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6 **BEFORE THE ARIZONA CORPORATION COMMISSION**

7 GARY PIERCE, CHAIRMAN
8 PAUL NEWMAN
9 SANDRA D. KENNEDY
10 BOB STUMP
11 BRENDA BURNS

12 IN THE MATTER OF THE APPLICATION OF
13 ARIZONA PUBLIC SERVICE COMPANY FOR
14 AUTHORIZATION FOR THE PURCHASE OF
15 GENERATING ASSETS FROM SOUTHERN
16 CALIFORNIA EDISON AND FOR AN
17 ACCOUNTING ORDER.

Docket No. E-01345A-10-0474

**NOTICE OF FILING TESTIMONY
OF ENVIRONMENTAL DEFENSE
FUND**

18 Environmental Defense Fund ("EDF"), through its undersigned counsel, hereby
19 provides notice that it has this day filed the written direct testimony of Bruce Polkowsky
20 in connection with the above-captioned matter.

21 DATED this 31st day of May, 2011.

22 Arizona Corporation Commission

DOCKETED

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23 DOCKETED BY 

24 ARIZONA CENTER FOR LAW IN
25 THE PUBLIC INTEREST

By 
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BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS

GARY PIERCE, Chairman
BOB STUMP
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IN THE MATTER OF THE APPLICATION
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DOCKET NO. E-01345A-10-0474

Testimony of

Bruce Polkowsky

on behalf of Environmental Defense Fund

May 31, 2011

Testimony of Bruce Polkowsky
Docket No. E-01345A-10-0474

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Introduction

Q. Please state your name and business address.

A. My name is Bruce Polkowsky. My business address is 1210 Clayton Street, Denver, Colorado 80206.

Q. By whom are you employed and in what capacity?

A. I am a contractor for the Environmental Defense Fund (EDF).

Q. Please describe Environmental Defense Fund.

A. The Environmental Defense Fund (“EDF”) is a non-partisan environmental organization with more than 700,000 members nationwide. EDF is dedicated to working towards innovative cost-effective solutions to environmental problems, building on a foundation of sound science, economics, and law.

Q. What are your professional qualifications for presenting testimony in this docket?

A. I worked on air pollution policy for the Environmental Protection Agency 1977 to 1997. My work included assessment of scientific studies used for development of National Ambient Air Quality Standards. I was the primary author of the EPA’s 1999 Regional Haze Rule. From 1998 to 2010 I worked for the National Park Service, Air Resources Division and was responsible for NPS’ consultation with all States in development of emissions control plans to address visibility impacts at Class I national parks. Additional qualifications are summarized in Exhibit BP-1.

Q. What is the purpose of your testimony?

A. My testimony examines the public health and environmental benefits of Arizona Public Service’s proposed plan to retire Units 1, 2, and 3 (560 MW) and reduce nitrogen oxide (NO_x) emissions at Units 4 and 5.

Description of the APS Proposal for Four Corners Power Plant

Q. What are the current air pollution emissions from Four Corners Power Plant?

A. Four Corners Power Plant is the largest industrial source of nitrogen oxides in the United States and is a significant source of a range of other pollutants. Data from the Western Regional Air Partnership emissions inventory indicates that for 2002, the nitrogen emissions from Four Corners represented approximately 8 percent of the total industrial and vehicular nitrogen oxide emissions in Arizona, Colorado, New Mexico and Utah combined. Table BP-1, below, summarizes emissions from the plant based on EPA's Clean Air Markets data:

Pollutant	2009 Emissions
Sulfur dioxide	10,195 tons
Nitrogen Oxides	39,300 tons
Mercury	572 lbs
Carbon dioxide	15 million tons

Table BP-1

2009 Air Pollutant Emissions from Four Corners Power Plant

Q. Is Four Corners Power Plant facing new environmental regulatory requirements?

A. Yes. Among other requirements, EPA has proposed to limit NOx emissions from Four Corners Power Plant to comply with Clean Air Act requirements to reduce haze in national parks and wilderness areas such as Grand Canyon National Park. EPA has proposed control technologies to limit NOx emissions at a level than can be met by Selective Catalytic Reduction ("SCR") technologies.

Q. Has APS issued a proposal for complying with these requirements?

A. Yes, APS has proposed to close Units 1-3 and implement advanced pollution controls for nitrogen oxides on Units 4 and 5.¹

Q. How would air pollution emissions change from Four Corners Power Plant as a result of the APS proposal?

A. Assuming that EPA requires an emissions limit for nitrogen oxides of 0.098 lbs/MMBtu or lower, for the same generation produced in 2009, and assuming the closure of Units 1-3, emissions from Four Corners Power Plant would be as described in Table BP-2.

¹ Supplemental Proposed Rule of Source Specific Federal Implementation Plan for Implementing Best Available Retrofit Technology for Four Corners Power Plant: Navajo Nation, 76 Fed. Reg. 10530, 532 (Feb. 25, 2011).

