Staff Report on:

STATE AND DISTRICT AIR QUALITY PLANNING: TRENDS AND RESTRUCTURING IMPLICATIONS

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INTRODUCTION

This paper provides an overview of the status of different activities in the air quality arena that may affect existing and future power plants under a restructured electricity market. It addresses portions of ***ER 96***, The Implications of Electricity Industry Restructuring on the Environment issues. Specifically, it discusses: a) the on-going revisions to the national ambient air quality standards for ozone and particulate matter; b) the latest activities at the international level to comply with the Framework Convention on Climate Change (FCCC); c) the issue of interbasin transport; d) the development of air quality management plans; and, e) the movement towards market-based programs as a means to provide a flexible and cost effective mechanism for achieving compliance with ambient air quality standards. The discussion of the above topics is by no means exhaustive, and is intended only to provide a framework to use in evaluating future developments in the electricity generating sector, transmission and distribution.

NATIONAL AMBIENT AIR QUALITY STANDARDS

The U.S. Environmental Protection Agency (EPA) is reviewing the National Ambient Air Quality standards (NAAQS) for ozone and particulate matter. The American Lung Association and others sued the EPA for failing to review the particulate matter standards on a five year interval, as required by the Federal Clean Air Act (FCAA). The latest review occurred in 1987 when the current PM_{10} standards were adopted. Now EPA is under a court order to decide by the middle of 1997, based on the latest scientific information, if the current standard for particulate matter should be maintained or replaced. With regard to the ozone standard, there is not a similar deadline imposed by a court, however, EPA is committed to reviewing the standard in an expeditious manner, and a formal proposal by the EPA administrator on the ozone standard is expected this year.

Particulate Matter Standards

A growing number of community epidemiological studies have pointed out an association between ambient concentration of particulate matter and human morbidity and mortality. This association has been found at concentrations well below the current NAAQS (EPA 1996a). Some scientists point out than an association does not demonstrate causality and that there is a need for more evidence from animal, occupational, and clinical studies before setting new standards. In addition, the same critics argue that community epidemiological studies do not capture actual human exposure since they infer human exposure from measurement taken in central outdoor monitoring stations, while most people spend most of their time indoors. On the other hand, some limited recent animal studies suggest that exposure to ultrafine particulate matter does cause increased mortality, even at moderate levels (Oberdörster 1995).

They also have determined that ambient concentrations of fine particles (less than 2.5 micrometer (µm) or $PM_{2.5}$) are evenly distributed and that measured concentrations in central monitoring stations correlate well with concentrations measured indoors[1] (Wallace 1996).

EPA staff have released a draft paper in which they argue for tightening the current particulate matter standard. The proposal would abolish the 24-hour PM_{10} standard and replace it with a 24 hour average (24-hr) $PM_{2.5}$ standard. The 24-hr $PM_{2.5}$ standard would be in the range of 25 micrograms per cubic meter (µg/m^3) to 85 µg/m^3. The EPA Administrator is in charge of determining the exact level of the standard. The same draft staff paper also recommends maintaining the current annual PM_{10} standard and adopting a new annual $PM_{2.5}$ standard between 15 and 30 µg/m^3.

From extensive field studies done in the South Coast and San Joaquin Valley Air Basins, and limited studies in the San Francisco Bay Area, it is known that during winter time high PM_{10} episodes, the contribution of secondary nitrates (mainly ammonium nitrate) is substantial and that most of the secondary nitrates are in the $PM_{2.5}$ range. Current efforts to reduce emissions of oxides of nitrogen, an ozone precursor, have the indirect effect of reducing the abundance of nitrogen compounds in the atmosphere, including nitrates. However, additional efforts to reduce ammonia emissions may be needed in areas where secondary nitrates are limited by the amount of ammonia present in the atmosphere. Implementing new national $PM_{2.5}$ standard at the levels proposed by EPA's staff may change current federal PM_{10} attainment areas, such as the San Francisco Bay Area, to a nonattainment status (Fairley 1996).

If EPA decides to establish a new $PM_{2.5}$ standard, there are several hurdles that must be overcome before specific control strategies are developed. One of the main obstacles has to do with the lack of $PM_{2.5}$ monitoring stations and therefore the lack of data to make formal determinations as to whether the different regions in the nation are in compliance or not. After a determination has been made for a specific region, the development of air quality plans may take one or two years. Therefore, it may be four or five years after the promulgation of the standard before specific control measures are identified.

Ozone Ambient Air Quality Standards

Recent information on the effect of ozone on public health indicates than exposures to ambient ozone concentrations for six to eight hours may result in similar or greater impacts than one or two hour exposures to higher exposure levels of ozone. For this reason, EPA staff is inclined to recommend an 8-hour (hr) average standard that would replace the current 1-hr standard. The level of the primary standard would be between 0.07 and 0.09 parts per million by volume (ppmv). The final determination on the exact level of the standard will be made by

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[1] The same studies do not find a good correlation between indoor and outdoor concentrations of coarse particles (the fraction of PM_{10} larger than 2.5 µm).

the EPA Administrator. The form of the standard, or the criteria used to determine compliance, may also be altered. EPA is considering, for example, allowing one to five expected exceedances averaged over 3 years before an area is determined to be out of compliance. Two reasons given for this proposal are: the lack of stability of compliance with the current form of the standard ("flip-flop" from attainment to nonattainment status); and the marginal improvement in public health protection afforded by the one exceedance form of the standard when compared with a less restrictive form of the standard.

