its overall objectives of eliminating trade barriers, promoting fair competition, and increasing investment opportunities. NAFTA also requires energy regulatory agencies to minimize disruptions to contractual relationships in applying their regulations.

A third option would be for the United States and Mexico to expand cooperation under the existing binational initiative to address transboundary air pollution in the U.S.-Mexico border region by providing economic incentives, such as emissions trading, to reduce pollution. Such programs have proven successful in the United States in reducing emissions that contribute to acid rain. At the international level, the United

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States and Canada have developed an air pollution agreement that could possibly serve as a model for a similar agreement between the United States and Mexico. However, based on the Canadian example, developing the legal and regulatory framework needed to create a binational emissions trading program with Mexico is likely to take a significant amount of time. The United States and Canada initiated cooperative efforts in 1980 through a memorandum of understanding, and 11 years later the 1991 U.S.-Canada Air Quality Agreement identified market-based mechanisms, including emissions trading, as areas for further discussion. In April 1997, the United States and Canada agreed on a joint plan of action for addressing transboundary air pollution, expanding the initial focus on acid rain to also examine ground-level ozone and particulate matter. In 2000, the Air Quality Agreement was formally expanded to address transboundary ground-level ozone issues. In 2004, the United States and Canada initiated a joint study to examine the feasibility of establishing a binational emissions trading program. Issues being addressed include the legal authority and the air pollution monitoring, assessment, and reporting system that would be needed to implement such a program.

At the state level, Texas passed legislation in 2001 that authorized the state's environmental agency to accept reductions in emissions from brick kilns in Ciudad Juarez, Mexico, to satisfy new state emission control requirements passed by the Texas Legislature in 1999. In return for air emission allowances under Texas law, the local utility, El Paso Electric, arranged the destruction of older, high-polluting, open-top kilns and replaced them with less polluting closed-top kilns. This emission control project serves the Paso Del Norte air basin, which is officially recognized in the La Paz Agreement, and includes El Paso, Texas, and Ciudad Juarez, Mexico.

Finally, another potential option is the development of a binational clean air trust fund that could provide grants and loans to support projects that would improve the air quality of U.S. and Mexican cities that share air basins in the border region. Implementing such a program could help offset emissions generated by a variety of sources, including power plants in Mexico that are not required to offset their emissions. Funds from a variety of sources, such as appropriations from both nations' legislatures, fast-lane fees for cars and trucks at ports of entry, and fees from airports and railroads operating along the border, could be held in a joint

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U.S.-Mexican trust fund for distribution to states, counties, cities, or local air pollution control districts along the shared border.<sup>19</sup> The binational clean air trust fund could also potentially obtain funds from power plants located in the U.S.-Mexico border region that are looking for opportunities to offset their emissions, although they are not required to do so by law. Both Intergen and Sempra have shown an interest in supporting projects aimed at improving the air quality in the border region. For example, Intergen supports an applied research grant program to improve air quality in the California–Mexico border region,<sup>20</sup> and Sempra is developing a fund to support the implementation of environmental projects, such as road paving, in the border city of Mexicali, Mexico, that it expects to implement before the end of 2005.

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## Conclusions

The Sempra and Intergen plants near Mexicali, Mexico, are modern power plants that use advanced air pollution control technologies. As a result, the pollution they emit is comparable to that emitted by similar plants that have recently received permits to operate in California and is low relative to dust and emissions from vehicles, the primary sources of pollution in Imperial County. Nevertheless, the plants emit some pollutants into an air basin that already does not meet some air quality standards and is home to many asthmatic children and a low-income population that may be particularly susceptible to adverse health consequences from any level of pollution increase. DOE concluded in its environmental impact statement that pollution from the plants would not result in significant health impacts in Imperial County and therefore did not require the plants to offset their emissions. However, the DOE analysis did not fully examine several issues that could have led to an assessment of a larger adverse health impact in Imperial County. In addition, if the plants were located 3 miles north in Imperial County, California, they would be required to fund projects to reduce pollution from other sources to offset their emissions regardless of whether there was a documented adverse health impact. However, now that DOE has determined that no offsets are required, options available to U.S. policymakers in the short term to directly address

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<sup>19</sup>Richard Ryan, “*Financing Clean Air on the Border: Establishing a Binational Clean Air Trust Fund (BiCAT)*” (paper presented at the Border Institute VII, Transboundary Air Quality Management conference, in Rio Rico, Ariz., April 2005).

