The Grand Canyon Visibility Transport Commission

Recommendations for Improving Western Vistas

June 10, 1996

REPORT OF THE

GRAND CANYON VISIBILITY TRANSPORT COMMISSION

TO THE UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

June 1996

EXECUTIVE SUMMARY

The Colorado Plateau's national parks and wilderness areas provide a unique, panoramic visual experience for people from around the world. This experience depends on maintaining high visual air quality in the region, which is threatened by haze resulting from projected growth over the next fifty years. Congress has set a national goal of remedying existing human-caused visibility impairment, and preventing future impairment, at these national parks and wilderness areas. Congress recognized that not all haze is human-caused and that haze is a regional issue. Congress created the Grand Canyon Visibility Transport Commission in 1991 to advise the U.S. Environmental Protection Agency on strategies for protecting visual air quality at national parks and wilderness areas on the Colorado Plateau. The Commission established a Public Advisory Committee (PAC) to obtain broad input as it formulated these strategies.

The Commission conducted an extensive review of scientific, technical, and other information with assistance from a range of governmental, business, tribal, and environmental interests. It developed more comprehensive databases, and new computer modules to analyze these data and model future air quality. The Commission significantly advanced understanding of regional haze, but limitations and uncertainties remain. Based on that information and its own deliberations, the PAC developed a set of emissions management recommendations for the Commission with a full understanding of progress and limitations in available knowledge. These recommendations are aimed at protecting clear days and reducing dirty days at national parks and wilderness areas on the Colorado Plateau. Following a series of public meetings in April 1996, the PAC and Operations Committee conducted a final review and approval of these recommendations and forwarded them to the Commission for action. The Commission formally considered the PAC and Operations Committee reports on June 10, 1996 and approved them as the Commissions report to the Environmental Protection Agency. The EPA should use the Commission's recommendations as guidance for developing national strategies and/or rulemaking. Implementation of all specific program components will remain the responsibility of tribes, states and their political subdivisions, and, in some cases, federal agencies.

Some of the Commission's recommendations ask the EPA to take specific **actions** or institute particular **programs**, in cooperation with the tribes, states and federal agencies as implementing bodies. Other recommendations provide a range of potential policy or strategy **options for consideration** by the EPA and implementing entities. As the EPA develops policies and takes actions based on this report, this distinction between "actions" and "options" should be maintained with diligence. That is, recommendations intended as policy options should not become mandated actions or regulatory programs.

The primary recommendations include:

- **Air Pollution Prevention.** Air pollution prevention and reduction of per capita pollution is a high priority for the Commission. The Commission recommends policies based on energy conservation, increased energy efficiency and promotion of the use of renewable resources for energy production.

- **Clean Air Corridors.** Clean air corridors are key sources of clear air at Class I areas, and the Commission recommends careful tracking of emissions growth that may affect air quality in these corridors.

- **Stationary Sources.** For stationary sources, the Commission recommends closely monitoring the impacts of current requirements under the Clean Air Act and ongoing source attribution studies. Regional targets for SO_2 emissions from stationary sources will be set, starting in 2000. If these targets are exceeded, this would trigger a regulatory program, probably including a regional cap and market-based trading. During the next year, participants in the Commission's process will develop a detailed plan for an emissions cap and market trading program.

- **Areas In And Near Parks.** The Commission's research and modeling show that a host of identified sources adjacent to parks and wilderness areas, including large urban areas, have significant visibility impacts. However, the Commission lacks sufficient data regarding the visibility impacts of emissions from some areas in and near parks and wilderness areas. In general, the models used by the Commission are not readily applicable to such areas. Pending further studies of these areas, the Commission recommends that local, state, tribal, federal, and private parties cooperatively develop strategies, expand data collection, and improve modeling for reducing or preventing visibility impairment in areas within and adjacent to parks and wilderness areas.

- **Mobile Sources.** The Commission recognizes that mobile source emissions are projected to decrease through about 2005 due to improved control technologies. The Commission recommends capping emissions at the lowest level achieved and establishing a regional emissions budget, and also endorses national strategies aimed at further reducing tailpipe emissions, including the so-called 49-state low emission vehicle, or 49-state LEV.

- **Road Dust.** The Commission's technical assessment indicates that road dust is a large contributor to visibility impairment on the Colorado Plateau. As such, it requires urgent attention. However, due to considerable skepticism regarding the modeled contribution of road dust to visibility impairment, the Commission recommends further study in order to resolve the uncertainties regarding both near-field and distant effects of road dust, prior to taking remedial action. Since this emissions source is potentially such a significant contributor, the Commission feels that it deserves high priority attention and, if warranted, additional emissions management actions.

- **Emissions from Mexico.** Mexican sources are also shown to be significant contributors, particularly of SO_2 emissions. However, data gaps and jurisdictional issues make this a difficult issue for the Commission to address directly. The Commission recommendations call for continued binational collaboration to work on this problem, as well as additional efforts to complete emissions inventories and increase monitoring capacities. These matters should receive high priority for regional and national action.

- **Fire.** The Commission recognizes that fire plays a significant role in visibility on the Plateau. In fact, land managers propose aggressive prescribed fire programs aimed at correcting the buildup of biomass due to decades of fire suppression. Therefore, prescribed fire and

wildfire levels are projected to increase significantly during the studied period. The Commission recommends the implementation of programs to minimize emissions and visibility impacts from prescribed fire, as well as to educate the public.

- **Future Regional Coordinating Entity.** Finally, the Commission believes there is a need for an entity like the Commission to oversee, promote, and support many of the recommendations in this report. To support that entity, the Commission has developed a set of recommendations addressing the future administrative, technical and funding needs of the Commission or a new regional entity and has asked the Operations Committee to complete detailed plans by September, 1996. The Commission strongly urges the EPA and Congress to provide funding for these vital functions and give them a priority reflective of the national importance of the Class I areas on the Colorado Plateau.

To the maximum extent feasible, Commission recommendations calling for additional exploration and study, etc. (necessary for filling information gaps and for resolving certain policy issues) should be accomplished by the year 2000. Until such time as future organizational arrangements have been determined, all tasks which are not assigned to any particular existing entity should be performed by or under the auspices of the Operations Committee.

The Commission believes that reasonable progress toward the national visibility goal is achieved to the extent that current Clean Air Act requirements, existing laws and regulations, and the Commission's recommendations result in a significant near-term decrease in emissions that contribute to visibility impairment and ensure long-term protection of visibility. For example by 2000-2010, pollutants from stationary and mobile sources are expected to be reduced by 30% from the 1990 levels.[1]

[1] Sulphur dioxide (SO_2) for stationary sources and nitrogen oxides (NO_x) and volatile organic compounds (VOC) for mobile sources.

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GLOSSARY OF TERMS USED IN THIS REPORT

Within each definition, terms defined elsewhere in this glossary are printed in italics.

Aerosol: Solid particles or liquid droplets that are small enough to be suspended in the air. Aerosols cause most of the *light extinction* responsible for haze on the *Colorado Plateau*.

Area source: Many small sources of air pollution in which the contribution of each source is relatively small, but combined may be a significant source of air pollution. A city can be an area source (although large facilities within the city could release enough air pollution to warrant their analysis individually as a *point source*).

BART: **B**est **A**vailable **R**etrofit **T**echnology, a process under the *CAA* to evaluate the need and, if warranted, install the most effective pollution controls on an already existing air pollution source.

BFS/Baseline Forecast Scenario: A computer model used by the Grand Canyon Visibility Transport Commission to estimate future haze-causing pollution and economics. The *GCVTC* based this scenario on current technologies, existing laws, and a variety of assumptions about how quickly various kinds of pollution sources will be retired and the type of facilities that will replace them. It is an extension of current policies, and allows comparisons with other air pollution management scenarios the *GCVTC* may propose.

CAA/CAAA: The **C**lean **A**ir **A**ct, and the **C**lean **A**ir **A**ct **A**mendments. National air pollution control is based on the Clean Air Act, passed in 1970. Congress amended the Clean Air Act in 1977 (adding many visibility sections that the *GCVTC* is addressing), and in 1990 (when it required creation of the *GCVTC*, assigned tribal governments power under the CAA similar to those of the states).

Class I site/area: In 1977, Congress identified 158 national parks, wilderness areas, international parks and other areas that were to receive the most stringent protection from increases in air pollution. It also set a visibility goal for these areas to protect them from future human-caused haze, and to eliminate existing human-caused haze, and required *reasonable progress* toward that goal.

Colorado Plateau: A high, semi-arid tableland in southeast Utah, northern Arizona, northwest New Mexico, and western Colorado. The unique erosional forms of the Plateau are world famous.

CNG: **C**ompressed **N**atural **G**as, a relatively clean-burning fossil fuel.

EC/OC: **E**lemental **C**arbon (such as soot, often the result of fire and diesel engines) and **O**rganic **C**arbon (carbon combined with other elements to form complex compounds, often given off by plants and most human activities).

Fine mass particulates: *Aerosols* that are smaller than 2.5 micrometers in diameter. (A micrometer is one millionth of a meter, a human hair is about 70 micrometers in diameter.)

GCVTC: The **G**rand **C**anyon **V**isibility **T**ransport **C**ommission, composed of the governors of eight western states (AZ, CA, CO, NM, NV, OR, UT, WY), five tribes (Acoma, Hopi, Hualapai, Navajo), four federal land managers (Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service), the Columbia River Inter-Tribal Fish Commission, and the Environmental Protection Agency. The states and tribes vote, the other GCVTC members do not. The Commission was established to recommend methods to preserve and improve visibility on the *Colorado Plateau*. Congress required establishment of the GCVTC through the Clean Air Act Amendments of 1990.

HC: Hydrocarbons. A group of chemicals containing hydrogen and carbon that often contribute to air pollution as *OC's* or *VOC's*. They are involved in forming ozone, and some hydrocarbons are toxic. Term often used interchangeably with *VOC*s.

Hopi Point: An important air quality monitoring site on the South Rim of the Grand Canyon in Grand Canyon National Park.

IAS: Integrated **A**ssessment **S**ystem, a computer model created by the *GCVTC* to generate information about future visibility and economic trends under a variety of pollution control scenarios.

IMPROVE: Interagency **M**onitoring of **Pro**tected **V**isual **E**nvironments, a group of federal agencies using a common set of standards to monitor visibility across the United States. Other nations have also adopted portions or all of the IMPROVE monitoring techniques.

Inverse megameters, Mm^{-1}: A measurement unit used for *light extinction*, the higher the value, the hazier the air is.

LEV/ZEV: Low **E**mission **V**ehicle/**Z**ero **E**mission **V**ehicle, motor vehicle classifications referring to their tailpipe release of air pollution. Today's ZEV's are generally battery-powered, but may use hydrogen fuel cells and other energy sources in the future.

Light extinction: The "loss" of light as it travels through the air. Light can be truly lost by being absorbed by gases and *aerosols* in the air. Light can also be "lost" as it scatters off gases and *aerosols*.

LNG: Liquefied **N**atural **G**as, a relatively clean-burning fossil fuel.

LPG: Liquefied **P**etroleum **G**as, a relatively clean-burning fossil fuel such as propane.

Mm^{-1}: *Inverse megameters*, a measurement unit used for *light extinction*, the higher the value, the hazier the air is.

MMA: **M**aximum **M**anagement **A**lternative, an *IAS* computer model used to estimate the maximum visibility improvements possible regardless of the cost of the pollution controls used. The MMA was used for comparisons, rather than as a policy option.

Mobile source: A pollution source that moves. Mobile sources are often divided into road sources, including cars, trucks, buses, and motorcycles, and non-road sources like trains, planes, boats, lawnmowers, etc.

Modeling: The use of a computer to mimic reality and predict the future behavior of the subject under study. Models of complex subjects like visibility are often limited by the raw data available and the capacity of the computer itself. The *GCVTC's IAS* is a computer model of regional air quality for the *Colorado Plateau* and uses information from throughout western North America.

NAAQS: **N**ational **A**mbient **A**ir **Q**uality **S**tandards, levels of air pollution set by the U.S. Environmental Protection Agency to protect public health and welfare. Standards are set for ozone (O_3), carbon monoxide (CO), sulfur dioxide (*SO_2)*, nitrogen dioxide (*NO_2)*, lead (Pb), and particulates (solid *aerosols*).

Non-attainment area: A geographic region where concentrations of a particular air pollutant exceed the *NAAQS*. A particular location may be non-attainment for more than one pollutant.

NO_x: A mixture of nitrogen dioxide and other nitrogen oxide gases. Nitrogen is the most common gas in the atmosphere. In high temperature and/or high pressure burning (as in an engine), the air's nitrogen is broken down and combined with oxygen, forming unstable or reactive NO_x gases. Nitrogen dioxide (NO_2) is yellowish brown, and thus contributes directly to haze. All the NO_x gases react in the air to form haze-causing *aerosols* and smog.

NPS: **N**ational **P**ark **S**ervice, a federal agency charged with protecting the natural and cultural resources and the processes that create and sustain them, in the National Park System.

New Source Review: A review of a new facility that has the potential to emit air pollutants in amounts specified by law. The review is done to establish the impact of the pollution, and the options available to control that pollution.

OC: **O**rganic **C**arbon, complex carbon-containing compounds often emitted by plants and many human activities. $OC_{2.5}$ is organic carbon of 2.5 micrometers of less.

PAC: **P**ublic **A**dvisory **C**ommittee, established by the *GCVTC* to represent a broad range of public interests. Members are drawn from all levels of government, business, industry, environmental organizations, academia, and private citizens. The *GCVTC* Commissioners charged the PAC with developing consensus recommendations for managing visibility.

Particulates: Solid material small enough to remain suspended in the air.

$PM_{2.5}$: *Aerosols* with a diameter smaller than 2.5 micrometers, the most effective size range to create haze (a micrometer, or micron, is one millionth of a meter, an inch is 25,400 micrometers long).

PM_{10}: *Aerosols* with a diameter smaller than 10 micrometers, on which the EPA has based current *NAAQS*. Larger aerosols in this size range (larger than 2.5 micrometers) are less effective in creating haze than the smaller ones. In addition to creating haze, higher concentrations of PM_{10} can also cause irritation of the throat and lungs, cancers, and early death.

Point source: A specific source of air pollution.

Prescribed fire: Fires in wildland areas that are allowed to burn under prescribed conditions. The "prescription" reflects ecosystem management goals, ability to control the fire, and air quality concerns.

Prescribed natural fire: A fire started by natural processes (usually lightning) and allowed to burn as long as it meets *prescribed fire* conditions.

PSD: **P**revention of **S**ignificant **D**eterioration. A program established under the Clean Air Act Amendments of 1977, whose goal is to prevent major increases in air pollution in areas with cleaner air. The program sets the tightest limits on pollution increases from large *point sources* in *Class I areas*.

Rayleigh or Rayleigh Scattering: The natural scattering of light caused by nitrogen and oxygen in the atmosphere which makes the sky look blue. Also called "blue sky."

Reasonable progress: Reasonable progress refers to progress in reducing human-caused haze in *Class I* areas under the national visibility goal. The *Clean Air Act* indicates that "reasonable" should consider the cost of reducing air pollution emissions, the time necessary, the energy and non-air quality environmental impacts of reducing emissions, and the remaining useful life of any existing air pollution source considered for these reductions. The GCVTC *Public Advisory Committee* has developed the following definition: "Reasonable progress towards the national visibility goal is achieving continuous emission reductions necessary to reduce existing impairment and attain steady improvement of visibility in mandatory Class I areas, and managing emissions growth so as to prevent perceptible degradation of clean air days."

Re-entrained dust/road dust: Fine and coarse dust stirred up from paved or dirt surfaces by the passage of vehicles. The dust may include soil particles, tire rubber, soot, and other materials.

Regional cap: A limit on the amount of specific air pollutants that can be released in a defined geographic area, or a limit on the amount of a specific air pollutant that is allowed to be in the air in a defined geographic area.

ROG: **R**eactive **O**rganic **G**ases, typically *hydrocarbons (HC)*, but include oxygenated hydrocarbons.

SIP/TIP: **S**tate **I**mplementation **P**lan/**T**ribal **I**mplementation **P**lan, plans devised by states and tribes to carry out their responsibilities under the Clean Air Act. SIP's and TIP's must be approved by the U.S. Environmental Protection Agency and include public review.

SO_2, SO_x, sulfates: Compounds composed of oxygen and sulfur. Burning fuels, manufacturing paper, or smelting rock containing sulfur produces sulfur dioxide gas (SO_2) which is converted in the air to other sulfur oxides (SO_x) or haze-causing *aerosols* (sulfates).

Source: Where air pollutants are released. Sources are usually classified as *point*, *mobile*, or *area sources*.

Source attribution: Determining how much a single *source* contributes to air pollution.

Stationary source: An air pollution *source* that remains in one place (generally a business or industrial facility).

Species: A term used to refer to types of pollutants.

TIP/SIP: **T**ribal **I**mplementation **P**lan/**S**tate **I**mplementation **P**lan, plans devised by states and tribes to meet requirements of the Clean Air Act as defined by the U.S. Environmental Protection Agency.

Trading program: In air quality management, a plan under which some limit is set on the amount of an air pollutant that can be released into the air. If a facility releases less than its limit, it may trade or sell the ability to release "unused" amount of air pollutant to another facility, so the second facility can release more than the limit.

Transfer coefficient: In computer *modeling* of air quality, a geographic area is divided into "cells." Transfer coefficients are mathematical formulas that tell the computer how much air pollution to "move" from one cell to another. Determining a transfer coefficient requires the computer model designer to consider wind directions, chemical changes to the air pollutants as they travel, loss of pollutants from the air, and other factors.

Transmissometer: A device that measures *light extinction* by shining a light beam of known brightness through the air and measuring how much is lost when the beam reaches a receiver, usually about 4 miles away.

Urban plume/plume blight: An urban plume is the "cloud" (either visible or invisible) of air pollution blown downwind of an urban area. Plume blight is a distinct band or layer of visible air pollution, often from a single pollution *source*.

Visibility impairment: The loss of clarity in the air that results when gases or *aerosols* scatter and absorb light. We usually see visibility impairment as a general haze or a distinct plume.

VMT: **V**ehicle **M**iles **T**raveled. This number is a measure of vehicle usage and is used to calculate the air pollution produced by *mobile sources*, such as passenger cars, tailpipe emissions and or *road dust*.

VOC: Volatile **O**rganic **C**ompound. A carbon-containing material that evaporates, such as gasoline, some paints, solvents, dry cleaning fluids, and the like. VOC's contribute to ozone formation and may form *OC aerosols*.

I. INTRODUCTION

The Colorado Plateau is a spectacular landscape of massive landforms, unique geology, and vivid colors. People from around the world have experienced these wonders at Grand Canyon, Canyonlands, Bryce Canyon, Zion, and other national parks and wilderness areas on the Plateau. The panorama is a visual experience, and air quality is the key to full enjoyment. On hazy days, when visibility is reduced, the human eye perceives a loss of color, contrast, and detail in the landscape. That loss of visibility diminishes the unique experience of nature's work on the Plateau. (See pictures at the end of this Section which illustrate variations in visibility at selected sites.)

Visibility and visual air quality are daily issues for the inhabitants of the Colorado Plateau, including Indian tribes. They experience, on an almost daily basis, the variations in visibility at national parks on the Plateau. The Colorado Plateau has some of the best visual air quality in the United States. Paradoxically, this means that reduced visual air quality that might go unnoticed in other parts of the United States is starkly apparent on the Plateau. Visual air quality in the West is quite sensitive to relatively small increases in pollutants.

Research shows that visual air quality in the West experienced a significant decline due to emissions from industrial activity from the 1940s to the 1970s. Visibility-impairing emissions began to decline in the 1970s following enactment of the federal Clear Air Act. Visual air quality at national parks and wilderness areas on the Colorado Plateau has not appeared to change since reliable monitoring data became available in the 1980s. However, all the projections point to continued population and economic growth in the region into the next century. This growth is a potential threat to air quality, and poses a challenge to states, tribes, and the federal government.

The National Visibility Goal Under Federal Law

Congress set a national goal of remedying existing visibility impairment, and preventing future impairment, from manmade pollution at 158 national parks and wilderness areas across the United States as part of the Clean Air Act Amendments in 1977. This group includes sixteen parks and wilderness areas on the Colorado Plateau, as well as others in the Western United States.

Congress adopted two main strategies to make progress towards the national visibility goal: Prevention of Significant Deterioration (PSD), which focuses on *new* or *modified* major sources that exceed specified emission thresholds; and a Visibility Protection Program directed at *existing* sources of emissions that impair visibility.

1. The PSD Program

The PSD program designates three classes of areas, with those designated Class I having the most pristine air and receiving the greatest protection under the federal statute. Mandatory federal Class I areas include all national parks, all national wilderness areas and national memorial parks over 5,000 acres, and all national parks over 6,000 acres in existence in 1977. In addition, states and tribes can designate Class I areas. Most Class I areas are located west of the Mississippi River.

Prior to either construction of a major new source or major modification of an existing source, the PSD program requires application to the Environmental Protection Agency (EPA) or the state for a permit. The permit is issued only if emissions from the new or modified major source will not exceed, or contribute to the exceeding of, maximum allowable increments under the CAA.

2. The Visibility Protection Program

Under the Visibility Protection Program, states and tribes must demonstrate to the EPA in their State/Tribal Implementation Plans (SIPs/TIPs) that they will make "reasonable progress" toward achieving the national visibility goal established by Congress in 1977. The EPA issued its first regulations under the program in 1980. These regulations did not include a tribal component. The first explicit consideration of tribal lands with respect to air quality regulations occurred in the 1990 Amendments to the CAA. These regulations are known as plume blight regulations and focus on a source or small group of sources to which visibility impairment at a Class I area can be "reasonably attributed." The EPA regulations require such sources to adopt the best available retrofit technology, or BART, to reduce emissions reasonably attributed to them.

The next phase of the EPA's regulations under the Visibility Protection Program focuses on widespread, regionally homogeneous haze from a multitude of sources that impairs visibility over a large area. These regulations are still under development.

Regional Haze

Haze and visibility problems do not respect state and tribal boundaries. Congress addressed this issue when it amended the CAA again in 1990 and authorized the EPA to establish visibility transport regions as a way to combat regional haze. Congress also specifically ordered the EPA to establish a visibility transport region for Grand Canyon National Park, and to create a Grand Canyon Visibility Transport Commission (hereafter referred to as the GCVTC or the Commission). The EPA established the Commission in November 1991.

Tribal Authority Under the Clean Air Act

Tribes have always had the inherent right to regulate air quality on tribal lands. Under the 1990 Clean Air Act Amendments (CAAA), the EPA may delegate authority to Indian tribes to regulate air quality. For example, tribes, like states, can prepare permitting programs under Title V of the CAAA, and establish Tribal Implementation Plans (TIPs) and submit those

programs to the EPA for approval. Tribal regulation of air quality on the Colorado Plateau and across the Transport Region requires full consideration of tribal interests and the active participation of Indian tribes on the GCVTC.

The Commission's Mandate and Structure

The Grand Canyon visibility Transport Region includes nine states and 211 tribal lands[2]. The states are: Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming. Idaho has chosen not to participate in the Commission. The GCVTC comprises:

- The Governors or their designees of each of the states in the Transport Region (with the exception of Idaho);
- The leaders of four Indian tribes (Navajo, Hopi, Hualapai, and Acoma Pueblo) or their designees; and
- The EPA and federal land managers from the National Park Service, Bureau of Land Management, Fish & Wildlife Service, and Forest Service, and the Columbia River Inter-Tribal Fish Commission, as *ex officio* members.

Congress specified that the GCVTC should assess scientific, technical, and other information related to adverse visual air quality impacts from potential or projected emissions growth from sources located in the Transport Region. The Commission adopted a work plan and created a committee structure in order to carry out its tasks. Technical committees drew upon expert resources in government, private industry, academia, and environmental groups.

The Commission's broad task is to report to the EPA on what measures, if any, are appropriate to address visual air quality on the Colorado Plateau. This report must address three areas:

1. The establishment of "clean air corridors" and whether additional restrictions on emissions in these corridors are appropriate to protect visibility at Class I areas on the Colorado Plateau.
2. The imposition of CAA requirements affecting construction of new, major stationary sources or major modifications to existing sources in clean air corridors.
3. Regulations to address long-range strategies for regional haze that impairs visibility in Class I areas on the Colorado Plateau.

The Commission created structures based on principles of broad public input and consensus in order to carry out its mandate, including establishment of a Public Advisory Committee (PAC). PAC members were drawn from government at the federal, tribal, state, and local levels; business and industry; educational institutions; and environmental advocacy groups.

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[2] A list of federally recognized tribes, organized by geographic area, is included as available from the Bureau of Indian Affairs or the National Tribal Environmental Council.