Pollutant	Emissions	% Reduction
Sulfur dioxide	7696 tons	25%
Nitrogen Oxides	4909 tons	90%
Mercury	222 lbs	61%
Carbon dioxide	10 million tons	30%

Table BP-2
Expected emissions from Four Corners Power Plant after implementation of APS'
plan (Source: EDF Analysis based on 2009 Clean Air Markets Data and EPA's
Proposed BART Alternative)

Four Corners Area: Sensitive Populations and Environments

Q. Are there unique atmospheric conditions in the Four Corners region of the United States?

A. Yes. Year-round, the atmospheric conditions near the Four Corners area are particularly susceptible to formation of ozone and fine particulate matter resulting from oxidation of sulfur dioxide and nitrogen oxides. Winter thermal inversions are particularly strong over Shiprock, New Mexico. As a result of thermal inversions, pollution is trapped close to the ground.²

Q. Please describe the air quality conditions near Four Corners Power Plant.

A. The Four Corners area experiences ozone concentrations above the level EPA has proposed to ensure adequate protection for human health. EPA has proposed establishing an 8-Hour ozone national ambient air quality standard (NAAQS) of 0.06 to 0.07 parts per million (ppm).³ In 2009, La Plata County in Colorado, the fourth highest daily maximum 8 hour concentration of ozone reached 0.071 ppm while in San Juan County, New Mexico, the same measurement registered ozone concentrations as high as 0.079 ppm in 2007.⁴ The three year averages of the annual fourth highest daily 8 hour ozone value in Mesa Verde National Park between 2005 and 2010 have been at or above the upper limit of the proposed range.⁵ Visibility in the Class I national parks and wilderness areas of the region is a concern since visibility impairment is still well above natural conditions. The latest 10-year trends

² Joseph Bunnell et al, *Navajo Coal Combustion and Respiratory Health Near Shiprock, New Mexico*, J. Envtl & Pub. Health 2 (2010)

³ See National Ambient Air Quality Standards for Ozone, 75 Fed. Reg. 2938 (Jan. 19, 2010).

⁴ Monitoring data from EPA Air Trends, at <http://www.epa.gov/airtrends/factbook.html>.

⁵ Monitoring data from EPA, Clean Air Status and Trends Network for Air Quality Monitoring (CASTNETS).

for monitoring of the haziest days at national parks in the region indicate no improvement or a possible degradation.⁶

- Q. Could you explain why your testimony refers to the “fourth highest daily value”?
- A. This type of measurement is the value EPA uses to provide a more stable and reliable measure of air quality.
- Q. Could you describe the Native American population near the plant?
- A. The New Mexico, Arizona, Colorado, and Utah counties closest to Four Corners Power Plant have a population of nearly 235,000; 46% are Native American.⁷ More than a quarter million Diné reside on the Navajo Nation.
- Q. How would you characterize the respiratory health of this population?
- A. Native Americans suffer from respiratory ailments at a disproportionate rate compared to the general American population. For instance, according to Center for Disease Control data, approximately 14% of American Indians suffer from asthma compared to 11.6% of white, non-Hispanic Americans and 8.6% of Hispanic Americans.⁸ These vulnerabilities are seen in the demand on Indian Health Services, which provide medical care to native populations in the United States. Respiratory system diseases are the leading cause of hospitalizations in Indian Health Services facilities for children aged 12 months to 15 years, for adults over 65, and for males overall.⁹ The demand for services is particularly acute in the area near Four Corners Power Plant – Indian Health Services facilities serving the Four Corners tribal population have the highest rates of asthma hospitalizations within the IHS system.¹⁰
- Q. Are individuals suffering from asthma particularly sensitive to exposure to ozone?
- A. Yes. Sensitive populations, such as those already suffering from respiratory diseases like asthma, are especially susceptible to the effects of higher ozone concentrations in areas such as those near Shiprock.¹¹

⁶ Air Quality in the National Park, 2009 Annual Performance & Progress Report, National Park Service, Natural Resource Report NPS/NRPC/ARD/NRR- 2010/266, at 13.

⁷ Compiled from State and County QuickFacts, US Census Bureau, based on 2009 estimates.

⁸ Patricia Barnes et al, Health Characteristics of the American Indian or Alaska Native Adult Population: United States, 2004-2008, National Health Statistics report, U.S. Center for Disease Control and Prevention, 2010 at Table 4.

⁹ U.S. Indian Health Service, Trends in Indian Health, U.S. Health and Human Services Dep’t, 2003 at Charts 5.8, 5.9, 5.14, and 5.16.

¹⁰ U.S. Indian Health Service, Regional Differences in Indian Health, U.S. Health and Human Services Dep’t, 2003 at Chart 5. 31.

¹¹ Am. Lung Ass’n, *State of the Air*, 22 (2010).

