The American Waterways Operators

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Peter J. Schrappen, CAE
Vice President – Pacific Region

March 24, 2022

Chair Liane Randolph
c/o Harbor Craft California Air Resources Board
1001 "I" Street
Sacramento, CA 95814

Re: Proposed Regulations for Commercial Harbor Craft

Dear Chair Randolph:

On behalf of The American Waterways Operators (AWO), thank you for the opportunity to provide comments on the California Air Resources Board (CARB) proposed amendments to the Commercial Harbor Craft (CHC) regulation.

AWO is the tugboat, towboat, and barge industry's advocate, resource, and united voice for safe, sustainable, and efficient transportation on America's waterways, oceans, and coasts. Our more than 300 member companies own and operate 6,200 towing vessels and 33,000 barges and transit 25,000 miles of inland and intracoastal waterways, the Great Lakes, and the Atlantic, Pacific and Gulf coasts and support green jobs that pay a living wage and provide long-term career opportunities for more than 300,000 Americans. Tugboats, towboats, and barges are also the greenest mode of freight transportation with one barge producing 30 percent less greenhouse gas emissions than rail and more than 1000 percent less than trucks. This is particularly significant in California which ranks third among states in waterborne commerce by tonnage and fourth in economic impact, with more than $12.2 billion in annual economic activity driven by the domestic maritime transportation industry.

At a time when California ports are experiencing historic congestion and supply-chain failures are impacting every American, the California Air Relations Board (CARB) is proposing to take regulatory action that stands to decimate maritime commerce. This new rule will force tugboat companies to retire safe and efficient harbor craft and all together consider to cease doing business in the state. AWO and its members and partners have met with CARB staff for the previous three years on the proposed Commercial Harbor Craft (CHC) rule. Unfortunately, none of the substantive recommendations and requests that industry made during that time are reflected in this final draft rule. **AWO urges CARB to not proceed with this rulemaking in**

**its current form**, but instead to build on the success of the collaborative approach that has yielded significant improvements in engine technology and emissions performance over the last decade. CARB has a long history of creating incentives and working collaboratively. Specifically, we ask CARB to:

- Change the compliance schedule for engine phase-outs depending on the manufacturing date and when the U.S. Coast Guard certifies Diesel Particulate Filters (DPFs) as safe to use.

- Amend the deadline for complying with DPF installation to no sooner than six years from the date of full approval by the U.S. Coast Guard (USCG), American Bureau of Shipping (ABS), and the engine manufacturer.

- Fully exempt all oceangoing tugs and barges and articulated tug and barges (ATBs) participating in interstate commerce and international transport from the CHC rule.

- Work with the California legislature to correct existing funding sources for CHC regulation compliance and increase supplemental state funding to provide financial assistance to companies to repower or purchase replacement vessels.

- Re-evaluate the inventory of commercial harbor craft vessels in California regulated waters and update the associated emissions and health risks based on this accurate data.

- Focus on updating vessels with Tier 2 engines and allow vessels with Tier 3 or Tier 4 engines to continue to operate for their entire useful life with the requirement that the vessel be fully retrofitted as a zero-emissions vessel.

**The existing compliance schedules cannot be met while also maintaining the integrity of the vessel and the safety of the mariners**

*Infeasible Compliance Schedule*

The tug, tow, and barge industry is committed to reaching zero emissions in the safest and most efficient manner. However, the timeline proposed in the new CHC rule gives companies less than four years to repower all their vessels and less than 6 years to modify Tier 4 engines with DPFs.

This framework is neither financially feasible, operationally achievable nor responsible, as it jeopardizes the safety of mariners and the viability of businesses. When the alternative is decommissioning a vessel, companies will rush changes to critical components without taking the necessary time to ensure these retrofits are completed in a safe and responsible manner. The USCG, ABS, and every major vessel class society recognizes, and requires operators to properly study and apply for any changes to major components or essential pieces of machinery. This study includes performing a proper engineering assessment of the change, and involves a:

- load analysis,
- stability study,
- propeller load in both static and dynamic conditions,
- failure mode and effects analysis (FMEA), and

- thorough engineering review of the results.

This process takes more than a year to complete, and cannot begin until each component, and all its specifications, are provided. Once this is complete, it can take months and even years to source an engine and compatible auxiliary equipment. In addition to procuring materials, a shipyard facility and replacement vessel must be located. Tier-4-plus-DPF repowers will require major structural changes and an increase in power generation capacity, significantly increasing the scope of engineering requirements over typical retrofits.

While there is a one-year extension in the proposed rule, the realities of vessel operations require a window that allows for all the steps above. The compliance schedule must be modified to allow for adequate time to transition vessels. AWO recommends a four-to-nine-year-phase-out period.

Compliance Dates for Tier 2, Tier 3, or Tier 4 Engines on Ferries (Except Short-Run Ferries), Pilot Vessels, All Tug/Towboats, and Push Boats

| Year of Engine | AWO Proposed Compliance Deadlines (Approved DPF) | AWO Proposed Compliance Deadlines (No Approved DPF) | CARB Proposed Compliance Deadlines |
|---|---|---|---|
| 2009 and Earlier | 12/31/2028 | 12/31/2034 | 12/31/2024 |
| 2012 and Earlier (Pilot Vessels) | 12/31/2030 | 12/31/2036 | 12/31/2025 |
| 2010-2012* | 12/31/2030 | 12/31/2036 | 12/31/2025 |
| 2013-2015** | 12/31/2032 | 12/31/2038 | 12/31/2026 |
| 2016-2019** | 12/31/2034 | 12/31/2040 | 12/31/2027 |
| 2020-2021** | 12/31/2036 | 12/31/2042 | 12/31/2028 |
| 2022 and Later** | 12/31/2038 | 12/31/2044 | 12/31/2029 |

*Ferries (Except Short-Run Ferries), All Tug/Towboats, and Push Boats.
**All vessels listed in the title of this table, including ferries (except short run), pilot, all tug/towboats, and push boats.

Compliance Dates for Tier 2, Tier 3, or Tier 4 Engines on Barges, Dredges, Crew and Supply Vessels, and Workboats

| Year of Engine | AWO Proposed Compliance Deadlines (Approved DPF) | AWO Proposed Compliance Deadlines (No Approved DPF) | CARB Proposed Compliance Deadlines |
|---|---|---|---|
| 2009 and Earlier | 12/31/2036 | 12/31/2042 | 12/31/2026 |
| 2010-2013 | 12/31/2038 | 12/31/2044 | 12/31/2027 |
| 2014-2017 | 12/31/2040 | 12/31/2046 | 12/31/2028 |
| 2018 and Later | 12/31/2042 | 12/31/2048 | 12/31/2029 |

*DPF Compliance Requirements*

CARB's proposed rule that requires Tier 4 engines with DPFs on existing vessels is not feasible. Currently, there is little to no DPF technology that can be used for marine applications nor is there a DPF-certified by the USCG or ABS. Additionally, operators cannot begin to determine the utility of DPFs on their vessels because there is no manufacture-approved DPFs available for marine engines.

