

California Environmental Protection Agency

~ Air Resources Board

**Initial Statement of Reasons
for Rulemaking**

Proposed Identification of
1,3-Butadiene

as a Toxic Air Contaminant

Staff Report/Executive Summary

Stationary Source Division
May 1992

INITIAL-STATEMENT OF REASONS FOR RULEMAKING

STAFF REPORT/EXECUTIVE SUMMARY

**PROPOSED IDENTIFICATION OF 1,3-BUTADIENE
AS A TOXIC AIR CONTAMINANT**

Prepared by the Staffs of
the California Environmental Protection Agency's Air Resources Board and
Office of Environmental Health Hazard Assessment

May 1992

INITIAL STATEMENT OF REASONS FOR RULEMAKING

STAFF REPORT EXECUTIVE SUMMARY

What is the Initial Statement of Reasons for Rulemaking?

This report is a summary of the information used by the members of the Air Resources Board (ARB or Board) to determine if 1,3-butadiene should be listed as a toxic air contaminant (TAC). The Board will consider the identification of 1,3-butadiene as a TAC at a public hearing in July 1992, in accordance with California Health and Safety Code Section 39662.

Are There Controls Associated with this Rulemaking?

No control measures for 1,3-butadiene are proposed for adoption at this hearing. California law (Health and Safety Code Sections 39650-39666) clearly separates TAC risk assessment (identification) from TAC risk management (control). Therefore, control measures are not considered during the identification phase. If 1,3-butadiene is identified as a TAC by the Board, a report on the need for and appropriate degree of control measures to reduce 1,3-butadiene emissions will be developed in accordance with Health and Safety Code Sections 39665 and 39666. If the Board determines that control of industrial sources are needed, the staff will work closely with all affected parties, actively seeking the participation of industry, the districts, and the public.

What is Contained in the Initial Statement of Reasons for Rulemaking?

The Initial Statement of Reasons for Rulemaking for the Proposed Identification of 1,3-Butadiene as a Toxic Air Contaminant consists of a Staff Report/Executive Summary (which summarizes the scientific basis for the proposed regulation), a discussion of the environmental and economic impacts of the proposal, the Findings of the Scientific Review Panel (SRP), and the proposed Regulation Order.

The Staff Report/Executive Summary summarizes Parts A and B of the Technical Support Document. Part A is prepared by the California Environmental Protection Agency's (Cal/EPA) ARB staff. It is an evaluation of 1,3-butadiene's emissions, ambient and indoor concentrations, statewide population exposure, and atmospheric persistence and fate. Part B is prepared by the Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA) staff. It assesses the health effects of 1,3-butadiene.

Part C (also part of the Technical Support Document) consists of the ARB/OEHHA staff responses to public comments on draft versions of the report. The Technical Support Document has been developed pursuant to California Health and Safety Code Sections 39660-39662 (Article 3 of Chapter 3.5 of Part 2 of Division 26 of the Health and Safety Code, titled "Identification of Toxic Air Contaminants").

What are the Requirements of Health and Safety Code Sections 39660-39662?

Health and Safety Code Section 39655 requires the use of the following criteria for prioritizing substances for evaluation as possible toxic air contaminants (TACs): 1) risk of harm to public health, 2) amount or potential amount of emissions, 3) manner of usage, 4) persistence in the atmosphere, and 5) ambient concentrations.

Once a substance is selected to enter the TAC identification process, the ARB requests relevant information from the public and a written evaluation of available health effects information (Part B of the Technical Support Document) from the OEHHA. The OEHHA staff's evaluation is required to contain an estimate of the threshold exposure level above which the substance causes or contributes to adverse health effects. In the case where no threshold of significant adverse health effects can be determined, the OEHHA is required to state the range of risk to humans resulting from current or anticipated exposure.

Simultaneous with the preparation of the OEHHA health evaluation, the ARB staff prepares an exposure assessment (Part A of the Technical Support Document) that includes information on the substance's usage, emissions or potential emissions, environmental persistence, and available ambient and indoor exposure levels.

Following a public comment period, the Staff Report/Executive Summary and Parts A, B, and C of the Technical Support Document are formally reviewed by the SRP at a public meeting. Upon reviewing the data, assessments, and conclusions of the report and ascertaining that appropriate scientific methods were used to gather and analyze the data presented, the SRP submits written findings to the Board. At a public hearing, the Board decides whether or not the evidence in the Technical Support Document supports the identification of the substance as a TAC and, if so, whether there is evidence of a threshold exposure below which adverse effects are not expected to occur. Once a substance is identified as a TAC and listed in Section 93000 of Title 17 of the California Code of Regulations, the ARB staff prepares a report on the need and appropriate degree of regulation pursuant to Sections 39665-39668 of the Health and Safety Code.