Q. Does the general population in the Four Corners area, including those in Arizona, suffer health impacts from the Four Corners Power Plant?

A. Yes. Data from a recent National Academy of Sciences report estimates that the total damages associated with Four Corners Power Plant, including costs associated cancer, asthma, premature deaths and other externalized costs to the economy, exceed \$92,000,000.¹²

Human Health Impacts

Q. What do we know about the impacts of ozone on human health?

A. A recent study in the *New England Journal of Medicine* provides confirmation that that long-term exposure to ozone increases the risk of death from respiratory causes.¹³ Even at ozone concentrations well below the current EPA standard, there is “strong evidence of a short-term association between ozone and mortality, with larger effects for cardiovascular and respiratory mortality, the elderly, and current-day ozone exposure”.¹⁴ Similarly, the National Academy of Sciences concluded that “short-term exposure to ambient ozone is likely to contribute to premature deaths”.¹⁵

Q. Would the APS proposal reduce those impacts?

A. Yes. The significant reduction in the amount of nitrogen oxides emitted from the Four Corners Power Plant would reduce the formation of ozone in the region since nitrogen oxides, together with volatile organic compounds, are the two major contributors to ground-level ozone formation. Volatile organic compound emissions in the region near Four Corners Power Plant are dominated by biogenic emissions.¹⁶

Q. What are the health effects of particulate matter (PM)?

A. Fine particulate matter exposure increases risk of premature death and increases morbidity in sensitive populations.¹⁷ The exposure to co-pollutants such as ozone

¹² Supporting data compiled for Nat'l Academy of Sciences, *Hidden Costs of Energy* (2009).

¹³ Michael Jerrett, et al. *Long Term Ozone Exposure and Mortality*, *New Eng. J. Med.*, 1085 (2009).

¹⁴ Michelle L. Bell et al. *A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study*, *Epidemiology*, 436 (July 2005).

¹⁵ Nat'l Research Council, *Estimating Mortality Risk Reduction and Economic Benefits from Controlling Ozone Air Pollution*, 4 (2008)

¹⁶ EDF Analysis of data from Western Regional Air Partnership Data Management System, <http://www.wrappedms.org>.

¹⁷ EPA, *Particulate Matter (PM) Health Effects*, <http://www.epa.gov/nheerl/resarch/pm>

and nitrogen dioxide are not likely to interfere significantly with estimates of PM-associated health risks.¹⁸

Q. How will the APS proposal affect PM exposure?

A. The APS proposal will reduce human exposure to fine PM in two ways. The closure of Units 1-3 will result in lowering of direct emissions of fine PM. In addition, the closure of Units 1-3 will reduce gaseous emissions of sulfur dioxide and nitrogen oxides. The additional controls on Units 4 and 5 to meet regional haze requirements will significantly reduce nitrogen oxides emissions from those units. The combined reduction of these gaseous pollutants will lower the atmospheric formation of fine particulate matter, usually ammonium sulfate and ammonium nitrate, that occurs from oxidation and nucleation processes.

Q. How does mercury exposure impact human health?

A. Mercury is a toxic heavy metal that contaminates water bodies, threatens the development of newborns and children, and contributes to the risk of heart disease.¹⁹ Once mercury has deposited into ecosystems, it can be transformed to methylmercury, a compound that can readily accumulate to very toxic levels in organisms. Exposure to methylmercury can damage the brain, heart, kidneys, lungs, and immune system of people of all ages. Newborn babies and young children are particularly vulnerable as high levels of methylmercury can harm their developing nervous systems, resulting in later difficulties thinking and learning.²⁰

Q. Would APS' proposal reduce emissions of mercury from Four Corners Power Plant?

A. Four Corners Power Plant is a significant source of mercury in the Four Corners region, emitting nearly 500 pounds of mercury in 2009,²¹ an amount that constitutes nearly 20% of total mercury emissions from power plants in the Four Corners

¹⁸ *Id.*

¹⁹ See, e.g., Leonardo Trasande, Philip J. Landrigan, and Clyde Schechter, *Public Health and Economic Consequences of Methyl Mercury Toxicity to the Developing Brain*, *Environmental Health Perspectives*, Vol. 113, No. 5 (May 2005); Kathryn Mahaffey, Ph.D., U.S. EPA, *Methylmercury: Epidemiology Update* (Fish Forum 2004); U.S. EPA, *Methylmercury Exposure* at www.epa.gov/mercury/exposure.htm; National Academy of Sciences' National Research Council, *Toxicological Effects of Methylmercury* (2000); Castoldi, Coccini, Ceccatelli, and Manzo, *Neurotoxicity and molecular effects of methylmercury*, *Brain Res. Bull.*, 55:197-203 (2001); Alan Stern, "A review of the studies of the cardiovascular health effects of methylmercury with consideration of their suitability for risk assessment," *Environmental Research*, Vol. 98, Issue 1 (May 2005) ps. 133-142; Gerald J. Keeler, Matthew S. Landis, Gary A. Norris, Emily M. Christianson, and J. Timothy Dvonch, *Sources of Mercury Wet Deposition in Eastern Ohio, USA*, *Environ. Sci. Technol.*, Article 10.1021/es060377q So013-936X(06)00377-4 (published on web Sept. 8, 2006).