Even if DPFs for towboats or barge existed, innumerable challenges remain. For example, estimated specs would preclude DPF installation in many of these types of vessels because of limited size and engine space. Also, back pressure created by the DPF could damage the engines, and the heat generated by the DPF may make vessels unsafe to operate. Even once approved, this type of installation will not be plug-and-play. Rather, it will require extensive engineering studies to determine if and how they can safely integrate into vessels. Before any work can start, an engineering study must determine its safe installation for the specific make and model of the engine. This study will need to evaluate the exhaust system in use, the available space in the exhaust trunk and stack, and the stability concerns of the vessel. After this comprehensive study, the impact of the DPF on the performance of the engine will need to be measured to determine if it creates unsafe operating conditions. There is not enough time to perform the studies necessary as well as all the other work that needs to be completed to repower an engine. It is unreasonable to require the implementation of unapproved and untested technology.

The proposed rule includes a two-year extension if no certified engines or DPFs are available by the date of compliance[1]. However, it limits the renewal of the extension to only an additional two years. At the current rate of development, it is unlikely that this technology will be certified by that time. AWO requests an amended deadline for complying with DPF installation to no sooner than six years from the date of full approval by the USCG, ABS, and the engine manufacturer. We ask that this determination would be made at least one year before the compliance deadline for the vessel year and type.

**Significant Operational Impacts and Compliance Costs**

*Arbitrary and Capricious Vessel Exemptions*

CARB's decision to exempt about 1,570 commercial fishing vessels (approximately 40 percent of the total CHC population) from the rule while not similarly exempting other vessels that meet the same criteria is arbitrary and capricious. This decision unfairly places 100% of the emission reduction burden of the CHC rule on 60 percent of the vessel population. CARB's rationale for excluding these commercial fishing vessels applies equally to towing vessels that operate in coastal and international trade. Specifically:

- Small profit margins,
- Demonstrated lack of feasibility for Tier 4 repowers and retrofits,
- Competition with out-of-state and global markets; and,
- Tendency to conduct most of their operations far from the coast.

Oceangoing tugs and barges, either towed on a wire or rigidly connected through an articulated tug barge (ATB) system, are directly analogous in their operation to commercial fishing vessels and share all four criteria that led CARB to exempt those vessels. AWO submitted information in April 2020 showing that "repowering with EPA Tier 4 engines could be significant and cost prohibitive for some ship assist and escort tugs." Similar technical challenges exist for oceangoing tugs, barges, and ATBs. These vessels commonly operate in interstate commerce in competition with self-propelled vessels in out-of-state and global markets. Additionally, the tugboats and barges operating in these markets are required by law

[1] Exception E2

to be U.S.-flagged, U.S.- owned, U.S.-crewed, and U.S.-built. This rule would place U.S.-flagged towing vessels at a competitive disadvantage against self-propelled foreign-flagged vessels that are not covered by CARB's rule. Finally, AIS and Marine Exchange data reveals that these vessels conduct most of their operations far from the California coast, giving them a similar air emission profile in California as the exempted commercial fishing vessels.

CARB should extend the exemption for commercial fishing vessels to oceangoing tugboats and barges to avoid arbitrary and capricious distinctions between similarly situated classes of vessels.

*Inappropriate regulating statute*
The proposed rule fails to address the unique nature of articulated tug and barge (ATB) systems. The operational profile of ATBs is equivalent to that of a self-propelled oceangoing tank vessel in its function. Under CARB's current rules, all self-propelled bulk tank vessels calling at port in California – whether foreign or U.S. flagged – are subject to the At Berth Regulation. It is neither fair nor rational that ATBs face significantly different emissions control requirements, despite performing the same function as other similar vessels. The CARB Board recognized this at their August 27, 2020 meeting by passing Resolution 20-22[2] which specifically directed staff to engage with industry to determine the best options for cost-effective-emissions-reduction regulations.

In the mind of AWO, this means removing ATBs from the CHC rule and regulating them under the existing At Berth Regulation.

*Compliance Cost*
CARB has relied on the California Maritime Academy's (CMA) report "Evaluation of the Feasibility and Costs of Installing Tier 4 Engines and Retrofit Exhaust Aftertreatment on In-Use Commercial Harbor Craft" to determine feasibility of Tier 4 retrofits, including DPFs. In their analysis, the cost to do this work was $2.81 million. Upon review of the report by an independent engineering firm[3], it was discovered that, because of its narrow scope, the CMA report vastly underestimated this cost. In reality, it costs $3.7-$4.5 million to repower a single vessel and it would cost $16-$24 million to purchase a new tug – something that an operator would be required to do if they could not comply. This significant investment would devastate smaller companies, who recently spent money to retrofit their vessels to meet the current CHC standards – an investment that was made with the expectation that the vessel would be used for its full useful life of 20-25 years before normal repowering.

We acknowledge that there are multiple opportunities to apply for government funding to help manage these unexpected costs, however, there are not enough grant dollars enough to assist with mitigating the cost of compliance for the entire tugboat, towboat, and barge industry in California. Also, these grants are extremely competitive and do not fund maritime projects like our industry. There is no way for the maritime industry to comply with this unfunded mandate without help. We urge the Board to provide a stipulation that some guaranteed financial assistance will be provided if this rule goes through.

[2] APPENDIX I
[3] APPENDIX II

**A more holistic, zero emissions approach is needed**

*Accurate Vessel Inventory*
Under existing harbor craft regulations, towing vessel operators are required to report to CARB the number of vessels they operate in California waters. Rather than relying on this reporting to determine the size of the towing vessel population, CARB used a USCG database that provides information on vessel ownership and regulatory status, but not area of operation. This is an inaccurate representation of the number of vessels operating in California regulated waters because a vessel can be registered at a California port where a company is headquartered, but not necessarily transits consistently through California waters.

Throughout its three years of engagement, AWO has repeatedly pointed out that the U.S. Coast Guard database CARB used to create its vessel inventory is designed to track ownership of a vessel and not where it operates. Despite this important clarification, CARB continues to use homeport information which overestimates towing vessel operation in California waters. This mistake has led the agency to overestimate the number of unreported vessels, the population of towing vessels operating in California, and their cumulative impact on air quality.

In order to demonstrate these inaccuracies, AWO contracted with Ramboll[4], a third-party engineering consulting firm, to conduct an independent assessment of the number of towing vessels operating in California and the likely impact of emissions from those vessels. Using Automatic Identification System (AIS) data for 2019[5], Ramboll tracked the movement of every towing vessel operating within California waters during that year. The AIS data affirms that CARB has significantly overcounted the size of California's towing vessel fleet. Ramboll found that only 200 towing vessels operated within 100 nautical miles of the California coast, nearly 30 vessels fewer than CARB estimated to be working in California. The CARB model also assumes that non-reporting vessels operated the same number of hours as reporting vessels. Using the AIS data, Ramboll was able to determine the number of hours the towing vessels operating in California waters were moving, which is more a reliable predictor of total engine hours and therefore engine emissions. AWO was later informed by CARB that data provided by staff was improperly labeled. Therefore, this audit is inaccurate in our view.