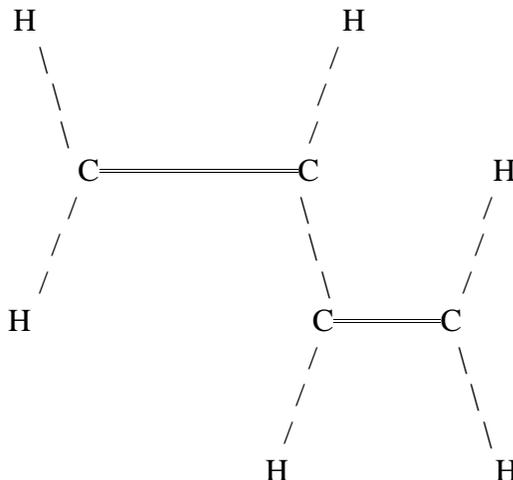
What is a Toxic Air Contaminant?

Health and Safety Code Section 39655 defines a toxic air contaminant as an air pollutant which "may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health."

What is 1,3-Butadiene?

1,3-Butadiene is a flammable, colorless gas with a pungent odor. It is known by a variety of synonyms including bivinyll, divinyll, erythrene, vinylyethylene, biethylene, and pyrrolylene.

1,3-Butadiene is commercially produced in the United States; however, it is not commercially produced in California. The chemical formula of 1,3-butadiene is C₄H₆. Its structure is:



1,3-Butadiene has a molecular weight of 54.09 grams per mole. At 25° Celsius, 1 part per billion by volume (ppbv) of 1,3-butadiene equals 2.21 micrograms per cubic meter of 1,3-butadiene; 1 microgram per cubic meter of 1,3-butadiene equals 0.45 ppbv.

Does the ARB Staff Recommend 1,3-butadiene Be Identified as a Toxic Air Contaminant by the Board?

Yes. Furthermore, the OEHHA staff concludes that there is not sufficient scientific evidence at this time to support the identification of an exposure level below which no significant adverse health impacts are anticipated; the OEHHA staff therefore recommends that 1,3-butadiene be treated as having no identified threshold below which cancer would not be expected to occur.

Why Does the ARB Staff Recommend 1,3-butadiene Be Identified as a Toxic Air Contaminant?

The staffs of the ARB and OEHHA have reviewed the available scientific evidence on the presence of 1,3-butadiene in the atmosphere of California and its potential adverse effect on public health. The ARB staff has determined that 1,3-butadiene is emitted from a variety of sources and can be detected in the ambient air throughout California. It is highly mobile in the environment, and is not naturally removed or detoxified at a rate that would significantly reduce public exposure. Furthermore, the OEHHA staff agrees with the United States Environmental Protection Agency (US EPA) and the International Agency for Research on Cancer (IARC) that 1,3-butadiene is a "probable human carcinogen." The OEHHA staff has concluded that at ambient concentrations, 1,3-butadiene may cause or contribute to an increase in mortality or serious illness and may therefore pose a potential hazard to human health. Based on the OEHHA's findings of carcinogenicity and the results of their risk assessment, the OEHHA staff concludes that 1,3-butadiene meets the definition of a toxic air contaminant.

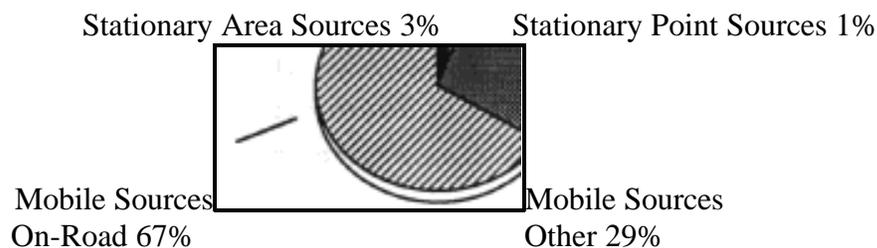
How Much 1,3-butadiene Is Released into California's Outdoor Air?

Total emissions of airborne 1,3-butadiene from quantified sources in California are estimated to be 3,900 tons per year.

What Are the Sources of Outdoor Airborne 1,3-Butadiene?

The incomplete combustion of petroleum-derived fuels by mobile sources accounts for approximately 96 percent of the statewide emissions of 1,3-butadiene. Vehicles that are not equipped with functioning exhaust catalysts emit far greater amounts of 1,3-butadiene than do vehicles with functioning catalysts.