GLOBAL CLIMATE CHANGE

The United Nations Framework Convention on Climate Change (FCCC) was signed in 1992. Currently, approximately 150 countries are signatories to this program. The ultimate objective of the UNFCCC is the "...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner." (Emphasis added)(IPCC 1995)

The first Conference of the Parties (COP1) to the UNFCCC met in Berlin early in 1995. From this conference came the consensus that to comply with the basic objectives of the UNFCCC, there is a need to establish a process and timetables that will lead to firm post-2000 reduction commitments in developed countries ("Berlin Mandate")(Manne 1996). A proposal for the post-year 2000 reduction of greenhouse gas emission should be ready for consideration and adoption by the COP3 in 1997.

In 1988 the United Nations requested the World Meteorological Organization and the U.N. Environment Programme (UNEP) to establish an Intergovernmental Panel on Climate Change (IPCC). This organization was established to provide technical expertise to review and summarize the current scientific understanding related to climate change. Two years after its formation, the IPCC issued the First Assessment Report, which predicted that a "business as usual" scenario would result in an increase of the global mean temperature of the earth of around 1.5 to 4.5 degrees C. The Second Assessment Report was released in December 1995 and one of its main conclusions is that the balance of new evidence suggests that the observed increase in global mean temperatures in the last century is, in part, the result of a discernible human influence (IPCC 1995). This is a significant finding since it indicates, for the first time, that the signals of human-induced global climatic change may be already detectable.

In California, the electricity generating sector (including utility and non-utility generation) contributes approximately 12 percent of the carbon dioxide emissions from the combustion of fossil fuels. However, about one third of the electricity generated for consumption in California is generated outside the state; this includes electricity generated by out-of-state

power plants owned or operated by California utilities. In fact, more carbon dioxide is released from out-of-state power plants, serving California than from in-state power plants (CEC 1996a). The reason for this is the prevalence of coal-burning power plants especially in the southwest, and the dominance of natural gas as a fuel in in-state power plants. In the United States as a whole, electric utilities contribute approximately 36 percent of the national carbon dioxide emissions originating from the combustion of fossil fuels. Since electric utilities are significant contributors to the state and national carbon dioxide inventories, energy conservation demand side management (DSM) programs[2] have the potential to substantially decrease future carbon dioxide emissions.

In 1992 the UNFCCC established a goal of stabilizing the net emissions of greenhouse gases in industrialized nations at the 1990 levels by the year 2000. The United States adopted this goal in the U.S. Climate Change Action Plan instituted in October 1993, which relies mainly on voluntary measures, including measures to be taken by electric utilities. By 1994, electric utilities in the U.S. had increased their carbon dioxide emissions by about 3.8 percent from their 1990 levels (EIA 1995). In California, in-state generation of electricity by electric utilities increased their emissions by around 20 percent during the same period[3]. Increasing trends have been reported for the U.S. as a whole and for other developed countries (EPA 1995). The goal of reducing the net 2000 emissions to 1990 levels may not be achieved at either the national or international levels.

AIR QUALITY MANAGEMENT PLANS

The Federal Clean Air Act (FCAA) and the California Clean Air Act (CCAA) require areas which fail to attaint ambient air quality standards to prepare air quality management plans (AQMPs). The AQMPs prepared to comply with the FCAA are known collectively as the State Implementation Plan. In general, the California Air Resources Board (CARB) and the air districts have coordinated the preparation of the plans to satisfy both the FCAA and the CCAA.

Federal Clean Air Act

The 1990 amendments to the FCAA establish a new classification requirements for nonattainment areas, deadlines to achieve attainment, and specific control measures based on the severity of the nonattainment problem. In 1990, California had nonattainment areas for

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[2] In this document we only consider DSM programs related to consumption of electricity.

[3] Calculations based on fuel consumption by in-state power plants owned by electric utilities and reported by Edison Electric Institute in their Statistical Yearbooks of the Electric Utility Industry.

carbon monoxide, nitrogen dioxide, ozone, and PM_{10}. The following paragraphs present a summary on the status of the planning activities related to these pollutants.

The California Air Resources Board (CARB)is proposing to request a redesignation of all of California, with the exception of the South Coast Air Basin[4], as attainment areas for the carbon monoxide (CO) national standard. The areas proposed for redesignation include: Bakersfield, Chico, Fresno, Lake Tahoe, Modesto, Sacramento, San Diego, San Francisco-Oakland-San Jose, and Stockton. All these areas have shown a significant reduction in ambient CO levels since 1990. This achievement is the product of programs designed to control emissions from the mobile sector, which contributes more than 80 percent to the CO emissions in the state. These programs include stricter emissions standards for motor vehicles and the use of wintertime oxygenated gasoline, which took effect in November 1992. The use of reformulated gasoline starting this year, the requirement for new low-emission vehicles, and the implementation of advanced on-board computer systems in vehicles, will all ensure that compliance with the federal CO standard will continue in the future (CARB 1996a).