<sup>20</sup>The program, known as the Border Ozone Reduction and Air Quality Improvement Program, is administered by a Harvard University-affiliated nonprofit organization, LASPAU: Academic and Professional Programs for the Americas.

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the existing health concerns are limited. In the long term, the United States and Mexico could implement an emissions trading program or a clean air trust fund to address pollution in the border area, but such programs are likely to take years, and require significant binational effort to develop.

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## Agency Comments and Our Evaluation

We provided draft copies of this report to the Department of Energy (DOE) and to the Environmental Protection Agency (EPA) for their review and comment. We received a written response from DOE's Director, Office of Electricity Delivery and Energy Reliability. EPA provided technical comments which we incorporated in the report.

DOE disagreed with our assertion that it did not analyze all of the likely asthma-related and other health impacts of increased pollution from the Sempra and Intergen power plants. Specifically, DOE stated that the environmental impact statement for the two plants (1) notes the full range of respiratory effects associated with exposure to airborne particulate matter (PM<sub>10</sub>) and (2) uses the number of potential additional asthma hospitalizations in Imperial County as a representative estimate of the number of potential health effects cases associated with power plant emissions of PM<sub>10</sub>. While DOE's environmental impact statement acknowledges that increases in PM<sub>10</sub> concentrations could have adverse health impacts such as increased asthma symptoms and chronic bronchitis, up to hospitalization and death, DOE did not quantify or report quantified estimates for any adverse health effects other than asthma hospitalizations. For example, DOE did not quantify the extent to which asthma sufferers would have increased doctor visits or medication use related to increased pollution. Furthermore, while asthma hospitalizations are one measure of potential adverse health impacts from increased emissions of particulate matter, there are many other adverse health effects that have been documented, such as chronic lung disease, chronic bronchitis, pneumonia, and cardiovascular disease that DOE did not quantify. For these reasons, asthma hospitalizations do not represent the "full range" of potential adverse health impacts in Imperial County.

DOE also disagreed with our assertion that it did not analyze the potential health impacts of pollution from the Sempra and Intergen power plants on susceptible populations in Imperial County. According to DOE, because the environmental impact statement's estimate of increased asthma hospitalizations is based on data that include children ages 14 and under, it accounts for health impacts on susceptible populations. However, asthmatic children are not the only susceptible population mentioned in our report, and asthma hospitalization is not the only potential health

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impact. Moreover, DOE's analysis does not differentiate among different population subgroups in terms of their susceptibility to the effects of air pollution but instead characterizes potential adverse health effects for the population as a whole. Consequently, we continue to believe that DOE's environmental impact statement did not address the full range of potential health impacts on susceptible populations in Imperial County.

Finally, DOE does not agree that the health impacts from ozone formation may be larger than it estimated in the environmental impact statement. DOE said that it addressed EPA's concerns regarding the uncertainty in the ozone modeling in the final environmental impact statement. However, while EPA acknowledged in its comments on the final environmental impact statement that the document clarified the limitations of the ozone modeling analysis, it also reiterated its support for off-site mitigation efforts to address these limitations to ensure that there is no net increase in air pollution in Imperial County. As a result, we continue to believe that ozone formation may have larger health impacts than estimated in the final environmental impact statement. DOE's specific comments and our detailed responses are presented in appendix II of this report.

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We are sending copies of this report to the Secretary of Energy, and the Administrator of the Environmental Protection Agency, and appropriate congressional committees. We will also provide copies to others upon request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.



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If you or your staffs have any questions about this report, please contact me at (202) 512-3841 or [stephensonj@gao.gov](mailto:stephensonj@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix III.

A handwritten signature in black ink, reading "John B. Stephenson". The signature is written in a cursive style with a long horizontal flourish at the end.