Stationary area sources can emit 1,3-butadiene in the exhaust of boilers, heaters, internal combustion engines, and turbines during activities such as agriculture, manufacturing, residential fuel combustion, and oil and gas production. Stationary point sources can emit 1,3-butadiene during stationary engine fuel combustion, petroleum refining, the production of certain fungicides, and styrene-butadiene copolymer production for the manufacture of tires, hoses, paint latex, carpet backing, and other rubber products.



Are Emissions of 1,3-Butadiene Expected to Increase in the State?

No, they are expected to decrease from mobile sources, California's largest source of outdoor 1,3-butadiene emissions. A large percentage (67 percent) of the 1,3-butadiene emitted to outdoor air comes from on-road motor vehicle exhaust. Vehicles with effective catalysts have dramatically lower emissions of 1,3-butadiene than uncatalyzed vehicles do. Based on data from the ARB's emission factor and emission inventory models (EMFAC7EP and BURDEN7C) and estimates of emissions from other mobile sources, total organic gas emissions from California's mobile sources (the basis of the 1,3-butadiene estimate) are expected to steadily decrease through the year 2010. These decreases are a result of motor vehicle regulations that have already been implemented (e.g., ARB's 1975 light-duty passenger vehicle catalyst regulation), and regulations that have been adopted and have future implementation dates.

Vehicles now sold in California are required to meet a standard of 0.39 grams per mile of non-methane organic gas. Starting in 1993, 40 percent of the new light-duty passenger vehicle

fleet must meet a standard of 0.25 grams per mile; in 1994, 80 percent; and by 1995, 100 percent of the light-duty passenger vehicle fleet must meet the 0.25 grams per mile standard for non-methane organic gas. A regulation adopted by the ARB in 1990 ("Low-Emission Vehicles/Clean Fuels") will result in significant reductions in non-methane organic gases from light-duty and medium-duty vehicles by requiring a growing percentage of the new vehicle fleet to meet "low emission vehicle" standards through compliance options that include the use of "clean fuels" (e.g., compressed natural gas). This program will be "phased in" over the period 1994 through 2003.

The ARB's 1991 "Phase-2" reformulated gasoline regulations include a comprehensive set of standards which will affect eight gasoline properties, including: Reid vapor pressure, aromatic hydrocarbon content, oxygen content, benzene content, olefin content, sulfur content, T90 distillation temperature (the temperature at which 90 percent of a given volume of gasoline would evaporate), and T50 distillation temperature. Use of reformulated gasoline (required statewide April 1996) is expected to result in significant reductions of benzene and 1,3-butadiene emissions from engines burning reformulated gasoline.

What Are the Ambient Concentrations of 1,3-Butadiene in the State?

The statewide population-weighted exposure to ambient (outdoor) airborne 1,3-butadiene (based on data from the ARB's toxic monitoring network) is estimated to be an average 0.37 ppbv, or 0.82 microgram per cubic meter. Average air basin exposure estimates range from a low of 0.22 ppbv (0.48 microgram per cubic meter) in the South Central Coast Air Basin to a high of 0.44 ppbv (0.97 microgram per cubic meter) in the South Coast Air Basin.

The 1987 South Coast Air Quality Study (co-sponsored by the ARB) provided a unique opportunity to characterize gaseous and particulate pollutants in the basin under well-documented meteorological conditions. The data represents samples taken over 1-hour periods, while the

tonics monitoring network data represents averaged samples taken over a 24-hour period. Data developed during the study (representing the period of June 1987 through December 1987) indicate that the 1-hour average 1,3-butadiene concentrations from the eight monitoring sites in the South Coast Air Basin were 1.6 ppbv (3.53 micrograms per cubic meter), with minimum hourly concentrations that ranged from below the level of detection of 0.1 ppbv (0.22 microgram per cubic meter) to a high of 17.7 ppbv (39.1 microgram per cubic meter).

What About Indoor Exposure to 1,3-Butadiene?

Indoor air is almost certainly the major route of exposure to 1,3-butadiene for individuals exposed to indoor environmental tobacco smoke (ETS). Based on measurements of 1,3-butadiene in a tavern, bar, and unventilated lab, the estimated dose of 1,3-butadiene inhaled in 3 hours in a high tobacco smoke environment could range from 10 to 60 micrograms. In contrast, the estimated dose of 1,3-butadiene inhaled in 3 hours during exposure to the statewide average outdoor concentration of 0.37 ppbv (0.82 microgram per cubic meter) is about 2.6 micrograms.