²⁰ See Env't Defense Fund, *Mercury Alert: Cleaning up Coal Plants for Healthier Lives*, (2011), http://www.edf.org/documents/11661_mercury-alert-cleaning-up-coal-plants.pdf.

²¹ U.S. EPA Toxic Release Inventory data, 2009

states.²² Units 1-3 have very inefficient mercury control systems, with only a 24.5% average removal rate, compared to 91.4% average mercury removal rate for units 4 and 5.²³ The APS proposal would retire those units, providing significant benefit from reduced mercury emissions.

Environmental Impacts

Visibility at National Parks and Wilderness Areas

- Q. What are the visibility impacts of nitrogen oxides, sulfur dioxide and PM?
- A. EPA has found that gaseous air pollutants such as SO₂ and NO_x that transform in the atmosphere to secondary particulate pollution are in a size range that has potent adverse impacts on visibility and “can be six times more effective at impairing visibility than direct particulate pollution.”²⁴
- Q. How does the Clean Air Act improve visibility in our national parks and wilderness areas?
- A. The Clean Air Act and implementing regulations require States to make “reasonable progress” toward the national visibility goal of the “prevention of any future, and the remedying of any existing, impairment of visibility in Class I areas which impairment results from manmade air pollution.”²⁵ To achieve reasonable progress towards restoring natural visibility conditions, EPA’s Regional Haze Rule requires States to assess the effects of emissions of visibility-causing pollutants in their State on visibility conditions at Class I national parks and wilderness areas over a broad geographic region. The review of emissions and control strategy options includes all sources, such as automobiles and industrial facilities. A State, in cooperation with neighboring States and in consultation with federal land managers of the Class I areas, establish emissions strategies every ten years that are designed to improve the worst visibility days and protect the best visibility days at Class I parks and wilderness areas. The Regional Haze Rule requires States with Class I areas to establish reasonable progress goals for Class I areas in their State every ten years, and compare those goals with a timeline that would return all Class I areas in the country to natural conditions in 60 years from establishment of the baseline period (2000-2004). As part of the emissions review and strategy implementation process, a State must assess certain industrial sources built between 1962 and 1977 and determine if any of those sources are “reasonably anticipated to cause or contribute

²² Env’t New Mexico, *Dirty Energy’s Assault on our Health: Mercury* (2011).

²³ Letter from APS to EPA, EPA Docket, EPA-R09-OAR-2010-0683-0039, table 4. (“APS Letter”).

²⁴ Assessment of Anticipated Visibility Improvements at Surrounding Class 1 Areas and Cost Effectiveness of Best Available Retrofit Technology for Four Corners Power Plant and Navajo Generating Station: Advanced Notice of Proposed Rulemaking, 74 Fed. Reg. 44313, 316 (Aug. 28, 2009).

²⁵ Regional Haze Regulations, 64 Fed. Reg. 35714 (July 1, 1999).

to” regional haze impairment. If cause or contribution to regional haze is found, a State must require installation of Best Available Retrofit Technology (“BART”) to address the source’s impacts on visibility at Class I areas. BART must be determined and implemented within the first 10-year strategy period (2008 to 2018).

Q. How does EPA’s Regional Haze Rule address the contribution to regional visibility impacts caused by emissions at Four Corners Power Plant?

A. Since Four Corners Power Plant is located on the Navajo Nation and the Navajo Nation does not have delegation of authority to implement visibility protection requirements, EPA acts on behalf of the Navajo Nation. Based on the requirements of the Regional Haze Rule and EPA guidance on implementation of BART,²⁶ EPA has determined that Four Corners Power Plant is a facility subject to BART. EPA has proposed a nitrogen oxides emissions limit of 0.11 lbs/mmBtu for all five units as BART.

Q. Are there alternative regulatory pathways for reducing haze from Four Corners Power Plant?

A. The Regional Haze Rule, and subsequent EPA BART guidance, allow for alternatives to the installation of BART if they achieve “more reasonable progress” than BART. The APS proposal is an alternative to EPA’s proposed BART determination.²⁷

Q. How is “reasonable progress” towards the goal of restoring natural visibility conditions measured?

A. EPA uses a metric called the “deciview” to assess visibility.

Q. What is a deciview?

A. Deciview is an index of haze. The higher the number the greater the haze.²⁸

Q. What are the features of the deciview index of haze?

²⁶ Regional Haze Regulations and Guidelines for Best Available Retrofit (BART) Determinations, 70 Fed. Reg. 39104 (July 6, 2005).