In 1990 the South Coast Air Basin was the only area in the state not complying with the federal nitrogen dioxide (NO_2) ambient air quality standard. However, recent monitoring data show that the federal NO_2 standard has not been exceeded since 1991 (SCAQMD 1996b).

All of the state's ozone nonattainment areas were required to submit air quality management plans as part of the State Implementation Plan (SIP) by 1994. On March 4, 1996, EPA proposed to approve California's SIP for achieving the federal ozone standards. The State SIP covers the following areas: South Coast, Southeast Desert, San Diego, San Joaquin Valley, Ventura, Santa Barbara, and Sacramento. The Monterey Bay Area region did not submit a plan because recent air quality data indicates that this region is in compliance with the federal ozone standards. CARB has submitted a redesignation request to the EPA for this area (EPA 1996b).

The areas in California not achieving the federal PM_{10} standards are South Coast, San Joaquin Valley, and sections of the Great Basin Valley, and Southeast air basins. These areas are required to prepare attainment plans by 1997. The Sacramento Air Basin was originally considered a non-attainment area, but recent air quality data indicate that this area is in attainment for the federal PM_{10} standards. CARB is in the process of preparing a redesignation and maintenance plan to the EPA.

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[4] Los Angeles County is the only area in the South Coast Air Basin experiencing violations of the national CO standard. This area is expected to achieve attainment in the year 2000 (SCAQMD 1994).

California Clean Air Act (CCAA)

In California, the 1988 California Clean Air Act (CCAA), and its amendments, require air districts to develop air quality management plans to achieve the California ambient air quality standards. In general, the CCAA is more stringent than the FCAA, but does not have a requirement for demonstrating attainment by specific years, as long as the districts plans identify and commit to implement, as expeditiously, as possible all feasible control measures. In addition, the CCAA does not require the air districts to prepare attainment plans for the state ambient air quality standards for PM_{10}. The CCAA requires the districts to update their plans every three years. The first round of AQMPs were developed in 1991 and the current plans were adopted in 1994. The next plans, which are due at the end of 1997, will be based on the 1994 plans.

The South Coast Air Quality Management District (SCAQMD) is the only air district actively working on the development of a 1997 AQMP. This is due to their desire to combine this plan with the PM_{10} plan due to EPA early next year.

Power plants and AQMP Attainment Demonstrations

In general, the District's 1991 AQMPs for ozone identified the control measures that would be required from existing power plants. The control requirements were basically the installation of the Best Available Retrofit Control Technology (BARCT)[5], or its equivalent, as required by the CCAA. The 1994 AQMPs do not include new measures to control existing power plants since all of the rules scheduled for adoption in the 1991 AQMPs have already been adopted. However, this does not mean that the existing rules and regulations will remain in their present forms under a deregulated electricity generating system. For example, some rules and regulations may need to change to take into account the change of ownership of some power plants. Such changes shall be made to comply with the CCAA in such a way as to maintain the BARCT requirement on a unit-by-unit basis or for the system or subsystems emerging from restructuring. These changes can be done without the need to revisit the adopted AQMPs. Please note that the air districts, in their BARCT determinations, made assumptions on capacity factors for the different units owned by a utility. These maximum capacity factors are explicitly enforced by the adopted regulations or included implicitly in electrical system emission daily and annual caps.

New power plants are subject to New Source Review Rules (NSR). Both the FCAA and the CCAA contain very specific requirements, depending on the severity of their nonattainment problem. NSR rules that comply with the requirements of the FCAA and the CCAA have

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[5] "Best Available Retrofit Control Technology" means an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source.

already been adopted by a number of air districts. Again, this does not mean that the air districts will not review their NSR rules to accommodate new findings or to make it less/more stringent as long as it complies with the requirement of the federal and state clean air acts. The objective of the NSR rules is, in general, to have a zero net increase of nonattainment pollutants and their precursors in nonattainment areas for new or modified stationary sources emitting more than specified trigger levels which are explicitly identified in the CCAA. For example, in moderate nonattainment areas (CCAA's definition) the no net increase program is only applicable for new or modified stationary sources emitting more than 25 tons per year. At the other extreme, in the South Coast (extreme nonattainment area), the NSR rules require a no net increase in emissions from all new or modified stationary sources, e.g., a zero trigger level. Air districts may exempt certain sources from offset requirements as long as the NSR program as a whole results in a no net increase of emissions for all the sources above the trigger level included in the CCAA, e.g., 25 tons per year for moderate nonattainment areas. One way this is done is by requiring offsets at a ratio greater than one for the nonexcluded sources to compensate for the emission increases from the excluded sources. Offset ratios are also required explicitly in the FCAA and these ratios depend on the severity of the nonattainment problem.

The FCCA requires ozone nonattainment areas to demonstrate that their AQMPs will achieve attainment of the federal standards within a specified time. The FCAA also requires that this ozone attainment demonstration be based on photochemical grid modeling. To understand how a restructured electricity industry may affect or be affected by these attainment demonstrations, we need to understand the basic assumptions used in these demonstrations.