Each Commissioner appointed up to five members to the PAC representing a broad range of the public, including government, business, industry, environmental organizations, academia and private citizens. The PAC's tasks were to develop consensus recommendations for the Commission, to serve as a sounding board for the Commission for social and economic issues affecting visibility, and to provide a balanced representation of views on the value and impacts of protecting visibility on the Colorado Plateau. The PAC relied on the extensive scientific and technical work of the other GCVTC committees to prepare its recommendations. These other committees include the Operations Committee and committees which report to it: the Alternatives Assessment Committee, the Technical Committee, and the Communications Committee.

Following a series of public meetings in April 1996, the PAC and Operations Committee conducted a final review and approval of these recommendations in May. The Commission formally considered the PAC and Operations Committee reports on June 10, 1996 and approved the recommendations to be forwarded to the EPA for action. Tribal perspectives on the Commission process and recommendations are elaborated in Section IV of this report.

Photographic Illustration of the Problem

The following four pages contain color photographs which illustrate the appearance of the average 20% best and worst days and an average day at four of the National Parks and Wilderness areas on the Colorado Plateau. A depiction of the average of the 20% worst or best days means that 10% of the days of the year can be expected to be worse or better, respectively. Please be aware of the limitations of reproduced photographs. They do not completely capture the detail and color of the originals. Note that the identification is incorrect for the location of the Grand Canyon photographs; the photographs were taken from Desert View.

Illustratons of Visibility at Grand Canyon National Park in Arizona

San Pedro from Hopi Point on a “clear” day. 10% of the days are this good or better.

The Grand Canyon from Hopi Point on an average day.

The Grand Canyon from Hopi Point on a “dirty” day. 10% of the days are this bad or worse.

Illustratons of Visibility at San Pedro National Wilderness area in New Mexico

San Pedro on a “clear” day. 10% of the days are this good or better.

San Pedro on an average day.

San Pedro on a “dirty” day. 10% of the days are this bad or worse.

Illustratons of Visibility at West Elk National Wilderness area in Colorado

West Elk on a “clear” day. 10% of the days are this good or better.

West Elk on an average day.

West Elk on a “dirty” day. 10% of the days are this bad or worse.

Illustratons of Visibility at Canyonlands National Park in Utah

Canyonlands on a “clear” day. 10% of the days are this good or better.

Canyonlands on an average day.

Canyonlands on a “dirty” day. 10% of the days are this bad or worse.

II. PROCESS FOR DEVELOPING EMISSIONS MANAGEMENT RECOMMENDATIONS

STAGES IN THE COMMISSION'S STUDY PROCESS

An understanding of the Commission's research and modeling process provides the context for its recommendations. There were six phases of the Commission's work:

1. Development of an emissions inventory for the Transport Region.

2. Development of a technical basis for assessing visibility impacts from changes in emissions.

3. Development of criteria to evaluate options.

4. Development of emission management options.

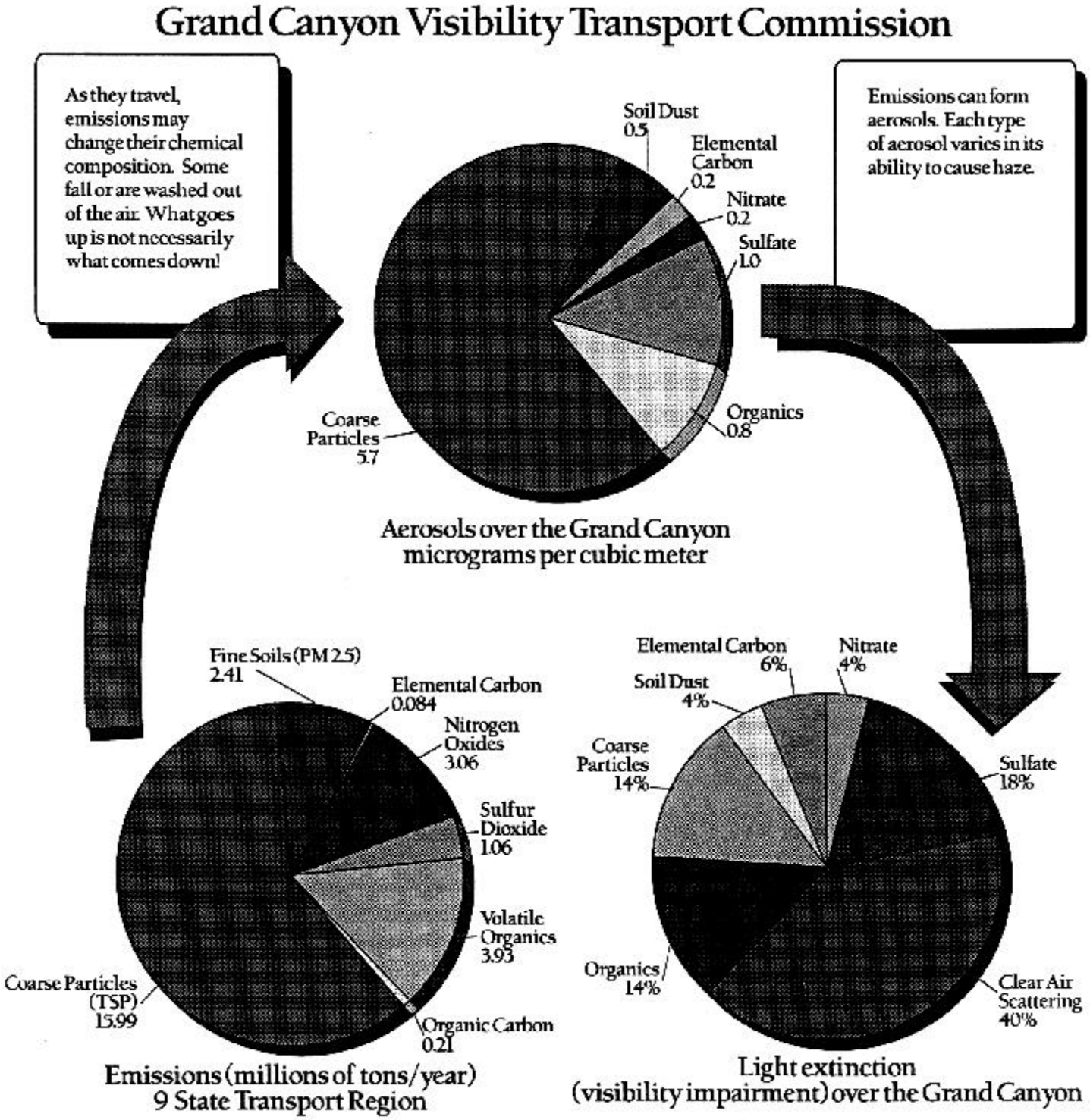
5. Development of scenarios based on varying levels of emission management options, including a baseline or "current law" scenario.

6. Development of a computer-based Integrated Assessment System (IAS) to compare/evaluate costs and visibility impacts of different scenarios.

The first step in the process was creating an inventory of emissions for each state on the Commission, neighboring states (Idaho, Montana, Washington, and Texas), northern Mexico and western Canada. This inventory uses 1990 as its base year, and includes all major stationary sources throughout the Transport Region, and mobile and area sources summarized at a county level. It covers key gaseous (sulfur dioxide, nitrogen oxides, and reactive organic gases/ROG) and aerosol (organic carbon, elemental carbon, and fine and coarse particles) emissions. Data specific to tribal lands have not been checked for adequacy or accuracy. Figure II-1 provides a graphic presentation of key elements of the emissions inventory.

Based on this inventory, the Commission then developed a series of emission management scenarios and a method for assessing the visibility and cost impacts of those scenarios. The Commission used three main emission management frameworks: a regional emission cap; a visibility standard for the Colorado Plateau; and standardized control technology and process requirements. These frameworks were refined into a series of scenarios that were evaluated under the Integrated Assessment System, or IAS. The scenarios included a baseline or lower bound, which projected effects of applying existing laws and regulatory programs; an upper bound which included maximum application of controls on emissions irrespective of costs; and several different intermediate goals. Each scenario reflected different combinations of options and goals for improving visibility.

II. PROCESS FOR DEVELOPING EMISSIONS MANAGEMENT RECOMMENDATIONS



As pollutants travel through the atmosphere, their composition and impact on visibility change.

The Commission's committees also developed technical tools for understanding the effect of different emission sources on visibility at Class I sites, principally the Grand Canyon. These tools include *transfer coefficients* that explain the relationship between pollution sources in various locations and visibility at specific Class I sites. These coefficients have been refined continuously to assist the Commission in its understanding of visibility impacts.

VISIBILITY ON THE COLORADO PLATEAU

The starting point for understanding the Commission's analytical process is visibility. In simple terms, visibility depends on three factors: Rayleigh scattering, other natural impairment, and human-caused impairment. Nitrogen and oxygen in the atmosphere cause the sky to look blue; this is Rayleigh scattering. Other natural sources, such as volcanoes, wind-blown dust, smoke from wildfires, and emissions from trees and plants also cause visibility impacts by scattering and absorbing sunlight. Human activities, from industrial manufacturing to farming, also impair visibility. Visibility varies depending on natural effects (including weather) and their interactions with human-caused emissions.

Note: All of the figures which follow in this section have been generated using the Commission's Integrated Assessment System (IAS). These figures all include future projections. Projections for 2040 are less reliable than projections for 2000.

Figure II-6 shows the relative visibility impairment from natural and human causes at four Class I areas on the Colorado Plateau: Hopi Point, Mesa Verde, Bryce Canyon, and Canyonlands. Values are shown as an annual average beginning in 1990 and continuing to 2040, and also as an average for the 20% of days during the year when visibility is worst. Visibility impairment or light extinction caused by light scattering and absorption that impairs visibility is stated in "inverse megameters," represented as "Mm^{-1}." Figure II-6 shows that natural causes account for approximately 15 Mm^{-1} to 17 Mm^{-1} of visibility impairment at these four areas on average. The remaining visibility impairment at each area is caused by human activities. This portion of total visibility impairment is considered manageable by the Commission, and is the focus for its recommendations.

For ease of comparison, light extinction can be converted to the theoretical distance at which a human eye could see a large dark horizon feature, such as a tree-covered mountain. As extinction increases, the distance one can see decreases. For example, if there is only blue sky or Rayleigh scattering (10 Mm^{-1}), one could theoretically see a horizon feature 245 miles distant. If light extinction is doubled to 20 Mm^{-1} due to natural and/or human caused aerosols, visibility would be reduced to about 120 miles.

Figure II-2

Figure II-2 shows annual average light extinction for one Class I area: Hopi Point in Grand Canyon National Park for 1990, 2000, 2010, and 2040. The dark portion of each vertical bar is the portion of light extinction caused by Rayleigh scattering or blue sky. This totals approximately 10 Mm^{-1}. The remaining portion of light extinction is caused by natural and human-caused aerosols. This total ranges from 24 Mm^{-1} to 25 Mm^{-1}. The corresponding

distance for visibility is only about 90 miles. Figure II-2 shows that natural and human-caused particles account for the majority of light extinction at Hopi Point.

Figure II-3

Figure II-3 shows the relative contributions of natural and human-caused particles to visibility impairment at Hopi Point. For a complete discussion of the development of the data underlying these figures, please refer to the GCVTC Report, *Options for Western Vistas*. Note that the sources identified have not been distinguished by location. Specifically, the relative contribution to visibility impairment from "local" versus "regional" sources has not been identified. Natural particles account for approximately 5.4 Mm^{-1} of light extinction on an annual average basis from 1990 through 2040. Human-caused particles are responsible for approximately 9 Mm^{-1} of light extinction at Hopi Point, roughly double the amount caused by natural particles. In terms of visible distance, human-caused particles reduce visibility at Hopi Point by about 66 miles on an annual average basis.

Figure II-4

Using its emissions inventory and other data, the Commission has identified the major sources of human-caused light extinction at Hopi Point. This information is shown in Figure II-4 for the period 1990 to 2040, on an annual average basis. Each source of emissions is listed on the right side of Figure II-4, along with its corresponding pattern shown in the vertical bars. Figure II-4 shows that light extinction caused by emissions from utilities is projected to decline by approximately 1 Mm^{-1}. This decline is due to emissions reductions. Light extinction caused by mobile sources is projected to decline until approximately 2005, and then increase through 2040. The same is true for road dust. However, as noted on page 46, there is considerable uncertainty surrounding the predictions about road dust.

Figure II-5

Visibility varies from day to day at Class I sites on the Colorado Plateau. Figure II-5 shows the relative contributions of different human-caused particles to light extinction on the 20% of "worst" days at Hopi Point.

A comparison of Figure II-5 with Figure II-4 indicates that there is approximately 60% more light extinction caused by human sources on the average of "worst" days (approximately 17 Mm^{-1}) than the annual average (approximately 9 Mm^{-1}).

Figure II-6 (4 pages)

Figure II-6 compares light extinction from natural and human causes at four Class I areas on the Colorado Plateau: Hopi Point, Mesa Verde, Bryce Canyon, and Canyonlands. Values are shown as an annual average beginning in 1990 and continuing to 2040, and also as an average for the 20% of days during the year (71 days) when visibility is worst. On each graph, the bottom layer represents Rayleigh scattering and other natural causes of light extinction. The additional layers represent light extinction caused by various human sources: stationary, area, mobile, and Mexico. The scale on the right of each graph shows visibility in distance.

Figure II-6 shows that natural causes account for approximately 15 Mm^{-1} to 17 Mm^{-1} of visibility impairment at these four areas on average. The remaining visibility impairment at each area is caused by humans. This portion of total visibility impairment is considered manageable by the Commission, and is the focus for its recommendations.

THE BASELINE FORECAST SCENARIO, BASED ON CURRENT LAW

The Commission needed a way to evaluate how its recommendations would affect visibility beyond current law and programs, and developed a baseline or "current law" scenario to meet that need. The Commission refers to this scenario as the Baseline Forecast Scenario (BFS).

The Baseline Forecast Scenario is the best possible estimate of future visibility impairment at Class I areas on the Colorado Plateau, assuming current law is enforced, with no additional actions to protect visibility.

The Baseline Forecast Scenario is built on the following assumptions:

- Emissions growth or decline is based on changes in economic demand in the region
- Sources retire at a specific age
- New sources are a mixture of new technology and assumed control levels
- State Implementation Plans under the Clean Air Act for attainment by 2010 are included, and emissions growth is permitted after that time based on economic growth
- There is no growth in unpaved road dust beyond 1990
- Emissions from Mexico are held constant

Because visibility is highly variable, the Baseline Forecast Scenario analyzes the average of the "best" and "worst" 20% of days, as well as annual averages.

Projected Baseline Annual Average Total Extinction at Hopi Point

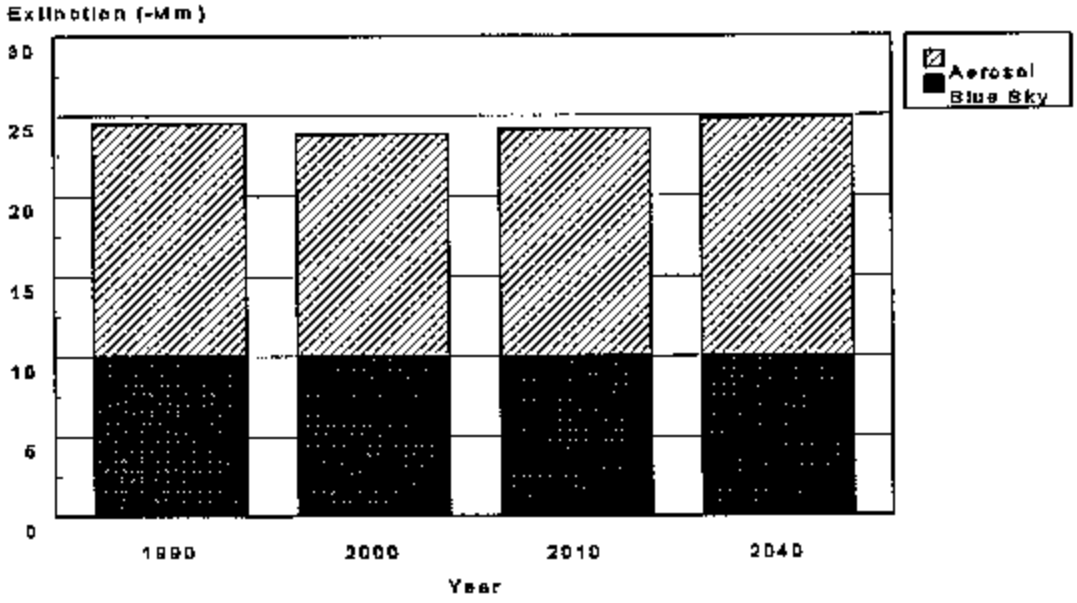


Figure II-2

Total extinction includes aerosol particles and gaseous extinction due to the atmosphere. The gaseous extinction is "blue sky." The aerosol portion is made up of both human-caused and natural aerosols (see Figure II-3).

Projected Annual Average Aerosol Extinction at Hopi Point

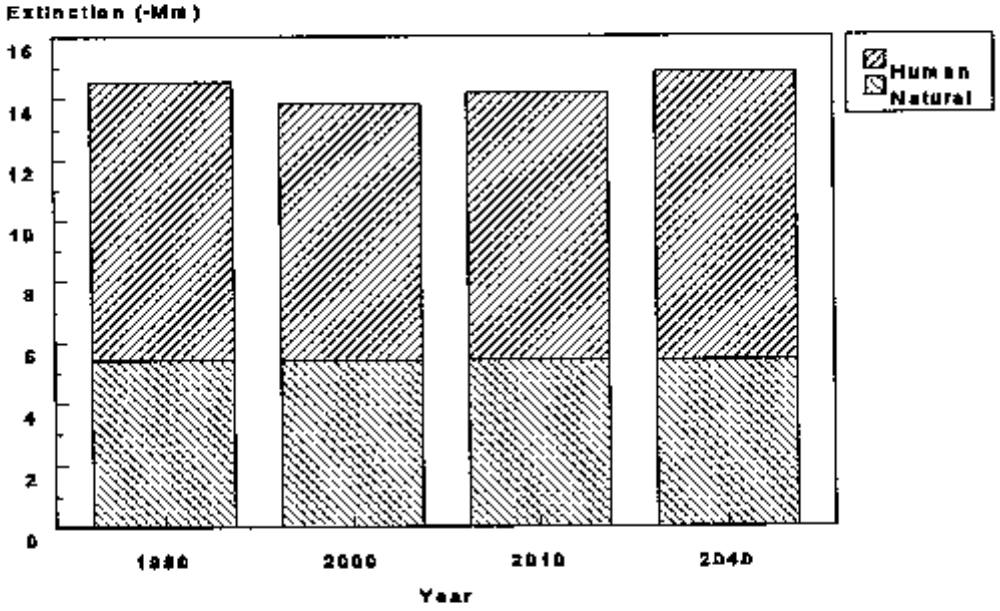


Figure II-3

The total aerosol extinction is made up partly of natural aerosols and partly of human-caused aerosols.

Note: Fires are estimated in this graph as part of aerosol natural background.

Projected Human-Caused Extinction on Annual Average at Hopi Point

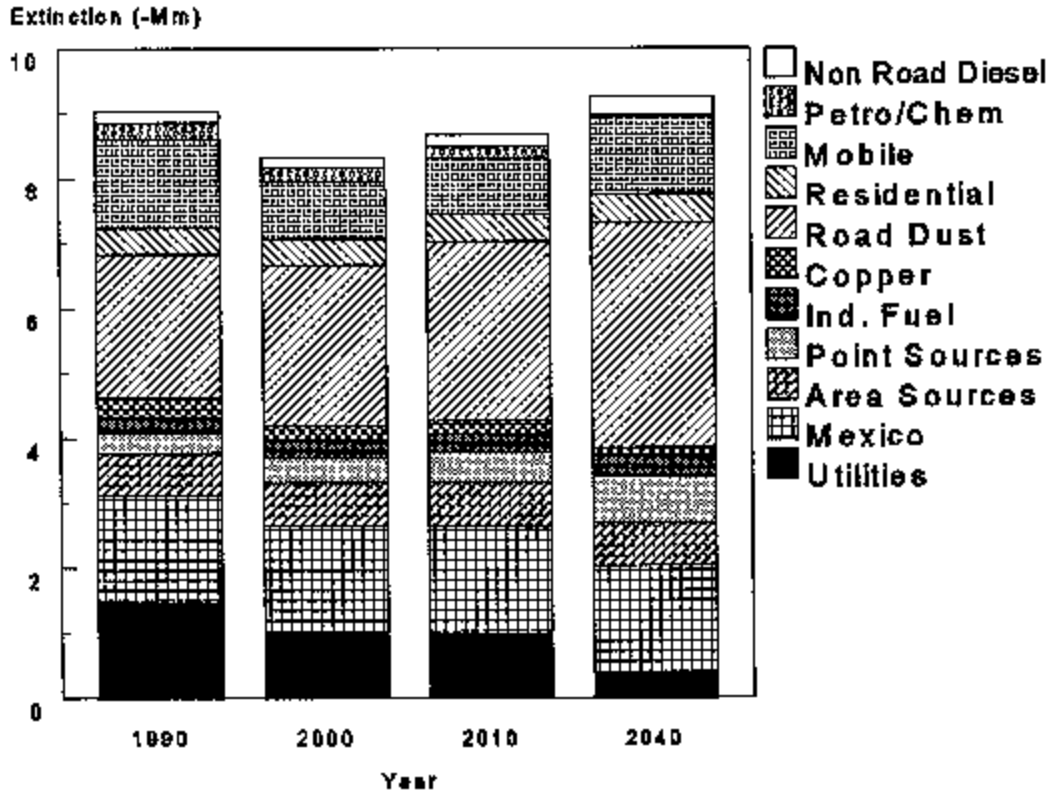


Figure II-4

Breakdown of sources of pollutants contributing to human-caused extinction.

Note: Emissions for Mexico were held constant at 1990 levels in these projections, due to lack of reliable projections of growth or decline in emissions.

Projected Human-Activity Caused Extinction on Worst Days at Hopi Point

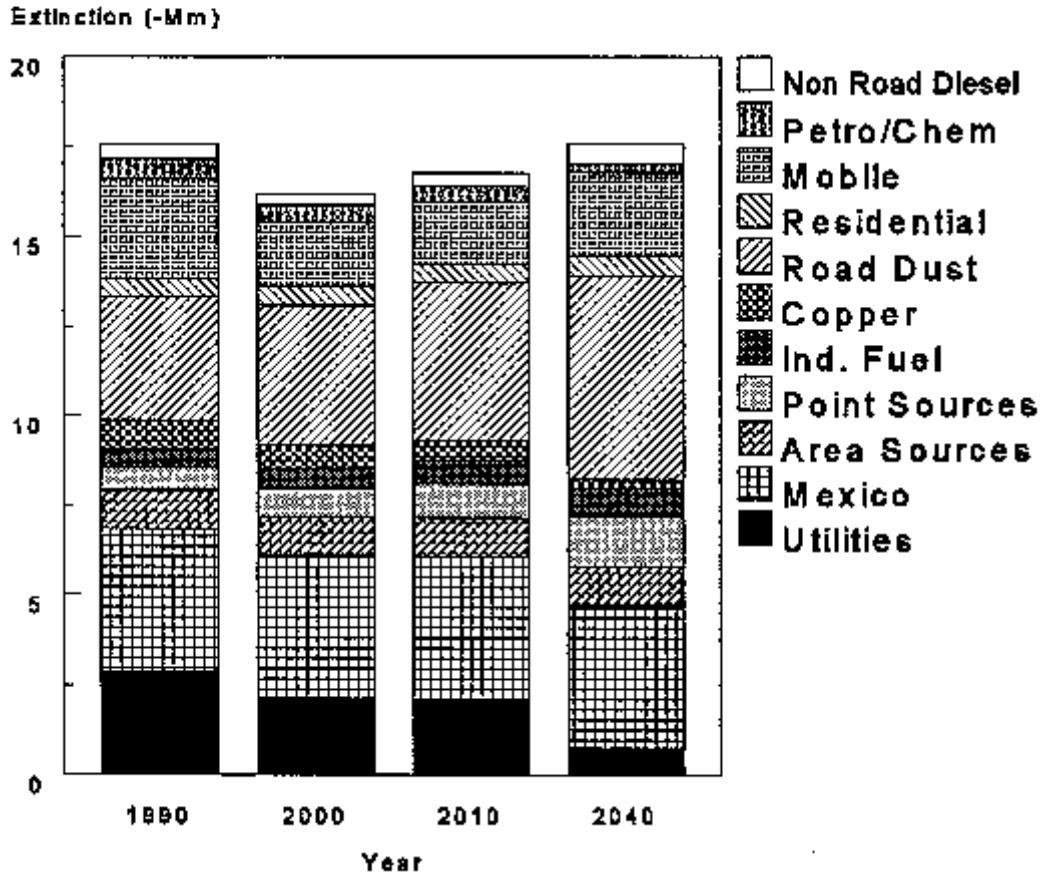


Figure II-5

Breakdown of sources of human-caused pollutants on the worst visibility days.