²⁷ Supplemental Proposed Rule of Source Specific Federal Implementation Plan for Implementing Best Available Retrofit Technology for Four Corners Power Plant: Navajo Nation, 76 Fed. Reg. 10530, 532 (Feb. 25, 2011).

²⁸ The Deciview was developed as a regulatory index because its numerical scale better represents changes in human perception of the visual quality of a scene, like the vistas in national parks, than changes in previous indexes used in atmospheric research, such as light extinction (in inverse megameters) and standard visual range (in miles or kilometers). Deciview is mathematically related to these other measures, but adds three key features described above.

A. The deciview index has three important characteristics. First, under the deciview index system, a calculated value of 0 deciview means that there is no haze. This is a condition known as a Rayleigh sky, where only the blue light scattering of Earth's gaseous atmosphere is present. Second, the deciview index is established so that a 1 deciview change is a very small, but noticeable, change in visual air quality for the complex views found in Class I areas. A complex view includes foreground, background, changes in ground color and texture, as well as sky color and perhaps cloud formations. Third, a change of 1 deciview resulting, for example, from an emissions reduction control strategy, will have the same perceived effect to a human observer whether that 1 deciview change improves a very hazy sky or fairly clear sky. The amount of pollution removed to create an improvement of 1 deciview in a hazy sky will need to be much greater than the amount of pollution needed to be removed to improve a clearer sky, but the perception of these changes would be the same. The linearity based on perception of the deciview index allows an easier comparison of emissions strategies that will have different effects at many Class I areas, all of which have different baseline visibility conditions.

Q. Could you provide more detail about how EPA uses the deciview scale?

A. In the implementation of the Regional Haze Rule, deciview is used in two ways. Monitoring of visibility conditions at Class I areas is reported in deciview for the haziest and clearest days on a yearly basis. States establish reasonable progress goals based on anticipated changes in the monitored values. Deciview is also used when modeling impacts of individual BART sources to determine if their impact on the Class I area(s) is large enough to subject the source to a BART determination. In a BART determination, deciview changes illustrate the effects of different control options. In BART evaluations, the deciview impact is calculated as a change from the clearest days at the nearby Class I area(s) to assure sources are appropriately screened for their potential to cause or contribute to regional haze.

Q. Which national parks and wilderness areas are affected by emissions from Four Corners Power Plant?

A. Sixteen Class I national parks and wilderness areas have modeled impacts above the perceptible threshold according to EPA and Federal Land Manager protocol.²⁹ These areas are: Arches National Park, Bandelier Wilderness Area, Black Canyon of the Gunnison Wilderness Area, Canyonlands National Park, Capitol Reef National Park, Grand Canyon National Park, Great Sand Dunes National Park, La Garita Wilderness Area, Maroon Bells Snowmass Wilderness Area, Mesa Verde National Park, Pecos Wilderness Area, Petrified Forest National Park, San Pedro Peaks Wilderness Area, Weminuche Wilderness Area, West Elk Wilderness Area and Wheeler Peak Wilderness Area. The average impact for these Class I areas is 3

²⁹ H. Andrew Gray, *Four Corners Power Plant Modeling: Visibility Impacts in Class I Areas*, Report submitted to EPA at Docket EPA-R09-OAR-2010-0683-0182.4 at 6.

deciviews, or three times the level required to be noticeable. For all of these areas, the total number of days modeled to have impacts above 1 deciview exceeds 650 per year.

Q. Would visibility impacts from Four Corners Power Plant be reduced by APS' proposal?

A. Yes. Depending on the final EPA Determination of BART emissions limits for nitrogen oxides, APS' proposal would reduce the magnitude of peak visibility impacts by one half to two thirds. At seven to ten of the Class I areas, the peak impact drops below 1 deciview.³⁰

Ozone and NOx impacts on plant and wildlife

Q. What are the impacts of ozone on plants?

A. Ozone causes injury and damage to plants. Ozone enters plants through leaf openings called stomata and damages plant tissue, causing visible injury and growth effects, including premature leaf loss, reduced photosynthesis, and reduced growth. Ozone effects on natural vegetation have been documented throughout the country, particularly in many areas of the eastern U.S. and in California.

Q. Are there ozone impacts that are specific to the Four Corners region?

A. In the arid Four Corners region, dry soil conditions help limit ozone damage to plants. In dry conditions, plants limit moisture loss by closing their stomata; this closure also limits ozone uptake and subsequent injury. However, a number of plant species that occur in the region are known to be sensitive to ozone.³¹ Sensitive species in riparian areas (i.e., along streams or wetlands) may be more vulnerable to ozone injury, as their stomata are more likely to remain open.