Despite this, AWO stands by its past comments stating that it is inappropriate to use the U.S. Coast Guard database to identify vessels operating in California and that emissions from vessels that have not reported their hours are only a fraction of the scaling factor CARB has used in their emission analysis.

This new rule is based on an inaccurate vessel inventory and overinflated emissions numbers. We need to pass a rule that is based on an accurate reflection of the industry and its impact on California.

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[4] Appendix III
[5] AWO chose 2019 for two reasons: first, it was the last year not affected by the impacts of COVID on vessel operations, and second, CARB provided vessel reporting status for that year, which allowed us to measure the difference between reported vessels and non-reported vessel hours.

*Zero Emissions*
AWO members are committed to reducing their vessel emissions and lessening their impact on the environment. The tugboat, towboat, and barge industry is already the greenest mode of freight transportation in the country and individual companies are already taking steps to introduce hybrid and zero emissions. CARB's proposed rule states that their end goal is to have all vessels operating in California waters to have zero emissions, but their incremental approach to this goal undercuts the industry's ability to do this by forcing operators to repower, retire, or purchase a new vessel every year. Harbor craft operators typically expect a newly built vessel to have a useful life of 20-25 years and investment decisions are made with the assumption that they can be recouped over this period. The proposed regulations would dramatically alter this calculus, forcing vessels from service after as little as 10 years. Not only is it extremely difficult, and economically untenable in many cases, for an operator to do this, the net environmental impact of forcing the premature retirement of serviceable vessels and replacing them with new builds (even if the newbuild has a lower emissions profile) must be considered as the procurement of materials and disposal of old vessels has an indirect, yet still noteworthy, emissions profile.

The most financially feasible and technologically efficient way for industry to help CARB reach their zero emissions goal within their long-term timeline is to allow a tug, tow, or barge to function for its useful life and then be replaced with a zero-emissions vessel. Tier 1 and Tier 2 engines should be brought up to a higher standard, but new Tier 3 and Tier 4 engines are operating at the most efficient technology available and should be able to run throughout their useful life. Best available technology is already in use here, so we request that CARB add an exemption to the rule that allows vessels currently with Tier 3 and Tier 4 engines to operate for the rest of their useful life with the stipulation that they will become fully retrofitted as a zero emissions vessel when that useful life is up. Moving forward, we remain committed to zero emissions. We are confident that we can get there, but regulations based on unfeasible technology is not the correct route.

**Conclusion**
AWO and its membership are committed to helping California reach their zero emissions goal and looks forward to playing a part in helping the state's maritime industry be a leader in this. However, this rule will not get us there. Please vote no and allow us to continue to engage with CARB staff and amend the rule to create one that works for industry, the Board, and the state as a whole.

Sincerely,

Peter Schrappen
AWO Vice President – Pacific Region

# APPENDIX I

Resolution 20-22

August 27, 2020

## Identification of Attachments to the Board Resolution

**Attachment A:** CEQA Findings and Statement of Overriding Considerations

State of California
AIR RESOURCES BOARD

# CONTROL MEASURE FOR OCEAN-GOING VESSELS AT BERTH

## Resolution 20-22

**August 27, 2020**

Agenda Item No.: 20-08-1

WHEREAS, sections 39600 and 39601 of the Health and Safety Code direct the California Air Resources Board (CARB or Board) to adopt standards, rules, and regulations and to do such acts as may be necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, sections 39658, 39659 and 39666 of the Health and Safety Code authorize the Board to establish airborne toxic control measures (ATCM) for substances identified as toxic air contaminants;

WHEREAS, section 43013 of the Health and Safety Code authorizes the Board to adopt standards and regulations to control criteria pollutants for off-road or nonvehicle engine categories, including marine vessels to the extent permitted by federal law; and to act as expeditiously as is feasible to reduce nitrogen oxide emissions from marine vessels;

WHEREAS, section 41511 of the Health and Safety Code gives CARB the authority to adopt rules and regulations in carrying out its duties that require the owner or the operator of any air pollution emission source to take such action as it may determine to be reasonable for the determination of the amount of such emission from such source;

WHEREAS, section 38560 of the Health and Safety Code directs CARB to adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas (GHG) emissions reductions from sources or categories of sources;

WHEREAS, section 38562 of the Health and Safety Code requires CARB to adopt GHG emissions limits and emissions reduction measures by regulation to achieve the maximum technologically feasible and cost-effective reductions in GHG emissions in furtherance of achieving the statewide GHG emissions limit;

WHEREAS, section 39730.5 of the Health and Safety Code requires CARB to begin implementing the comprehensive short-lived climate pollutant strategy to reduce statewide anthropogenic black carbon emissions by 50 percent below 2013 levels by 2030;

WHEREAS, the 2016 Sustainable Freight Action Plan identified strengthening the Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port (2007 At-Berth ATCM), as a State agency action to advance the objectives of Executive Order B-32-15;

WHEREAS, the 2016 State Strategy for the State Implementation Plan (SIP Strategy) included a CARB measure to strengthen the emission controls from vessels at berth by including additional vessel fleets, types, and operations to achieve emission reductions needed for attainment;

WHEREAS, the October 2018 Community Air Protection Blueprint identifies amendments to the At Berth regulation as a near term action to reduce emissions and exposure in disproportionately burdened communities throughout the State.

WHEREAS, ports provide direct and substantial contributions to California commerce;

WHEREAS, during the March 23, 2017, Board Meeting, the Board adopted Resolutions 17-7 and 17-8 (and addenda thereto), adopting the 2016 State Strategy for the SIP, and the 2016 Air Quality Management Plan for Ozone and PM2.5 in the South Coast Air Basin and the Coachella Valley, respectively;

WHEREAS, the addenda to Board Resolutions 17-7 and 17-8 direct CARB staff to develop a regulation that would strengthen the 2007 At-Berth ATCM and provide further emission reductions to increase public health benefits;

WHEREAS, staff has proposed the Control Measure for Ocean-Going Vessels At Berth (Regulation), as set forth in Appendix A to the Initial Statement of Reasons (ISOR) released to the public on October 15, 2019;

WHEREAS, the Regulation would reduce emissions in communities heavily burdened by cumulative air pollution impacts, as required by Assembly Bill 617 (Stats. 2017, Ch. 136);

WHEREAS, the Regulation is designed to achieve added public health and air quality benefits that result from emissions reductions of oxides of nitrogen (NOx), particulate matter 2.5 (PM2.5), reactive organic gas (ROG), GHG emissions, black carbon, diesel particulate matter (DPM) and other toxic air contaminants, beyond those realized by the 2007 At-Berth ATCM;