Note: Emissions for Mexico were held constant at 1990 levels in these projections, due to lack of reliable projections of growth or decline in emissions.

Projected Baseline Hopi Point Extinction

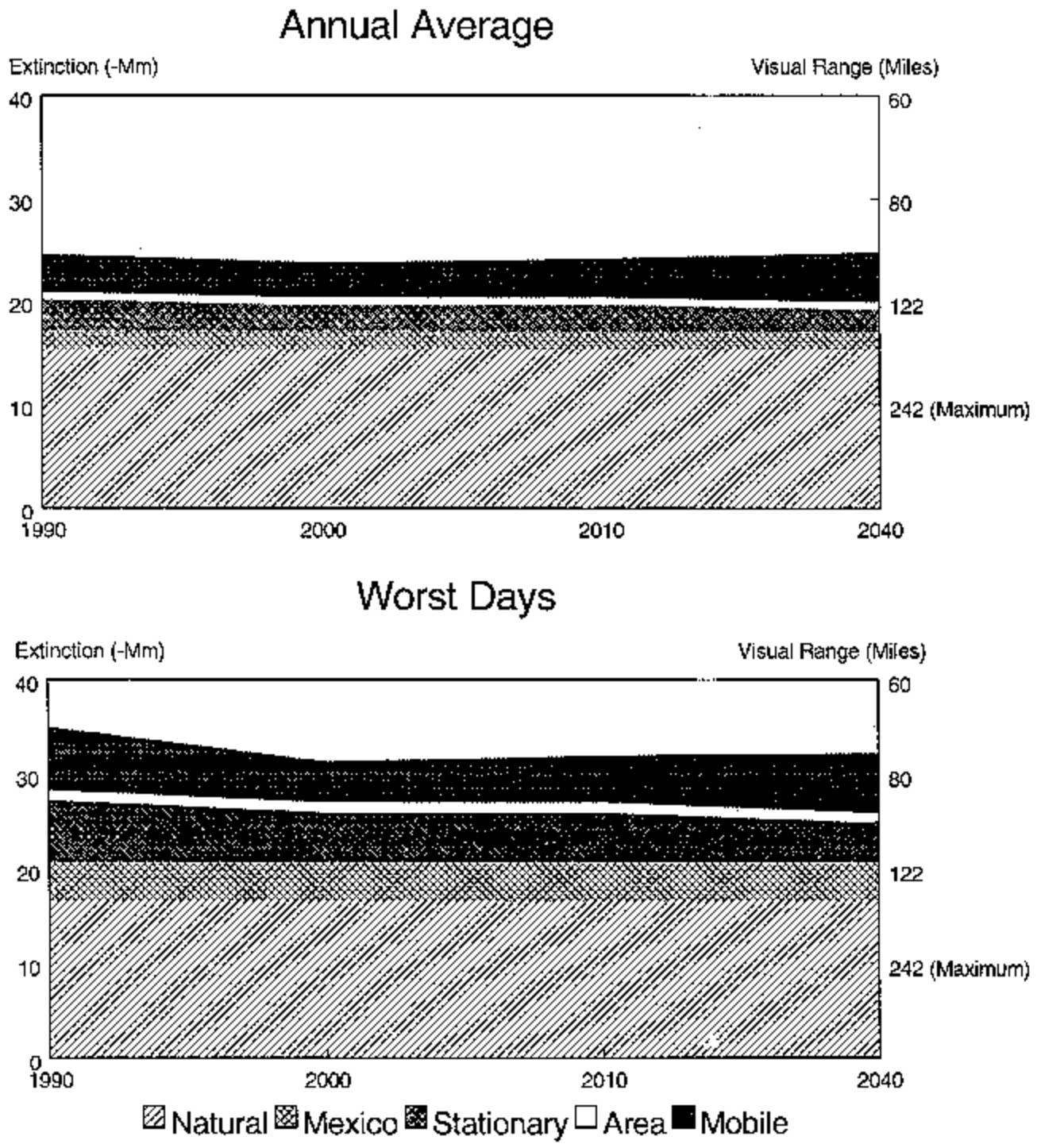


Figure II-6

Projected Baseline Canyonlands Extinction

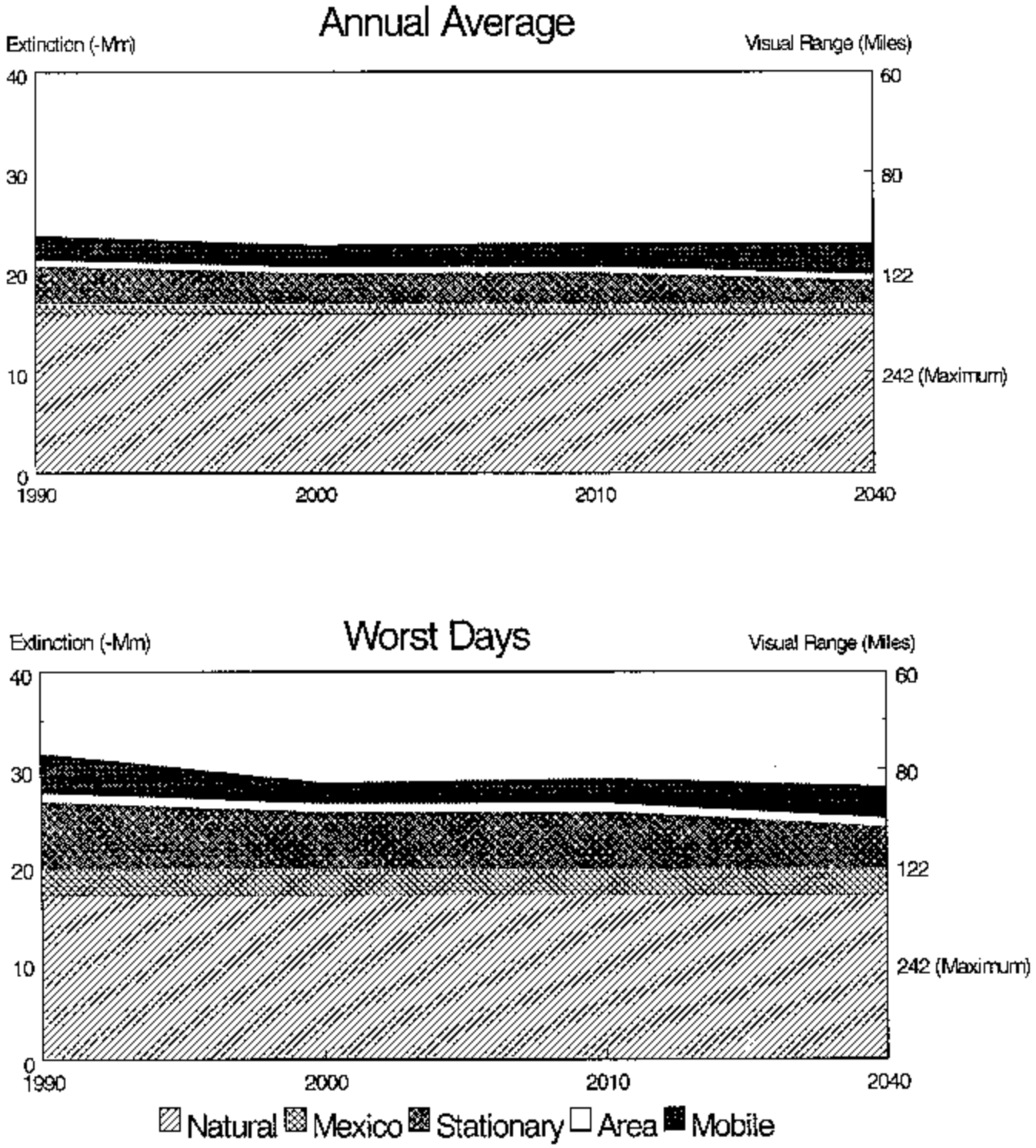


Figure II-6

Projected Baseline Bryce Canyon Extinction

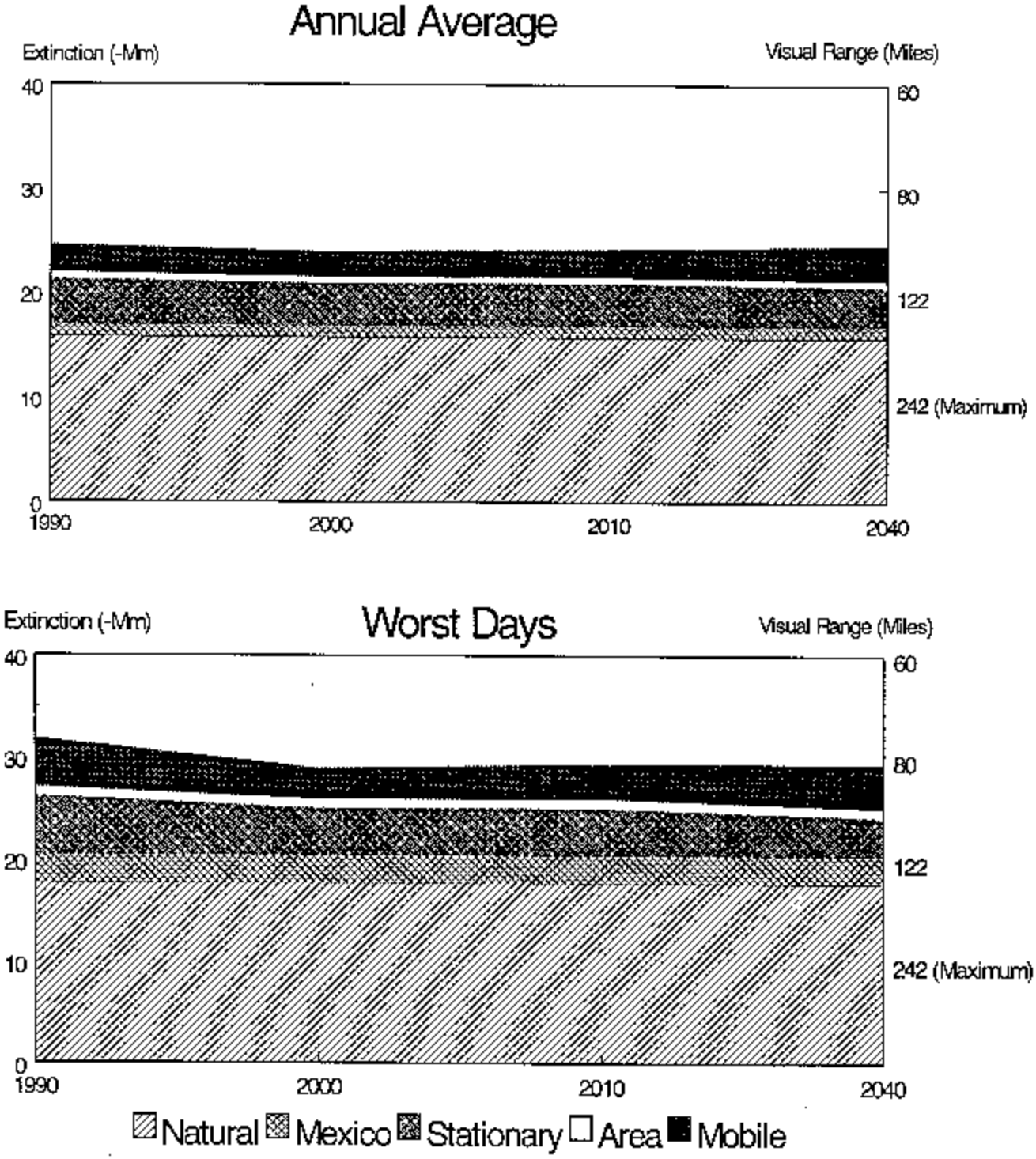


Figure II-6

Projected Baseline Mesa Verde Extinction

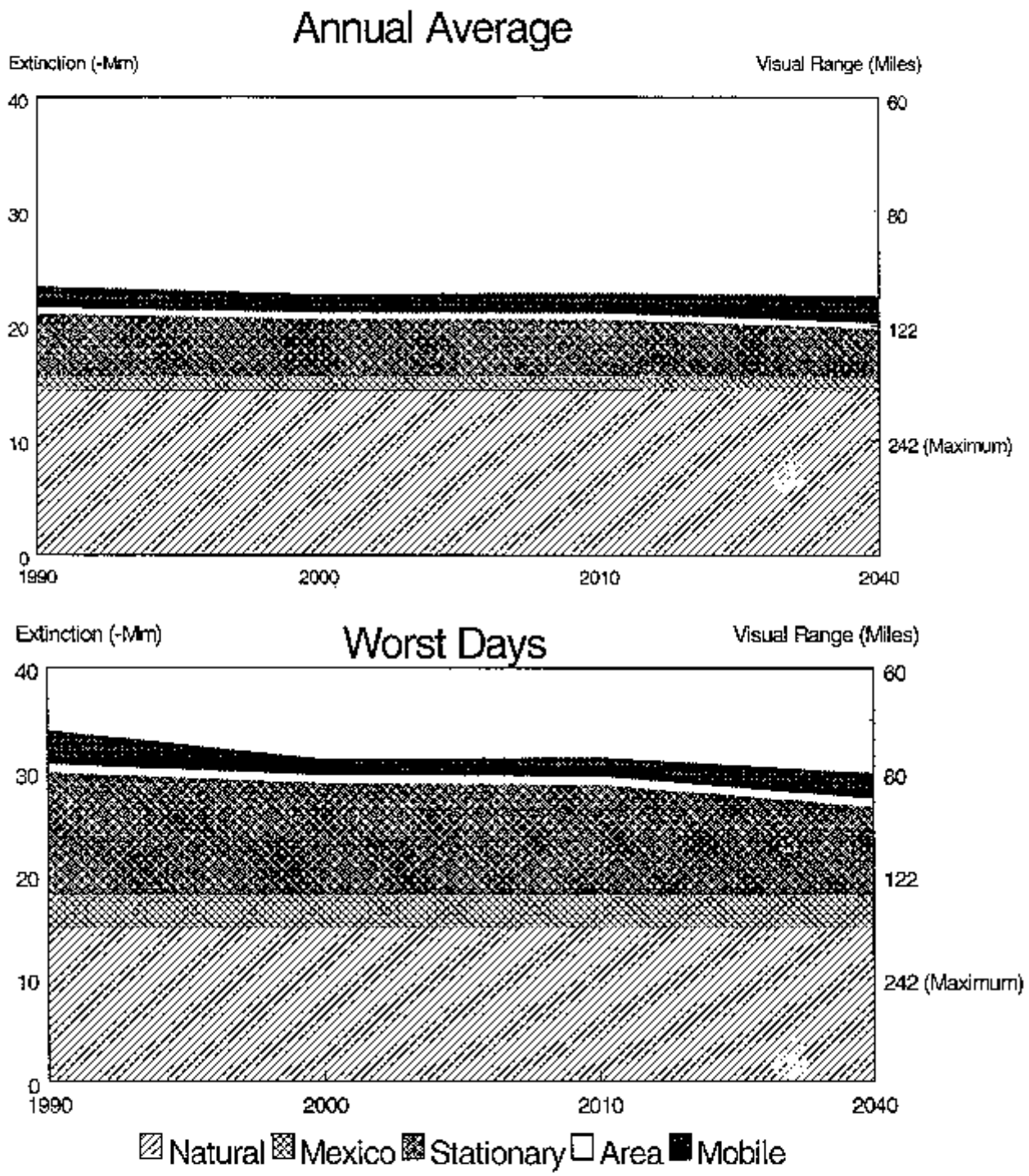
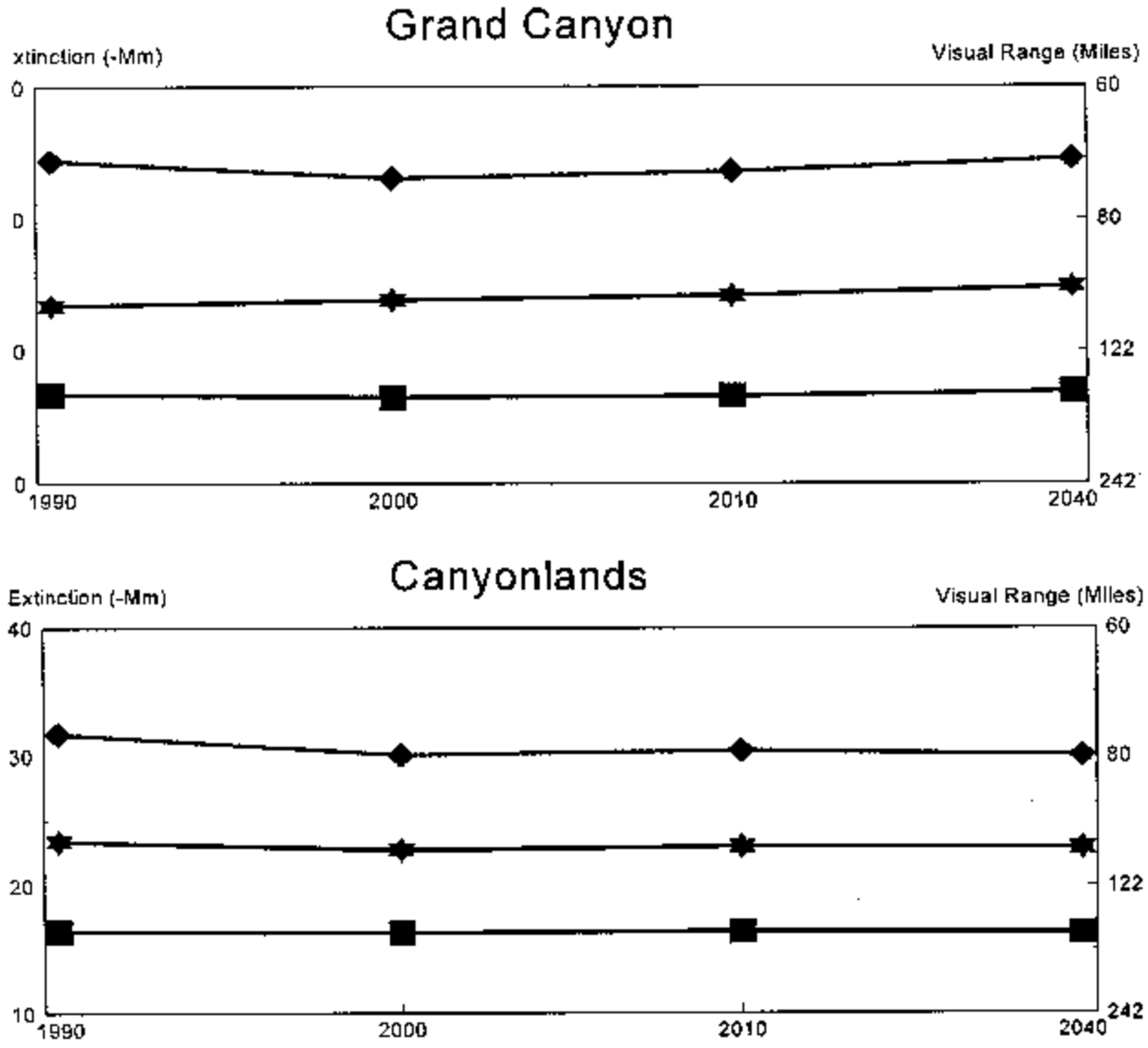


Figure II-6

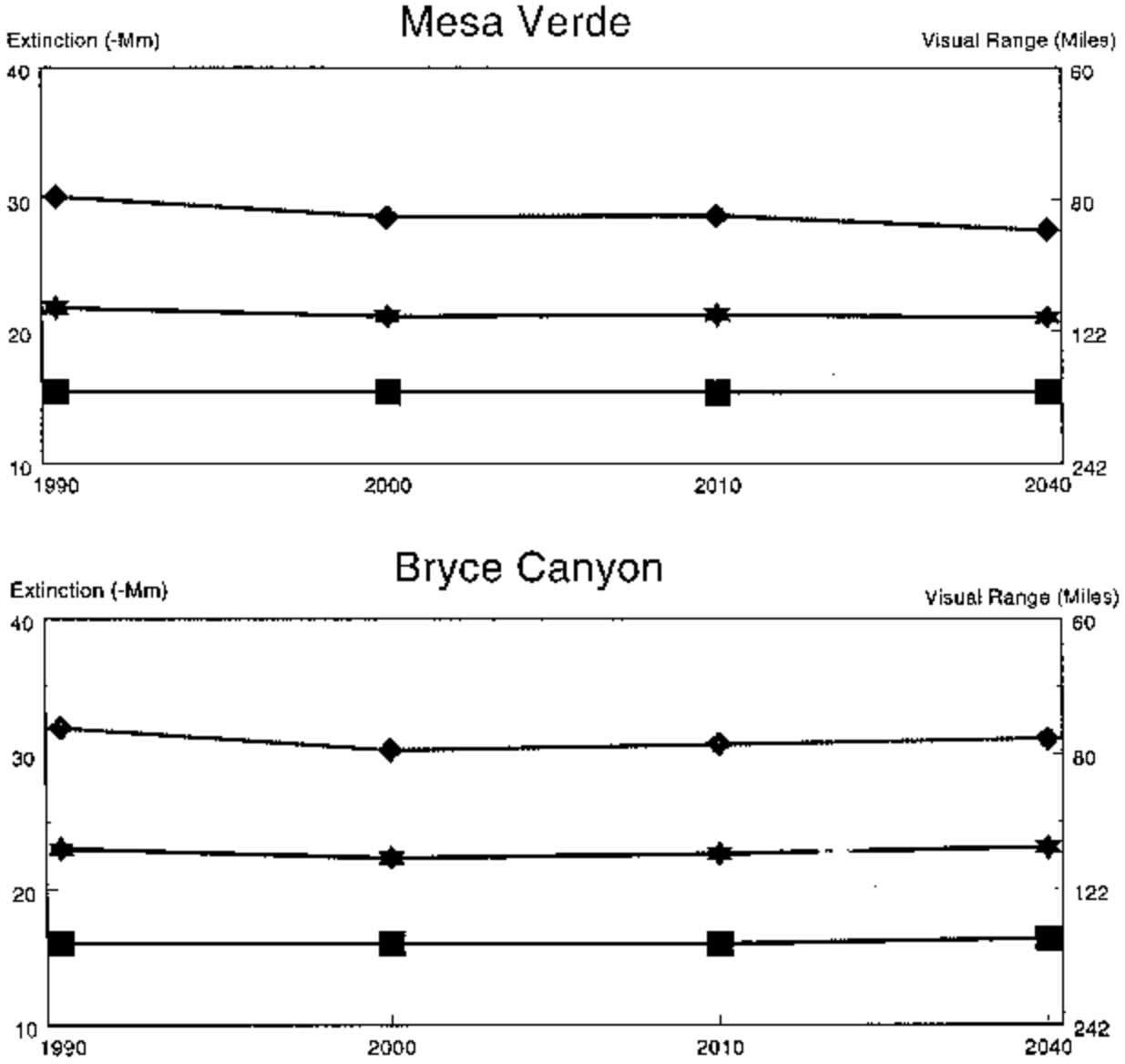
Projected Baseline Visibility



Graph starts at 10-Mm Which is Blue Sky or Rayleigh Extinction.

Figure II-7

Projected Baseline Visibility



Graph starts at 10-Mm Which is Blue Sky or Rayleigh Extinction.

Figure II-7

Figure II-7

Figure II-7 shows current and predicted visibility impairment through 2040 under the Baseline Forecast Scenario at the same four Class I areas discussed above: Hopi Point, Mesa Verde, Bryce Canyon, and Canyonlands. For each of the four areas, the top line shows visibility on the "worst" days, the middle line shows the annual average visibility; and the bottom line shows visibility on the "best" days.

Figure II-7 shows the wide difference in air quality on the "best" and "worst" days. There is virtually no human-caused impairment on the "best" days at these four parks through 2040. On the "worst" days, visibility impairment is more than doubled, and most of that increase is caused by human sources. This is particularly significant because the human eye is more sensitive to changes in the "worst" visibility conditions than the "best" conditions.

PAC INTERACTIONS IN DEVELOPING CONSENSUS RECOMMENDATIONS

Members of the PAC represented diverse interests from throughout the West. Given the divergent perspectives and concrete interests, the struggle to consensus was difficult at times, but PAC members maintained a cordial atmosphere of collaboration in their search for good policy. The resulting policy recommendations do not represent what any one group would have advocated on its own. The recommendations embody concessions, compromises and creative solutions which all members of the PAC support.

The PAC assisted in gathering public input at different phases of this process to refine emission management options and evaluation criteria. In November 1995, the PAC received a contractor's report entitled *Options for Improving Western Vistas*. That report summarized the work of the Commission's committees to that point and discussed the results of Integrated Assessment System modeling. Based on that report and other technical information, and with continuing input from the Commission's committees and the general public, the PAC developed consensus recommendations for consideration by the Commission. It should be noted that there is a significant divergence among the scenarios analyzed in the technical assessment process and the recommendations included herein. To the extent that the recommendations diverge from the Commission's analyses, they reflect the input from the public and deliberations of the PAC.