The amount of 1,3-butadiene inhaled in a ETS environment will vary due to the number of cigarettes smoked, room size, room ventilation rates, and other factors. The following table provides concentrations and accompanying doses for the limited indoor non-residential smoking environments for which data are available:

3 Hour Estimated Inhaled Doses of 1,3-butadiene in Smoking Environments

LOCATION	INDOOR CONCENTRATION (ppbv)	INDOOR CONCENTRATION (microgram/cubic meter)	ESTIMATED INHALED DOSE (microgram/exposure)
Tavern	5.0-8.6	11-19	35-60
Bar	1.5-2.0	3.3-4.5	10-14
Unventilated Lab	4.3	9.5	30
Well-Ventilated Lab	0.3	0.75	2.4

In contrast to the measured concentrations in heavy smoking environments, the range of levels of 1,3-butadiene in more typical environments is not as well defined. A recent study sponsored by the ARB measured indoor levels of 1,3-butadiene in 62 Northern California homes during the summer of 1990. Only 5 of the 62 homes had 1,3-butadiene concentrations above the study's limit of detection of 0.54 ppbv (1.2 micrograms per cubic meter). Results indicate that the concentrations in these 5 homes ranged from 1.22 to 4.53 ppbv (2.7 to 10.0 micrograms per cubic meter). In 4 of the 5 homes with measurable 1,3-butadiene, 20 to 40 cigarettes reportedly were smoked during the monitoring period. The source of 1,3-butadiene in the other home with measurable 1,3-butadiene is uncertain. Of the homes in this study, 57 (92 percent) had average indoor concentrations that were less than 0.54 ppbv (1.2 micrograms per cubic meter), and smoking occurred in 16 of those homes. Further studies are needed to quantify typical indoor 1,3-butadiene concentrations.

Are There Near-Source Exposures to 1,3-butadiene in the State?

Some Californians may be exposed to near-source, or "hot spot" concentrations of 1,3-butadiene added to the average ambient concentration of 1,3-butadiene. "Hot spot" exposure to airborne 1,3-butadiene may significantly increase the cancer risk to individuals living near sources. Sources of "hot spot" emissions of 1,3-butadiene may include facilities using butadiene to make resins and polymers, synthetic rubber manufacturing facilities, chemical production facilities, petroleum refineries, and stationary fuel combustion sources.

The US EPA has roughly estimated that 1,3-butadiene exposure for individuals living near two facilities in California may be almost double the average exposure experienced by individuals not living near these facilities. However, the ARB staff does not have enough emissions and exposure information available at this time to validate the US EPA's estimate. This information is expected during 1992, when the ARB staff will evaluate 1,3-butadiene emissions data reported by

facilities under the AB 2588 Air Toxics “Hot Spot” emissions reporting program. If the Board identifies 1,3-butadiene as a toxic air contaminant, this “hot spot” information will be used during the risk management phase to help determine priority and need for control of sources emitting 1,3-butadiene.

Are There Other Routes of Exposure to 1,3-Butadiene?

Water ingestion, polybutylene pipes, and some foods have been examined as possible contributors to 1,3-butadiene exposure. To date, only minor amounts of 1,3-butadiene have been detected in one food (olive oil) packaged in bottles made from butadiene polymers.

How Long Does 1,3-butadiene Remain in that Atmosphere?

The atmospheric residence time of 1,3-butadiene is estimated to range from a few hours (because of reactions with hydroxyl radicals present in polluted atmospheres during the day) to approximately 12 hours (because of reactions with nitrate radicals present in polluted atmospheres at night). Thus, 1,3-butadiene is often confined to the local airshed in which it is emitted.

What are the Health Effects of 1,3-butadiene Exposure?

The health effects of 1,3-butadiene exposure have been reviewed and evaluated to determine whether 1,3-butadiene meets the definition of a toxic air contaminant. The following text summarizes the OEHHA staff's findings regarding the health effects of 1,3-butadiene exposure:

Carcinogenic and Potentially Carcinogenic Effects

The OEHHA staff has concluded that at ambient concentrations, 1,3-butadiene may cause or contribute to an increase in mortality and illness, thereby posing a potential hazard to human

health. The OEHHA staff recommend that 1,3-butadiene be considered a carcinogen without an identified threshold below which cancer would not be expected to occur.

Studies of rodents exposed to parts-per-million concentrations of airborne 1,3-butadiene indicate that it is taken up rapidly by the body and distributed with metabolites to all tissues. This distribution can result in cancer in multiple sites, including the heart, lung, mammary gland, ovaries, forestomach, liver, pancreas, thyroid, testes, and hematopoietic system. It is only one of two chemicals (the other being the fungicide Captafol) known to induce cancer in the heart of laboratory animals.

Epidemiological studies of production workers exposed to 1,3-butadiene provide limited evidence of an increased risk of death from hematologic neoplasms, especially leukemia and other lymphomas.