WHEREAS, CARB's regulatory program that involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans has been certified by the

Secretary for Natural Resources under Public Resources Code section 21080.5 of the California Environmental Quality Act (CEQA; California Code of Regulations, title 14, section 15251(d)), and CARB conducts its CEQA review according to this certified program (California Code of Regulations, title 17, sections 60000-60007);

WHEREAS, CARB prepared a draft Environmental Analysis (Draft EA) under its certified regulatory program for the Regulation and circulated it as Appendix D of the ISOR for public comment for at least 45 days from October 15, 2019, through December 9, 2019;

WHEREAS, the Draft EA concluded that implementation of the Regulation has the potential to result in: less than significant impacts, or no impacts, to energy demand, land use, air quality, GHGs, population, employment and housing, public services, and recreation; and potentially significant impacts to aesthetics, agriculture and forest resources, air quality (construction-related emissions), biological resources, cultural resources and tribal resources, geology and soils, hazards and hazardous materials, hydrology and water quality, mineral resources, noise and vibration, transportation and traffic, and utilities and service systems. The potentially significant and unavoidable adverse impacts are primarily related to short-term, construction-related activities.

WHEREAS, on December 5, 2019, the Board conducted a public hearing on the proposed Control Measure for Ocean-Going Vessels At Berth and the Draft EA prepared for the proposal;

WHEREAS, following the public hearing, the Board adopted Resolution 19-28 directing the Executive Officer to consider any additional conforming modifications that are appropriate, and make them available for public comment, with any additional supporting documents and information, for a period of at least 15 days. The Executive Officer was further directed to consider written comments submitted during the public review period and make any additional appropriate conforming modifications available for public comment for at least 15 days, explore innovative concepts where equivalent or greater community benefits would be achieved, evaluate all comments received during the public comment periods, including comments on the Draft EA, and prepare written responses to EA comments as required by CARB's certified regulations at California Code of Regulations, title 17, sections 60000-60007 and Government Code section 11346.9(a). The Executive Officer was directed to present to the Board, at a subsequently scheduled public hearing, staff's written responses to any comments on the Draft EA, along with the Final EA, for consideration for certification, and the finalized regulation for consideration for adoption;

WHEREAS, following the Board hearing on December 5, 2019, the modified regulatory language and supporting documentation were circulated for a 36-day public comment period, with the changes to the originally proposed text clearly indicated, according to provisions of California Code of Regulations, title 1, section 44

and Government Code sections 11340.85 and 11346.8, from March 26, 2020, to May 1, 2020;

WHEREAS, staff presented to the Board on June 25, 2020 at an informational hearing, an update on the status of the regulation development in light of the current economic conditions, and received guidance on the next steps for finalizing the Regulation;

WHEREAS, following the informational Board hearing, a second version of modified regulatory language and supporting documentation were circulated for a 15-day public comment period, with the changes to the regulatory language text clearly indicated, according to provisions of California Code of Regulations, title 1, section 44 and Government Code section 11340.85, from July 10, 2020, to July 27, 2020;

WHEREAS, staff reviewed written comments received on the Draft EA and prepared written responses to those comments in a document entitled *Response to Comments on the Environmental Analysis Prepared for the Control Measure For Ocean-Going Vessels At Berth* (Response to EA Comments);

WHEREAS, on August 25, 2020**,** staff posted on the rulemaking page the Final EA, which includes minor revisions; and on August 25, 2020, staff posted on the rulemaking page the Response to EA comments;

WHEREAS, prior to the duly noticed public hearing held on August 27, 2020, staff presented the Final EA and the Response to EA Comments, as released to the public and posted on the rulemaking page on August 25, 2020, to the Board for consideration;

WHEREAS, at the public hearing on August 27, 2020, staff received additional written comments on the Final EA and prepared further written responses to those comments in a document entitled *Supplemental Responses to Comments on the Environmental Analysis Prepared for the Control Measure For Ocean-Going Vessels At Berth* (Supplemental Response to EA Comments, collectively referred to as the "responses to EA comments" along with the August 25, 2020, Response to EA Comments), which was provided to the Board for its consideration and posted to CARB's website prior to the Board's vote on this item;

WHEREAS, a public hearing and other administrative proceedings have been held according to the provisions of Chapter 3.5 (commencing with section 11340), part 1, division 3, title 2 of the Government Code; and

WHEREAS, the Board finds that:

1. The Regulated California Waters, which include California ports and independent marine terminals, feature meteorological, wind, and

atmospheric conditions peculiar to the local waters of California, and such conditions make it likely that emissions of DPM, PM2.5, ROG, and NOx occurring within these waters and ports are transported to coastal communities and adversely affect human health and welfare and the environment in such communities, thereby calling for special precautions to reduce these emissions;

2. The emissions from diesel auxiliary engines used on ocean-going vessels and boilers used on tanker vessels with steam driven boilers while at berth contribute to regional air quality problems and to potential risk of cancer and non-cancer health effects for residents living in communities near California's major ports and independent marine terminals;

3. Upon implementation, the Regulation approved herein would reduce emissions of DPM, ROG, GHG and NOx from diesel auxiliary engines used on ocean-going vessels and PM2.5, ROG, and NOx from boilers on tanker vessels with steam driven pumps while at berth and will reduce emissions of carbon dioxide, a GHG;

4. The Regulation approved herein will be consistent with CARB's environmental justice policy by reducing the health risks from DPM in all communities near major California ports and independent marine terminals as well as further inland, including those with low-income and minority populations regardless of location;

5. The Regulation approved herein will conform to the requirements of the SIP Strategy;

WHEREAS, in consideration of the ISOR, written comments, and public testimony, the Board finds that:

1. In accordance with Health and Safety Code section 43013(b), the in-use operational requirements and other provisions of the Regulation approved herein are necessary, cost-effective, and technologically feasible for diesel auxiliary engines used on ocean-going vessels and boilers used on tanker vessels with steam driven pumps while at berth within the time provided for compliance;

2. The emissions from diesel auxiliary engines used on ocean-going vessels and auxiliary boilers used on tankers with steam driven pumps while at berth contribute to regional air quality problems and to potential risk of cancer and non-cancer health effects for residents living in communities near California's major ports and independent marine terminals;

3. Upon implementation, the Regulation approved herein would reduce emissions of DPM, NOx, ROG, and GHG from diesel auxiliary engines used on ocean-going vessels and PM2.5, NOx, ROG, and GHG from boilers used on tanker vessels with steam driven pumps while at berth and will reduce emissions of carbon dioxide, a greenhouse gas;

4. The compliance schedule contained within the Regulation approved herein is necessary, cost-effective, and technologically feasible;