John B. Stephenson  
Director, Natural Resources  
and Environment

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# Appendix I: Objectives, Scope, and Methodology

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The objectives of this report were to determine (1) how emissions from the Sempra and Intergen power plants compare to emissions from recently permitted plants in California and emissions from sources in Imperial County, and what emissions standards the plants would be subject to if they were located in Imperial County; (2) the health impacts of emissions from the power plants on Imperial County residents; and (3) what options exist for U.S. policymakers to ensure that emissions from these power plants do not adversely affect the health of Imperial County residents. To address all three of these objectives we visited the Sempra and Intergen plants in Mexicali, Mexico; interviewed plant representatives, various U.S. federal, state, and local air quality officials, and other stakeholders; and reviewed relevant documents and studies.

To determine emissions from the Sempra and Intergen plants we obtained data from emissions performance tests conducted at the plants by third party contractors (GE Mostardi Platt and Air Hygiene). These tests were designed to document the average emissions of selected pollutants (nitrogen oxide, particulate matter, carbon monoxide, volatile organic compounds, and ammonia) from the combustion turbines at each of these plants. The results of these tests were reported in standard units of measurement, namely parts per million or pounds per hour. According to the contractors, they completed the tests according to Environmental Protection Agency and California-approved methods and conducted quality assurance activities related to their test results. We assessed the reliability of the data by (1) reviewing documentation of test objectives and quality control procedures provided by the third party contractors, (2) conducting interviews with plant officials to determine the scope and generalizability of the tests, and (3) reviewing reports of actual NO<sub>x</sub> emissions submitted to the Mexican government to ensure consistency with the test results. Based on this assessment, we determined that the data were sufficiently reliable for the purposes of this report.

To determine annual emissions estimates from these plants, we used the results from the emissions tests to calculate the annual tonnage that these plants would be likely to emit. We computed these values based on the conservative assumption that these plants would be operating 24 hours a day, 365 days a year. In addition to the estimates obtained from the testing results, we also used the maximum allowable emission limits of comparable plants in California to develop a more conservative estimate of annual emissions from these plants. For Sempra, we utilized the Elk Hills power plant as the primary basis for developing comparative estimates. This natural gas-fired power plant is partially owned by Sempra Energy and utilizes very similar equipment and pollution control

technology as the Mexicali plant. For the Intergen plant, we used a combination of comparable estimates because no similar, Intergen owned facilities were recently constructed in California. To estimate nitrogen oxide (NO<sub>x</sub>) and ammonia (NH<sub>3</sub>), we used vendor guarantee limits, which are the maximum emissions levels specified by the manufacturer that a specific piece of equipment is likely to produce (e.g. selective catalytic reduction systems). Particulate matter (PM<sub>10</sub>) was estimated using the average allowable emissions limit from all comparable plants in California permitted between 2000 and 2004. Because the Intergen plant is not equipped with an oxidation catalyst, carbon monoxide (CO) was estimated using a specific plant in California, permitted in 2000, that was the only one licensed without such control equipment. Finally, because some California permits establish volatile organic compounds (VOC) limits in parts per million and others do so in pounds per hour, we were not able to develop an average for all recently permitted plants in California. For this reason, we used emissions limits from the Elk Hills power plant to estimate annual emission levels of VOC at the Intergen plant.

To determine how estimated emissions from the Sempra and Intergen plants compare to recently permitted plants in California, we developed a range of maximum allowable emission limits for all natural gas-fired power plants in California with similar specifications, licensed between 2000 and 2004. This time frame was chosen because it corresponded to the dates that the Sempra and Intergen plants in Mexicali were designed, permitted, and began commercial operations. Because all California power plants are permitted on a case-by-case basis, emissions limits may vary with each project. Therefore, we used the entire range of emission limits for the 23 plants that were identified during our selection process. We then compared the range of emission limits from the 23 plants that we identified with the third party testing results we obtained from the Sempra and Intergen plants.