Q. What are the impacts of NOx on the environment?

A. NO_x emissions contribute to deposition of nitrogen into ecosystems. In the atmosphere, NO_x transforms to nitrate, which is deposited out in rain, snow, or dryfall. Once in aquatic or terrestrial ecosystems, nitrate acts as a fertilizer. Although this may be beneficial to farmlands, it can induce unwanted changes to natural systems. Natural ecosystems have evolved under low nitrogen conditions and have limited capacity to absorb excess nitrogen. Excess nitrogen may favor certain plant species, particularly invasive annual grasses, allowing them to outcompete and

³⁰ *Id.* at 8.

³¹ Nat'l Park Serv. Air Res. Div., *Ozone-sensitive plant species, by network* (2006).

displace native plants and resulting in a loss in biodiversity.³² In arid shrublands in California, excess nitrogen has increased fire risk by promoting a continuous fine fuel layer of grasses.³³ Although specific studies have not been conducted to assess the effect of excess nitrogen in the Four Corners Area, the National Park Service has identified parks in that area as being at high risk from nitrogen deposition.³⁴

- Q. Would these impacts be influenced as a result of APS' proposal?
- A. While there are no quantitative estimates of the APS proposal's effect on these environmental concerns, lowering of emissions of NO_x can be reasonably expected to lead to lower ozone concentrations and result in lower amounts of nitrogen to be deposited in the ecosystem.

Mercury impacts on fish and wildlife

- Q. Does mercury have an impact on fish and wildlife?
- A. As with humans, mercury can harm fish and wildlife, which may suffer reduced reproductive success, impaired growth and development, behavioral abnormalities, reduced immune response and decreased survival.³⁵ Aquatic systems, particularly wetlands, are ideal for converting mercury into its highly toxic form, methylmercury. As a result, mercury can reach very high levels in fish and fish-eating birds and mammals.
- Q. Are fish and wildlife in the Four Corners area impacted by mercury?
- A. As seen in Exhibit BP-2 below, the Four Corners region has one of the highest levels of mercury deposition in the country.³⁶ Exhibit BP-3, below, shows the 51 water bodies with mercury consumption fish advisories within 300 miles of Four Corners Power Plant. For instance, in the Four Corners Area of Colorado, fish from five reservoirs have been tested for mercury and all five are now listed for fish

³² Matthew L. Brooks, *Effects of increased soil nitrogen on the dominance of alien annual plants in the Mojave Desert*, J. Applied Ecology, 344 (2003); Chris M. Clark, et al. C., *Environmental and plant community determinants of species loss following nitrogen enrichment*, Ecology Letters, 596 (2007).

³³ Leela E Rao et al., *Risk-based determination of critical nitrogen deposition loads for fire spread in southern California deserts*, Ecological Applications, 1320 (2010).

³⁴ T.J. Sullivan et al., *Evaluation of the sensitivity of inventory and monitoring national parks to nutrient enrichment effects from atmospheric nitrogen deposition: Southern Colorado Plateau Network (SCPN)*, Nat'l Park Serv., Natural Resource Report NPS/NRPC/ARD/NRR—2011/330 (2011).

³⁵ Koren Nydick, *Mercury in Precipitation and Lakes of Southwestern Colorado*, Mountain Studies Institute, 4-5 (2010).

³⁶ National Atmospheric Deposition Program, Mercury Deposition Network, map available at <http://nadp.sws.uiuc.edu/maps/Default.aspx>.

consumption advisories (i.e., McPhee, Narraguinnep, Totten, Vallecito, and Navajo Reservoirs).³⁷