The Commission sought broad public input to develop its emission management options and evaluation criteria. Beginning in April 1993 and continuing until November 1995, the Commission held several series of public workshops and meetings across the Transport Region to provide information and receive feedback. Public comments were discussed at PAC meetings and incorporated into the PAC's recommendations to the Commission.

CRITERIA FOR ASSESSMENT OF EMISSIONS MANAGEMENT OPTIONS

The Commission developed six criteria for assessing different emission management strategies:

1. effectiveness in achieving visibility goals
2. economic effects
3. social effects
4. environmental effects in addition to visibility
5. equity, and
6. administrative ease and effectiveness

The purpose of these criteria is to ensure that all significant impacts of different emission management strategies are considered in making recommendations for the future.

Most of the available scientific and technical information—emissions budgets, emission management options, scenarios, criteria, and transfer coefficients—is brought together in the Integrated Assessment System (IAS). The Commission's goal in designing the IAS was to enable a user to select different combinations of emission reduction strategies applied to sources within the Transport Region to yield desired visibility conditions at any one of sixteen Class I sites on the Colorado Plateau over the next forty years (2000, 2010, 2020, 2030, and 2040). Development of the IAS was a major task, and work continues to expand its capabilities. Most of the modeling output to date is based on visibility at a single Class I site, Hopi Point in Grand Canyon National Park.

TECHNICAL FOUNDATION FOR THE COMMISSION'S RECOMMENDATIONS

Introduction

In order to fulfill its mandate, the Commission needed a reliable picture of the impacts of regional haze on visibility at sixteen Class I areas on the Colorado Plateau, and a way to assess the changes in visibility and costs associated with different options for managing emissions. Meeting these needs was not simply a matter of gathering existing data and running it through a basic computer model. The Commission needed new information and new analytical tools, and its technical committees and outside consultants have done groundbreaking work to meet these needs in only a few years. This work has significantly improved understanding of visibility impairment in the Transport Region, and provides the technical foundation for the Commission's recommendations.

It is important to understand that this technical work, while representing a significant advance in knowledge, is not yet complete. The large size and complex terrain of the Transport Region, the time, funding, and other resources available for work, significant data gaps, and the amount of information that could be modeled with current technology were important limiting factors. As a result, the Commission's technical data and findings, discussed below, are characterized by varying degrees of uncertainty. In particular, the modeling has, to date, given a limited picture of the regional, and particularly sub-regional, including tribal, dynamics of both emissions and economics. Nevertheless, the Commission has sufficient confidence in its overall understanding of the causes of regional haze and its effects on visibility to make the recommendations presented in Section III.

Important Technical Data Findings

The following are some of the results and technical findings from the Commission's work to date which form a basis for policy recommendations.

- **The most comprehensive inventory to date of emissions across the Transport Region.** The Commission gathered 1990 data from a variety of sources to create the most comprehensive inventory yet of emissions for the Transport Region. This inventory is the cornerstone for most emissions forecasting by the Integrated Assessment System model.

- **The Commission's current modeling shows improvements in visibility, under existing regulations and programs, through the year 2000.** After that, predicted gains in visibility are offset by increases in economic activity related to population increases.

- **Regional phenomena can contribute to visibility impairment.** The Commission's air quality monitoring data and modeling show that a part of the haze problem can be caused by long-range transport of emissions. Visibility at Class I sites on the Colorado Plateau is affected by pollutants that have travelled long distances, i.e., more than approximately 100 miles. These pollutants often cross the boundaries of several states within the Transport Region. Some centrally located emission sources are frequent contributors to visibility impairment at multiple receptor sites across the Transport Region, regardless of wind direction. In addition, Clean Air Corridors are a regional phenomenon of clear air transport from low emission areas located to the north.

- **There is also a local aspect to the haze problem on the Colorado Plateau.** Emissions from sources located roughly under 100 miles away can affect visibility at Class I sites. These local-source emissions are less diluted than emissions that travel long distances. The Commission has an improved understanding of the conditions that lead to local source impacts on visibility. For example, local emissions can build up during windless periods, and are subject to being trapped above low-lying terrain during temperature inversions. Also, urban areas (Las Vegas and Salt Lake City) have been studied and may have significant[3] impacts on visibility at the Grand Canyon and Canyonlands, respectively.

[3] In numerous places, this report refers to "significant" contributions to visibility impairment and "significant" decreases or increases in emissions, but "significant" is not defined. "Significant" will be defined in the context of developing implementation plans with full participation by the affected parties.

The Commission's current analyses suggest that visibility impairment caused by local sources may be much greater than predicted by prior studies. If correct, these new analyses have significant implications for reducing current visibility impairment. In light of their conflict with prior studies, the Commission's results should be treated with caution. Years of technical work may be necessary before the relative visibility impacts of local sources can be confirmed.

- **The relative visibility effects of regional and local emissions are variable, but local emissions have a greater impact per ton emitted.** Seasons, weather conditions, and terrain elevations influence the relative visibility impacts of regional and local emissions. Both emission types contribute to visibility impairment much of the year, and either type can be the dominant cause of impairment on any particular day regardless of the season or the location of a receptor. There is little doubt, however, that local emissions have a greater visibility impact per ton emitted than emissions from distant sources.

- **Wildfire and prescribed fire play an important role in visibility on the Colorado Plateau.** During coming years, land managers are projecting significant increases in prescribed fire in order to reduce the effects of wildfire resulting from past decades of fire suppression. Therefore, prescribed fire has the potential for outweighing visibility improvements on an episodic basis.

- **Emissions from Mexico are significant and growing, particularly contributing to the SO_2 emission budget.** Without control strategies for Mexican sources, they will have continuing and growing adverse visibility effects.

- **Visibility effects are a combination of emissions and meteorology and other uncontrollable factors, such as wildfire.** Meteorology and wildfire can vary significantly from year to year. Therefore, in assessing the visibility gains from an emissions management strategy, measurements of visibility from any one year may not show improvements. Data trends from multiple years are needed. In the short term, gains or losses in visibility may be better represented by the emissions inventory than from monitoring data at Class I sites.

- **Source areas with large transfer coefficients merit particular attention.** The Commission developed transfer coefficients for 95 source areas across the Transport Region as a tool to model changes in visibility. In the simplest sense, each source area's transfer coefficients represent the mathematical relationship between emissions in that source area and aerosol concentrations at a specific Class I receptor. The Integrated Assessment System model indicates that emissions reductions will yield the greatest visibility improvements if they occur in source areas having "large" transfer coefficients and large emissions. Source areas having large transfer coefficients but low emissions merit increased attention in emissions planning. Finally, for any specific reduction in emissions, source areas with large transfer coefficients will yield the largest improvements in visibility at Class I sites.

Summary of Data and Model Limitations

The Commission's technical models are designed primarily to assess the regional impacts of pollutant transport, i.e., to give a picture of how pollutants travel across the nine-state Transport Region. The meteorological and air quality models simulate regional scale phenomena—such as wind—reasonably well. The models are best at demonstrating the relative effects of regional emissions on visibility. As a result, the Commission has a reliable understanding of the relative significance of most regional sources. For example, information shows that Southern California is the largest regional source of visibility-impairing particles in the Transport Region.

Because the Integrated Assessment System models were designed with a regional transport focus, they offer only limited insights into (1) the absolute contributions to visibility impairment from "local" sources located under approximately 100 miles of Class I sites, and (2) the visibility impacts of local sources relative to regional sources. The Integrated Assessment System permits qualitative understanding of local source influences, but does not permit quantitative understanding. In particular, the Integrated Assessment System model is not designed to be used for local source attribution. Accordingly, further study on local sources should be undertaken prior to enactment of recommendations for emissions controls on specific local sources.

There are several reasons for the limitations in the Integrated Assessment System model concerning local source impacts on visibility.

- Most of the modeling was done using coarse grid cells measuring thirty miles on each side. Modeling the transport and dispersion of pollutants between adjacent cells did not reflect the actual physics of such activity. The Commission used a fine grid (six mile) for several major sources for a limited period of the modeled year. While this approach should improve the model's performance, data and time limitations made it impractical as a substitute for all of the coarse-grid analysis.

- While the Commission's model reliably simulates the effects of meteorological factors on pollutant transport, it does not simulate effects caused by "smaller" terrain features such as the Grand Canyon.

- The model's projected visibility impacts are scaled to reflect actual measurements. This means that an inaccurate projection of local influence on visibility causes a distortion of the regional influence.

- The model's projections of pollutant concentrations at Class I areas are generally in the form of seasonal and annual averages, and the 20% best and worst days. Day-to-day variations in pollutant concentrations are not projected. This is a significant limitation because visibility changes are instantaneous, occurring within hours depending on meteorology.

- In addition, uncertainties in the emission inventory, meteorology, atmospheric chemistry and transport modeling methods, and background assumptions contribute to uncertainties in the modeled relative contributions of sources in the region. Although these have not been quantified, they could have a significant effect on the model results.

One other important limitation involves the number of receptors where pollution data were available. The Commission collected data from only six receptors, and ultimately scaled its modeling for only four of these: Hopi Point, Mesa Verde, Canyonlands, and Bryce Canyon. The most detailed information came from one receptor, Hopi Point in Grand Canyon National Park. As a result, the Commission has a reliable understanding of visibility impacts at Hopi Point. However, this single receptor does not provide a comprehensive picture for the entire Grand Canyon, let alone the other 15 Class I sites on the Colorado Plateau.

Even with these limitations, however, the Commission's models and its technical data and findings provide an adequate foundation for the recommendations presented in the next section.

SECTION III: EMISSIONS MANAGEMENT RECOMMENDATIONS

GUIDING PRINCIPLES

In developing the set of recommendations that follow, the Commission has been guided by several general principles.

Achieve Reasonable Progress Toward the National Visibility Goal

The overall goal of the Commission's recommendations is to improve visibility on the worst days and to preserve existing visibility on the best days, at Class I areas on the Colorado Plateau. Reasonable progress towards the national visibility goal is achieving continuous emission reductions necessary to reduce existing impairment and attain steady improvement of visibility in mandatory Class I areas and managing emissions growth so as to prevent perceptible degradation of clean air days.

Address All Important Sources of Visibility Impairing Emissions

The recommendations are designed to address all important sources of visibility impairing emissions.

Apply Emissions Control Measures Equitably

The Commission has sought to distribute the burden of improving visibility in an equitable manner. No single source or geographic region should be unfairly required to bear costs or limit expansion while others are not. The Commission recognizes that equity considerations require that past emissions reductions, current levels of control, technical feasibility, cost of controls, the time necessary for compliance, the energy and non-air quality environmental impacts, the remaining useful life of existing emissions sources, and other relevant equity factors must be considered in achieving reasonable progress.

Prevent Future Visibility Impairment by Protecting Clear Days

Key strategies, imbedded in many of the recommendations, are aimed at protecting the present sources of clear days at Class I sites on the Colorado Plateau.

Remedy Existing Impairment by Reducing Present Levels of Emissions

Present emissions that cause visibility impairment must be reduced significantly in order to improve visibility.

Take a Regional Approach

Strategies for both preventing future impairment and remedying existing impairment demand regional approaches that can be applied, in a coordinated manner, by tribes, states, and federal authorities throughout the Transport Region. Such strategies should be developed in concert with existing cooperative efforts to assess and manage air quality within the region.

Assume that Existing Federal, Tribal and State Laws Will Remain in Force

The recommendations assume that state, tribal and federal air quality laws, programs, and regulations will remain in force for the foreseeable future.

Consider Costs and Benefits of Emission Control Measures

The Commission has been guided in most cases by estimates of the costs and improvements to visibility associated with various strategies for controlling emissions.

Develop Action Plans for All Recommendations

The responsible entities should develop detailed plans for implementing Commission recommendations.

Provide Funding

Specific funding sources should be identified for implementing the Commission's recommendations.

Consider Social, Cultural and Environmental Factors

In analyzing the potential impacts of recommendations, social, cultural and environmental costs and benefits should be considered.

Note: For tribal perspectives and commentary on the recommendations in this Section, see Section IV.

AIR POLLUTION PREVENTION

Background: Pollution Prevention as Key to Protection of Western Vistas

The spectacular scenery of national parks and wilderness area on the Colorado Plateau is an important part of our Nation's natural heritage. We have a legal and moral obligation to protect this national resource for future generations. Visibility in this region is extremely sensitive to even small increases and decreases in air pollution.

As the population and economy of the West grow, the only way to prevent further degradation of this national resource—as well as the air we share generally throughout the West—is to combine cost-effective pollution control strategies with a greater emphasis on air pollution prevention, including low or zero emissions technologies and energy conservation. Because so much of the Transport Region is relatively undeveloped, including tribal lands, regional stakeholders have the opportunity to take a proactive approach to pollution prevention. In fact, given expected growth in the Transport Region, it provides an excellent place to experiment with an incentive-based approach to managing not only air quality but other environmental effects of growth.

As demand for more power increases, and the region's power production base evolves, there is a tremendous opportunity to realize substantial benefits from energy efficiency, as well as to integrate cleaner, sustainable energy technologies into all aspects of our society. The West enjoys high potential for renewable energy production, especially electrical energy generation employing solar and wind power. The relative cost of renewables is declining over time. Based on forecasts of electrical energy consumption in the Transport Region by the Western Systems Coordinating Council, renewables could supply 18,000 gigawatt hours of energy annually by 2002. Others have suggested that this potential could be much higher (approaching 50,000 gigawatt hours annually) from renewables (geothermal, solar and wind) by 2002. These latter targets would still only comprise approximately 10% of region-wide power consumption. A recent study by the Land and Water Fund of the Rockies (*How the West Can Win*, 1996) suggests that renewable energy could comprise 19% of regional power needs, by adding additional capacity by 2015. The study also concludes that as much as 40% of projected power needs in 2015 could be met by improved energy efficiency alone..

Based on estimates of renewable energy potential, achieving the above goals for renewables and efficiency could result in substantial emissions reductions, which could translate into visibility improvements, as well as secondary environmental and economic benefits. Although the Commission did not have the resources necessary to model or completely quantify the effects of its recommendations in this area, it is convinced that, if implemented, they have the potential to become some of the most successful and cost-effective contributions to improved visibility.

Hastening the utilization of renewables requires new and increased investments, assisted by economic incentives. Huge economic and environmental benefits from improving energy

efficiency gains are also possible with adequate commitment and investment, since investment in energy efficiency is the most cost-effective resource option.

RECOMMENDATIONS REGARDING AIR POLLUTION PREVENTION

1. Place a high priority on pollution prevention.

Supporting pollution prevention, education about pollution prevention, and innovative ways of reducing per capita pollution is one of the Commission's highest priorities.

2. Model the effects of renewable energy and pollution prevention.

Potential emissions reductions, visibility improvements, cost savings, and secondary benefits associated with renewables, energy efficiency, and pollution prevention should be part of future modeling work.

3. Develop economic incentives for pollution prevention efforts.

Economic incentives are a powerful tool for effecting change. The Commission supports creation of incentives that encourage low-emission industries to locate in the Transport Region, retooling of industries to reduce emissions and increase their efficient use of energy, the development of energy production based on renewable resources, and providing consumers with opportunities to reduce their individual contributions to air pollution. The Commission recommends that federal power management suppliers be given incentives to increase renewable energy generation and pollution prevention actions, and that public utility commissions continue to influence retail power markets to encourage efficiency and investments in renewables.

4. Encourage zero and near-zero emitting technologies.

The Commission encourages zero and near-zero emitting technologies through incentives, education and information exchange, such as a clearinghouse. Opportunities should be explored to promote economic development and job creation through the development and deployment of such technologies.

5. Provide incentives for actions beyond compliance.

Incentives should also be provided to reward efforts that go beyond compliance and/or achieve early compliance with air pollution-related requirements.

6. Consider charging emission fees.

A variety of market approaches should be analyzed. Emission fees could be charged for pollution emitted into the air to encourage people and industry to reduce pollution in the most efficient manner possible. Revenues could be used to substitute for taxes on property or income or to provide financial assistance to those industries

or communities wishing to implement pollution prevention projects. Emission fee caps that exist in some states should be analyzed.

7. Support development of renewable energy sources.

The Commission promotes the transition to power production based on renewable resources such as wind, solar, biomass, and geothermal resources and supports the establishment and tracking of annual goals for increases in renewable power generation in the Transport Region that fosters the sustained, orderly development of renewables in the region. Specific areas should be identified where renewables have the potential to supply power where it is now lacking and where renewables are most cost-effective. Encouraging development of renewables has particularly high potential for tribal lands (see page 69). The goal of the states in the Transport Region should be to achieve annual additions in order that renewables will comprise 10% of the regional power needs by 2005 and 20% by 2015.

Progress towards this goal should be evaluated every five years, in conjunction with regular reviews of emissions reductions and progress toward the national visibility goal. Incentives provided by tribal, state and federal governments may be necessary to achieve this goal. In the interests of equity, the Commission recommends that spending and investment in energy research and development should be equalized among fossil fuel-based and renewable energy programs. The EPA should coordinate with the Department of Energy to achieve funding for the range of pollution prevention programs authorized by the Energy Policy Act and administered by the Department of Energy's Center of Excellence for Sustainable Development. All new power generation projects should include a percentage of renewables associated with them, in order to help achieve regional renewable energy portfolio goals.

8. Promote energy conservation.

The Commission supports the continued development and implementation of national energy efficiency standards for motors, appliances and lighting and recommends the national adoption of California energy efficiency standards. The Commission also supports the construction of energy efficient buildings, both residential and commercial, and proposes the reinstatement of incentives for building energy efficient structures similar to those in place during the early 1970s. The Commission also suggests the continuation of demand-side management programs, despite current funding restrictions. The Commission recommends that continuing attention be paid to maintaining the role of energy conservation within the changing electric power industry markets. Energy conservation programs should be preserved and expanded through such mechanisms as "system benefit charges" paid at the distribution level, rather than in the commodity electricity rate. This approach would be equitable and would not disadvantage utilities in relation to their competitors.

9. Promote education and public outreach efforts on preventing pollution.

The Commission encourages the integration of pollution-prevention and renewable energy concepts in elementary, secondary, higher and continuing education programs and in public environmental education efforts. Teaching by first-hand example, through the incorporation of energy efficient technologies at school facilities is encouraged.

10. Introduce product labeling.

The Commission recommends a market-based approach to pollution prevention and energy conservation and efficiency through "green pricing." The EPA, the Federal Energy Regulatory Commission and the states should institute labeling, on a voluntary basis at first, but potentially based on national standards, that provides consumers with information about the pollution potential, energy requirements and relative efficiency of products. Voluntary product labeling can be beneficial to businesses by providing more consumer information and improving product attractiveness in the marketplace. Such approaches could begin with a limited scope, such as providing information to consumers about the characteristics of their sources of electric power generation.

11. Promote the use of clean fuels.

The Commission also supports the regional use of cleaner-burning fuels, including reformulated gasoline and diesel and extending towards natural gas, electricity and hydrogen.

STATIONARY SOURCES

Background

Emissions from stationary sources throughout the Transport Region contribute in varying degrees to light extinction in Class I Areas. The extent to which these sources produce pollutants that impair visibility is a function of the size of the source and its location in relation to the protected areas. The GCVTC analytical work addressed three species of pollutants that are significantly produced by stationary sources: sulfates, nitrates and organic compounds. This section of the recommendations proposes a program to deal with all species, but focuses on sulfates, which are the most significant contributor to visibility impairment of the three.

Because of the significance of the role sulfates have played in the Commission's studies and analyses related to visibility, more information is available related to sulfates and their relationship to light extinction. Additionally, because SO_2, the dominant precursor to sulfates, is associated with a relatively small number of large sources, trends in emissions can be forecasted with a relatively high degree of certainty. Moreover, the Commission is aware of efforts to restructure the utility industry and should monitor its impact on regional visibility.

The stationary source proposal envisions relying on the implementation of current programs through the year 2000 before the implementation of a new regulatory program. Current programs include those mandated by the federal Clean Air Act and by states and tribes that have resulted in or are expected to result in the installation of significant emission control technologies with associated emission reductions. The Baseline Forecast Scenario conservatively estimated only a 6% reduction (13% in the Transport Region) in the emissions of sulphur dioxide (SO_2) through the year 2000. However, implementation of current programs could result in greater reductions in SO_2 emissions in the short term. In particular, a number of open issues with a bearing on the visibility problem could be resolved prior to 2000. These include the “source attribution” studies at the Centralia, Mohave and Hayden power plants, greater than expected emission reductions in the copper smelting industry, and the imposition of lower fuel sulfur standards. With these additional reductions not anticipated by the Baseline Forecast Scenario, it is estimated that actual SO_2 reductions could be closer to 20-30%.

A major component of this proposal is that, if a regulatory program is deemed necessary, it may be an incentive-based trading program (e.g., including, but not limited to, a market-trading program.) It is the intent of this recommendation that any trading program include as many source categories and species of pollutants as is feasible and technically defensible. This preference for a “comprehensive” market is based upon the expectation that a comprehensive program would be more effective at improving visibility and would yield more cost-effective emission reduction strategies for the region as a whole. However, the Commission recognizes that the inclusion of multiple pollutants and sources, as well as inter-pollutant/sector trading, raises a number of complex issues (e.g., emission inventories, validity of reductions, etc.) that would need to be addressed before multiple sources or pollutants could be included.

The Commission also recommends that any incentive program contain specific provisions to encourage and reward early emission reductions, including reductions achieved before 2000. The Commission recognizes the potential impact this will have on less-developed areas, including Indian lands. Also, the program should include incentives for emission reduction measures that go beyond pollution controls (e.g., investment in renewable energy and energy conservation measures.)

RECOMMENDATIONS REGARDING STATIONARY SOURCES

The objectives of the approach outlined below are:

- to achieve significant reductions in sulfur dioxide emissions in the near term;
- to ensure reasonable progress toward the national goal through continuing decreases in sulfur dioxide emissions over the long term; and
- to avoid increases of other visibility-reducing pollutants within the Transport Region as a whole from stationary sources.

The Commission believes these objectives are best achieved by relying on diligent implementation of current regulatory requirements in the short term while working to develop an incentive-based approach to ensure long-term protection.

The following specific recommendations are presented with the recognition that the tribal participants support these recommendations and have offered additional concerns and recommendations in Section IV of this report.

1. Implement existing Clean Air Act requirements through the year 2000.

Implementation of existing Clean Air Act requirements is expected to result in a significant decrease in sulfur dioxide emissions and their contribution to light extinction in the short term (1990-2000). Because some of these reductions are associated with the installation of SO_2 control equipment currently under construction, they can be projected with a very high degree of confidence (e.g., a 6% reduction in the total SO_2 emissions inventory resulting from emissions reductions at the Navajo Generating Station). In addition to these known reductions, the rate of SO_2 emissions decline will be influenced by ongoing source attribution studies and decisions similar to "best available retrofit technology" in the Transport Region, as well as other factors mentioned above. By the year 2000, the amount of SO_2 emissions reductions achieved (or represented by enforceable commitments) could be in the range of 20-30%. These pending matters may also affect the amount and rate of SO_2 emission reductions that will occur after the year 2000. States and tribes are encouraged to review the visibility impacts at Class I sites on the Colorado Plateau of uncontrolled pollution sources and make expeditious determinations regarding the need for additional pollution controls pursuant to the Clean Air Act. To the extent decisions are made to require additional

emission reductions at existing facilities, the Commission supports the adoption of the best, most cost-effective strategies.

2. Establish stationary source emission targets[4] as regulatory triggers.

a) An SO_2 emissions target for stationary sources will be established effective in the year 2000. The level of the target would be calculated by (1) determining the amount of emission reductions that has actually been achieved (or legally committed to) between 1990 and 2000; (2) comparing the actual reduction to the 13% reduction from 1990 actual emission levels that was projected by the Baseline Forecast Scenario; (3) assuming the actual reduction is higher than the projected reduction, set the emissions target at a level midway between the projected and actual, unless any affected party convinces the Commission or its successor that a different distribution is needed (e.g., emissions growth in undeveloped areas, operational flexibility needs, deteriorating visibility). As part of this calculation, the 1990 emissions inventory will be compared to the reported emissions to 1995/1996 data now available from sources (all utilities and many stationary sources have Continuous Emission Monitors).

b) An ultimate SO_2 emissions target for the visibility Transport Region will be established for the year 2040 that locks in the 50-70% reduction in SO_2 emissions projected by the Baseline Forecast Scenario.[5] Interim targets may also be needed to ensure steady and continuing emission reductions and to promote investment in pollution prevention (in accordance with five year review periods as described in #4 below).

[4] These "targets" are intended as firm limitations on emissions and have the same effect as a "cap." However, we are reserving the term "cap" to refer to the limits set under a regulatory program which would be triggered if the "targets" are exceeded.