Non-Carcinogenic Health Effects

The OEHHA staff has concluded that it is unlikely that noncarcinogenic and nonmutagenic adverse health effects would be caused by the levels of 1,3-butadiene currently found in the ambient air.

Studies of rodents exposed to parts-per-million concentrations of airborne 1,3-butadiene indicate that it is taken up rapidly by the body and distributed with metabolites to all tissues. Fetotoxic, genotoxic, and reprotoxic effects were observed only at 1,3-butadiene concentrations hundreds to thousands of times higher than those found in the ambient air.

What is the Risk Assessment for Exposure to 1,3-Butadiene?

The staff of the OEHHA recommends that the unit risk of 3.7×10^{-4} per part per billion (1.7×10^{-4} per microgram per cubic meter) be considered the “best value of the upper bound of

risk." This value is based on data from a recent bioassay in mice. This unit risk, coupled with a lifetime exposure to 1 microgram per cubic meter, would yield 170 excess cancers per million people. The use of this "best value" with California's average ambient 1,3-butadiene exposure concentration of 0.37 ppbv (0.82 microgram per cubic meter) yields 140 excess cancers per million people exposed throughout their lives. It can be estimated that up to 4,200 1,3-butadiene-induced cancers would occur statewide among a population of 30 million people exposed to current ambient concentrations throughout their lives. The "best value" unit risk is a plausible upper bound estimate based on health-protective assumptions; the actual risk may be significantly lower.

The upper limit estimate of the number of potential excess cancers due to outdoor airborne 1,3-butadiene exposure ranges from 4 to 300 additional cancers per million people exposed throughout their lives, based on California's present average ambient 1,3-butadiene exposure concentration of 0.37 ppbv (0.82 microgram per cubic meter), and an excess cancer risk range of 9.8×10^{-6} to 8×10^{-4} per part per billion (4.4×10^{-6} to 3.6×10^{-4} per microgram per cubic meter). This range of risk is based on data from studies in rats and mice. The upper limit estimate of the number of potential excess cancers for the South Coast Air Basin (with an average exposure concentration of 0.44 ppbv or 0.97 microgram per cubic meter) is 4 to 350 additional cancers per million people exposed throughout their lives.

"Hot spot" exposure to airborne 1,3-butadiene may increase the cancer risk to individuals living near sources. The U.S. EPA has roughly estimated that lifetime cancer risks for individuals living near two facilities in California may be increased above the ambient risk by 10 to 100 excess cancers per million people exposed to the maximum 1,3-butadiene concentrations near the facilities. Emissions reporting under the Air Toxics "Hot Spots" Information and Assessment Act (AB 2588) will provide facility emissions information that will be used during the risk management phase if 1,3-butadiene is identified as a toxic air contaminant by the Board.

Based on the information available on 1,3-butadiene-induced carcinogenicity and the results of the risk assessment, the OEHHA staff conclude that 1,3-butadiene is an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health.

**What Are the Alternatives to Identifying 1,3-butadiene?
as a Toxic Air Contaminant?**

Government Code Section 11346.14 requires agencies to describe alternatives to the regulation considered by the agency and the agency's reasons for rejecting those alternatives. The only alternative to identifying 1,3-butadiene as a toxic air contaminant is to not identify it as such. The ARB staff is not recommending this alternative because 1,3-butadiene meets the statutory definition of a toxic air contaminant.

**What Would Be the Environmental Impact of the Identification of
1,3-butadiene as a Toxic Air Contaminant?**

The identification of 1,3-butadiene as a toxic air contaminant through the AB 1807 risk assessment program is not expected to result in any adverse impact on the environment. The Board's identification of 1,3-butadiene as a toxic air contaminant and the subsequent analysis of the need to control emissions in the AB 1807 risk management program may result in the adoption of control measures pursuant to Health and Safety Code Sections 39665 and 39666. In considering the adoption of control measures, the ARB will consider all potential impacts of the measures on human health, as well as the potential benefits to public health by reducing 1,3-butadiene emissions. Therefore, the identification of 1,3-butadiene as a toxic air contaminant may ultimately result in control measures that will result in environmental benefits. Environmental impacts identified with respect to specific control measures will be included in the consideration of such control measures pursuant to Health and Safety Code Sections 39665 and 39666.

**What Would be the Economic Impact of the Identification
of 1,3-butadiene as a TAC?**

The Board's identification of 1,3-butadiene will not directly affect 1,3-butadiene production and use facilities. Should the Board decide to formally identify 1,3-butadiene as a TAC, it will enter the control phase of the program. During the development of control measures, the impact of these measures on businesses will be fully assessed by the ARB and the air pollution control districts in a public forum where the need, degree, and cost of control would be evaluated.