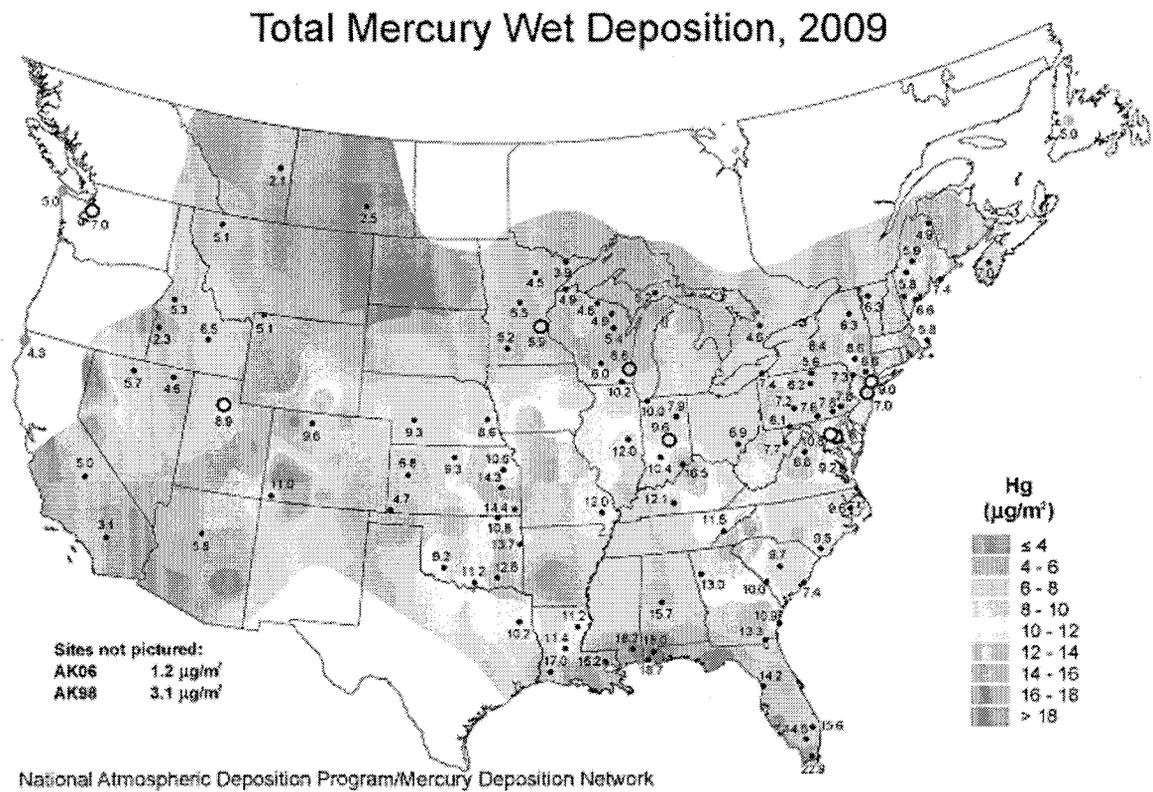


Figure BP-1
 Total Wet Mercury Deposition, 2009
 (Source: National Atmospheric Deposition Program/Mercury Deposition Network)

³⁷ Env't Data Unit, Water Quality Control Div., *Colorado Fish Tissue Study*, Colo. Dep't Pub. Health & Env, (2011), <http://www.cdphe.state.co.us/wq/fishcon/index.html>.



Figure BP-2

Waterways with mercury fish consumption advisories within 300 miles of Four Corners Power Plant

(Source: EDF Analysis of Fish Consumption Advisories issued by US EPA and Navajo Nation EPA as of March 2011)

Q. What are some of the impacts of mercury on fish near Four Corners Power Plant?

A. Two endangered species of fish are located in waterways that are directly polluted by FCPP, the Colorado Pikeminnow and the razorback sucker. It is estimated that 64% of Colorado Pikeminnow in the San Juan River Basin currently experience reproductive impairment due to mercury contamination.³⁸

Q. Is there any evidence linking mercury deposition in the Four Corners area to the Four Corners Power Plant?

A. The US Fish and Wildlife Service projects that the mercury discharged from FCPP is associated with at least 16 pounds of mercury precipitating into the San Juan River Valley each year.³⁹ Historical evidence from lake sediments indicates that mercury deposition in the Four Corners region sharply increased as FCPP units 1-5 began operations in the 1960's and 1970's.⁴⁰ Sediment cores from mountain lakes in the San Juan Mountains in Colorado, near Mesa Verde, show that "mercury is

³⁸ U.S. Fish & Wildlife Serv., Draft Biological Opinion for the Desert Rock Energy Project, U.S. Bureau of Indian Affairs, Gallup, New Mexico, Cons. # 22420-2005-F-117, 95 (2009). ("FWS Draft Biological Opinion").

³⁹ Calculated from data cited in FWS Draft Biological Opinion at 16.

⁴⁰ FWS Draft Biological Opinion, at 75

accumulating in sediments at a rate of 1.6 to 3 times faster than pre-industrial rates.”⁴¹ Current rates of deposition in the San Juan Mountains are similar to those in Mesa Verde National Park,⁴² with mercury concentrations in lake zooplankton in seven lakes in the San Juan Mountains reaching levels similar to or higher than those in reservoirs with fish consumption advisories.⁴³

Q. How would mercury concerns be addressed should APS retire Units 1-3?

A. The retirement of Units 1-3 in 2014 as proposed in the APS proposal would reduce mercury emissions by 307 pounds per year, reducing human and wildlife exposure to this toxic metal.⁴⁴

Global Warming Pollution

Q. Would CO₂ emissions be reduced as a result of the APS proposal?

A. Yes. The BART Alternative would reduce climate-disrupting CO₂ emissions by more than 5 million tons per year.⁴⁵

Q. Do CO₂ emissions contribute to global warming?

A. Yes. A recent National Academy of Sciences report emphasizes that “the higher the total or cumulative carbon dioxide emitted ... the higher the [global] warming will be for the next thousand years.”⁴⁶ Reductions in carbon dioxide emissions reduce the risks associated with global warming.