Power plants emit both reactive organic gases (ROGs) and oxides of nitrogen (NO_x), both of which are considered ozone precursors. However, ROGs are, in general, emitted at much lower rates than NO_x, and ROGs coming from fossil fuel burning power plants are mainly simple hydrocarbons, which have a lower photochemical reactivity (ozone generating potential) than complex hydrocarbons emitted from other sources, such as cars and trucks[6]. Fossil fuel burning power plants also emit CO, PM_{10}, and oxides of sulfur. However, in California their relative contribution to the state inventory is well below one percent. For these reasons, we will focus our attention on NO_x emissions from power plants, which is consistent with the approach taken by the different air districts in their development of rules and regulations adopted to control emissions from fossil fuel burning power plants.

Power plants in California (utility and non-utility owned) contribute approximately 4.1 percent of the total NO_x inventory (CARB 1995a). This is in sharp contrast to the 32 percent

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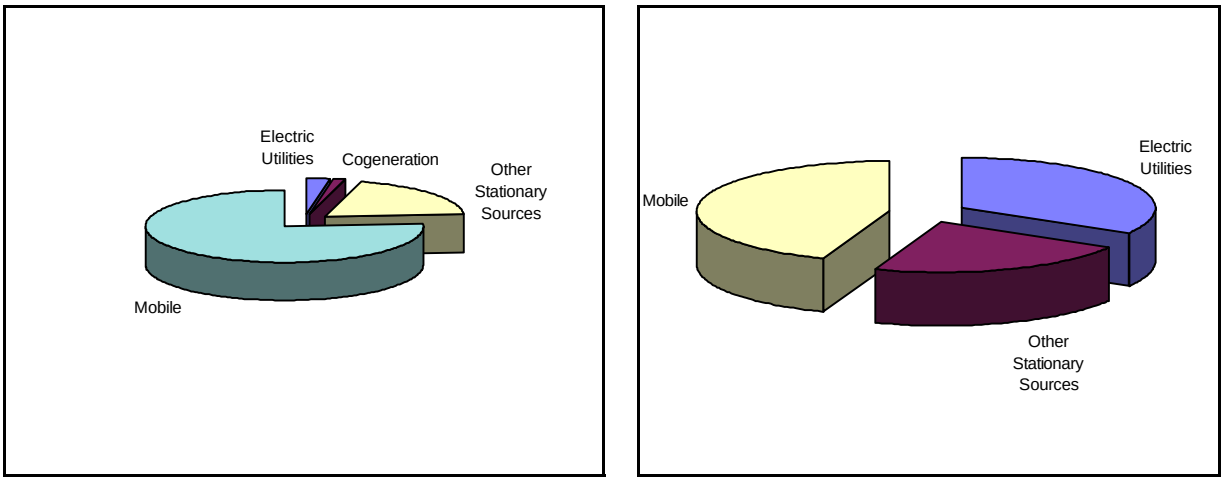
[6] New definitions for VOC/ROGs have been adopted. These definitions exclude ethane due to its low photochemical reactivity. Recent measurements on flue gases from natural gas burning power plants indicate that ethane is approximately 40 percent of the non-methane VOCs (CARB 1995b). Therefore, future VOC/ROGs inventories and offsets requirements for power plants will be significantly reduced.

contribution by electric utilities to the national NO_x inventory (see Figure 1)(EIA 1995). However, as mentioned before, California imports a substantial portion of its electricity from out-of-state sources and therefore the in-state consumption of electricity is responsible for more the 135 tons of NO_x per year, as reported in the state inventory (CARB 1995a). Out-of-state emissions, however, should not result in significant ozone impacts in California in part due to the westerly winds which typically occur in the summer season. These emissions would affect western states, excluding California, which are, for the most part, in compliance of the federal ozone ambient air quality standard.

FIGURE 1
RELATIVE CONTRIBUTION BY ELECTRIC UTILITIES TO NO_x EMISSIONS IN CALIFORNIA AND U.S.: 1993



California U.S.A.

In California the highest ozone concentrations are typically measured during multi-day ozone episodes, which are the result of a buildup of ozone and ozone precursors in the atmosphere. To model these episodes, complex photochemical grid models are used, requiring hourly emission inventories. For power plants, actual emission data are collected and the hourly historical emission profiles are used in the grid models. Future years are modeled using the same meteorological data but with different inventories (planning inventories) that reflect the estimated net reductions in emission resulting from the implementation of AQMPs and economic growth.

In general, future emissions are calculated using the following equation:

$$\text{Emissions}_{\text{year i}} = \text{Emission}_{\text{base line year}} \times \text{Control Factor} \times \text{Growth Factor}$$

Some of the assumptions used by air districts to estimate future emissions from power plants are as follows:

South Coast Air Quality Management District (SCAQMD) did not use the above equation and assumed that the existing power plants will emit at the emission levels allowed by their allocated RECLAIM trading credits (RTCs).

San Diego Air Pollution Control District (APCD) assumed that the growth factor is equal to one but, at the same time, only takes credit for emission reductions from Rule 68 (Fuel-Burning Equipment: Oxides of Nitrogen) which allows higher emission rates than Rule 69 (Electrical Generation. Steam Boilers, Replacement Units and New Units).