While the majority of 1,3-butadiene emitted to California's atmosphere is a result of the incomplete combustion of mobile source fuel, 1,3-butadiene emissions can also occur from stationary facilities combusting fuel, refining petroleum, or using butadiene for the production of chemicals, resins, polymers, and copolymer products. There may be indirect economic impacts on these types of sources associated with individual district rules. Districts have the authority to require that public exposure to particular toxic substances not exceed levels deemed by the district to be protective of public health. Some districts' permitting requirements mandate that no new or modifying facilities exceed a specific risk level based on the OEHHA recommended cancer risk numbers for specific toxic substances. These requirements may result in operators needing to purchase control equipment or being denied a permit.

Districts are required by state legislation to implement the AB 2588 Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588; Health and Safety Code Sections 44300-44384). This Act establishes a program to inventory emissions of toxic air pollutants and to assess the risk to public health caused by these emissions. Under this program, districts prioritize, require risk assessments, and determine which facilities must notify the public of potential health risks posed by emissions of toxic substances that are on the "Hot Spots" program list. The program is supported by fees paid by the affected industries. The fees are specified by state and district regulations which are updated each year through a public process,

including public workshops and public hearings. 1,3-butadiene is on the “Hot Spots” toxic substances list, and qualified facilities must report their emissions of 1,3-butadiene and pay program fees. The amount of “Hot Spots” fees due from facilities that emit 1,3-butadiene will not be affected by the identification of 1,3-butadiene as a toxic air contaminant.

Some districts include AB 2588 Air Toxics “Hot Spots” program-listed substances in their list of sources and substances subject to or affected by permitting rules. Other districts may add 1,3-butadiene upon its identification as a toxic air contaminant. If districts add facilities that emit 1,3-butadiene to their permit program, the affected facilities may be required to pay new or additional district permitting fees. Districts must conduct socioeconomic analyses, as well as public workshops and hearings before identified toxic air contaminants are added to their programs and new or additional fees are assessed. Because the OEHHA's recommended potency number is slightly lower than the U.S. EPA's, fewer sources may be affected by district rules.

Finally, Health and Safety Code Section 42311 authorizes local air pollution control districts to assess permit fees to recover the cost of district programs required or authorized by state law. Most districts charge facilities fees to cover the cost of developing and implementing the controls required by Health and Safety Code Section 39666. The amount of these fees are generally determined by the district resources needed to implement the control requirements. The fees are established by district rulemaking action, and districts must conduct socioeconomic impact analyses, workshops and public hearings before adopting or revising any fee rule. The ARB is not proposing controls for 1,3-butadiene at this time. If 1,3-butadiene is identified as a toxic air contaminant by the Board as a result of the risk assessment, it will enter the risk management phase where control technology and costs will be considered in detail by the ARB and local districts. Public workshops and hearings will held before 1,3-butadiene control measures are adopted by the Board or the districts.

What are the Findings of the Scientific Review Panel?

Findings of the Scientific Review Panel on
THE REPORT ON 1,3-BUTADIENE
As Adopted at the Panel's March 19, 1992 Meeting

In accordance with the provisions of Health and Safety Code Section 39661, the Scientific Review Panel (SRP) has reviewed the report ("Proposed Identification of 1,3-butadiene as a Toxic Air Contaminant") of the staffs of the Air Resources Board (ARB) and the Office of Environmental Health Hazard Assessment (OEHHA) on the public exposure to, and health effects of 1,3-butadiene. The Panel also reviewed the public comments received on this report. Based on this review, the SRP finds that the report on 1,3-butadiene is without serious deficiencies and agrees with the staffs of the ARB and OEHHA that:

1. There is evidence that exposure to 1,3-butadiene results in carcinogenicity. The International Agency for Research on Cancer (IARC), the United States Environmental Protection Agency (U.S. EPA), and the U.S. Occupational Safety and Health Administration (OSHA) have found that 1,3-butadiene causes cancer in animals. The IARC and the U.S. EPA have classified 1,3-butadiene as a possible (Group 2B) and probable (Group B2) human carcinogen, respectively, on the basis of sufficient evidence for carcinogenicity in animals and inadequate evidence in humans. However, it is our understanding that, based on three recent epidemiology studies, the IARC will upgrade its human evidence evaluation to "limited" this year, and categorize 1,3-butadiene as a probable (Group 2A) human carcinogen. The OSHA has found that exposure to 1,3-butadiene is associated with an increased risk of death from cancer of the lymphohematopoietic system, and has classified 1,3-butadiene as a potential occupational carcinogen.
2. Because 1,3-butadiene is listed as a hazardous air pollutant under Section 112 of the United States Clean Air Act of 1990, identification of 1,3-butadiene as a toxic air contaminant is required by the California Health and Safety Code Section 39655.
3. Based on available scientific information, a level of 1,3-butadiene exposure below which no carcinogenic effects are anticipated cannot be identified.
4. Based on a health protective interpretation of the available scientific evidence, the upper bound of the lifetime excess cancer risk resulting from 1,3-butadiene exposure ranges from 9.8×10^{-4} to 8×10^{-3} per ppb [4.4×10^{-6} to 3.6×10^{-4} per microgram per cubic meter ($\mu\text{g}/\text{m}^3$)]. This range of risk is based on data from studies in rats and mice. The best value of the upper bound of risk is 3.7×10^{-4} per ppb (1.7×10^{-4} per $\mu\text{g}/\text{m}^3$). This value is based on data from a recent bioassay in mice. Appendix I compares the best value of the upper bound