To determine how the emissions from these plants compare to emissions from sources in Imperial County we utilized the 2004 estimated annual average emissions inventory for Imperial County developed by the California Air Resources Board. We also met with officials from the California Air Resources Board and reviewed emissions reports for stationary sources obtained from the Imperial County Air Pollution Control District. To determine the levels of nitrogen oxide emissions from the Sempra and Intergen plants in relation to existing plants in Imperial County and Baja California, Mexico, we obtained reports developed for the Mexican government that included annual emissions of nitrogen oxides based on data from the continuous emissions monitoring system on

each turbine. Comparable data for the El Centro plant in Imperial County and the two Baja California plants were obtained from a report produced by the Commission for Environmental Cooperation of North America.<sup>1</sup> To assess the reliability of these data sources we (1) spoke with officials at the California Air Resources Board and reviewed documentation related to data collection and quality control procedures used to develop the annual emissions inventory, and (2) corroborated the emissions data related to the El Centro plant with the EPA Clean Air Markets database. Based on these assessments, we determined that the data were sufficiently reliable for the purposes of this report.

To determine what emissions standards the plants would be subject to if located in Imperial County we reviewed the principal federal regulations applicable to new power plants located in the United States and the emission limits of similar plants recently permitted in California. The primary federal regulations we reviewed were those established under EPA's New Source Review program for new or modified major pollution sources. We reviewed selected state and local air pollution regulations because state and local agencies have responsibility for implementing specific permitting activities as part of the federal program. The state and local regulations we reviewed included the permitting conditions of several power plants licensed by the California Energy Commission to determine the standard permitting criteria and the air quality rules established by the Imperial County Air Pollution Control District for sources located in Imperial County.

To identify the potential health impacts from emissions generated by the Sempra and Intergen power plants, we reviewed the health assessment in DOE's environmental impact statement. We met with the project manager of DOE's health assessment to gather additional information about the assessment methodology. We reviewed EPA's comments on the environmental impact statement, and interviewed EPA officials and health experts regarding DOE's health assessment methodology. In addition, we reviewed relevant EPA reports, and other health studies regarding the impacts of particulate matter and ozone on human health. Finally, we reviewed a recent California health survey to obtain current information

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<sup>1</sup>The Commission for Environmental Cooperation of North America was established by the North American Agreement on Environmental Cooperation—one of the two side agreements to the North American Free Trade Agreement.

on asthmatic populations in Imperial County and other California counties.

To determine the policy options available to ensure that emissions from the Semptra and Intergen plants do not adversely affect the health of Imperial County residents, we reviewed the federal Clean Air Act, the California Clean Air Act, key provisions of the North American Free Trade Agreement, as well as environmental agreements between the United States and Mexico, such as the La Paz agreement, and a trilateral agreement between the United States, Mexico, and Canada—the North American Agreement on Environmental Cooperation; and academic research. We also participated in a transboundary air quality management conference where officials from various federal, state, and local agencies in the United States and Mexico met to discuss strategies to address binational air pollution.

We conducted our work between September 2004 and August 2005 in accordance with generally accepted government auditing standards.

# Appendix II: Comments from the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



Department of Energy  
Washington, DC 20585

July 29, 2005

Mr. John B. Stephenson  
Director, Natural Resources  
And Environment  
U.S. Government Accountability Office  
441 G Street, N.W., Room 2T23A  
Washington, DC 20548

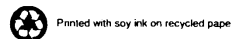
Dear Mr. Stephenson:

Thank you for the opportunity to comment on the Government Accountability Office's (GAO) draft report entitled, "Air Pollution: Estimated Emissions from Two New Mexicali Power Plants Are Low, but Health Impacts Are Unknown." The Department of Energy (DOE) has reviewed the draft and offers comments in the following three areas of the report.

**The GAO report noted on Page 27 that:** *DOE Did Not Analyze All the Likely Asthma-Related and Other Health Impacts of Increased Pollution from the Sempra and Intergen Power Plants.*

**DOE Response:** The environmental impact statement (EIS) notes the full range of respiratory effects associated with exposure to airborne particulate matter (PM<sub>10</sub>), ranging from asthma symptoms, chronic bronchitis, and lower respiratory effects, up to hospitalizations and death, and assumes a general 3% across-the-board increase in all such effects for each 10- $\mu\text{g}/\text{m}^3$  increase in PM<sub>10</sub> as reported in Pope and Dockery (1999). This factor is based on a summary of results of epidemiological studies of acute exposures to particulate matter. The EIS uses the number of potential additional hospitalizations (less than one per year) in Imperial County as a representative estimate of the number of potential health effects cases associated with power plant emissions of PM<sub>10</sub>. DOE used this measure of health effects rather than any of the other levels in GAO's "Pyramid of Potential Health Impacts for Asthmatics" (Figure 4 in GAO's draft report) because DOE considered hospitalizations to be the best parameter for representing impacts on asthma for two reasons. First, the actual number of baseline hospitalizations is well documented (compared to other parameters such as doctor visits or use of rescue inhalers). Second, hospitalizations are a measure of one of the most severe impacts and, thus, of high interest to stakeholders and decision makers.