The San Joaquin Valley Unified APCD and the Sacramento Metropolitan Air Quality Management District assumed a growth factor equal to the growth factor forecasted for Standard Industrial Codes (SICs) 491 to 497 (Public Services).

Since photochemical grid models need information on hourly emission rates, the historical hourly profile (measured during the ozone episode) is used to establish the hourly distribution of emissions for future years. However, please note that future emissions are, in general, based on what is known as ozone planning inventories. In these inventories, emissions from a specific unit (e.g. a boiler) are estimated based on the historical daily average emissions during operating days in the ozone season. For example, if a boiler operated for five days in the entire ozone season during the baseline year, its emissions in the ozone planning inventory will be given by the average emissions during those five days (corrected by its corresponding control and growth factors) (Shimp 1996). In most of the photochemical grid models used for attainment demonstrations, the emissions from power plants are "numerically" instantaneously diluted in the grid where the power plant is located. These grids are normally 5 by 5 kilometers, which casts serious doubts on the correct representation of the physics and chemistry of power plant plumes (Sillman 1990)(Gillani 1996).

Some concern has been expressed regarding the possibility of shifts in daily electricity demand profiles under a restructured electricity generating industry to obtain less expensive electricity; that demand side management (DSM) programs will be reduced; and that small generating units may mushroom in a way that has not been anticipated. All of these concerns are related to the possibility that the attainment paths identified in the AQMPs may not be followed in a restructured electricity system. We do not provide a complete analysis of these issues but we offer a preliminary analysis based on the information provided above.

From an air quality perspective, the worst case changes in the shape of the load demand may result in more generation (or emissions) occurring in the morning in power plants near the coast. These emissions are in the parcels of air that move inland, picking up more pollution and resulting in the highest ozone concentrations in an air basin. This has the potential for resulting in higher ozone levels than were expected in the AQMPs. However, sensitivity

modeling analyses done by the SCAQMD indicate that shifting the emissions from stationary sources during the day does not have a significant impact on ozone levels (SCAQMD 1996a). In addition, multi-day episodes with increasing levels of ozone may indicate that emissions from a given day (regardless of the hour) may have impacts on subsequent days. These two facts, together with the fact that emissions from power plants represent only a small fraction of the total inventory, suggest that this concern may not be warranted, but more analysis may be needed.

Committed and uncommitted DSM programs do not seem to be taken into account explicitly or implicitly in the AQMPs and their attainment demonstrations. For example, the SCAQMD demand side management programs will not change the allocation scheme for power plants or the total diminishing caps afforded by the RECLAIM program. Even if DSM programs do result in lower than projected electricity demand, power plant owners could sell the "excess" RTCs to other facilities, resulting in the same NO_x burden to the South Coast Air Basin. The San Diego, Sacramento, and San Joaquin districts are also not taking DSM programs into consideration in their "attainment demonstrations". In addition, since air districts can only take credit in their AQMPs for committed measures, uncommitted energy saving DSM[7] programs can not be counted as a source of emission reductions.

The Commission Staff has estimated that energy saving DSM programs in California can lower the expected baseline demand of electricity by about 5.6 percent (CEC 1996b). An order of magnitude analysis based on this assumption indicates that this would translate to around 10 tons of NO_x per day in the middle of the next decade. This would represent less than 0.6 percent of the state-wide NO_x inventory for the same period[8,9] (see Appendix A). However, this seems to be in the same order of magnitude as reductions already required by some marginal NO_x emission control measures adopted in some of the 1994 AQMPs (EPA 1996b). Furthermore, DSM programs are still useful tools to reduce emissions from power plants and there are other benefits associated with such programs that justify their existence. It can also be argued that DSM programs are feasible control measures and that therefore, they should be included in AQMPs. However, there are a number of arguments against using

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[7] Load shaping DSM programs may have only a limited, if any, benefit in an ozone attainment program unless the load shifts outside the "ozone season".

[8] These estimates are based on the following assumptions: a) an energy demand of 267,800 GWh (CEC 1996b); b) a state-wide NO_x emission reduction from the 1993 levels in the order of 50 percent (the percent reductions required to achieve attainment from 1990 levels vary per air basin, South Coast requires the highest reductions (60 percent) (EPA 1996b)); c) all the generation is produced in California; and, d) the in-state electricity generation of 203,474 GWh (electricity generated in 1993 for California minus "imports" (CEC 1995)).

[9] These in-state reductions in NO_x emissions from the "base case" will not occur if the electricity is generated by out-of-state power plants. In addition, these savings are based on what is technically feasible which could be much higher than what would be achieved in practice.

energy saving DSM measures as part of AQMP control strategies, including: (1) they are not enforceable; (2) the "potential" reductions may occur outside the state (the displaced power plants are located in a different state); (3) they may result in double counting of benefits when there is an electricity generating sector that is subject to an emission cap; and, (4) the "excess" in-state capacity may be used to satisfy the electrical load outside the state.