1,3-butadiene cancer unit risk with those of other compounds reviewed by the SRP. These 95 percent upper bound lifetime risk estimates are health-protective estimates; the actual risk may be much lower.

5. Mobile sources (both on- and off-road) are responsible for the majority of the identified emissions of 1,3-butadiene. Mobile sources that do not have a functioning exhaust catalyst emit far greater amounts of 1,3-butadiene than do mobile sources with functioning catalysts. Stationary sources contribute to ambient concentrations of 1,3-butadiene during petroleum refining, fuel combustion, production of certain chemicals, and the manufacturing of styrene-butadiene copolymer products.
6. Based on data collected by the ARB's ambient toxic air contaminant monitoring network from 1988 through 1989, the estimated mean annual population weighted outdoor ambient exposure for California is 0.37 ppbv ($0.82 \mu\text{g}/\text{m}^3$).
7. Based on the ARB emission inventory, areas that may be expected to have 1,3-butadiene levels higher than the mean statewide concentration are near facilities using 1,3-butadiene for the production of resins and polymers, synthetic rubber manufacturing facilities, chemical production facilities, petroleum refineries, stationary fuel combustion sources, and congested freeways. New data from the AB2588 Air Toxics "Hot Spots" emissions reporting program should be used to evaluate "hot spot" exposures if 1,3-butadiene is identified as a toxic air contaminant.
8. Based on its gas-phase reactivity with the hydroxyl radical, ozone, and the nitrate radical, 1,3-butadiene's estimated tropospheric lifetime ranges from a few hours to about 12 hours.
9. Limited indoor monitoring for 1,3-butadiene indicates that individuals exposed to indoor environmental tobacco smoke (ETS) are almost certainly exposed to higher concentrations of 1,3-butadiene indoors than outdoors. The estimated dose for an individual spending three hours in an ETS environment is 10 to $60 \mu\text{g}$. The same individual, spending three hours in outdoor air at the statewide average 1,3-butadiene concentration of 0.37 ppbv ($0.82 \mu\text{g}/\text{m}^3$), will experience an estimated dose of $2.6 \mu\text{g}$.
10. Studies of mice exposed to ppm concentrations of 1,3-butadiene indicate that 1,3-butadiene is taken up rapidly by the body and distributed with metabolites to all tissues. This distribution can result in cancer in multiple sites, including the heart, lung, mammary gland, ovaries, forestomach, liver, pancreas, thyroid, testes, and hematopoietic system. Exposure to 1,3-butadiene at higher concentrations ($\geq 1,000$ ppm) is associated with tumors in the rat. Although it is not included in the calculations for the risk assessment, it is important to note that 1,3-butadiene is one of only two chemicals (the other being the fungicide Captafol) known to induce cancer in the heart of laboratory animals.

11. Epidemiological studies of production workers exposed to 1,3-butadiene provide limited evidence of an increased risk of death from hematologic neoplasms, especially leukemia and other lymphomas. Adverse health effects other than cancer are not expected to occur at mean statewide outdoor ambient concentrations.
12. Based on the OEHHA staffs best value cancer unit risk of 3.7×10^{-4} per ppb (1.7×10^{-4} per $\mu\text{g}/\text{m}^3$), and the ARB staff's population-weighted outdoor ambient exposure of 0.37 ppbv ($0.82 \mu\text{g}/\text{m}^3$), up to 140 potential excess cancers per million are predicted if exposed to this level over a 70-year lifetime. This corresponds to an excess cancer burden of up to 4,200 cancers statewide (based on a population of 30 million people).
13. Based on the available scientific evidence, we conclude that 1,3-butadiene should be identified as a toxic air contaminant.