[5] For example, the utility industry is committed to achieving the current baseline projections of 73% reductions in SO_2 emissions from utility sources by 2040. All projected percentage reductions in SO_2 emissions within the Transport Region will need to be verified by an updated assessment of the Baseline Forecast Scenario in the year 2000. Some stationary source categories require additional detailed analysis in order to produce more reliable projections. For this reason, the percentage reductions in stationary sources as a whole are expressed here as a range.

c) Various emissions management options for stationary source NO_x and PM will be explored, including considering the establishment of emission targets, in order to avoid any net increase in these pollutants from stationary sources within the region as a whole and to provide a foundation for future incorporation into a multi-pollutant and possibly multi-source market-based program.

3. Develop a plan for allocating trading credits under a regulatory program emissions cap.

a) Development of an equitable plan for allocating the trading credits among existing and future sources will be accelerated. The Commission expects that the targets will be met based on existing commitments and other actions that are likely to be required because of ongoing source attribution studies. However, in order to create economic incentives for early reductions as well as to provide flexibility and certainty to sources in planning future actions, participants in the Commission's process are committed to designing the plan before the EPA takes final action on the Commission*s recommendations so that the elements of that program can be incorporated into the federal regulatory program. (The estimated date for completing development of the program is June, 1997). A number of factors will be considered in developing the program, including measures to:

- prevent new sources from causing the target to be exceeded;
- account for sources which achieve emission reductions early or have achieved maximum control efficiency;
- ensure that all allocations to tribal lands, rural areas and relatively undeveloped areas (e.g., clean air corridors) are of practical benefit; and
- account for the effects of increases or decreases of emissions on visibility.

b) In order to generate information for development and implementation of the incentive-based program, owners and operators of existing facilities located within the Transport Region should: (1) by 1997, notify states and tribes of existing or planned pollution control or prevention measures; and (2) report biannually on efforts that are being made to manage their emissions or engage in other transactions to voluntarily meet their emissions reductions responsibility per the trading credit allocation scheme. These plans would not be incorporated as enforceable permit conditions or SIP revisions except as noted below.

4. Review compliance with targets and establish incentives.

Progress in complying with the emissions target(s) would be assessed in the year 2000 and at five-year intervals thereafter.

a) In 2000, or any subsequent five-year review period, if the regional target in effect at that period has not been exceeded no additional regulatory program will be required.[6] Any source that has contributed significantly to achieving the needed reductions by going beyond compliance or achieving early reductions will be rewarded. For instance, the following rewards could be included:

- an exemption from any interim target requirements that might be established;
- streamlined treatment in the permitting process;
- ability to bank emissions; or
- bonus allowances if credits are used to achieve development on tribal lands or other areas that are relatively undeveloped.

Incentives will be further developed and included in the design of the program.

b) In 2000, or at any subsequent five-year review period, if the regional emissions target has been exceeded[7], a regulatory program (most likely an emissions cap and incentive-based market trading program) will be implemented. Any source that is exceeding the emission allocation presented in the plan will have no more than five years to come into compliance and any reductions achieved will be discounted. Other disincentives will be developed and included in the design of the program.

[6] Reductions actually achieved or subject to legally enforceable commitments will be included in determining whether the cap has been exceeded.

[7] See footnote above.

5. Complete source attribution studies.

The Commission strongly encourages the EPA to complete, within one year, the source attribution study currently underway at the Mohave Power Project. Further, the Commission strongly encourages the EPA to take action consistent with the results of that study within twelve months of its completion. The Commission supports the commitment by the Mohave Power Project to maintain voluntarily its emissions at or below current levels (e.g., an average of the past two year's emission levels).

6. Develop an improved monitoring and accounting system.

A major deficiency in the technical analysis associated with the GCVTC activities has been the lack of adequate and reliable monitoring data. In order for any visibility policy to be effective, there must be an adequate benchmark of existing conditions against which to measure progress. To obtain a better understanding of visibility throughout the Colorado Plateau, Class I areas other than Hopi Point in the Grand Canyon need to be included as receptors in visibility modeling and additional monitoring sites should be established.

Emissions in the Transport Region provide another benchmark against which to measure progress. An accurate and credible emissions accounting method will be essential in determining compliance with the emissions targets or caps. Shortcomings in the emissions inventory need to be remedied, and a method for routinely tracking emissions needs to be developed.

It is critical that the emissions monitoring and tracking system be developed quickly so that emission reductions achieved between now and the year 2000 can be recorded and so that those areas that are presently lower-emitting can receive appropriate credit. If an incentive-based regulatory program is implemented after the year 2000, early emission reductions achieved before the year 2000 should be awarded credit, provided established criteria are satisfied.

MOBILE SOURCES

Background:

Emissions from mobile sources—including both light- and heavy-duty vehicles, marine vessels, trains, and airplanes—contribute to visibility degradation on the Colorado Plateau. Although the relative contribution of mobile source emissions is generally not as large as the contributions of some other sources, direct emissions and re-entrained road dust from motor vehicles contribute significantly to urban plumes that are transported across the Colorado Plateau. Emissions from an automobile manufactured today are substantially lower—better than 90% lower, on a per-vehicle-mile traveled basis—than emissions from one manufactured thirty years ago, in large part due to the Federal Motor Vehicle Emission Control Program in the Clean Air Act and the California motor vehicle emissions control program. However, the number of vehicles and the total vehicle miles traveled have increased dramatically. This trend is expected to continue. And while NO_x and PM emissions from heavy-duty on-road diesel engines have been reduced 70% and 95%, respectively, since the early 1970's, emissions from interstate and cross-border truck traffic and urban delivery and transportation vehicles continue to contribute significantly to total emissions.

Reducing total mobile source emissions is an essential part of any long-term emissions management program to protect visibility in the western United States generally and on the Colorado Plateau specifically. Further reductions can be achieved through a combination of national, regional and local actions.

RECOMMENDATIONS REGARDING MOBILE SOURCES

1. Adopt an emission management objective and establish a regional emissions budget.

The objective of the recommended strategies described below is to reduce emissions of VOC, NO_x, elemental carbon, and fine particulates from the mobile source sector and then hold them constant. To the extent that mobile source emissions contribute significantly to visibility impairment in the Class I areas of the Colorado Plateau, an emissions budget should be established for any area with a significant contribution, beginning in the approximate year in which emissions are projected to reach a minimum, or 2005. The emissions budget should serve as a regional planning objective and performance indicator.

2. Develop a system for tracking emissions.

In order to periodically assess progress, a system for tracking emissions will need to be developed. That protocol should take into account the relatively rural nature of much of the area within the Transport Region and not impose unnecessary burdens on small communities, including tribal lands, with air quality better than national ambient air quality standards. National and regional initiatives should ensure compliance with the regional emissions budget.

3. Suggest targeted local actions.

In addition to national and regional strategies, targeted local actions are needed to reduce mobile source emissions within the Colorado Plateau's Class I areas, in adjacent communities, and in major urban areas that contribute significantly to visibility impairment. If the strategies described below and elsewhere in this report do not keep emissions within the emissions budget, options for expanding and increasing the accountability of the relevant authorities will need to be considered and implemented.

Recommended National Strategies

Introduction to Recommended National Strategies

Most of the mobile source-related emissions reductions achieved to date have been brought about by increasingly stringent tailpipe and evaporative emissions standards. Further progress in reducing mobile source emissions outside of California can only be achieved through action on a national level. Although it would be difficult to justify a national-scale program based strictly on the impact on the Colorado Plateau, there are numerous initiatives and proposals to address urban ozone non-attainment problems already being considered for national implementation that would benefit air quality in the Colorado Plateau's Class I areas. The EPA should ensure the coordination of the Commission's efforts related to national standards and programs with other regional organizations (e.g., Ozone Transport Commission/Ozone Transport Assessment Group), because there may be synergies or conflicts among technologies or fuels aimed at different air quality goals.

The Commission promotes the following initiatives on a national level:

1. Adopt 49-state LEV standards.

The Commission supports adoption of the nationwide Low Emission Vehicle standards (49-state LEV), beginning in 2001, and adoption of federal Tier II

standards in 2004[8], if determined to be more effective. In the time frame to 2040, the Commission supports the promotion of ultra-low and zero-emission vehicles.

2. Support development of heavy-duty vehicle standards.

The Commission supports the EPA's current proposal to further reduce NO_x and particulate emissions from new on-road, heavy-duty vehicles by at least 50%, compared to the 1998 requirements contained in the 1990 Clean Air Act Amendments, while maintaining current stringent PM emission limits.[9] The Commission requests the EPA to pursue additional PM reductions from on-road vehicles.

3. Negotiate and adopt off-road vehicle standards.

The Commission requests that the EPA continue to pursue the adoption of additional engine emission standards for new off-road vehicles (heavy-duty, construction-type) that provide reasonably achievable reductions.

4. Promote broader application of cleaner fuels.

The Commission requests that the EPA explore broader application of and additional reductions in the sulfur content of both gasoline and diesel fuel. The Commission also supports the promotion of cleaner burning fuels as discussed in Recommendation #11 on page 31.

5. Pursue strategies for diesel locomotives, boats, airplanes and federal vehicles.

The Commission requests that the EPA pursue fuel standards and control strategies for diesel locomotives, marine vessels/pleasure craft, airplanes and federal vehicles. States and tribes are preempted from controlling most emissions from these sources. Emissions from these categories are relatively uncontrolled compared to other mobile sources (e.g., light-duty cars and trucks) and will continue to increase with population and economic growth. In particular, the EPA should:

[8] In March 1996, the California Air Resources Board confirmed an agreement with the largest automobile manufacturers to sell nationwide only cars and light trucks which meet standards equivalent to California's Low Emission Vehicle (LEV) standards, beginning in 2001. This action was part of a larger agreement in which these manufacturers were given greater flexibility in introducing Zero Emission Vehicles (ZEVs) prior to 2003 in California.

[9] The heavy duty engine manufacturers, the U.S. EPA and the California ARB signed a statement of principles in July 1995, committing to the introduction of a NO_x standard of 2.0 grams per brake-horsepower hour by 2004, compared to the 1998 CAAA requirement of 4.0.

a) promulgate national NO_x, HC and PM standards for "captive fleet" marine vessels and work with the International Maritime Organization to reduce emissions through international standards;

b) finalize the proposed HC standards for recreational boats and personal watercraft;

c) adopt NO_x standards for new and remanufactured diesel locomotive engines;

d) strengthen existing national HC standards for aircraft engines;

e) adopt stringent national NO_x standards for aircraft engines; and

f) pursue emission control strategies, such as alternative clean fuels, for all federal fleets.

6. Support improved control of evaporative emissions

The Commission supports requirements for effective refueling vapor recovery systems that capture evaporative emissions.

Recommended Regional Strategies

Introduction to Recommended Regional Strategies

To the extent that mobile source emissions from certain areas are found to contribute significantly to visibility impairment in the Class I areas of the Colorado Plateau, an emissions budget should be established, beginning in the approximate year in which emissions are projected to reach a minimum, or 2005. As mentioned above, a protocol for inventorying and tracking emissions will need to be developed. The adoption of more stringent national standards as noted above would help maintain compliance with the regional mobile source budget. In addition, the Commissioners promote incentives for the use of clean fuels on a wide basis. Economic pricing strategies should also be analyzed for implementation on a regional scale. The analysis should include an examination of the extent to which certain populations (for instance, rural communities, low-income groups or tribes) may be disproportionately affected. In the event that inequities are identified, alternative strategies should be developed to address the particular needs of those populations. The initiatives which follow should be pursued.

1. Establish clean fuel demonstration zones.

The feasibility of providing incentives for clean fuel demonstration zones or corridors for heavy-duty trucks and buses should be assessed by 1998. For example, and at a minimum, incentives for converting vehicles used for mass transportation and delivery

within national parks on the Colorado Plateau, as well as in nearby urban areas, to CNG, LNG, LPG or alcohol-based fuels should be provided. In addition, the Western states should cooperatively:

a) explore the feasibility of establishing alternative fuel corridors in urban areas and along major trucking routes (e.g., I-15, I-5, I-80, and I-40);[10] and

b) conduct an analysis comparing the relative emissions from trucks and trains (including tailpipe/stack emissions as well as road dust, tire wear, etc.).

2. Analyze pricing and incentive approaches.

A regional analysis of economic pricing and incentive approaches should be conducted by 1998, including an analysis of equity effects of such approaches, that could be used to reduce reliance on vehicle use and better internalize the true cost of operating motor vehicles. If such programs were implemented and generated revenue, these funds could be rebated to drivers (for instance, as a credit against state income or property taxes), used to develop multi-modal transportation options, or used to help maintain the existing highway infrastructure. The Commission supports states that are implementing programs to curtail visible emissions and encourage region-wide adoption of these programs.

3. Explore an inspection program for heavy-duty vehicles.

Truck traffic contributes to regional visibility impairment, including haze in the Class I areas in the Colorado Plateau. The Commission supports development of options and opportunities for implementing an emissions inspection programs for heavy-duty, on-road vehicles that routinely travel the highways in the Transport Region. Within the limitations of existing interstate commerce regulations and the North American Free Trade Agreement, the states and tribes could explore programs to assure compliance with in-use emission requirements, including vehicles involved in cross-border transport.

[10] A privately-initiated effort is already under way to establish LNG fuel stations along the I-15 corridor from Salt Lake City to St. George, Utah and along the I-15, I-5 and I-80 corridors between Salt Lake City, Los Angeles and Sacramento. Efforts are also under way in Southern California for electric vehicles and hydrogen corridors. The Commission supports these and similar efforts. If the establishment of a regional mobile source emissions budget leads to development of a market-based program, the Commission should support the awarding of emissions reduction credits to private entities involved in these types of efforts.

4. Promote vehicle maintenance.

The Commission also encourages local authorities to mount public education campaigns to inform citizens of the air quality advantages of maintaining their vehicles properly. It is critical for control of mobile source emissions that all components of a vehicle's emissions control system be maintained according to the manufacturer's specifications as detailed in the owner's manual. Such a public education effort could be coupled with implementation of a mechanics' training and certification program and state-of-the-art vehicle inspection and maintenance programs.

Recommended Local Strategies

Introduction to Recommended Local Strategies

Decisions as to how to achieve emissions objectives are best made at the local or metropolitan level. However, the Commission recognizes that mobile source emissions from some areas have a disproportionate impact on visibility in the Colorado Plateau Class I areas. Strategies for addressing mobile source emissions within Class I areas and in adjacent communities are discussed elsewhere in this report. In addition, major metropolitan areas located near the Colorado Plateau must be encouraged to take actions to reduce in-use vehicle emissions. The types of programs described below would be targeted initially at these areas, but consideration should be given to extending their application on a broader scale to achieve regional air quality objectives. Any such extension would be preceded by an analysis of the equity effects associated with these types of programs in non-urban areas.

1. Promote incentives for innovative and effective approaches.

The Commission challenges states and tribes with major urban areas to develop funding and other incentive-based schemes that give priority to allocating discretionary funding to transportation projects that are consistent with the goal of reducing reliance on single-occupant vehicles. For example, governors could exercise fiscal discretion (e.g., preferential allocation of state highway/transit, open space, economic development/enterprise zone funds or rebates of state fees) to reward communities that find appropriate or innovative ways of reducing reliance on single-occupant vehicles. Examples include land use ordinances that favor development in existing transit/transportation corridors, high density development needed to ensure the viability of mass transit, and co-located residential, business and commercial development to support non-vehicular modes of transportation. If possible, this incentive-based approach with state funds could be coupled with a similar preferential allocation of discretionary federal funding to states and tribes that develop appropriate approaches.

2. Encourage better integration of transportation, land use and air quality planning.

In order to avoid incremental degradation of visual air quality as the population and economy of the West continue to grow, the Commission encourages sustainable community and economic development by:

a) promoting multi-modal transportation options through both public and private investments;

b) encouraging local, state and tribal governments to reduce or eliminate entry and rate regulations in the transit industry as a means of fostering greater competition;

c) establishing a clearinghouse for information about sustainable communities and methods for integrating multi-modal transportation systems with land use planning; and

d) sponsoring conferences on transportation, land and air quality issues generally (e.g., to showcase various communities' efforts), and transportation alternatives within and between Class I areas in the Colorado Plateau specifically.

3. Establish mobile source emissions budgets for selected major urban areas.

To the extent that mobile source emissions from certain major urban areas are found to contribute significantly to visibility impairment in the Colorado Plateau's Class I areas, the Commission requests that local emissions budgets be developed specifically for mobile sources. (Most areas are already required to do this under the CAAA for purposes of assuring conformity of transportation plans and programs.) Methods for managing mobile source emissions budgets need to be explored further. Regardless of which approach is taken, there must be developed a credible and replicable way of inventorying, tracking and reporting emissions.

a) Develop analytical criteria and accounting methods for implementing emission budgets.

If the proposed emission budgets allow an increase in current emission levels, an analysis will be needed to assess whether the budgets ensure protection of NAAQS, PSD increments, and visibility in downwind Class I areas. In this event, the Commission would develop criteria and an analytical method for conducting such an analysis, and establish requirements for adjusting urban emission budgets found to be inadequate to protect downwind areas, as well as accounting and enforcement mechanisms.

b) Consider use of pricing strategies.

The economic pricing analysis called for above may indicate that the most efficient method of complying with emissions budgets would be to institute pricing strategies for use of roadways that internalize the cost of operating motor vehicles so that individuals have an incentive to modify their travel behavior. The consideration of such pricing strategies should take into account the possibility that incremental changes in price, in absolute dollar terms, will have a larger effect on rural areas and lower-income populations.

c) Develop an accounting system for market-based programs.

If some sort of market-based program is deemed appropriate, accountability for complying with the emissions budget must be clearly assigned, with consequences attached to failure to maintain emission levels consistent with the budget. For example, emissions from mobile sources could be aggregated and responsibility for managing them delegated to a private or public "broker", or assigned to a local/ regional governmental entity. Alternatively, individuals (including businesses, government agencies, etc.) could be given responsibility for managing emissions from vehicles they own or control. In any event, if emissions trading were allowed, credible methods would be needed for certifying the validity and value of emissions reductions at the start of the program and ensuring their permanence over time.

4. Suggest retiring high-emitting vehicles.

The Commission suggests that local authorities consider the advantages of retiring higher polluting vehicles and develop incentives for citizens to upgrade to newer, less polluting cars and trucks.

AREA SOURCES

DUST FROM PAVED AND UNPAVED ROADS

Background:

Chapter II of the Commissions November 1995 report, *Options for Western Vistas*, discussed the limitations of the Integrated Assessment System results with respect to paved and unpaved road dust. More recent modeling has shown that local sources of road dust play a more important role than distant sources. The Commission has considered this issue and has concluded that there are good reasons to discount the Integrated Assessment System's predictions about the regional importance of this source of emissions until more study is completed. For example, the large magnitude of emissions projected for this source are tied to projections of future growth in population and vehicle-miles-traveled, whereas road dust effects on visibility are generally localized, especially with respect to large, coarse material which settles out of the air relatively close to roadways.

RECOMMENDATIONS REGARDING DUST FROM PAVED AND UNPAVED ROADS

Actions to address the control or reduction of emissions related to road dust are found in the recommendations regarding emissions "In and Near Class I Areas." The Commission further recommends that voluntary measures be taken in local areas in and near Class I areas to control emissions of dust from paved and unpaved roads. Consistent with other Commission recommendations, there is also a recognized need to develop an accurate emissions inventory and an improved air quality model for controlling or managing this specific source sector. Finally, if visibility impacts are validated, the Commission recommends that performance standards for road dust emissions be developed.

Due to considerable skepticism regarding the modeled contribution of road dust to visibility impairment, the Commission recommends further study in order to resolve the uncertainties regarding both near-field and distant effects of road dust, prior to taking remedial action. Since this emissions source is potentially such a significant contributor, the Commission feels that it deserves high priority attention and, if warranted, additional emissions management actions.

FIRE

Background: Fire Emissions and Visibility

Fire has played a major role in the development and maintenance of most ecosystems in the West. The long-term future of the West is dependent on healthy ecosystems that are capable of sustaining natural processes and human uses.

An increase of accumulated forest fuels in the West has occurred because of past land management practices, including decades of fire suppression. Evident ecosystem changes include increasing tree densities, disrupted nutrient cycling, and altered forest structure. As a result, wildfires are becoming larger in size, unnaturally destructive, and more dangerous and costly to control. In 1994, wildfire burned 3.1 million acres in the West and cost $1 billion dollars in direct suppression costs while causing firefighter deaths and serious human health impacts. Rectifying this problem will take years and is a basic responsibility of wise land stewardship. Fire is an essential component of most natural systems, and perpetuation of fire at a level required to maintain ecosystem processes is necessary. The natural role of fire in the wildland/urban interface must also be addressed to protect life and property. A substitute for fire and its natural role has not been found in many ecosystems. The objective of future prescribed fire programs is to cooperatively meet land management, human health and visibility objectives.

Emissions from fire (wildfire and prescribed fire) are an important episodic contributor to visibility-impairing aerosols, including organic carbon, elemental carbon, and particulate matter ($PM_{2.5}$). Agricultural burning emissions and their effects have been identified as a concern of the GCVTC but have not been quantified due to a lack of data. All types of fire (prescribed fire and agricultural burning) must be addressed equitably as part of a visibility protection strategy. This may require state legislation in some cases.

Discussion of Management Alternatives

Wildfire impacts are increasingly uncontrollable or unmanageable, due to excessive fuel loads, except through the application of prescribed fire and/or mechanical means, such as brush removal and logging. Field experience has shown that prescribed fire can reduce the size, frequency, and intensity of wildfires. Areas that have been treated with prescribed fire demonstrate much less burning in the tops of trees and a slowing of wildfire spread. Prescribed fire therefore promotes better fire control, predictable fire effects and allows for management of emissions as compared to wildfire.

The future use of prescribed fire and the restoration of fire in its natural role with natural fuel loadings will provide sustainable ecosystems where environmental and human health impacts can be managed. This future desired situation contrasts with the current adverse public health impacts and permanent damage to natural resources and property from wildfires. Wildfires are causing exceedances of ambient air quality standards and air quality-triggered community evacuations with greater frequency. Prescribed fire programs will influence future wildfire in many locations of the West. However, infrequent large-scale forest replacement wildfire will still occur naturally in some vegetation types.

Land managers employ emission reduction and smoke management techniques to reduce air quality impacts of prescribed fire. Current smoke management techniques take into account the timing and location of burns so that impacts on human health are reduced. These techniques can be expanded to reduce current and future impacts on visibility. Emission reduction techniques can also be utilized to reduce the quantity of emissions from a prescribed burn. The appropriateness and effectiveness of emission reduction techniques vary based on vegetation type, burn objectives, location, other environmental constraints such as water quality, and funding. Effective agricultural smoke management programs have been developed in some states using similar measures.

Utilization of mechanical treatments such as logging or firewood sales to remove fuels will be necessary in some areas prior to prescribed burning. The potential use of mechanical treatments is limited, however, since large areas of the West are not physically available due to inaccessibility, slope or soil sensitivity. Significant emission reductions from mechanical treatment would only occur in timber areas. Administrative constraints, such as wilderness or habitat protection, also impose limitations. Approximately 30% of the total timber area has the potential to be treated using mechanical methods. In areas where mechanical treatments are used alone, some level of prescribed fire treatment may still be necessary. Mechanical treatment cannot replace the natural role of fire in ecosystem health and sustainability processes.

In order to address the fuels problem and ensure adequate protection of visibility in the West, funds will need to be greatly increased. With the development of increased prescribed fire programs, it is crucial to fund smoke management programs that protect public health and visibility, while meeting the underlying land management objectives.

RECOMMENDATIONS REGARDING FIRE

1. Plan for the visibility impacts of smoke.

The Commission recommends that the EPA require all federal, state, tribal, and private prescribed fire programs to incorporate smoke effects in planning and application by the year 2000.

2. Implement an emissions tracking system for all fire activities.

A consistent emissions tracking system for prescribed fire, wildfire, and agricultural burning should be implemented region-wide.

3. Improve integrated assessment of emissions.

Federal, state, tribal and private land managers, in conjunction with relevant regulatory agencies and interested parties, should improve the current integrated assessment of emissions from prescribed fire, wildfire and agricultural burning by 1999. The assessment should:

a) identify specific areas where fire activities have or could have an adverse impact on health and visibility;

b) identify areas where mechanical treatments could substantially reduce emissions and subsequent impacts on health and welfare;

c) in the areas identified, assess the feasibility of biomass utilization (woody material use), market development, and non-statutory administrative barriers[11]; and

d) assess meteorological information needs, air quality monitoring needs, smoke dispersion model needs, interstate planning needs, wildfire/prescribed fire trade-offs (economics, air quality and other resource effects), and emission factor research (vegetation/fuels and effects of emission reduction techniques).