Another potential outcome of restructuring, a rapid penetration of small generating units, may have the potential to increase air pollutant emissions beyond what is projected in the AQMPs. The CCAA requires that in serious, or worse, ozone nonattainment areas (CCAA's definition), new or modified emission units with the potential to emit 10 pounds per day[10] or more shall incorporate the best available control technology (BACT). BACT for small generating units may be less restrictive than the BACT for larger units. For example, from the CARB's latest BACT Clearinghouse Database, historical BACT determinations of installed and in-operation gas turbines with a heat input of less than 23 MMBtu/hr correspond to a level of about 19 ppmvd (15% oxygen)[11], while units larger than that have a BACT level of about 5 pmmvd (15% oxygen). The BACT determination of 19 ppmvd was made several years ago, and a much lower concentration may be required in any new BACT determination. However, the potential still exists for higher emission levels from small units. On the other hand, we may expect small generating units to be part of an existing facility, and used for self-generation, with waste heat used for various industrial applications. In these cases, a net increase in emissions beyond what was estimated in the AQMPs for a source category, after taking into account projected economic growth, may occur only when emission reductions in other units in these facilities do not compensate for the emission increases from the new small generating units.

AIR POLLUTANT TRANSPORT

The CCAA requires that "districts responsible for or affected by air pollutant transport shall provide for attainment and maintenance of the state and federal standards in both the upwind and downwind district." The air districts are also required to include in their AQMPs, at a minimum, all the mitigation measures identified by CARB. The California Code of Regulations (Title 17, Article 5, Section 70500) contains a list of the areas impacted by transport and the areas of origin oaf transport. The minimum mitigation requirements identified by CARB are contained in Title 17, Article 5, section 70600. Basically, the air districts in the areas of origin of transported ozone pollutants have to adopt rules and

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[10] Units with a generating capacity of less than 1 MW may generate less than 10 lb/day of NO_x if properly controlled (10 ppmvd, 15% O_2 or less).

[11] The gas turbines were permitted in 1989 and each one had a capacity of 1.3 MW and could burn natural gas or crude oil.

regulations requiring the installation of best available retrofit control technology for stationary source categories emitting 75 percent of the 1987 reactive organic gases and 75 percent of 1987 emissions of nitrogen oxides. These rules and regulations were to be adopted before January 1, 1994.

The problem of transport is very complex and the level of quantitative knowledge required to fully implement the requirements of the CCAA has not been achieved yet. For example, in a modeling episode for the Sacramento Area, transported ozone and its precursors aloft were observed in one of the episodes but the area of origin of the polluted air could not be determined. The possible areas of origin are the San Francisco Bay Area region, the San Joaquin Valley region, or just recirculation of the pollutants emitted in the Sacramento Area on previous days (EPA 1996b). CARB and air districts in Southern California are planning an extensive ozone field study that will be carried out in 1997 to better understand the role played by interbasin transport in that region.

The potential timing and extent of further regulations addressing transport are unknown at this time.

MARKET-BASED EMISSION REDUCTION PROGRAMS

Emission reduction programs, in different forms, have been used in the nation and in California in efforts to improve air quality. New source review programs, with their offset requirements, can be considered a primitive form of a market-based program. However, historically, the NSR programs have generated very limited amounts of emission reduction credits (ERCs) which are used to offset emission increases from new facilities. The yearly flow of ERCs represent less than one per cent of the total inventory from stationary sources (CARB 1996b).

In recent years, the acid rain program under Title IV created a national market for SO_2 allowances affecting electric utilities. In California the South Coast RECLAIM program which covers a portion of the stationary sources is a modern version of an emissions cap and trading marked-based program. Recently, EPA has circulated a draft proposal entitled "Open Market Trading Rule" (OMTR) for ozone precursors (60 Federal Register 39668, August 3, 1995). In the future, nonattainment areas would have the option to adopt the OMTR and implement a market-based program almost immediately. However, we are not aware of any air district in California now planning to adopt the OMTR.

In California, the CCAA, as amended by Assembly Bill 1054, allows air districts to implement marked-based trading programs to improve air quality, with the intent of achieving emission reductions at less cost compared with command and control regulations. Also, Assembly Bill 1777 requires CARB to adopt a methodology for air districts to use in calculating the value (actual emission reductions) of emission reduction credits from

stationary, mobile, indirect, and area sources for interchangeable use. Finally, in October 1995, Senate Bill 1098 authorized granting emission reduction credits for reductions that occurred after January 1991, to sources that are exempt from air district permitting requirements.

In California, the South Coast Air Quality Management District is pursuing an intercredit trading program that would expand RECLAIM to a considerable degree. The main elements of this proposed program are:

One universal market covering stationary, mobile, and area sources.

Trading instruments known as a Universal Trading Credit expressed in pounds per year.

Interseasonal trading for VOC. The program will provide incentives to shift VOC emissions from the ozone to the non-ozone season.

UTCs that may be banked and used at any time after they are generated. Backstop measures will be taken to ensure that attainment goals are met.

Interpollutant trading as implemented under NSR.

At this time, we are not aware of any other air districts proposing a market-based program.