Q. How is the southwest being impacted by climate change?

A. Already, the southwest is experiencing declines in spring snowpack and decreased Colorado River Flows.⁴⁷ As CO₂ emissions increase, global warming will intensify the droughts characteristic of the region’s natural climate variability.⁴⁸ Higher temperatures and more intense droughts have already contributed to the die-off of piñon pine trees in 4600 square miles of piñon-juniper woodlands in the Four Corners area.⁴⁹ The characteristics of fire in the southwest will change, as well. The

⁴¹ Nydick at 18.

⁴² *Id.* at 10-11.

⁴³ *Id.* at 14.

⁴⁴ See APS Letter on Mercury at Table 3.

⁴⁵ EPA Clean Air Markets Data (2009).

⁴⁶ Nat’l Academy of Sciences, *Warming World: Impacts by Degree 7* (2011).

⁴⁷ U.S. Global Change Research Program, *Global Climate Change Impacts in the United States* 129 (2009).

⁴⁸ *Id.* at 130.

⁴⁹ *Id.* at 131.

total area burned is expected to increase and the pattern of fires may change.⁵⁰ As temperatures rise and species shift northward, iconic species such as the Saguaro cactus may be crowded out by invasive species.⁵¹ More intense floods are expected, with resulting challenges in managing the region's delicate water supply system.⁵² Temperature increases and square conflicts over access to water will have detrimental impacts on the region's agriculture industry.⁵³

Conclusion

Q. Do these observations lead you to any conclusions about the APS application?

A. To the extent that approval of APS' request for a waiver from the self-build moratorium is contingent on a requirement to retire Units 1-3 at Four Corners Power Plant, APS' application to purchase SCE's interest in Units 4 and 5 would have significant health and environmental benefits. The following environmental benefits would result from such action:

- Reduced formation of ozone and fine particulate matter in the Four Corners region
- Reduced emissions and deposition of mercury in the Four Corners region
- Improved visibility in more than a dozen national parks and wilderness areas on the Colorado Plateau and beyond
- Reductions in emissions of fossil fuel generated carbon dioxide which contributes to world emissions of green house gases.

As discussed in detail above, these environmental benefits carry significant consequential health benefits. A summary is provided as Exhibit BP-2.

Q. Does this conclude your direct testimony?

A. Yes.

⁵⁰ *Id.*

⁵¹ *Id.*

⁵² *Id.* at 133.

⁵³ *Id.* at 134.

Exhibit BP-1: Summary of Qualifications of Bruce Polkowsky

Experience

Consultant (Denver, CO), (2010 – present).
National Park Service (Lakewood, CO), Senior Policy Analyst (1998-2010).
Environmental Protection Agency (Research Triangle Park, NC, San Francisco, CA),
Environmental Engineer (1977– 1998).

Education

MS Environmental Engineering, Duke University
BSE Civil Engineering and Public Policy, Duke University

Recent Testimony and Public Comment Before:

Colorado Air Quality Control Commission, California Air Resources Board, Minnesota
Pollution Control Agency

Selected Publications

(with Vickie Patton) “The EPA’s Regional Haze Proposal: protecting visibility in national parks and wilderness areas,” *Tulane Environmental Law Journal*, vol. II, 1998

(with John Bachmann et al.) Review of National Ambient Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information. OAQPS Staff Paper, U.S. EPA, 1996 EPA/452/R-96/013. (NTIS, Springfield, VA PB97-115406REB)

(with Marc Pitchford) “Percent change in extinction coefficient: a proposed approach for federal visibility protection strategy,” in “Visibility and Fine Particles” Conference Transactions, TR-17, A&WMA 1990

Implementation Plans for Visibility Protection- Part II, *Journal of the Air Pollution Control Association*, conference proceedings, paper 85-9.7, 1985

(with David Stonefield and William Hamilton) Implementing Section 126: Controlling Interstate Pollution, *Journal of the Air Pollution Control Association*, conference proceedings, paper 82.34.1, 1982

Exhibit BP-2
Summary of Health and Environmental Benefits of the APS Proposal

Pollutant	Emissions Reduced*	Benefits
Nitrogen Oxides Closure of Units 1-3 SCR on Units 4, 5	14 thousand tons per year 20 thousand tons per year	Improvements in human health from reductions in ozone and fine particulate matter exposure. Significant Improvement in Visibility in the region around FCPP, including reduction of peak impacts of FCPP at 16 Class I areas by one half to two thirds Lowering of nitrogen deposition to desert ecosystems
Sulfur Dioxide	2.5 thousand tons per year	Improvement in human health from reductions in fine particulate matter exposure Small improvement in visibility in the region
Mercury	300 pounds per year	Less human exposure to mercury Less mercury deposition to ecosystems
Fine Particulate Matter	678 tons per year	Small improvement in human exposure Small Improvement in local visibility
Carbon Dioxide	3 to 5 million tons per year	Contribution to addressing global increase in greenhouse gas emissions.

* Based on 2009 Emissions reported in EPA's Clean Air Markets Database and APS Proposal submitted to EPA,.