5. Without the Regulation approved herein, statewide at berth baseline emissions of NOx, PM2.5, DPM, and ROG from diesel auxiliary engines used on ocean-going vessels and boilers on tankers with steam driven pumps while at berth, are expected to be 12.37 tons per day (TPD), 0.387 TPD, 0.183 TPD, and 0.68 TPD, respectively, in 2032;

6. The Regulation approved herein would reduce emissions of NOx, PM2.5, DPM, and ROG statewide by about 5.4 TPD, 0.14 TPD, 0.094 TPD, and 0.30 TPD, respectively, in 2032;

7. The Regulation approved herein would reduce emissions of carbon dioxide equivalent (CO2e) by about 44,000 metric tons in 2032;

8. The reduction of NOx emissions resulting from the Regulation approved herein would also reduce the formation of secondarily-formed PM in the atmosphere;

9. The reduction in ambient DPM levels and the secondary formation of PM resulting from the Regulation approved herein will likely prevent an estimated 240 premature deaths by 2032, with a total valuation pursuant to standard U.S. Environmental Protection Agency methodology of $2.32 billion for avoiding both morbidity and various other non-cancer health effects;

10. The added costs of the Regulation approved herein have been analyzed as required by California law, and the analysis of these impacts, as set forth in the Staff Report and revised in the Supplemental 15 Day Notices, indicates that the total cost we expect the affected industry will expend in response to the Regulation will be about $2.23 billion through 2032;

11. The reporting requirements applicable to businesses in the Regulation approved herein are necessary for the health, safety, and welfare of the people of the State;

12. The benefits of the Regulation approved herein to public health and welfare and the environment outweigh the costs of compliance, implementation, and enforcement;

13. The implementation of shore power infrastructure facilitate additional skilled human operations in and around the port to support zero emission technologies including vessel plug-ins, as well as maintenance, and repair of electrical infrastructure and shore power equipment;

WHEREAS, the Board finds that:

The proposed regulation meets the statutory requirements identified in sections 39600, 39601, 39658, 39659, 39666, 43013, 41511, 38560, 38562, and 39730.5 of the Health and Safety Code;

The Regulation was developed in an open public process, in consultation with affected parties, through numerous public workshops, individual meetings, and other outreach efforts, and these efforts are expected to continue;

No reasonable alternatives to the Regulation considered to date, or that have otherwise been identified and brought to the attention of CARB, would be more effective at carrying out the purpose for which the regulation is proposed or would be as effective and less burdensome to affected entities than the Regulation; and

The Regulation is consistent with CARB's environmental justice policies and do not disproportionately impact people of any race, culture, or income.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby certifies that the Final EA (including the Response to EA Comments, as released to the public and posted on the rulemaking page on August 25, 2020, and the Supplemental Response to EA Comments, as provided to the Board and released to the public at the August 27, 2020, public hearing) was completed in compliance with CARB's certified regulatory program to meet the requirements of CEQA, reflects the agency's independent judgment and analysis, and was presented to the Board whose members reviewed and considered the information therein before taking action to approve the Regulation.

BE IT FURTHER RESOLVED that in consideration of the Final EA, the responses to EA comments, and the entirety of the record, the Board adopts the CEQA Findings and Statement of Overriding Considerations set forth in Attachment A to this resolution.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby adopts amendments to section 2299.3, Title 13 and section 93118.3, Title 17 California Code of Regulations, and adopts sections 93130 – 93130.22, Title 17, California Code of Regulations, as released to the public and posted on the rulemaking page on August 25, 2020.

BE IT FURTHER RESOLVED that the adopted regulatory text may be further revised with non-substantial or grammatical changes, which will be added to the rulemaking record and indicated as such.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to finalize the Final Statement of Reasons, submit the completed rulemaking package to the Office of Administrative Law, and transmit the Notice of Decision to the Secretary of the Natural Resources Agency for posting.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to periodically review the test methods, which are incorporated by reference in the regulation adopted herein, to determine if modifications to the test methods are warranted.

BE IT FURTHER RESOLVED that, pursuant to sections 39515, 39516, 39600, and 39601 of the Health and Safety Code, if modifications to the test methods are warranted, the Board expressly delegates to the Executive Officer the authority to: (a) adopt regulatory amendments to the test methods, set forth in section 93110.5(g), title 17, CCR; (b) conduct public hearings, if necessary; and (c) take other appropriate actions to make such amendments.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to conduct outreach efforts as soon as possible with affected industry to ensure that vessel owners or operators, terminal operators, ports, and CARB Approved Emission Control Strategy operators, are aware of the requirements of the regulation.

BE IT FURTHER RESOLVED that the Board supports human operated zero emission equipment and infrastructure.

BE IT FURTHER RESOLVED that the Board directs the staff to assess the progress made in deploying control technologies for use with tanker and roll on roll off vessels, including assessing data and information received from external stakeholders, to review the potential feasibility of control technologies for use with bulk vessels, general cargo vessels, and vessels at anchor and to publish the findings in a report by December 1, 2022, as specified by the Regulation.

BE IT FURTHER RESOLVED that the Board directs staff to engage the local community group or local AB 617 community steering committee regarding an applicant's proposed project to ensure these adjacent communities are informed and involved in any proposed innovative concept's public comment period prior to an applicant's approval.

BE IT FURTHER RESOLVED that the Board directs staff to continue to engage the articulated tug barge (ATB) industry to determine the best options for cost-effective

emission reductions that recognize the unique nature of ATBs as CARB updates the commercial harbor craft regulation.

BE IT FURTHER RESOLVED that the Board directs the staff to monitor the implementation of the regulation for all regulated vessel types, including progress updates for infrastructure and vessel activity, to report back to the Board with periodic updates, annually or as needed, and to propose amendments to the regulation for the Board's consideration when warranted to resolve any implementation problems that may arise.

BE IT FURTHER RESOLVED that the Board hereby determines that the regulations adopted herein will not cause California off-road engine emission standards, in the aggregate, to be less protective of public health and welfare than applicable federal standards.

BE IT FURTHER RESOLVED that, to the extent necessary, the Executive Officer shall, upon adoption, forward the regulations to the Environmental Protection Agency with a request for an authorization or confirmation that the regulations are within the scope of an existing authorization pursuant to section 209(e)(2)(A) of the Clean Air Act, as appropriate.

I hereby certify that the above is a true and correct copy of Resolution 20-22 as adopted by the California Air Resources Board.