CONCLUSIONS AND RECOMMENDATIONS

New National Ambient Air Quality Standards

The new federal ozone and $PM_{2.5}$ air quality standards that may be proposed in the near future would require the development of new "attainment" plans. It is unlikely that these plans would require additional control measures for power plants. The reasons for this assumption are: fossil-fuel burning power plants in California rely almost exclusively on natural gas, which may be considered BACT for particulate matter control purposes; and, emissions of oxides of nitrogen are already being controlled for ozone attainment purposes with a secondary benefit of reducing the impact on secondary $PM_{2.5}$ nitrates in the atmosphere. Some air districts may need to control ammonia emissions in their air basins since ammonia reacts in the atmosphere forming secondary $PM_{2.5}$ nitrates (ammonium nitrates). South Coast has already reviewed its NSR rules to require controls of ammonia emissions. However, this rule does not apply to emissions resulting from ammonia "slip" from the use of selective catalytic reduction (SCR). Other Districts may follow South Coast's lead and institute similar requirements. In a worst case scenario, air districts may require a reduction of ammonia slip

in the winter time, which would result in an increase in NO_x emissions. This only entails changes in operation, but due to its speculative nature, should not be incorporated in any feasible future scenario for restructuring.

Global Climate Change

The possible implementation of the "Berlin Mandate" has tremendous implications for the energy generating sector in the United States. Electric utilities burn about 86 percent of all coal consumed in the United States (EPA 1995). In contrast, California consumes only marginal amounts of coal in in-state power generation (in non-utility owned power plants). Studies on CO_2 control options have shown that fuel switching (from coal to natural gas) in power plants is one of the cheapest measures available to reduce or maintain current levels of CO_2 emissions. If there is agreement between nations on a definite and legally binding goal of reducing the emission of greenhouse gases, similar negotiations will be conducted among the states at the national level. In these negotiations it should be recognized that California has a per capita CO_2 annual emission which is substantially lower than the nation as a whole. This, together with our reliance on natural gas in all sectors of the state economy (CEC 1995), may indicate that efforts to further reduce the emissions of greenhouse gases may be more costly in California.

Energy savings from DSM programs can produce significant decrease of future carbon dioxide emissions from in-state and out-of-state power plants serving California. Reductions in the funds for DSM programs, in a deregulated electricity industry, may result in a total or partial loss of these benefits.

The analyses of a restructured electricity generating system should include estimates of its impact on the emissions of greenhouse gases, and perhaps, the implications that the "Berlin Mandate" may have on the restructured system.

Air Quality Management Plans

Demand side management programs have the potential of contributing to small reductions of NO_x emission inventories in California. This small contribution is mainly the result of the stringent control requirements to which the power plants located in the state are already subject. In addition, since the air quality benefits of DSM programs may not be realized in the same air basin or even in the state, they should not be considered as a "control option" , especially, within a restructured electricity system. However, any decrease in emission realized by energy saving DSM programs even if they are not easily quantified, or they can not be enforced, and therefore should not be included in their AQMPs, will help the Districts in their quest of achieving compliance with ambient air quality standards. A more in depth

analysis of the air quality implications of DSM programs will be filed by staff in the near future.

A rapid penetration of small electricity generating units has the potential to increase emissions beyond what is expected in the AQMPs. However, the BACT requirement of the CCAA for units with the potential to emit more than 10 pounds per day of NO_x may limit the significance of this speculative penetration effect. If an analysis of a restructured electricity market shows that a rapid penetration of small generating units is probable, the air district should be alerted and a further analyses should be conducted. The objective of this analysis will be the determination of the need to include control measures for these units in the 1997 revisions of the AQMPs that will be prepared by the different air districts.

New source review rules are designed by law to result in a no net increase in emissions from new and modified stationary sources. These rules have been approved by CARB and EPA, and at least in theory, should not cause an increase in the emissions burden in a given air basin.

Changes in ownership of utility owned power plants will require changes in the regulations implementing BARCT requirements included in the CCAA. However, these changes, if made using current BARCT levels on a unit by unit basis or for the system as a whole, should not result in an increase of impacts from existing power plants. Please note that this assertion is only true if the changes in the regulations are made, as they should be, maintaining and enforcing the basic power plant's operating assumptions used in the development of the existing BARCT rules. This can be accomplished, for example, by maintaining the maximum capacity factors contained in some BARCT rules, and/or designing the new rules in such a way that it would maintain the current emission caps, even in a fragmented electricity industry.

Some argue that restructuring will result in an increase of operation of existing, older, inefficient, and high NO_x emitting power plants. The argument is based on the assumption that they may be cheaper to operate than other cleaner sources (e.g., new cogeneration power plants owned by IPPs). These older units are regulated by BARCT rules which include explicit or implicit maximum capacity factors. The fear is that these units would operate at their maximum capacity factors under a restructured electricity system, while without restructuring they may operate with much lower capacity factors. This is a valid concern and its likelihood should be analyzed. If it is found that this is not a mere speculative outcome, and to the contrary, it is very likely to occur, mitigation options should be implemented if these potential increases of emissions are deemed as producing significant impacts under California Environmental Quality Act (CEQA). However, please note as discussed previously, that the ozone planning inventories may already include a reasonable worst case emission scenario for these older, inefficient units.