4. Enhance smoke management programs.

The Commission recommends the development and implementation of criteria and requirements for the use of enhanced smoke management programs (including alternative management practices) and emission reduction strategies in the identified areas. Such programs should consider factors of efficiency, economics, law, land management objectives, and reduction of visibility impacts. States, tribes, state and federal land management agencies and private parties should create and implement smoke management programs that address public health, visibility and land management objectives by the year 2000, using the results of the assessment listed in Recommendation #3.

5. Develop cooperative funding mechanisms.

The Commission promotes the development of cooperative funding mechanisms between burners and regulatory agencies to implement increased smoke management programs and integrated assessment costs.

6. Promote public education programs.

The Commission supports the creation of a public education program regarding the role of fire in air quality, to be undertaken by land managers and other interested governmental and private groups.

[11] In identifying areas where alternatives to burning are appropriate, it is not the intent of the Commission to require actions that are inconsistent with applicable laws or regulations.

7. Establish annual emission goals for fire programs.

The Commission recommends that annual emission goals for all fire programs, where appropriate, be established by the year 2000. These goals will be set to minimize emission increases from such programs to the maximum extent feasible. The goals will be established cooperatively by states, tribes, state and federal land management agencies and their private sector counterparts.

8. Remove administrative barriers to the use of alternatives to burning.

The Commission recommends that the federal land management agencies and their state, tribal, local and private counterparts identify and remove non-statutory administrative barriers to emission reduction strategies by the year 2000, to the maximum extent feasible. In removing such barriers, the Commission intends that subsequent actions will be undertaken consistent with applicable laws and regulations.

CLEAN AIR CORRIDORS

Background

One finding of the Commission's process is that clean air corridors exist. One such source of clean air studied by the Commission covers major portions of Nevada, southern Utah, eastern Oregon and southwestern Idaho. This area provides clean air days at Grand Canyon National Park. Projected emissions growth through 2040 within the studied clean air corridor is not expected to have a perceptible negative effect on visibility at Class I sites. Clean air corridors also influence visibility at other Class I sites in the Colorado Plateau, although the precise relationships have not been fully established at this time. In order to ensure that sources of clear air for all Class I sites on the Colorado Plateau are protected, additional data collection and analysis will be needed.

RECOMMENDATIONS REGARDING CLEAN AIR CORRIDORS

1. Do not establish special targeted programs at present.

The Commission considered whether special programs or regulations were needed in clean air corridors in order to protect the clean air provided to Class I sites on the Colorado Plateau. Given the Commission's findings, there is no present need for special targeted policies or regulatory programs to control emissions growth within clean air corridors beyond existing laws and programs. In addition, clean air corridors will be covered by other regional initiatives recommended elsewhere in this report.

2. Improve regional tracking and monitoring.

Because uncertainties in data and forward projections exist, a regional tracking and accounting system is needed to make sure that the frequency of clear days increases or does not decrease at Class I sites and that the Commission's present assumptions regarding population and economic growth and the resulting effects on increased emissions prove reliable. In addition to these concerns, a regional tracking and accounting system should:

a) **within** areas that are sources of clear air, identify patterns of growth or specific sites of growth that cause significant emissions increases having a negative impact on visibility at one or more Class I sites on the Colorado Plateau;

b) in areas **outside** of clean air corridors, identify significant emissions growth that begins to impair the quality of air in the corridor and thereby reduce the frequency of clean air days at Class I sites; and

c) continue technical studies to see whether other sources of clear air exist and take measures, if needed, to protect against future degradation of air quality in these areas.

3. Establish triggers for additional action.

The occurrence of any of the conditions described in paragraph #2 above should trigger analysis of the effects of increased emissions and the implementation of additional measures to protect clean air days, if necessary.

EMISSIONS WITHIN AND NEAR CLASS I AREAS

Background

Emissions from within and near Class I areas contribute to impaired visibility. Transportation-related emissions and other emissions from energy use are of particular concern. Prescribed fire emissions are also a concern since land managers plan to increase necessary prescribed fire activities in order to restore natural fire cycles and preserve natural ecosystems.

National park general management plans and forest land management plans are appropriate ways to address some contributions to visibility impairment at Class I areas. National Park Service (NPS) nation-wide policy is to mitigate visibility impairment and other air quality effects from in-park sources by reducing emissions and incorporating sustainability concepts into all plans and management decisions. The NPS has already implemented several innovative approaches to pollution prevention in many Colorado Plateau parks and intends to do more. These actions include more in-park transportation systems (such as low-emission shuttles), conversion of park vehicle fleets to cleaner fuels, increasing energy efficiency, and taking other steps at parks on the Colorado Plateau.

The Commission recognizes the importance of visibility issues related to emission sources in and near Class I areas, and supports funding for these transportation, energy, and other programs that help improve visibility.

RECOMMENDATIONS REGARDING EMISSIONS WITHIN AND NEAR CLASS I AREAS

1. Implement park and wilderness planning processes.

Federal land managers, through their planning processes, should strive to limit and reduce visibility impairing emissions within Class I areas. Land managers should also use existing opportunities, such as the states' required consultation process with federal land managers in the review of state visibility protection plans (discussed below), to inform the appropriate regulatory authority regarding agency actions and strategies taken or planned within Colorado Plateau Class I areas to prevent or reduce pollution emissions that affect visibility.

Specifically, such plans or actions would assure that:

a) emissions growth from human-caused sources within the Class I area does not cause visibility to deteriorate;

b) human-caused sources within the Class I area (or that result from activities within the area) that contribute to existing visibility impairment are mitigated; and

c) prescribed fire programs (excluded from 1a. and b. above), after considering and applying non-fire alternatives whenever possible, seek to minimize emissions and visibility impacts through smoke management and emissions reduction measures.

2. Develop strategies for nearby communities and activities.

All significant sources or combinations of sources near each Class I area must be examined and cooperative, enforceable management strategies developed and implemented among tribal, local, state, federal, and private interests, as necessary, to assure reasonable progress toward no human-caused impact on visibility (the national visibility goal). The development of management strategies must take into account such equity-related concerns as relative contribution to visibility impairment and whether any one population (such as lower-income groups) is unfairly burdened by the strategies. Regulatory and planning authorities have a pivotal role in assuring that sources near Class I areas are inventoried and assessed, and that their emissions are mitigated with regard to visibility impacts on these areas. Existing planning and regulatory mechanisms should be strengthened and funded to create a systematic approach to address this issue. For example, existing regulatory requirements for long-term visibility strategies and their review and revision no less than every three years should be enforced.

To this end, all land managers should:

a) be vigilant and aggressively pursue opportunities to participate in external planning arenas where decision-making could have effects on visibility in nearby Class I areas;

b) review permit applications for new or modified stationary sources proposed for construction and operation near Class I areas; and

c) request that the appropriate regulatory authority (or authorities) propose emissions reduction strategies for nearby sources that contribute to existing visibility impairment, either during development of the visibility protection plans or during the required periodic review of such plans.

Regulatory programs should provide exemptions for tribal ceremonial practices and for people who are dependent on a single source (wood or coal) of heating and cooking.

3. Apply existing regulatory requirements.

Regulatory and planning authorities are already required to develop, maintain, and enforce visibility protection plans for mitigating nearby source impacts on the Class I areas. Regulatory agencies should develop criteria for these plans that are consistent across the Transport Region. An important element of this activity is the development and maintenance of an emissions inventory, tracking, and reporting program for each Class I area. The authorities must consult and actively involve the respective Class I area land manager(s) throughout the process.

4. Utilize other planning processes.

Federal land managers and authorities in local political subdivisions and on tribal lands should perform analyses of potential visibility impacts to Class I areas on the Colorado Plateau and include them in land management plans for lands located near these areas.

TRANSBOUNDARY EMISSIONS FROM MEXICO

Background

Pollution from stationary, mobile and area-wide emission sources in Mexico contributes to visibility degradation in the Colorado Plateau's Class I areas. Expected economic development in the border region will likely exacerbate transboundary pollution transport unless steps are taken to reduce and prevent pollution. The Commission lacks the authority to address these transboundary pollution problems directly, but should support several ongoing efforts to develop emissions inventories, establish binational institutions and bilateral agreements to facilitate cooperation, and create incentives for implementation of cost-effective air pollution abatement strategies.

RECOMMENDATIONS REGARDING EMISSIONS FROM MEXICO

Mexican sources are a significant contributor, particularly of SO_2 emissions. However, data gaps and jurisdictional issues make this a difficult issue for the Commission to address directly. The recommendations below call for continued binational collaboration to work on this problem, as well as additional efforts to complete emissions inventories and increase monitoring capacities. The Commission feels that they should receive high priority for regional and national action.

1. Develop a comprehensive emissions inventory.

Characterizing and quantifying emissions from sources in Mexico provide a necessary foundation for developing emissions management options. Some data exist as a result of past or ongoing governmental efforts. In addition, the Western Governors' Association, in cooperation with Mexican government officials, is developing methodologies for preparing an emissions inventory for the entire border region. The Commission supports these efforts.

2. Establish binational institutions and agreements.

The Commission urges the EPA, the U.S. State Department, and affected states to make effective use of opportunities provided by existing binational treaties and agreements. For example, Annex V to the 1983 La Paz Agreement directs the EPA and INE (the National Institute of Ecology of Mexico) to assess the causes of, and develop solutions to, air quality problems in border sister cities. As a result, the U.S. and Mexican governments have developed an environmental plan for the border that is periodically revised (next revision: summer 1996); the National Coordinators meet regularly to discuss progress; and working groups composed of federal and state officials (e.g., the Border Air Working Group) have been established to address

pollution problems in various media. The Border Governors' Association also examines environmental problems in the border region. The Commission supports these activities and is prepared to work cooperatively with these groups as necessary/appropriate.

3. Develop community mechanisms for cooperative transboundary planning.

While pollution transport from Mexico affects the West generally, local communities in the border region are most severely affected and have the greatest need to develop cooperative, creative approaches. Greater local involvement in decision making will likely lead to more effective and expeditious pollution abatement strategies. The Commission supports the designation of international air quality management districts in border cities and the establishment of community-based binational committees charged with developing air quality management plans. The U.S. and Mexican governments are currently negotiating an international agreement to institutionalize such an approach in the "Paso del Norte" region (El Paso, Texas; Dona Ana County, New Mexico; and Ciudad Juarez, Chihuahua). The Commission supports this effort and recommends that the respective federal governments consider expanding this type of approach to other border communities.

4. Finance air pollution control projects.

The Commission recommends that the governments of the U.S. and Mexico utilize several new institutions established by the North American Free Trade Agreement to improve air quality. Although there are critical needs in the areas of water supply and treatment, the Commission urges the Border Environmental Cooperation Commission (BECC) and the North American Development Bank (NADBANK) to apply available capital for border infrastructure projects to high priority air pollution problems whose resolution will have marked effects on regional air quality (e.g., emission control technology on major industrial or electricity-generating facilities).

5. Provide incentives for transboundary investment in pollution control.

The Commission encourages the EPA to explore the feasibility of allowing U.S. industries to earn emission reduction credits for investment in pollution control and prevention projects in Mexico. These might be applied to existing Clean Air Act programs for nonattainment areas or as part of a western regional emissions management program implemented to protect visibility. Criteria and procedures for awarding appropriate credits should be developed to provide an incentive for investment in transboundary pollution control projects that would have a beneficial impact on air quality in border communities and throughout the western United States. The ongoing international negotiations directed at the Paso del Norte region mentioned above include consideration of conducting a feasibility analysis for an international emissions trading program. The Commission should support this effort. Conversely, the Commission supports disincentives to discourage U.S. companies

from investing in facilities in Mexico that do not achieve pollution control levels comparable to those required in the United States.

6. Pursue pollution control projects at specific major sources in Mexico.

The construction and operation of major stationary sources in Mexico may be a significant cause of long-distance pollution of Class I areas on the Colorado Plateau. The Commission encourages the respective federal governments to pursue, through international negotiations and agreements, implementation of pollution reduction strategies aimed at specific facilities that may be found to have identifiable impacts on the Colorado Plateau.

FUTURE SCIENTIFIC AND TECHNICAL NEEDS

Introduction[12]

Many of the recommendations in this report call directly for continued, expanded or improved collection of technical information in order to provide the basis for future regional policy recommendations and development of appropriate implementation strategies by tribes, states and federal agencies. In order to implement some of the recommended programs, additional technical data will have to be collected, interpreted and modeled on an ongoing and regional basis.

The following sections of this report and related recommendations include reference to technical needs:

Stationary Sources: In order to track emissions targets and/or to implement a regional cap and trading program, an improved emissions monitoring and accounting system will be needed.

Mobile Sources: The recommendations call for establishing mobile source emissions budgets for selected major urban areas, which will require accurate data collection.

Area Sources: The recommendations call for improved modeling of road dust effects, setting up an emissions tracking system for all fire activities, and improved integrated assessment of emissions.

Clean Air Corridors: Regional tracking and monitoring of emissions is needed in order to make sure that the Commission's projections regarding the relative insensitivity of sources of clear air prove correct.

Transboundary Emissions from Mexico: Cooperative work with Mexican officials and corporations requires an accurate emissions inventory.

Air Quality on Tribal Lands: There is a need for more comprehensive emissions inventories for areas on and near tribal areas as well as monitoring of air quality on tribal lands. The limitations of present models do not permit modeling of impacts on tribal lands.

[12] For a more comprehensive discussion of technical and scientific needs, see "Subcommittee Report on the Future Needs of the Commission," November 6, 1995, developed by a subcommittee of the Public Advisory Committee.

In general, four types of initiatives are required to meet the technical needs of future programs: improved emissions inventories, expanded monitoring of visual air quality, refined modeling capacities, and improved assessment information and methods.

Emissions Inventory

The emissions inventory developed by the Commission represents all known emissions of visibility-impairing pollutants from all known sources. Programs which call for assessment of reasonable progress toward the national air quality goal based on targeted emission reductions, or on model-projected estimates of improvements, will require an accurate and complete emissions inventory. The current GCVTC emissions inventory represents cooperative work among many in the region and an advance in comprehensive data collection, but the emissions inventory process can and should be improved.

A substantial effort will be needed to coordinate and update continuously the emissions inventory to reflect actual emissions in the region on a year-by-year basis. In addition, any disparity in methods for developing emission estimates by any entity, whether federal, state or tribal, must be adjusted or equalized in order to assure a consistent inventory. This will be particularly critical if a regional trading program is implemented where tons of emissions from one state or tribal land may be traded for tons of emissions from another. If the emissions inventory methodologies are different, then it will be difficult to assess the true impact of trading programs among various jurisdictions.

Air Quality Monitoring

Now that the Commission has completed these recommendations to the EPA, it will be necessary to measure and report on reasonable progress toward the goal of remedying existing and preventing future impairment of visibility in mandatory Class I areas. This implies that federal, state, tribal, and local air quality agencies must be committed to a long-term monitoring program.

The current federal visibility monitoring program (IMPROVE) distributed monitoring sites to address national needs at Class I areas throughout the country. IMPROVE has led to limited visual air quality data collection in the GCVTC region. There are sixteen Class I areas on the Colorado Plateau that have been selected as requiring visibility protection. Of these sixteen sites, limited monitoring is currently being done at only six sites:

- Bryce Canyon National Park
- Canyonlands National Park
- Grand Canyon National Park
- Mesa Verde National Park
- Petrified Forest National Park
- Weminuche National Wilderness Area

While these sites are reasonably representative of visual air quality conditions on the central Colorado Plateau, existing visibility in the vast majority of the region, especially on tribal lands, has only been inferred from the current IMPROVE data set.

Modeling

In general terms, air quality models are needed to convert emissions from all sources and areas into an estimate of visibility impairment at the key receptors (Class I sites) on the Colorado Plateau. The Commission's committees and contractors have developed a model that roughly approximates how weather and emissions result in air quality at Class I sites.[13] Further development of regional models is needed to more accurately show the relationships among emissions sources and effects at specific Class I sites under specific conditions, in order to resolve the limitations of the present model. Further, future modeling efforts should assess expected wide-reaching effects from electric utility industry restructuring.

Assessment Information and Methods

The key inputs to the IAS include, in addition to technical inputs described above, information related to the current levels of controls and installed technologies on sources, the control options that are available for sources (including costs and efficiencies), and methods to project changes in the future. These need to be significantly improved to reduce uncertainties in assessing or forecasting the effects of emissions management options. In addition, the methods for evaluating overall economic effects and other secondary assessment criteria must be improved.

RECOMMENDATIONS REGARDING FUTURE SCIENTIFIC AND TECHNICAL NEEDS

The Commission foresees that the following regional scientific and technical work will need to be done. The tasks may be performed by a combination of state, tribal, and federal organizations, with coordination by a regional body.

EMISSIONS INVENTORY

1. Secure adequate long-term funding.

Emissions inventories require significant human and financial resources. Enough resources must be allocated to the task from state and federal sources.

[13] The accomplishments and limitations of the present model are discussed in Section II.

2. Develop and update a regional emissions inventory.

A quality inventory must be completed and then updated on a regular basis. A complete plan should be developed prior to the start of data collection. All states, tribes, and federal agencies should follow this plan, so that data collection methods are compatible for all areas and sources.

3. Standardize comprehensive data collection.

Inconsistencies and gaps in the emissions inventory should be addressed, including the following:

a) current inconsistencies in the ways states collect and quantify emissions data;

b) emissions inventory information for agricultural activities;

c) all data collection for a single calendar year;

d) a mechanism to accept/reject/determine factors to fill in data gaps;

e) information regarding current levels of controls; and

f) emissions inventory data specific to tribal lands.

4. Develop agreements on how data will be used.

Agreement should be reached on how and for what purposes the data will be used. For instance, states, tribes and federal agencies should determine whether inventories and analyses developed for regional programs and policy development can or should be incorporated into national databases.

5. Develop adequate trained human resources.

Agencies should be staffed to conduct and maintain emissions inventories. In the past, the EPA has not placed a high priority on emissions inventories even though they provide the basis for state or tribal implementation plans, rulemaking and application of Section 169B of the Clean Air Act.

6. Address the need for micro-inventories.

A greater emphasis should be placed on micro-inventories of emissions for areas in and near Class I Areas and other areas of concern, such as tribal lands. Modeling indicates that nearby sources may have a greater impact on visibility than sources at a greater distance on a per ton basis. As such, comprehensive micro-inventories are needed for the near-field around Class I areas. Without them, it will be impossible to

reliably identify that portion of the contribution to visibility impairment caused by long-range transport of regional haze.

7. Agree on an emissions forecasting methodology.

Agreement should be reached on the source of information and methods to be used to forecast future emission changes related to economic growth and anticipated effects from control programs.

AIR QUALITY MONITORING

1. Continue and expand the number of monitoring sites and frequency of sampling.

The current IMPROVE monitoring network only measures aerosol samples twice a week and at only a few Class I sites. Thus, five-sevenths of the time, the chemical make-up of the particulates contributing to visibility impairment is unknown. Consideration should be given to expanding the coverage or redeployment of resources in the IMPROVE network to enhance completeness of the data set, including on tribal lands. In addition, background surveillance sites could be established at intermediate locations between the Class I areas and large regional sources (metropolitan areas) to provide a better understanding of the intermediate course of atmospheric chemistry and transport. Monitoring should be maintained at existing sites in order to allow for long-term trend analysis.

2. Establish three essential components.

The three fundamental components of a future visibility monitoring program should be: 1) light extinction measurements from transmissometers; 2) aerosol chemistry measurements from fine/coarse-mass-particulate samplers; and 3) meteorological measurements of wind speed, direction, temperature, and humidity. Tribal lands would be particularly appropriate sites for tracking and monitoring case studies.

MODELING

Both sophisticated and reduced form models are needed. Once these methods and data are in hand, any simulation can be prepared. In other words, the two types of issues placed before the GCVTC of subregional or region-wide issues can be assessed with equal facility.

1. Develop a comprehensive, sophisticated model.

A comprehensive model must be able to match its *predictions* of air pollution and visual air quality with *actual observations* of both factors. This model should generate output at least on a twelve-hour basis using emissions and meteorological

observations on this time scale. To reproduce the observations on a space and time basis, there is a need for accurate emissions data over the entire modeling area, reliable wind fields, cloud and other climatological data, and samplings of pollutants and visual air quality, as well as dependable algorithms for the physics and chemistry of transport and the transformation of pollutants during transport and deposition. This model is likely to be sufficiently complicated that it would have to be run on a sophisticated computer. To the extent that interpretation of fine grid geography or of urban plumes is necessary to match the data, this capability should be included. The model must also be able to accurately model both near-field (within about 30 miles) and far-field effects.

2. Develop a "Reduced Form Model."

A second type of model will be needed for assessing the effects of control options on emissions and visual air quality. This would be a reduced form model (RFM) that can be installed on a personal computer and run in seconds to minutes to convert emissions into estimates of ambient fine particle loadings and visual air quality. This model should relate emissions of various species from the source regions of the entire study area to data collected at receptor sites in the Class I areas of interest.

The RFM needs to be able to replicate the predictions of the more comprehensive model. Therefore, the transfer coefficients should be constructed by the comprehensive model for use in the RFM.

3. Assess impacts of new sources.

The existing visibility protection program requires a review of visibility impairment from new or modified major stationary sources to prevent adverse impact on visibility in nearby Class I areas as part of the source permitting process. This is currently done following guidance issued by the Inter-Agency Workgroup for Air Quality Modeling. This review is needed to prevent future attributable impairment. To assess regional impacts, new sources should be incorporated as part of the process to address "reasonable progress." As noted above, EPA should develop appropriate guidance on new, large-scale regional models which will be able to incorporate all source impacts.

4. Obtain improved meteorological data.

Large-scale regional models are highly dependent on input of meteorological data. The wide separation between locations that measure winds aloft (i.e., National Weather Service balloon stations) contributes a high degree of uncertainty to the results of the modeling. Consideration should be given to expanding the network of sites that collect upper air soundings. In addition, local meteorological data at the Class I areas are needed to identify potential local source impacts. The coordination of region-wide intermittent control systems (such as region-wide smoke management) will necessitate an expansion in the meteorological data collection network in order for such a system to be effective.

ASSESSMENT TOOLS AND METHODOLOGY

1. Undertake more detailed economic studies.

More detailed economic studies are needed in order to determine more accurately the costs of controls and, of more importance, to understand the effects, both positive and negative, past and future, that these costs have on the local and regional economies and their growth. Potential economic effects needing more study include: economic benefits of cleaner air (such as to tourism), impacts of costs on companies and individuals that pay them (for instance, effects on profits, competitiveness and disposable income), and the feedback of control expenditures into other industries in the region (such as pollution controls, parts and services and electricity production to operate controls).

2. Develop better assessment tools and methods.

In order to provide an objective analysis of the effects of emissions management strategies for regional haze, specific components of research and development are needed, including:

a) expanded and improved inventory of control options and costs for use in assessments;

b) establishment of a mechanism to aggregate sources into assessment groups consistent with the spacial distribution of air quality modeling and economic assessment regions;

c) improved econometric analysis tools and techniques to characterize more accurately subregional, including tribal, impacts; and

d) upgraded methodological approaches for performing secondary assessments.

SECTION IV: TRIBAL PERSPECTIVES AND POSITION REGARDING RECOMMENDATIONS

Introduction

The following section provides background regarding tribal participation in the Commission process and the legal framework for tribal relationships with states and the federal government. Tribal participants in the process have also provided their unique perspectives on the Commission's recommendations, commenting on how those recommendations may affect tribal lands and peoples.

In large part, the tribal participants support the guiding principles set forth in Section III of this report and agree with the Commission's recommendations, as discussed in more detail below. In some instances, however, the tribal participants wish to highlight certain points made in this report or provide a distinct perspective and emphasis arising from tribal experience. These views are also set forth in this section.

The Tribal Environment

It is the philosophy of most Indian tribes that the quality of life of their members is intimately related to the quality of their environment, and that people and nature should be in harmony and balance. Vistas are important to tribes in spiritual and cultural ways but they are also important for economic reasons. The pristine and visible beauty of their homelands are often the reason for tourist visitations. These visitations support tourism and many cottage industries on the reservations and provide revenue for tribal governments.

As "harmony" requires, tribes also recognize that tribal populations are increasing and tribal governments must address the needs of their developing nations. Tribes are working to develop their economic infrastructure so that they can achieve self-sufficiency and provide for their people, including revenues for tribal governments. Tribal governments provide community services, such as road maintenance, water, environmental protection, education, health care, day care and other social services. As in any community, the demand for these services is expected to grow with the population, and tribes desire to grow economically to support these demands.

In order to achieve these goals, tribes cannot be unfairly burdened by regional or federal regulations. Any recommendations must ensure that emission control burdens do not fall disproportionately upon tribes. It must be remembered that tribes, by and large, have not contributed to the visibility problem in the region, precisely because of the lack of economic development in Indian country. Therefore, what is fair for states may not necessarily be fair for tribes. Tribal economies are much less developed than those of states, and tribes must have the opportunity to progress to reach some degree of parity with states in this regard. Further, economic and cultural differences may magnify the effects of recommended emission controls.