/s/

Ryan Sakazaki, Board Clerk

# MEMORANDUM

**Date:** November 11, 2021

**To:** American Waterways Operators

**From:** Amnon Bar-Ilan, Christian Lindhjem, Sonja Sax

**Subject:** Ramboll Comments on the California Air Resources Board (CARB) Proposed Amendments to the Commercial Harbor Craft (CHC) Regulation

## 1. REVIEW OF HARBOR CRAFT EMISSIONS IMPACTS AND COMPARISON OF CALIFORNIA HARBOR CRAFT EMISSION INVENTORY

### 1.1 Introduction

**The California Air Resources Board (CARB) air emissions inventory and proposed rule effectiveness are presented in Appendix H of the proposed regulation supporting documentation. This 2021 document updates CARB's emission inventory methods from the 2007/2009 Commercial Harbor Craft (CHC) emission inventory methods.[1] In general, the approach is similar, but many of the default inputs were substantially revised to lower overall emissions as shown in Figure 1.**

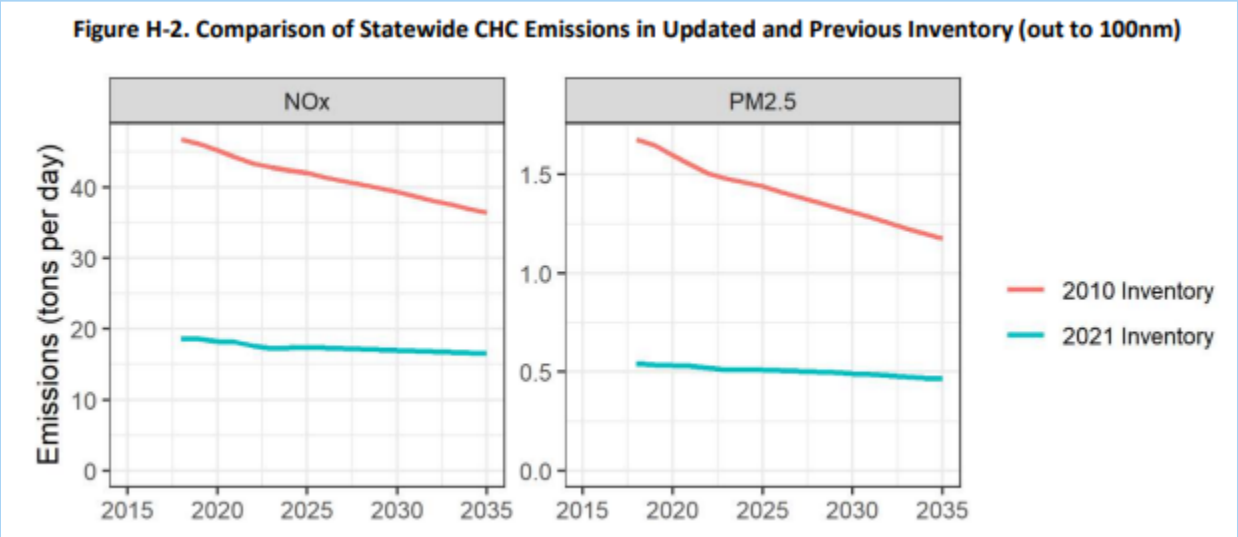


**Figure 1. CARB commercial harbor craft emissions inventory comparison. (CARB 2021)**

[1] https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road



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**CARB segregated the vessels by type (including vocation) shown in Figure 2. In this report, we focus on the Tugboat types, which include Tugboat-Escort/Ship Assist, Tugboat-Push/Tow, and Tugboat-Articulated Tug and Barge (ATB).**

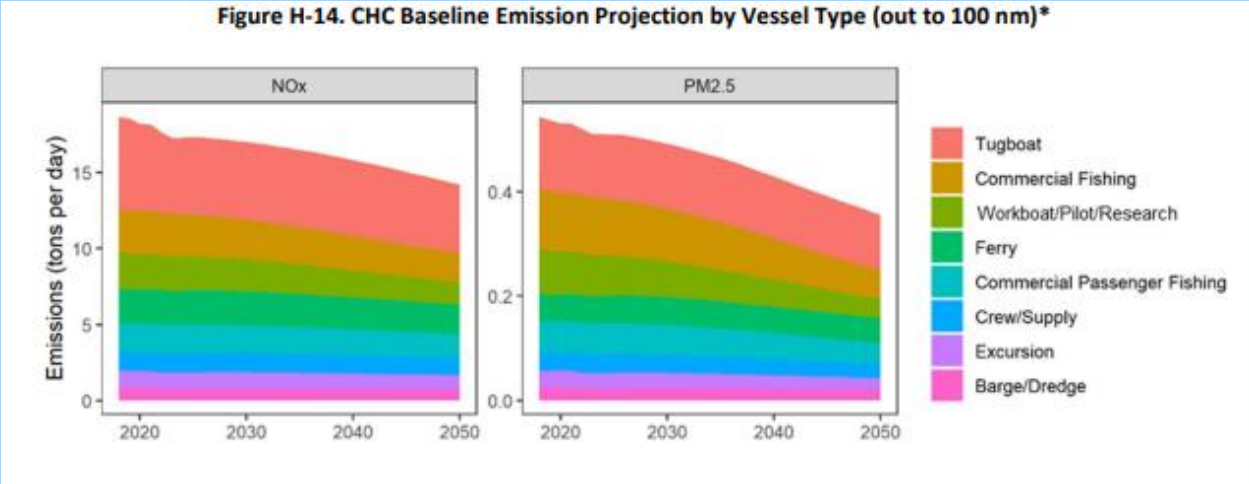


**Figure 2. CARB commercial harbor craft emissions inventory by vessel type. (CARB 2021)**

**Alternative source of activity data includes AIS data that is publicly and freely available from a trusted source.[2] The AIS data identifies tug and towboats using vessel codes 31 for towboats and 52 for tugs and provide position, speed, and course. The AIS data identifies every vessel operating in US continental waters identified by MMSI for a given year.**

**Emissions estimates depend on input factors related to the vessel activity and engine characteristics. The AIS data provides the population and activity for all vessels operating in a defined domain. Emissions estimates also require that the new engine emission factors be identified by Tier level in Table H-5 of Appendix H of CARB (2021), age, and fuel correction.**

**Emissions = Pop x Power x Activity (hrs) x Load Factor x (zhEF + DF x (Age/Life)) x Fuel Correction**

**Pop – Population of vessels (activity input)**
**Power – Engine power (activity input)**
**Activity – Hours of engine operation (activity input)**
**Load Factor – Average fraction of available power (CARB input estimate)**
**zhEF – Emission factor when new (zero-hour) (CARB input estimate)**
**DF – Deterioration factor (CARB input estimate)**
**Age – Engine age (activity input)**
**Life – Useful Life (CARB input estimate)**
**Fuel Correction – In-use relative to engine certification fuel (CARB input estimate for 2011+ engines is 0.948 – NOx and 0.852 - PM[3] and PM correction is more significant for older engines)**

[2] https://marinecadastre.gov/ais/
[3] https://ww3.arb.ca.gov/msei/chc-appendix-b-emission-estimates-ver02-27-2012.pdf

The vessel types average load factor estimates according to primary vocation for the range for tugs and towboats is shown in Table 1. Because of the difference in assumed load factor, it is important to appropriately characterize the activity that each vessel performs.