Finally, it has also been suggested that ozone modeling using the Urban Airshed Model (UAM IV) should be included as part of the environmental evaluations of the restructured electricity system. The UAM IV does not include a nested plume submodel and therefore may not estimate impacts from power plant plumes correctly. If ozone grid models are used to estimate impacts, it should be done with models that include a better representation of power plant plumes, such as the UAM V. However, modeling small changes in the total inventory in an air basin should be done very carefully to make sure that the results are meaningful (CARB 1992). Before any modeling is executed a modeling protocol should be prepared and subjected to review by CARB, EPA, air districts, and the California Energy Commission.

Interbasin Transport

Our quantitative knowledge on interbasin transport is increasing over time. But still too limited to support any prediction of future district actions on impacts on power plant regulations. Future regulations may require further emission reductions beyond what has already been identified in the AQMPs. However, at this point, we should not speculate on this issue.

Market-Based Air Emission Reduction Programs

An open market-based program for air emission reductions may result in more and less costly emission reduction credits to be available. This may have a profound effect on the ability of developers to site new power plants in California. This fact, combined with a potential decrease in electricity rates due to restructuring, may result in a rapid penetration of electro-technologies with a subsequent increase of electricity demand. This potential increase in demand may result in more NO_x emissions originating from power plants. However, as indicated by some fuel substitution studies, this may actually result in a net decrease of NO_x emissions in the state. Any environmental analysis looking at the potential effects of restructuring on air quality should take this issue into consideration.

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APPENDIX A

Order of Magnitude Optimistic Estimation of Decreases of NO_x Emissions Due to DSM Programs

The potential NO_x emission decreases are calculated for the middle of the next decade (e.g. 2007) assuming that the NO_x emissions in the middle of the next decade are around half the NO_x emissions estimated for 1993.

Emissions = 3300 tons per day (tpd)/2 = 1650 tpd

where: 3300 tpd are the 1993 emission levels from CARB, 1995a. We assume that the state inventory has to be reduced by half in order to achieve attainment (see the following table).

FIGURE A-1
ACTUAL NO_X EMISSION REDUCTIONS FROM 1990 LEVELS NEEDED TO ACHIEVE ATTAINMENT OF THE NAAQS FOR OZONE (EPA, 1996)

Actual NO_x Emission Reductions from 1990 Levels Needed to Achieve Attainment of the NAAQS for Ozone (EPA, 1996).	
Air Basin	% Reduction
Santa Barbara	20
San Diego	26
San Joaquin Valley	about 40
Sacramento	40
Ventura	36
South Coast	60

The maximum "increase" of demand from the elimination of DSM programs is about 5.6 percent. Energy demand in the middle of next century is about 267,766 GWh (CEC, 1996b). Therefore:

$$(\Delta \text{ demand}) = 0.056 \times 267{,}766 = 14{,}995 \text{ GWh}$$

Generic Emission Factor (EF) for electricity production in California is given b y 135 tpd of NO_x divided by (149,037 + 54,437) GWh. The 135 tpd are the 1993 NO_x emissions reported by CARB (CARB, 1995a) for electric utilities plus cogeneration. In 1993, California utilities produced 149,037 GWh. QF and Self Gen. produced about 54,437 (CEC, 1995). Therefore:

$$EF = 135/(149{,}037 + 54{,}437) = 0.00066 \text{ tpd/GWh}$$

The (Δ demand)corresponds to

$$14{,}995 \text{ GWh} \times 0.00066 \text{ tpd/GWh} = 9.9 \text{ tpd}$$

These 9.9 tpd would represent about 0.6 percent state NO_x inventory in the middle of the next decade:

$$9.9 \text{ tpd} / 1650 \text{ tpd} \times 100 = 0.6 \text{ percent}$$

Note: From the analysis by Darwin Hall, Sanii Win and Jane Hall ("Air Pollution Impacts from Demand-Side Management". Energy Vol.20, No. 1, pp27-35, 1995) for the Southern California Edison (SCE) system the variations of the EF for energy conservation DSM programs are calculated in the following table:

FIGURE A-2
DSM PROGRAM VARIATIONS IN EMISSION FACTORS FOR SCE SYSTEM

Year	Commercial Lighting (GWh)	Residential Air Conditioning (GWh)	Reduction in NO_x Emissions in the SCAQMD airshed (tons/year)	EF (tpd/GWh)
1996	18.3	1.5	-15.5	-0.0021
1998	22.7	3.7	2.9	0.0003
2000	33.1	5.0	3.5	0.0003
2003	55.6	5.5	-1.0	-0.00004
2005	70.4	5.6	8.9	0.0003
2009	101.0	5.8	6.1	0.0002
2011	112.1	5.9	11.5	0.0003

Note: Hall et. al. presents data from 1992 to 2011. According to the paper "This empirical analysis shows, for 2 years out of 20, that demand-side management (DSM) programs increase air pollution." These years are 1996 and 2003. Please also note that the EF is around 0.0003 tpd/GWh which is lower than the 0.0006 tpd/GWh used in this CEC staff analysis.