Acknowledgements

Tribal government approval and support of the Commission's recommendations is reserved to individual tribal government discretion. This reservation is not intended to represent rejection of efforts to arrive at consensus-based policy recommendations. Rather, it is based upon the legal and historic status of tribes as individual tribal nations; as sovereigns, tribal governments have the prerogative to deal directly with the federal government and may choose to do so in regard to western visibility protection and improvement. Whatever actions tribal governments ultimately choose to direct or pursue, they nevertheless have found value in working within the GCVTC process and have directed tribal representatives to learn from the GCVTC deliberations and contribute to the best of their abilities toward achieving a good that will benefit all people in the West.

A number of tribes have been represented on the Commission and on the various committees established by the Commission. Although these "tribal participants," as they are called in this report, do not represent all 211 tribes in the Transport Region, as individual participants in the GCVTC process they have joined together and reached consensus on a number of issues, as reflected in this report. When this report presents tribal positions on the Commission's recommendations, therefore, it is presenting the views of these tribal participants.

Co-Management Principles

The Grand Canyon Visibility Transport Region, as defined by the EPA, includes 211 tribes. Therefore, visibility improvement and protection strategies ultimately adopted by the EPA must be selected and implemented not only in light of statutory requirements of reasonable progress toward visibility, but also in light of certain basic principles of Indian law. The GCVTC recognizes and respects that the federal and tribal governments have a unique government-to-government relationship that is built on historic legal principles. The Commission's recommendations must be considered, not in terms of a federal-state framework, but in terms of a federal-state-tribal framework. These principles of Indian law and their ramifications for the Commission are set forth below.

Tribal Sovereignty

It is a basic principle of Indian law that tribes have inherent sovereignty over tribal lands, or "Indian country." Moreover, if a tribe does not assert its jurisdiction in a particular instance, then the federal government may have jurisdiction in the tribe's place, but a state government could not. As a result, emission management strategies will be implemented within Indian country by tribal governments or, failing that, by the federal government, but not by state governments.

Federal Trust Responsibility

The Courts have found that the federal government bears a trust responsibility toward American Indian tribes. This imposes fiduciary duties on the conduct of federal agencies toward Indian tribes and their natural resources. The trust relationship therefore presents a second basis, in addition to the principle of tribal sovereignty, for the EPA and other federal agencies involved in the GCVTC process to ensure that tribal interests are protected in any regulatory scheme.

Tribal Self-Determination

As acknowledged by Congress in the Indian Self-Determination and Education Assistance Act, there must be "effective and meaningful participation by the Indian people in the planning, conduct and administration" of programs affecting Indian people [25 U.S.C. § 450a(b)]. These principles are also embedded in the EPA policy for the Administration of Environmental Programs on Indian Reservations (November 8, 1984) in which the EPA states that it will "view Tribal Governments as the appropriate non-Federal parties for making decisions and carrying out program responsibilities affecting Indian reservations, their environments, and the health and welfare of the reservation populace." Each tribe is the decision-maker for its own future and is responsible for ensuring that the needs and rights of its people are met and protected. Tribal concerns must be taken into account in formulating recommendations.

Tribal Impacts Reports and Studies

Tribal participants feel that the report *Impact Projections of Emission Management Scenarios on Western Tribal Lands* (January 1996), was inadequate and provided only very general conclusions. The various other studies undertaken by the Commission did not adequately evaluate and describe the unique economic structures and demographic patterns of Indian tribes, nor their unique cultures and aspirations. Also, the studies very narrowly focused on straight line economic cost/benefit analysis. Other values are important to tribes: quality of life, freedom of religion and choice in lifestyle, to name a few. Future studies should address these important areas of concerns so that the tribes, and those concerned about impacts on tribes, will be able to more fully evaluate management option impacts.

Tribes were greatly disappointed that secondary assessment studies were not fully carried out. Little or no work was done to identify impacts on health and welfare, land and water uses, solid and hazardous waste disposal, threatened and endangered species, and terrestrial and aquatic ecosystems. This information would have been of great interest to the tribes and probably many others.

Program Implementation

Tribal governments have the responsibility to develop, implement, and manage programs within Indian country. If a tribe chooses not to establish a program, then the federal government has the trust responsibility to establish a program. Thus if the EPA promulgates a rule based on a control technology scenario, for example, tribes must have the option of implementing the rule within Indian country or prompting federal implementation of the rule within Indian country.

Similarly, a market trading scenario in which there was separate tribal participation or federal participation on behalf of the tribes could be legitimate.

Many tribes are just beginning to develop environmental programs, and these programs receive very minimal funding from the EPA, if any. Tribal governments also lack the tax base available to states to help fund environmental programs independently. Therefore, tribal implementation of visibility programs will require policy development support, technical assistance, and program funding.

In the implementation of an emissions trading program, special consideration for tribes is necessary. Given that many tribal lands are "underdeveloped," tribes should be allocated some additional share of trading credits to allow for future development, much as "clean" states were under the acid rain trading program.

Tribes, states, local governments and federal agencies must find innovative ways to support implementation of regional haze programs. Memoranda of Understanding or Memoranda of Agreement, and/or other state/tribal/federal agreements, could be utilized to share resources, expertise and responsibility.

TRIBAL PARTICIPANTS' POSITIONS ON COMMISSION RECOMMENDATIONS

As discussed above, the tribal participants for the most part concur in the Commission's recommendations set forth in this report. Specifically, the tribal participants agree with all six of the assessment criteria listed on page 20-21 of this report, although the tribal participants feel that the criteria were not uniformly applied. The tribal participants also have certain additional recommendations and perspectives which are presented below.

Air Pollution Prevention

Some of the most pristine, and yet the most threatened, ecosystems are found within the lands of indigenous peoples. The lack of many basic necessities, such as sustainable employment and adequate housing, creates the need for immediate economic development. Coupled with this is the lack of environmental protection infrastructure to manage and check efforts to develop economic opportunities which are proceeding without consideration for the traditional Indian commitment to resource conservation. Tribal communities, like others in the Transport Region, have the opportunity to take a proactive approach to pollution prevention and to avoid the mistakes of the past which have resulted in environmental degradation. Future initiatives should make sure that growth planning and development is coupled with environmental mitigation.

In the first subsection of Section III of this report, various pollution prevention recommendations are offered, including economic incentives for pollution prevention efforts, encouragement of zero and near-zero emitting technologies, and development of alternative (i.e., renewable) power sources. The importance of these recommendations is indicated by the prominence they receive in the Executive Summary of this report (they are listed as the first recommendation). Tribal participants support this recommendation wholeheartedly.

However, the extent to which deployment of renewable energy will improve visibility is not, nor can it be, stated with certainty, based on the modeling outputs available.

The modeling of renewable energy control scenarios is of paramount importance, particularly to western tribes. A significant number of tribes (33) are actively pursuing development of renewable energy and end-use efficiency technology applications. These development options involve remote electrification, bulk power generation, improving reservation economic conditions and reducing the emissions associated with fossil fuel generation. The Energy Policy Act of 1992 has intensified tribal interest in renewables by authorizing the Department of Energy to provide grants to tribes to evaluate the feasibility of renewable energy development.

The fact that western reservations are prominent within prime solar and wind energy resource areas and a number are situated in major electricity transmission corridors has focussed Congressional and tribal attention on joint ventures and other strategies for securing investment capital to build and operate bulk renewable electric generation capacity. Clearly, apart from the income obtained through wholesale power sales, renewable energy development will have great added value to tribal governments in the form of revenues from payments for accrued "air credits," and wages from jobs in a vertically integrated electric power industry.

Tribal participants support the recommendations to establish goals for bringing renewable power on line, but modeling efforts clearly need to be expanded to include the impacts of this recommendation. More specific details should underlie this recommendation, including goals, incentives and a timeline for adding renewables to the resource mix.

Stationary Sources

Tribal participants are concerned that PSD and the current visibility program (§ 169A) under the Clean Air Act insufficiently address the national goals of preventing and remedying visibility impairment in Class I areas caused by human-induced air pollution. Government Accounting Office estimates indicate that sources accounting for up to 90% of pollutants emitted near five Class I areas are exempt from PSD requirements, which apply only to new sources. Existing sources and small new sources are ignored by PSD. In addition, § 169A (existing sources) concentrates only on visible plumes, rather than regional haze, and very few existing sources have been required to implement BART controls.

Tribal participants in the Commission process support the stationary source recommendations presented in Section III of this report with the following additional concerns and recommendations:

1. All uncontrolled and undercontrolled stationary sources should be subject to equivalent emission standards as controlled sources.

2. An emissions cap should be set for SO_2.

3. A better inventory and better modeling should be developed for PM.

4. If a cap is established for a particular pollutants, minor sources on tribal lands should be inventoried since they may not currently appear in state inventories.

5. Data from the Federal Energy Regulatory Commission should be used as a basis for forecasts of future electric utility emissions and for recommendations regarding emission reduction goals. This will also enable the Commission to identify opportunities for early retirement of high-emitting facilities.

6. The effects of increased wholesale and retail competition in the utility industry must be taken into account in predicting future emission levels.

Moreover, if an emission trading strategy is adopted, tribal participants recommend the following:

1. Tribes must be involved in the development of the trading scenario.

2. Credits should not be based on historical emissions, but should be based on equitable factors, including the need to preserve opportunities for economic development on tribal lands. In general, these lands are currently lacking in economic bases and have not contributed to the visibility problems.

3. Whatever body administers the trading program must be representative of all of the groups involved.

4. The cap should be defined by region, not by state.

Mobile Source Controls

As programs are initiated, participating governments should receive compliance assurance assistance and equitable funding to administer their respective programs. In addition, tribal communities would benefit immensely from educational programs explaining the need for controls and demonstrating vehicle maintenance methods for minimizing vehicle emissions.

Tribal participants are concerned about mobile source emissions from federal vehicles on or near Indian lands, especially sites run by the Departments of Defense and Energy. Federal air traffic in these areas is of particular concern.

Area Sources

There are major gaps in delineating accurately the contribution of tribal land sources to visibility impairment. Very few air quality monitoring programs have been placed in or near tribal lands. To more accurately inventory emissions sources, monitoring capability should be significantly improved on and near tribal lands.

Wood Burning
Many rural Indian homes rely on wood-burning stoves as the sole source for cooking and residential heating. Programs should include a sole-source heating/cooking and ceremonial burning exemption from visibility and other air quality regulations on tribal lands.

Dirt Roads
There are numerous dirt roads within Indian country. If paving is required as a visibility protection measure, financial assistance will be needed. In addition, non-paving options should be considered.

Forest Management Practices
Many tribal lands include forest lands which the tribes often manage with prescribed fire. Although fire can contribute significantly to visibility impairment, tribal participants recognize that fire is an important management tool. Tribal participants recommend that the various jurisdictions (federal, tribal, state, etc.) develop and implement time, place and manner constraints that minimize visibility impairments.

In addition, forest land managers need to take into consideration the needs of tribal communities in their practice of religion and traditional cultural activities. Some of these activities may be protected under the provisions of the American Indian Religious Freedom Act. The availability of and access to areas where traditional medicines and spiritual foods are located should not be diminished by fire management practices.

Clean Air Corridor Controls

Tribes should not be penalized for having clean air and little economic development. Therefore, no inequitable restrictions should be imposed on tribal and other corridor residents and/or economic growth.

Future Scientific and Technical Needs

There is a need for the development of comprehensive emission inventories on and near tribal lands. These inventories may be used to provide more accurate data for future studies, and to prioritize regulatory development. Tribal participants recommend that the EPA assist tribes in this effort. In future tribal population and socio-economic studies, the data collection process should be designed to work more closely with tribes.

Future modeling tools need to be able to accommodate political subdivisions smaller than large counties. The economic modelling system needs to be adapted to tribal situations. The distinctive characteristics of tribal lands deserve special attention. Given the diversity of tribal populations and land bases, the broad-based regional and state level impact analyses do not provide sufficient and accurate data. Also, the unique economic structure and demographics of tribal peoples may be missed in the broader regional analysis.

Tribes need to be meaningfully involved in the development and implementation of future technical studies and in accommodating the special needs of tribes in various study methods and tools. Tribes will need the services of their own experts to help with these efforts, and will need financial assistance to obtain such experts.

Future Administrative Needs

Indian tribes have rarely been asked to participate in region-wide policy development such as that undertaken by the Commission. Although not all tribes have been involved, the tribal participants agree in principle that the work of an administrative body on air quality issues should continue.

SECTION V. FUTURE ADMINISTRATIVE NEEDS

Background

The Grand Canyon Visibility Transport Commission represents an experiment in regional policy development through cooperative partnership among state, tribal and federal governmental entities. The Commission has also engaged a broad range of interested parties from industry, environmental organizations, academics, technical experts, elected officials, and various citizens' organizations. Throughout this process, the Commission has provided a means for cooperative development of improved scientific information and for intergovernmental consideration of policy recommendations. The following recommendations regarding future administrative needs draw on this experience.

RECOMMENDATIONS FOR FUTURE ADMINISTRATIVE STRUCTURES

1. Continue a regional air quality entity, similar to the Commission.

The implementation and ongoing review of regional haze management strategies will require the work of an entity similar to the present Commission, most likely in a streamlined structure, based on the evaluation performed in recommendation #4 below. The Commission therefore recommends that the functions of the GCVTC should continue, in order to further develop this important partnership and perform vital policy and implementation functions as outlined in #3 below.

The name GCVTC focuses disproportionately on the Grand Canyon and should be changed to reflect the larger geographic entity it serves. The primary role of the Commission, or its successor, will continue to be coordination and monitoring in order to recommend policies to the appropriate entities. States, tribes and federal agencies will undertake implementation actions.

An equitable body of state, tribal and federal representatives should convene, as necessary but at least annually, for the purpose of: discussing visibility and other air quality issues, including public health concerns, and coordinating data collection efforts, and making recommendations to the EPA on reasonable progress and other air quality issues.

2. Integrate efforts of an administrative body with other regional air quality needs and planning efforts.

It is expected that the EPA will soon undertake new air quality initiatives that also require regional approaches. The participating entities should explore expanding the scope and structure of a successor body to address regional haze and other fine particulate impacts on visibility and health throughout the Western United States. (If the mandate is expanded the name of the successor body should reflect the new mission.)

3. Establish functions of a successor entity.

After it makes its initial recommendations to the EPA, the Commission or its successor should, through its subgroups, perform functions including, but not limited to, the following:

a) tracking and providing feedback to the EPA on EPA's interpretation and implementation of Commission recommendations;

b) coordinating implementation of inter-jurisdictional mechanisms for addressing regional haze, including monitoring activities;

c) tracking implementation of programs for addressing regional haze to ensure equity;

d) assessing emissions and visibility data to determine if reasonable progress is being made towards the national visibility goal, and recommending adjustments to regional haze management strategies, as necessary;

e) promoting the development of innovative, cost-effective mechanisms for addressing regional haze;

f) coordinating research and development efforts on visibility and airborne particulate assessment methodologies in the West to ensure that such efforts are focussed on concerns relevant to policy formulation[14];

g) providing a forum for interested parties to offer input on the development of regional haze policies;

h) promoting and supporting educational programs furthering visibility (or expanded air quality) goals, in public schools, in higher education and to the general public;

i) supporting energy-conservation measures; and

[14] See Section III, Future Scientific and Technical Needs.

j) promoting outreach and communications programs for tribal communities in order to address the remoteness and educational needs of most Indian reservations.

4. Evaluate and review Commission structures.

In order to create efficient, effective and sustainable long-term structures, an evaluation of the Commission's present and past functioning should be conducted. Such a review should examine the composition of the Commission, operational structures, and management arrangements, and should generate recommendations regarding future functional arrangements. To ensure neutrality in the evaluation, the review should be conducted by an independent outside source. Following such an evaluation, each participating governmental entity will be consulted about whether and how it will take part in future activities.

During the period through its report to the EPA in the spring of 1996, the Commission has functioned with governors or other high-level state, tribal and federal leaders serving as Commissioners. If the Commission becomes an ongoing body, consideration should be given to whether other federal, state and tribal officials may be the most appropriate appointees as Commissioners. Any future management or administrative structures should consist of an equitable body of federal, state and tribal representatives. Public participation in future efforts should be ensured through the use and creation of publicly accessible working groups.

5. Develop ongoing funding mechanisms.

In order to estimate the resources, human and financial, that will be necessary to sustain this work (e.g., basic administrative functions, specific research and monitoring activities), a projected five-year budget should be developed in conjunction with development of a comprehensive plan for future operations.

The EPA should provide ongoing financial support for the basic administrative functions of the Commission or its successor. Work should continue in cooperation with the EPA to support efforts to secure such funding. In the course of evaluating all current Commission functions (see #4 above), the benefits and feasibility of additional sources of funds for specific activities should be explored, including:

a) visibility surcharges on entrance fees for Class I areas within the Colorado Plateau;

b) dedicated air permit or emission fees; and

c) redistribution of existing air pollution control funds.

Equitable funding should be made available to tribal, state and federal officials to support participation in ongoing data collections and modeling efforts.

6. Planning process for future functions.

The Commission is convinced that its functions must continue in some form in order to ensure that regional haze management strategies which are implemented meet with regional approval. In order to continue the functions of the Commission without any hiatus, the Commission directs the Operations Committee to:

a) Follow up on the Commission's recommendations, monitor interpretation by EPA of the Commission's recommendations, seek funds for future operations, and perform needed interim tasks;

b) Prepare a comprehensive set of recommendations regarding how and in what form to continue the Commission by early September 1996, building on the recommendations in this section above. These recommendations will include provisions regarding:

- the structure of the Commission and any subsidiary bodies;
- the participation of states, tribes, and federal agencies on the Commission;
- involvement of stakeholder representatives in Commission processes;
- administrative arrangements;
- the scope of Commission activities; and
- changes in the Commission's by-laws needed to implement a reconstituted Commission.

By mid-September 1996, the Operations Committee will distribute its detailed recommendations as above to the Commissioners by mailed ballot for action.

Note: For tribal perspectives and commentary on these recommendations, see Section IV.

SECTION VI: ANALYSIS OF THE COMMISSION'S RECOMMENDATIONS

Introduction

This section presents the Commission's analysis of the likely effects associated with its recommendations. The analysis attempts to address these key questions:

1. How will the Commission's recommendations affect visibility at Class I sites in the Transport Region?

2. What are the likely economic effects, both direct and indirect, of the Commission's recommendations?

3. What are the likely environmental, social, equity, and administrative effects of the Commission's recommendations?

The analysis is divided into two main parts. The first is a summary, using graphs, of likely visibility effects associated with the Commission's recommendations, where effects are known. Such effects are not, in all cases, known. The second part is a detailed discussion of the Commission's recommendations in light of the evaluation criteria identified in Section II of this report (page 20-21).

Visibility Gains from the Commission's Recommendations

The overall goal of the Commission's recommendations is to improve visibility on the worst days and to preserve existing visibility on the best days, at Class I areas on the Colorado Plateau. The recommendations focus on reducing emissions from sources that presently contribute to visibility impairment and are likely to do so in the future.

The Baseline Forecast Scenario described in Section II (page 9) projects the way in which current federal, state, and tribal laws and programs are likely to affect visibility at Class I areas on the Colorado Plateau through 2040. The Commission used this "current law" scenario to evaluate the *additional* improvements in visibility that its recommendations are likely to achieve in order to meet the national visibility goal.

Figure VI-1 consists of two graphs. The first, labeled Figure VI-1A: "Visibility Range Determined by the Integrated Assessment System", represents the range of estimated visibility conditions between the baseline forecast assumptions and a maximum emissions management alternative in the Integrated Assessment System. The darkly shaded area on the graph represents the difference between the estimated visibility conditions resulting from current air quality programs and the maximum improvement from emissions control actions that were included within the Integrated Assessment System.

One limitation of the Integrated Assessment System is that several source categories were not characterized as incorporating cleaner emissions technologies over time as is likely under current and future air quality management programs. To address this shortcoming, the Commission developed a "bounding" estimate of the upper limit visibility conditions that could result from making adjustments to the Integrated Assessment System baseline assumptions for both growth of certain sources and future controlled emissions from certain sources.

The second graph labeled Figure VI-1B: "Visibility Range Expected from Recommendations", reflects this approach. The darkly shaded area of this graph represents the difference between holding visibility constant from the year 2000 to a maximum potential improvement from changes in the Integrated Assessment System baseline assumptions and future source control levels. To define the maximum source control, certain source categories were assumed to reduce their contribution to extinction over time in a way similar to Integrated Assessment System source categories that had technological improvements of approximately 74% reduction from 1990 levels of impact. This probably results in an overprediction of the likely effect, however it is a reasonable estimate of the maximum effect for this bounding exercise.

The Integrated Assessment System source categories that were adjusted for this estimate are: industrial/commercial fuels, non-road diesel, industrial processes, solvent use, a portion of other point sources, and other area sources. The estimate also reflects a change in the baseline assumptions for paved road dust in the Integrated Assessment System. This graph assumes small growth in paved road dust from increased vehicle miles traveled to the year 2000 and then a leveling off. This was based on uncertainty of the current contribution of road dust to light extinction. Overall, the graph demonstrates the Commission's belief that, under its definition of "reasonable progress," most source categories will improve efficiency and reduce emissions over time. The emissions reductions and associated visibility change plotted in this graph would be tracked and checked by monitoring long-term trends.

The lightly shaded region on the bottom of both graphs in Figure VI-1 represents the "background" light extinction from natural causes (e.g., windblown dust). On average, this amount of extinction represents the best annual average extinction possible if all the effects of human-caused impairment are addressed. Currently approximately 20% of the days have this visibility level. This is approximately equivalent to the best visibility conditions pictured in the Introduction and plotted in Figure II-7. Human activities that were not included in the Integrated Assessment System options for control are approximately 2 Mm^{-1} above this "background" level. While the improvement in extinction associated with the recommendations in the second graph in Figure VI-1 may appear small, they will correspond to much larger changes on some days. While these graphs show effects only at Hopi Point, the Commission's recommendations are likely to result in approximately the same range of visibility benefits at other Class I areas.