Table 1. CARB Load Factor input by vessel type. (Table H-9, CARB 2021)

| Vessel Type | Load Factor | |
|---|---|---|
| | Main | Auxiliary |
| Tugboat-ATB | 0.50 | 0.50 |
| Tugboat-Push/Tow | 0.33 | 0.37 |
| Tugboat-Escort/Ship Assist | 0.16 | 0.34 |

## 1.2 Vessel and Emission Inventory and Comparison with CARB Estimates

We used the AIS records to identify tug and towboats using vessel identification numbers 31 and 52, and American Waterways Operators (AWO) provided more detailed input for their vessel fleet including primary vocation, engine power, Tier level, and, in some cases, hours of operation in California waters. Table 2 shows the comparison of the vessel population found operating within 100 nm of the California coast during 2019. CARB (2021) reported that they identified the population of 177 tugs and towboats through the harbor craft reporting in Table H-3 and upwardly adjusted that inventory to account for unreported vessels through Coast Guard lists at California home ports. The AIS records find only 200 tug and towboats (23 vessels or about 13% more than reported by CARB) during 2019 compared with CARB's estimate in Table H-3 of 229 vessels or 29 more than were reported in the AIS records.

Table 2. Vessel population found in California waters <100 nm in 2019

| Vessel Type | CARB App. H | | | AIS Records | | |
|---|---|---|---|---|---|---|
| | Table H-3 | Adjusted Total Table H-3 | Average Hours Table H-4 | Population | Average Hours (>0.1 knots) | Average Hours (<0.1 knots) |
| Tugboat-ATB[a] | 11 | 19 | 2,466 | 14[a] | 1,991 | 1,380 |
| Tugboat-Push/Tow | 108 | 147 | 1,550 | 118 | 817 | 1,216 |
| Tugboat-Escort/Ship Assist | 58 | 63 | 2,676 | 68 | 2,141 | 3,855 |
| Combined Tug and Towboat | 177 | 229 | 1,936 | 200 | 1,350 | |

[a] – AIS does not distinguish ATBs from Towboats; AWO identified six fleet vessels and eight others found in AIS records as ATB.

We used the AIS records to determine hours of operation for each tug and towboat operating in California waters out to 100nm during 2019. The average hours for AIS compared favorably with the CARB averages except for towboats where the operating hours about half that estimated by CARB. Total and average hours at less than 0.1 knots speed were considered to use no propulsion power, but auxiliary engines running at normal loads, though many tugs at their base will use shore power for auxiliary loads such as to keep the AIS transponders emitting a signal.

AWO supplied tier and power of the main and auxiliary engines for their members' fleets as summarized in Table 3. For other tugs and towboats found in the AIS data, we used CARB default information with Tier 1 emissions rates to towboats (including ATB) and Tier 2 to tugboats to hours of operation. The AWO supplied fleets generally had higher installed power

**than the CARB averages by vessel type, so using the CARB default for AIS extra (non-AWO) fleets leads to a conservative overestimate of emissions.**

**Table 3. Vessel population and inputs use found in California waters <100 nm in 2019**

| Vessel Type | CARB App. H Default Inputs | | | AWO Fleet | | |
|---|---|---|---|---|---|---|
| | AIS Extra Population | Main Engines (hp) | Tier | AIS AWO Population | Main Engines (hp) | Tier |
| Tugboat-ATB[a] | 8 | 4395 | 1 | 6[a] | 6400 | 2, 3 |
| Tugboat-Push/Tow | 94 | 731 | 1 | 24 | 2700 | 0 – 3 |
| Tugboat-Escort/Ship Assist | 7 | 2450 | 2 | 61 | 3898 | 0 – 4 |
| Combined Tug and Towboat | 109 | | | 91 | | |

[a] – AIS does not distinguish ATBs from Towboats, AWO identified six vessels in AWO fleets and eight in AIS records as ATB.

**The CARB default and AIS hours of operation were combined in the emissions to estimate tug and towboat emissions for 2019 as shown in Table 4. When applied, deterioration and fuel corrections primarily increase PM emissions relative to our baseline estimate. We also investigate the impact that fleet mix of engine Tier levels could have on average emissions rates primarily increasing PM emissions rates. The Tier levels for the AWO fraction of all vessels was provided, while CARB default fleet mix was used for the other tugs and towboats found in the AIS records.**

**Table 4. Tug and towboat emissions in California waters <100 nm in 2019.**

| Vessel Type | AIS Emissions Estimates | | AIS (with deterioration, fuel correction) | | AIS Additional Correction for Fleet Mix | |
|---|---|---|---|---|---|---|
| | NOx tpd | PM tpd | NOx tpd | PM tpd | NOx tpd | PM tpd |
| Tugboat-ATB[a] | 1.36 | 0.020 | 0.92 | 0.019 | 0.85 | 0.020 |
| *Idle <0.1 knots* | *4%* | *5%* | | | | |
| *Fraction within 24 nm* | *87%* | *83%* | | | | |
| Tugboat-Push/Tow | 0.97 | 0.023 | 1.11 | 0.032 | 1.05 | 0.039 |
| *Idle <0.1 knots* | *9%* | *15%* | | | | |
| *Fraction within 24 nm* | *82%* | *85%* | | | | |
| Tugboat-Escort/Ship Assist | 2.04 | 0.041 | 2.31 | 0.057 | 2.31 | 0.057 |
| *Idle <0.1 knots* | *17%* | *26%* | | | | |
| *Fraction within 24 nm* | *99%* | *99%* | | | | |
| Sum Tug and Towboats | 4.37 | 0.086 | 4.34 | 0.109 | 4.22 | 0.117 |
| CARB App. H (Estimated from Figure H-14) | 6.1 | 0.14 | | | | |
| Relative to CARB Figure H-14 | 72% | 62% | 71% | 78% | 69% | 83% |

## 1.3 Assumptions

- AIS data using a <0.1 knot cutoff to eliminate vessel activity when main (and often auxiliary) engines are at least low power or entirely off. The '<0.1knot' criteria best matched the propulsion engine time for tugboat (4% overestimate) and towboats and others identified in AWO fleets (4% underestimate).
    - Under <0.1 knot, the auxiliary engines were assumed to continue to be used to supply power for the AIS and other electrical demands. This is a known overestimate because many tugs plug into shore power while at base.
- Based on the CARB default model year, we used Tier 1 engines for towboats (both ATB and others) and Tier 2 for tugboat-Escort/Ship Assist.
    - CARB reported to have used a distribution of Tier levels; Andrew Daminao (CARB, email to Charles Constanzo, Friday, September 3, 2021 8:55 AM) provided a file 'Towing Vessel Inventory 2019' that provided information about the fleet mix by tier level.
    - Shown in Table 5 is a comparison of the impact on emissions that fleet mix could have compared with either Tier 1 or Tier 2. The small fraction of Tier 0 in the fleet has a significant impact (greater than 50% for DPM) on towboat emissions rates estimated and less but still significant on the tugboats.
    - AWO provide fleets' engines characteristics for 2019 that had generally higher Tier levels and averaged lower emissions levels than the fleets provided by CARB.