For these reasons, we agree with the ARB staff recommendation to its Board that 1,3-butadiene be listed by the ARB as a toxic air contaminant.

I certify that the above is a true and correct copy of the findings adopted by the Scientific Review Panel on March 19, 1992

//s//

Dr. James N. Pitts, Jr.
Chairman, SRP

APPENDIX I

SUBSTANCES APPROVED BY THE SCIENTIFIC REVIEW PANEL FROM 1984 TO 1992
(in order of cancer potency)

Dioxins	3.8×10^1	Particulate Matter
Chromium VI	1.4×10^{-1}	Particulate Matter
Cadmium	4.2×10^3	Particulate Matter
Inorganic Arsenic	3.3×10^{-3}	Particulate Matter
Nickel	2.6×10^{-4}	Particulate Matter
1.3-Butadiene	1.7×10^{-4}	3.7×10^{-4}
Ethylene Oxide	8.8×10^{-5}	1.6×10^{-4}
Vinyl Chloride	7.8×10^{-5}	2.0×10^{-4}
Ethylene Dibromide	7.1×10^{-5}	5.5×10^{-4}
Carbon Tetrachloride	4.2×10^{-5}	2.6×10^{-4}
Benzene	2.9×10^{-5}	9.3×10^{-5}
Ethylene Dichloride	2.2×10^{-5}	8.9×10^{-5}
Perchloroethylene	8.0×10^{-6}	5.4×10^{-5}
Formaldehyde	6.0×10^{-6}	7.0×10^{-6}
Chloroform	5.3×10^{-6}	2.6×10^{-5}
Trichloroethylene	2.0×10^{-6}	1.1×10^{-5}
Methylene Chloride	1.0×10^{-6}	3.5×10^{-6}
[Asbestos	1.9×10^{-4} per 100 fiber/m ³]	

* Perchloroethylene's unit risk is under review by the OEHHA.

PROPOSED REGULATION ORDER

Amend Titles 17 and 26, California Code of Regulations, Section 93000 to read as follows:

93000. Substances Identified as Toxic Air Contaminants.

Each substance identified in this section has been determined by the State Board to be a toxic air contaminant as defined in Wealth and Safety Code Section 39655. If the State Board has found there to be a threshold exposure level below which no significant adverse health effects are anticipated from exposure to the identified substance, that level is specified as the threshold determination. If the Board has found there to be no threshold exposure level below which no significant adverse health effects are anticipated from exposure to the identified substance, a determination of "no threshold" is specified. If the Board has found that there is not sufficient available scientific evidence to support the identification of a threshold exposure level, the "Threshold" column specifies "None identified."

Substance	Threshold Determination
Benzene (C ₆ H ₆)	None identified
Ethylene Dibromide (BrCH ₂ CH ₂ Br; 1,2-dibromoethane)	None identified
Ethylene Dichloride (ClCH ₂ CH ₂ Cl; 1,2-dichloroethane)	None identified
Hexavalent Chromium (Cr(VI))	
Asbestos [asbestiform varieties of serpentine (chrysotile) riebeckiute (crocidolite) cummingtonite-grunerite (amosite), tremolite, actinolite, and anthophyllite]	None identified
Dibenzo-p-dioxins and Dibenzofurans chlorinated in the 2,3,7 and 8 positions and containing 4,5,6, or 7 chlorine atoms	None identified
Cadmium (metallic cadmium and cadmium compounds)	None identified
Carbon Tetrachloride (CCl ₄ ; tetrachloromethane)	None identified
Ethylene Oxide (1,2-epoxyethane)	None identified

Substance	Threshold Determination
Methylene Chloride (CH ₂ Cl ₂ ;Dichloromethane)	None identified
Trichloroethylene	None identified
Chloroform (CHCl ₃)	None identified
Vinyl Chloride (C ₂ H ₃ Cl;Chloroethylene)	None identified
Inorganic Arsenic	None identified
Nickel	None identified ¹
Perchloroethylene (C ₂ Cl ₄ ;Tetrachloroethylene)	None identified ¹
Formaldehyde (HCHO)	None identified ¹
1,3-Butadiene (C ₄ H ₆)	<u>None identified</u>

NOTE: Authority cited: Sections 39600, 39601 and 39662, Health and Safety Code.
Reference: Sections 39650, 39660, 39661 and 39662, Health and Safety Code.

1. Nickel, Perchloroethylene, and formaldehyde are not part of this regulatory action. The Board has adopted three separate amendments to Section 93000, Title 17, California Code of Regulations, identifying nickel, Perchloroethylene, and formaldehyde as toxic air contaminants; however, those three amendments have not been submitted to the Office of Administrative Law for review and filing with the Secretary of State.