Figure VI-1A

Visibility Range Determined by the Integrated Assessment System

(Hopi Point, Annual Average)

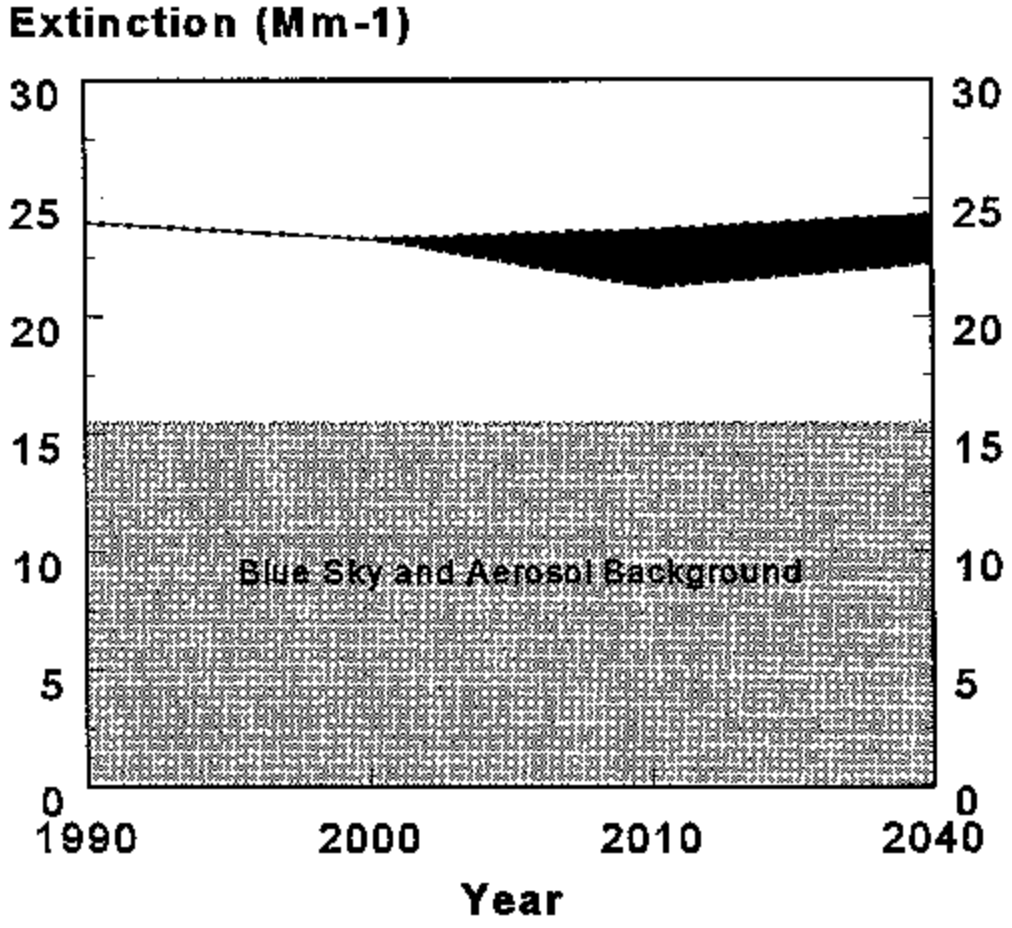
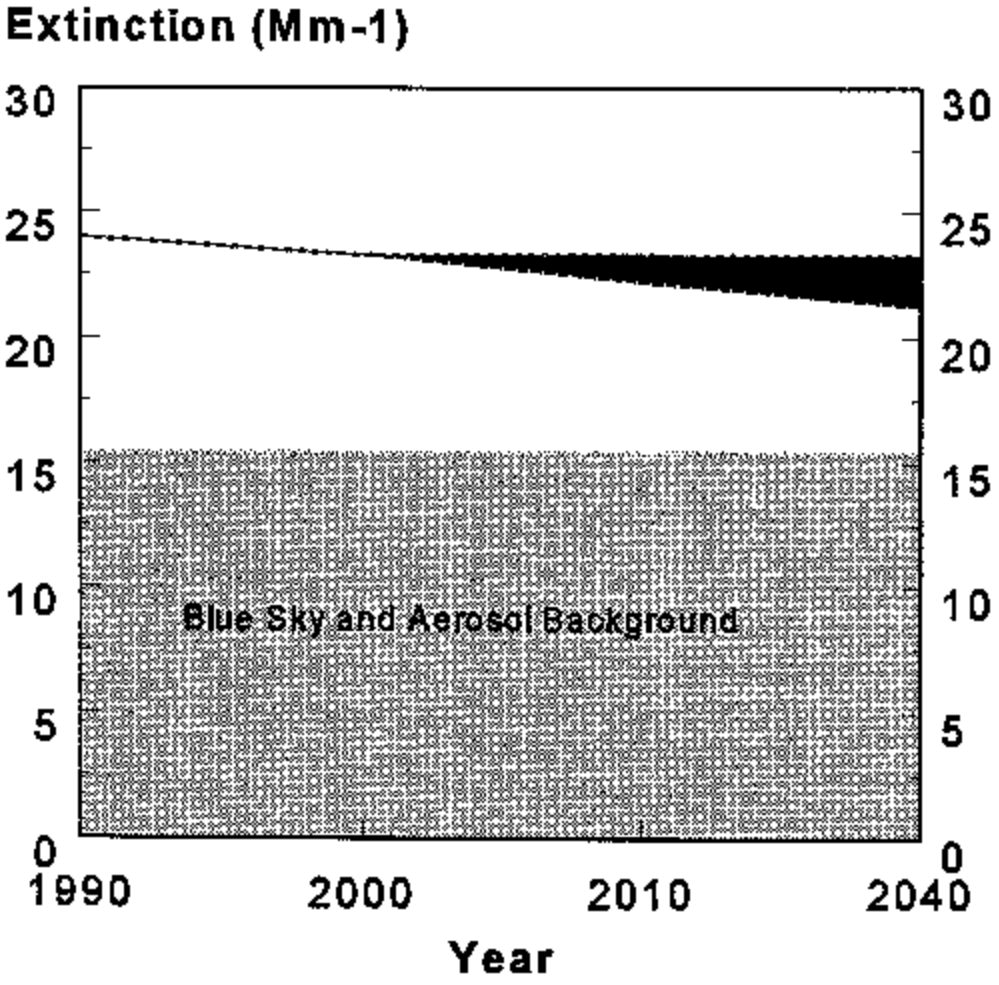


Figure VI-1B

Visibility Range Expected from Recommendations

(Hopi Point, Annual Average)

Includes Changes to IAS Baseline and Results of Recommended Measures to Protect Visibility



ANALYSIS OF SPECIFIC COMMISSION RECOMMENDATIONS

Introduction

This section reviews in greater detail the likely effects of the Commission's recommendations in light of the evaluation criteria described in Section II. The Commission has divided its six criteria into two groups: visibility benefits and economic effects in one group, and social, environmental, equity, and administrative effects in another. The first part of this section is an overview of the Commission's efforts to develop rough cost estimates for its recommendations. The second part of this section discusses specific Commission recommendations. Visibility and costs are addressed in connection with each set of recommendations. The remaining four criteria are discussed as a separate group.

The Commission's recommendations reflect, but are substantially different from the scenarios developed initially by its technical committees. The Commission represents a range of interests, and its recommendations exhibit the real world of give and take among these interests. The Commission could not simply decide to adopt one of its earlier scenarios because Commission members needed to address a range of concerns not reflected in those scenarios. One such example is recommendations supporting pollution prevention and renewable energy. In addition, the Commission's early scenarios could not have anticipated all the different combinations of controls that would be considered.

As a result, there is not a perfect fit among the Commission's recommendations, the early scenarios used in modeling, and prior reports to the Commission. Where some or all of a recommendation is not part of an earlier scenario, it is possible only to estimate its visibility benefits or economic costs at this time. An examination of the Commission's recommendations requires a synthesis of its earlier analytical work and new analyses that reflect the control choices recommended by the Commission. The results of the work of the Commission's technical committees are discussed below.

Certain points should be kept in mind when looking at modeling results that show visibility effects. One is that data about visibility effects often are stated in terms of an annual average. This average includes effects for "clear" days as well as "dirty" days. Most emissions reductions, however, are directed at improving air quality on dirty days, and using an annual average understates their short-term effect. For example, the effects of emissions reductions achieved in Los Angeles will only be observed 25% of the time on the Colorado Plateau, due to wind patterns. On days when those improvements are observed, they will be much greater than the annual average.

Another important point is that most of the modeling to date addresses visibility effects at only one receptor: Hopi Point in Grand Canyon National Park. This receptor is not necessarily representative of all Class I sites, but it offered a substantial amount of high-quality data. Hopi Point may have unique localized influences, and it is also influenced by emissions from a combination of directions that may not occur at other Class I areas. To address these potential limitations, the Commission has analyzed three other Class I areas. This broader approach makes more emission source regions relevant to the analysis, but is not a complete substitute for modeling all Class I areas.

Preliminary Cost Scenario

It is not possible to estimate reliably the economic costs and benefits of the Commission's recommendations at this time. The recommendations are largely conceptual in nature, and the direct and indirect costs and benefits will vary depending on when and how specific strategies are implemented.

The Commission has developed preliminary rough projections of the direct and indirect costs of achieving visibility improvements at Class I areas on the Colorado Plateau. Direct costs are the costs of imposing emission controls to improve visibility. Indirect costs are the additional effects on the region's economy from imposing those controls, including wages, employment, and "feedback" of expenditures into the regional economy.

Sources of emissions in the West previously have incurred costs in order to comply with requirements of the federal Clean Air Act, and state and tribal programs covering all aspects of air quality. These costs will continue. The Commission's focus is on any *additional* costs, beyond those resulting from compliance with current law, that may be associated with improving visibility at Class I areas on the Colorado Plateau.

As a first step, the Commission has developed rough estimates of some of the potential costs and benefits associated with emission management options that bear some similarity to its recommendations. These emission management options were designed early in the Commission's process, and do not match the Commission's recommendations. The Commission's rough estimates using these early options show the following:

1. There will be no significant incremental cost associated with the Commission's recommendations in the short term because they reflect diligent implementation of existing programs and new programs likely to be implemented for other reasons.

2. If the full set of recommendations is implemented, including a market-based emissions cap and trading program, the potential range of costs after 2010 under the Commission's preliminary rough estimate is from $500 million to $1.8 billion per year. (These cost estimates were generated by the IAS based on optimization runs for 25% and 80% of the Maximum Management Alternative.) This translates roughly into a 0.1% decrease in gross regional product in peak years, or approximately $10 per person, and an overall increase of jobs in the region of approximately 0.5% through 2040.

These rough estimates are only the first step in developing an estimate of costs associated with the Commission's recommendations. They do not reflect any cost savings or economic benefits that may be associated with these emission reductions, such as health care savings and enhanced property values.

Analysis of Air Pollution Prevention Recommendations

Visibility and Cost Effects

There currently is no quantitative assessment of the visibility improvements that might result from the Commission's recommendations in this area, or of their likely economic effects.

Intuitively, substituting non-emitting or lower emitting technologies likely will result in improved visibility. This includes encouraging "clean" sources of energy in new industries. Several recommendations will probably have direct economic effects. One example is recommendation #3, which supports economic incentives to promote industrial retooling that reduces emissions. Another example is recommendation #6, which suggests the possibility of charging emission fees for air pollution.

Analysis of Stationary Source Recommendations

Visibility and Cost Effects

The recommendations regarding stationary sources involves establishing emission reduction targets for sulfur dioxide consistent with those anticipated under the Baseline Forecast Scenario, which was designed to reflect requirements under current regulations. It is anticipated that the emission reduction targets will be achieved through compliance with current regulations and voluntary and economically driven decision making of sources. Therefore, no additional costs would be incurred to impose controls if the targets are met. The only cost of the program would be the administrative aspects of collecting and analyzing information on emission trends in the Transport Region.

If emission reductions are not achieved through compliance with current regulations and voluntary and economically driven decision making, then a program would be established to enforce more rigid reductions. Earlier studies showed that a regional emissions cap and market trading program is the most cost-effective approach to deal with regional haze. However, equity and administrative issues associated with this type of program are complex and need to be dealt with thoroughly in developing a detailed implementation plan. Under this "back stop" program, some costs of controls may be expected, but cannot be quantified at this time.

The incorporation of other pollutant species into the stationary source program will have similar emission reduction effects. To the extent that long range targets are established on the basis of expectations under current regulatory requirements, then no additional costs associated with the visibility program would be incurred, other than monitoring and assessment. It is anticipated that annual average light extinction from 1990 through 2040 at Hopi Point would be improved between 0.8 and 1.0 Mm^{-1}, depending on the actual control levels achieved for those stationary sources sectors which have not been analyzed in detail.

Analysis of Mobile Source Recommendations

Visibility and Cost Effects

The Commission's recommendations incorporate national, regional, and local strategies for addressing mobile source emissions. In reviewing these recommendations and their projected effects, it is important to bear in mind that the Commission's model appears to understate urban effects and that mobile sources are a significant part of urban emissions. As a result, it is likely that the model underpredicts mobile source impacts on visibility, primarily from tailpipe emissions.

Current modeling shows that approximately 30% (3.5 Mm^{-1}) of the annual human-caused light extinction at Hopi Point in the year 2000 is caused by mobile sources (roads, on-road vehicles, off-road vehicles, aviation, marine, and locomotives). Most of this impact (2.5 Mm^{-1}) is attributed to road dust under current modeling; the balance (1 Mm^{-1}) comes from tailpipe emissions.

As part of a national strategy, the Commission recommends supporting the 49-state LEV. A recent study by the AAMA shows that the 49-state LEV is likely to reduce emissions of NO_x and VOC from on-road vehicles below the BFS by at least 35% by 2020. According to the Commission's model, this would translate into only a small annual visibility improvement at Hopi Point. However, more work is required to determine whether the model underestimates this impact.

Potential visibility benefits from all other mobile source categories (off-road vehicles, boats, airplanes, locomotives) are approximately 11% of the total mobile source contribution based on current modeling.

The Commission has not modeled the visibility effects of its proposed regional and local mobile source initiatives. The same limitation applies to estimates of the costs associated with imposing mobile source controls. Depending on the costs associated with different categories, it may be cost-effective to achieve the relatively small visibility benefits associated with different national strategies noted above. Additional work is required to develop this information.

Analysis of Area Sources/Fire Recommendations

Visibility and Cost Effects

Millions of wildland acres in the Transport Region are at risk from catastrophic wildfire. These areas will burn eventually, and the fires will impair visibility at Class I areas on the Colorado Plateau. The Commission's models indicate that emissions from fire, both wildfire and prescribed fire, is likely to have the single greatest impact on visibility at Class I areas through 2040. Current modeling indicates that, at certain times, increased visibility impairment from fire is likely to exceed the potential visibility improvements associated with other Commission recommendations.

The Fire Emissions Project of the Commission found that, historically, fire occurred on approximately 35 million acres annually. This corresponds to an annual visibility impact of 8-13 Mm^{-1}. Current prescribed fire programs across the Transport Region cover approximately 1.2 million acres annually. In 1995, $PM_{2.5}$ emissions from prescribed fire were estimated to be approximately 75,000 tons per year, less than 1% of total $PM_{2.5}$ emissions from all sources in the Transport Region. The proposed future prescribed fire programs of land managers would treat approximately 6 million acres annually by the year 2040, increasing the relative contribution to 3% of total $PM_{2.5}$ emissions in the Transport Region. This projected target is consistent with current land management agency fire policies, but is dependent on available resources and funding. Significant increases in fire on all wildlands will occur, whether by managed prescribed fire or by uncontrolled wildfire, if proposed prescribed fire programs are not implemented.

Fire has seasonal impacts on visibility; it is not a constant influence. During certain periods (days or weeks) of intense fire activity, the visibility impacts of prescribed fire may be much greater than the average annual impacts. Most wildfires occur in the summer and fall; prescribed fires are used in the spring, summer, and fall. The clearest days on the Colorado Plateau occur during the winter. As a result, increased fire emissions are likely to make the worst 20% of days even worse, rather than impair visibility on clear days. Both prescribed fire and wildfire activity are dependent on weather conditions, resulting in visibility effects that can fluctuate widely from year to year. Table VI-1 shows the range of visibility impacts that are projected to occur from the use of prescribed fire and wildfire.

TABLE VI-1

Annual Average[1] Prescribed Fire/Wildfire Visibility Impacts in Mm^{-1}

Year	Prescribed Fire Baseline[2]	Prescribed Fire with Maximum Controls[3]	Wildfire[4]
1990-2000	0.3 - 0.5	NA	0.1 - 1.0
2010	1.5 - 2.0	1.4 - 1.7	0.1 - 1.0
2040	1.6 - 2.2	1.4 - 1.9	0.1 - 1.0

[1] Seasonal impacts may be 2-3 times higher than the annual average.

[2] Baseline projections in 2010 and 2040 reflect projected prescribed fire programs under current land management policies. Emissions may be overestimated due to fiscal and personnel constraints and National Ambient Air Quality Standards requirements.

[3] Prescribed fire emissions can be reduced through smoke reduction measures (mechanical treatment, etc.). These impacts may be further mitigated by managing the timing of burning based on meteorology.

[4] Although the Commission believes that increased use of prescribed fire activity will result in long-term reductions of wildfire emissions, the Commission has been unable to quantify this benefit.

The Commission's recommendations focused on ways to limit the increased visibility impairment from fire that could occur through 2040. Since land managers will be increasing their use of prescribed fire techniques to reduce wildfires, there is an opportunity to reduce the growth in visibility impairment projected to occur.

It is important to bear in mind that fire has highly variable effects on visibility, even on a daily basis. The Commission's model cannot reflect this variability.

Even using "optimal" smoke management measures, prescribed fire's contribution to annual visibility impairment at Hopi Point could increase by 400% between 1995 and 2040. The Commission's fire modeling projects that use of optimal smoke management measures could decrease fine particle ($PM_{2.5}$) emissions from prescribed fires by approximately 15-20%. This would limit the increased visibility impairment at Class I areas that likely will be caused by prescribed fires through 2040. In practice, land managers consider daily weather conditions to minimize effects from prescribed burning. The Commission's model does not permit an analysis of how these decisions, based on weather conditions, influence smoke impacts.

Using "optimal" smoke management and emission reduction measures is projected to cost approximately $500-$2,000 per ton of $PM_{2.5}$ reduction. Reducing $PM_{2.5}$ emissions by 15-20% over projected increases is estimated to cost approximately $65-$75 million annually.

Analysis of Clean Air Corridors Recommendations

The Commission is not recommending any special programs or regulations for clean air corridors beyond existing law. The basis for this approach is model results showing that projected emissions growth in the studied clean air corridor is not expected to have a perceptible impact on visibility at Class I sites.

Analysis of Recommendations Regarding Emissions Within and Near Class I Areas

Visibility and Cost Impacts
The Commission's recommendations address a range of transportation and energy-related emissions, as well as emissions from prescribed fire, that occur both within and near Class I areas.

Particle emissions in and near Class I areas deserve particular attention because they have potential immediate consequences for visibility. Approximately two-thirds of particles measured at Hopi Point consist of fine soil and coarse material ($PM_{2.5}$ and PM_{10}). Fine soil from sources near and distant from Class I areas accounts for about one-third of the visibility impairment caused by particles. Sources of coarse material have relatively small spheres of influence, i.e., coarse material generally doesn't travel far. As a result, the data from Hopi Point indicate that sources of coarse material located close to Class I areas, such as unpaved roads, are likely to be more important to visual air quality than regional sources. Forest fires burning close to or within Class I areas can also be expected to have significant impacts on visibility, since they emit coarse and fine dust as well as elemental and organic carbon.

The Commission recommends improved planning to reduce visibility effects from sources of coarse material and fine dust both within and near Class I areas. The Commission's model does not allow modeling of the potential visibility impacts of this recommendation. The same modeling limitation applies to the recommendation that strategies be developed to limit emissions from local sources.

The Commission has not quantified the visibility benefits associated with its recommendations concerning other transportation and energy-related emissions. The Commission has not developed any cost analysis for these recommendations.

Analysis of Transboundary Emissions Recommendations

Visibility and Cost Effects

The Commission's model presently shows that emissions from Mexico result in annual average visibility impacts at Hopi Point of approximately 1.68 Mm^{-1}. Of this amount, approximately 1 Mm^{-1} is attributed to industrial and residential sources near the U.S.-Mexico border. Of the remainder, approximately half is attributed to specific stationary sources; the remainder to off-shore shipping emissions that travel across Mexico to the United States. This is approximately 17% of manageable visibility impairment at Hopi Point on an annual average basis. Using an annual average likely understates the impact of these emissions on a given day, because meteorological conditions limit their influence to approximately 25% of the year. It is likely that on certain days the light extinction is much greater. The Commission has not modeled visibility impacts at other Class I areas.

Most of the transboundary emissions (about 60%) are SO_x, and most come from area sources within Mexico. At least one smelter located within Mexico is projected to be responsible for approximately 14% (0.24 Mm^{-1}) of the annual total transboundary light extinction at Hopi Point. The Commission is aware of reports that this source is scheduled to be shut down within the next few years.

A comprehensive emissions inventory will give a clearer picture of the different sources of transboundary emissions. Programs to finance air pollution control projects, to provide incentives for transboundary investment in pollution control, and to retire major emitting sources are likely to have visibility benefits at Hopi Point. However, more work is required on the emissions inventory before these benefits can be quantified.

One important issue associated with these emissions is whether they are "manageable" in the same way that emissions from sources located within the United States are manageable.

The Commission is unable at this time to estimate the potential costs associated with its recommendations.

Analysis of Scientific and Technical Needs Recommendations

The Commission has made a number of recommendations that include additional monitoring, data collection and reporting. These activities are the key to implementing many of its other recommendations. It is not practical at this time to estimate the costs associated with these activities.

Discussion of Environmental, Social, Equity, and Administrative Effects

The Commission's recommendations are a mix of the specific and the general. While analysis of the economic, social, environmental, equity, and administrative impacts of *specific* recommendations can yield robust conclusions, predicting the effects of *general* recommendations is at best an uncertain process. This is particularly true for the 211 Indian tribes located on the Colorado Plateau, whose peoples have unique economies and lifestyles. These issues are addressed more fully in Section IV on "Tribal Perspectives" in this report. The Commission's economic model also has certain limitations. The process for evaluating criteria other than costs relies primarily on data from the economic model, which present impacts at the level of a large county. The economic model is not designed to address rural areas with small populations, or Indian tribes, and its output has limited utility at best in assessing impacts for these groups.

The Commission's equity concerns include addressing the following questions: Are the sources causing the problem paying for/contributing fairly to the solution? Are sources causing the problem paying for the solution in proportion to their current contribution and current control levels? The Commission's formal assessments have not analyzed whether some income groups will be affected more than others or whether there are ethnic patterns to the outcomes of the recommendations. These issues are of particular concern to areas which are relatively underdeveloped within the Transport Region.

With respect to equity for rural and underdeveloped areas, including most tribal lands, it is important to note that such areas have not contributed significantly to the regional haze problem. One method for measuring equity is to ensure that all groups contribute fairly to solutions, relative to their role as an emissions source and their economic position (that is, in proportion to the ability to pay).

While the Commission has sought to distribute the burden of its recommendation equitably, inadequacies in the primary and secondary assessment process (e.g., lack of emissions data for tribal lands, inability of the economic model to analyze areas smaller than a county, and lack of tribal data inputs to economic modeling) require continued vigilance to guarantee strong application of the equity criterion in all implementation plans and in monitoring the impacts of the Commission's recommendations.

With these limitations in mind, the Commission offers its perspective on the so-called "secondary" impacts associated with its recommendations.

Tourism. One issue relevant to all the Commission's recommendations is tourism in the region. Research conducted for the Commission shows that national parks in the West are

important contributors to the economy as well as the quality of life. National parks in the study generated over 100,000 jobs and almost $5 billion in gross regional product in 1994. Most park visitors come to enjoy the scenery. Any noticeable impairment of visibility could significantly affect park visits and, as a result, the regional economy. However, there currently are no studies that assess the link between air quality and park visits, so stronger conclusions cannot be drawn.

Air Pollution Prevention. The Commission's recommendations concerning air pollution prevention illustrate the limitations of projecting effects at this time. The recommendations themselves are general in nature. Because they were not modeled, there presently is no information about the costs and benefits. Nevertheless, there is reason to believe that promoting alternative energy sources would have some economic benefits, in the form of increased investment in alternative technologies and increased employment in the alternative technology sector. Some Indian tribes have invested significant resources in this area, and could benefit economically from expansion of alternative energy technologies and creation of incentives for their use. To the extent there are economic benefits to Indian tribes investing in these technologies, it is reasonable to expect some social benefits. "Clean" technologies would likely have an overall positive impact on the environment of the region. However, a more specific conclusion would require knowledge of the specific technologies under consideration.

Stationary Sources. Turning to the recommendations about stationary sources, there are some important concerns. Under a regional cap/trading program, there are fundamental questions about how initial credits will be allocated and how reductions would be timed. If credits are allocated simply on the basis of historical emissions, there are potential equity issues for new emissions sources. This concern has been raised specifically by Indian tribes. There also are significant equity and other issues about how such a program affects sub-regions where companies may sell their credits and move away, or conversely how it would affect areas where industries that acquire pollution credits are located.

Mobile Sources. To the extent that national strategies, such as the 49-state LEV or low sulfur fuels, are adopted, the average costs of implementation will decrease because they are spread over a large area and population.

The Commission is aware of the potential equity impacts associated with some of its mobile source recommendations. One example is retiring high-emitting vehicles. These vehicles tend to be owned by persons without the economic means to acquire newer, low-emitting vehicles. This recommendation also poses potential equity issues for Indian tribes. Another example is enhanced inspection and maintenance programs. These can have differential impacts on lower income groups, and raise equity concerns.

Area Sources/Fire. The use of prescribed fire has clear significance for the health of ecosystems throughout the West. A better understanding of fire's role in ecosystem health underlies the recommendation supporting the increased use of prescribed fire, along with smoke management techniques. In the long run, this recommendation will result in environmental benefits in the Transport Region.

Mechanical treatment will be labor-intensive and may provide significant employment opportunities. Substantial subsidies may be required for some use of the biomass resulting from mechanical treatment programs. Biomass utilization may be possible in some energy markets, and the development of other woody material markets is also possible.

There are social and equity issues associated with fire policy. One of these involves Indian tribes that conduct their own timber, agriculture, and habitat management operations. Any policy that restricts the ability of these tribes to develop these operations could have an impact disproportionate to that felt by other groups, such as federal land managers. This issue is discussed further in the section on "Tribal Perspectives."

Emissions Within and Near Class I Areas. The Commission's recommendations are likely to affect communities located "within and near" Class I areas. These could be major urban centers, smaller rural communities, or Indian tribes. One potential emissions source in these communities is unpaved roads. Measures to reduce dust could have disproportionate impacts on these communities, and on groups within each community. Paving roads can increase use, thereby causing a range of economic and social impacts. Depending on who paid to pave roads, there could be significant equity impacts as well. Pollutant "plumes" from urban areas also raise equity issues involving who should bear the cost of addressing mobile and area source emissions that are part of these plumes.

Transboundary Emissions. Communities located close to the border may be bearing a disproportionate share of the impact from transborder emissions. These same communities probably would reap the greatest benefit from emissions reductions, but may be unable to contribute financially to emission reduction strategies. This issue is also addressed in the section on "Tribal Perspectives."