While the "Pyramid" is a useful tool for expressing the general idea that less severe effects have higher frequency, we think that it is not a useful model for computing actual numbers of effects. Take, for example, the 2003 report "Asthma in California, Findings from the 2001 California Health Interview Survey," which GAO cites in its report. The



Now on p. 23.

See comment 1.

See comment 2.

See comment 3.

See comment 4.

report notes that the frequency of asthma symptoms is reduced by timely and regular use of medication, regular consultation with physicians, and education regarding the recognition of the onset of symptoms. Therefore, as the frequency of use of medication and physician visits increases, the frequency of asthma symptoms, emergency room visits, and hospitalizations would be expected to decrease and impacts from PM<sub>10</sub> on one level of the "Pyramid" are not expected to be directly related to impacts on the next level in a simple and quantifiable way. DOE instead relied on verifiable baseline rates of hospitalizations to calculate additional cases of this representative health effect of PM<sub>10</sub>.

Regarding the potential relationship between PM<sub>10</sub> and increased cardiovascular effects, including coronary obstructive pulmonary disease, which the EIS does not discuss, DOE notes that the observed association for these diseases is relatively recent in the literature of impacts and is based on far fewer studies than the association between PM<sub>10</sub> and respiratory effects (Pope and Dockery 1999). Sufficient facts and research have not yet been published from which DOE can draw the inference that a statistically linear relationship exists between the small increase in PM<sub>10</sub> attributable to the power plants and an increased incidence of these cardiovascular diseases.

**The GAO report noted on Page 29 that:** *DOE Did Not Analyze the Health Impacts on Particularly Susceptible Populations in Imperial County.*

**DOE Response:** The EIS acknowledges such populations in the estimate of additional hospitalizations. The baseline hospitalization rate in Imperial County is the highest in the state and is nearly twice the state average computed from actual discharge rates in Imperial County over a three-year period (CDHS 2003). The EIS presents hospitalization rates for 0-14 year olds (p. 4-103) as well as for all ages to highlight the susceptibility of children to asthma. The EIS contains a computation (p. 4-104) of the estimate of additional hospitalizations in the county using the all-ages baseline rate, which implicitly accounts for contributions from all groups. The estimated impact in terms of additional hospitalizations accounts for susceptible populations because they are included in the baseline rate.

**The GAO report noted on Page 30 that:** *Health Impacts from Ozone Formation May be Larger Than Estimated by DOE. The section of the report goes on to discuss EPA's comments on the draft EIS in which it did raise concern about the uncertainty in ozone modeling.*

**DOE Response:** EPA's concerns regarding the uncertainty in ozone modeling in the draft EIS were addressed in the final EIS. Indeed, DOE included in the final EIS the results of sensitivity analysis to respond to EPA's comments. That analysis showed that the production of ozone was insensitive to changes in input assumptions for model parameters for which estimated values were used. These results reduce the uncertainties associated with the ozone modeling and support the conclusion reached that impacts to air quality would be minimal. That is, emissions from the power plants would be expected to have very little impact on the ozone levels in Imperial County.

See comment 5.

Now on p. 26.

See comment 6.

Now on p. 27.

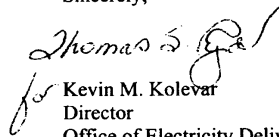
See comment 7.

See comment 8.

On page 30 of its report, GAO cites EPA's comment that "peak ozone concentrations generally occur in areas away from sources of high NO<sub>x</sub>, not at the monitor where high NO<sub>2</sub> concentrations are measured." In response to the EPA comment, all references to air monitoring data with respect to ozone formation were removed in the final EIS. Therefore, citing the EPA comment regarding the location of peak ozone concentrations is not relevant since the ozone model (OZIPR) that DOE used estimates peak ozone concentrations, wherever they would occur.

DOE appreciates the opportunity to comment on this draft report and looks forward to receipt of the final version.

Sincerely,



for Kevin M. Kolevar  
Director  
Office of Electricity Delivery and  
Energy Reliability



## GAO Comments

The following are GAO's comments on DOE's written comments provided in their letter dated July 29, 2004.

1. While DOE's environmental impact statement acknowledges that increases in PM<sub>10</sub> concentrations could have adverse health impacts such as increased asthma symptoms and chronic bronchitis, up to hospitalization and death, DOE did not quantify any potential adverse health effects other than asthma hospitalizations. Instead, the EIS relies solely on comparisons to significant impact levels to gauge the magnitude of potential adverse impacts on human health. In doing so, DOE determined that emissions from the two plants were below significant impact levels, and therefore, these emissions would not produce any significant air quality or adverse health impacts in Imperial County. As we stated in our report, significant impacts levels were designed to be used only in areas that meet air quality standards; Imperial County is currently designated as a nonattainment area for PM<sub>10</sub> and ozone because it does not meet air quality standards for these two pollutants.
2. Asthma hospitalizations are just one measure of potential adverse health impacts from increased emissions of particulate matter. While asthma hospitalizations are more severe and likely to occur less often than doctor visits or increased medication use for asthma, they cannot be considered representative of the "full range" of potential adverse health impacts associated with asthma in Imperial County. In addition to asthma-related adverse health effects, numerous studies have linked increased exposure to particulate matter to other non-asthma-related adverse health effects, such as chronic bronchitis, chronic lung disease, pneumonia, and cardiovascular disease.
3. We disagree with DOE that hospitalizations are the best parameter for representing impacts on asthma. While asthma hospitalizations in Imperial County may be well documented, the 2003 California Health Survey provides information on other asthma-related health impacts in Imperial County. For example, the survey contains information on the number of Imperial County residents who take medication to control asthma. In addition, the survey presents information on the number of Imperial County residents who had asthma symptoms within a specified time frame and who visited an emergency room or urgent care facility for asthma-related health problems during that time frame. Such information could have been used, along with information on hospitalizations, to create a more complete estimate of the potential asthma-related health effects from increases in pollution from the power plants.

4. The report does not use the health effects pyramid, or suggest it should be used, to compute instances of potential health effects from air pollution. However, we believe that the health effects pyramid is useful for understanding the variety of ways in which increased pollution can aggravate asthma suffering in Imperial County. In so doing, it also highlights the full range of potentially quantifiable effects related to asthma.
5. During our review of the health effects literature, we identified a number of studies that support a linear relationship between increases in particulate matter pollution and increased incidence of cardiovascular diseases.
6. Asthmatic children are not the only susceptible population mentioned in our report, and asthma hospitalization is not the only potential health impact. Consequently, we continue to believe that DOE's environmental impact statement did not address the full range of potential health impacts on susceptible populations in Imperial County. DOE's quantification of just one adverse health impact for the entire population of Imperial County masks the differential effects that can beset more susceptible subpopulations in the County.
7. In commenting on the final environmental impact statement, EPA acknowledged that DOE had clarified the limitations and uncertainties of the ozone modeling analysis. However, in its comments EPA said it continues to support and encourage off-site mitigation efforts to address the limitations in the ozone modeling to ensure that there is no net increase of air pollution in Imperial County.
8. We believe that EPA's comment regarding peak ozone concentrations is relevant because it is presented in the context of EPA's comments on the draft environmental impact statement. We also note in the report that DOE took action in response to EPA's comment.

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# Appendix III: GAO Contact and Staff Acknowledgments

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## GAO Contact

John B. Stephenson (202) 512-3841

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## Acknowledgments

In addition to the contact named above, Leo G. Acosta, Charles Bausell, Nancy Crothers, Brandon Haller, Ryan Lambert, Omari Norman, Kim Raheb, and Stephen Secrist made key contributions to this report.

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