**Table 5. Fleet mix emissions impacts from CARB towing vessels file and AWO Submittals for 2019.**

| Vocation | Tier | Count | AWO Count | Emission Factor by Tier (g/hp-hr) | | CARB Tier 0, 1 Contribution | |
|---|---|---|---|---|---|---|---|
| | | | | NOx | DPM | NOx | DPM |
| Tugboat-ATB | 0 | 2 | 0 | 7.34 | 0.37 | 25% | 49% |
| Tugboat-ATB | 1 | 1 | 0 | 6.97 | 0.12 | 12% | 8% |
| Tugboat-ATB | 2 | 6 | 2 | 5.08 | 0.09 | | |
| Tugboat-ATB | 3 | 2 | 4 | 3.69 | 0.05 | | |
| Tugboat-ATB | 4 | 0 | 0 | 1.04 | 0.03 | | |
| Average ATB (CARB) | | 11 | | 5.41 | 0.136 | | |
| Average ATB (CARB) | | Ratio vs. Tier 1 | | 0.78 | 1.14 | | |
| Average ATB (AWO) | | 6 | | 4.15 | 0.063 | | |
| Tugboat-Push/Tow | 0 | 32 | 1 | 7.34 | 0.37 | 39% | 65% |
| Tugboat-Push/Tow | 1 | 14 | 4 | 6.97 | 0.12 | 16% | 9% |
| Tugboat-Push/Tow | 2 | 42 | 8 | 5.08 | 0.09 | | |
| Tugboat-Push/Tow | 3 | 17 | 11 | 3.69 | 0.05 | | |
| Tugboat-Push/Tow | 4 | 0 | 0 | 1.04 | 0.03 | | |
| Average Towboat (CARB) | | 105 | | 5.80 | 0.173 | | |
| Average Towboat (CARB) | | Ratio vs. Tier 1 | | 0.83 | 1.44 | | |
| Average Towboat (AWO) | | 24 | | 4.85 | 0.088 | | |
| Tugboat-Escort/Ship Assist | 0 | 4 | 5 | 7.34 | 0.37 | 15% | 34% |
| Tugboat-Escort/Ship Assist | 1 | 8 | 12 | 6.97 | 0.12 | 28% | 22% |
| Tugboat-Escort/Ship Assist | 2 | 18 | 22 | 5.08 | 0.09 | | |
| Tugboat-Escort/Ship Assist | 3 | 6 | 21 | 3.69 | 0.05 | | |
| Tugboat-Escort/Ship Assist | 4 | 0 | 1 | 1.04 | 0.03 | | |
| Average Tugboat (CARB) | | 36 | | 5.52 | 0.121 | | |
| Average Tugboat (CARB) | | Ratio vs. Tier 2 | | 1.09 | 1.35 | | |
| Average Tugboat (AWO) | | 61 | | 5.09 | 0.104 | | |

- **The deterioration of emissions due to age is a large uncertainty given that engines are regularly rebuilt and that historic regulations have encouraged engine rebuilds with emission upgrades to higher Tier levels.**
    - **CARB (2021) assumed that towboats would average a model year of 2003 (Table H-1), which in 2019 is 16 years old and past their useful life (Table H-8) of 14 years for main engines. This would increase NOx emission rates by 24% and PM by 77% for towboats.**
    - **CARB (2021) assumed that tugboats would average a model year of 2009 and be 10 years old in 2019. This would increase NOx emission rates by 15% and PM by 48% for towboats.**

### 1.4 Conclusion

**We demonstrated using publicly available AIS records that it is possible to accurately identify vessel activity spatially defined. Individual vessels are identifiable through MMSI numbers unique to the AIS transmitters along with their actual activity within California waters. Using the AIS data, CARB can more accurately identify the unreported vessels and not rely on a less reliable list of vessels by home port.**

**Overall, the number and emissions from tugs for both NOx and PM (including towboats) appear to have been overestimated in Appendix H. The emissions overestimate depends on several input variables, but engine emissions deterioration and fleet fraction, especially the remaining Tier 0 engines still in operation, have a significant effect on PM emissions rates.**

## 2. COMMENTS ON THE HEALTH STUDY (APPENDIX G)

### 2.1 Health Risk Assessment for South Coast and Bay Area Air Basins

#### *CalPuff Modeling*

**The CalPuff modeling conducted in support of the Proposed Amendments to the CHC Rulemaking involve a number of model inputs and assumptions as outlined in Appendix G. Ramboll reviewed the modelling methodology as well as supporting documentation provided by CARB.**

**A missing element of the modeling was any validation of the key model inputs as well as the model results. Because of the complex nature of the modeling, including a number of assumptions regarding the emissions inventory, spatial and temporal allocation of emissions, complex terrain and meteorology, it is paramount that CARB validate to the extent possible the model inputs and results.**

**With regards to model inputs, at the very least CARB should verify that the meteorological estimates used in the model compare to actual measured estimates from a relevant meteorological station. In addition, CARB used a single year of meteorological data and it would also be important to consider using more than one year in order to capture any variability in meteorological parameters that tend to vary from year to year.**

**With regards to model results, one important way to validate results includes comparing modeled results with measured values at monitor locations at or near the modeled receptor points. While we understand that the CARB is only considering contributions from CHCs in the form of diesel particulate matter, the modeling is used to estimate exposures to diesel**

particulate matter and $PM_{2.5}$. We also understand that ambient monitors will be measuring $PM_{2.5}$ from all sources. Therefore, we expect that modeled concentrations would be within the range of measured estimates or lower.

Ramboll conducted a check of how modeled PM concentrations compare to measured $PM_{2.5}$ concentrations for the South Coast Air Basin. Table 6 shows the results of the comparison between measured concentrations at monitoring sites in the South Coast Air Basin and nearby receptors.

As shown in Table 6, the results from this preliminary check of the data show that the modeled estimates are overestimating exposures as these estimates are up to 4 times higher than actual measured concentrations of $PM_{2.5}$ particularly in the most impacted regions (i.e., near the shoreline). Inland modeled estimates (which are expected to be less impacted by CHC emission) are closer to the measured concentrations although still exceed these concentrations for some receptors. This indicates that overall the modeled estimates are overestimating exposures. CARB should similarly verify the results for the Bay Area Air Basin.

An additional source of uncertainty is associated with scaling the concentrations for future years based on changes in emissions. Because the concentrations are not only based on the changes in emissions, but other key factors including meteorology, this introduces a significant amount of uncertainty, making the validation of model estimates even more critical. Also, because we believe that emissions are overstated this will contribute to even more uncertain exposure estimates based on simply scaling.

**Table 6. Comparison between annual average $PM_{2.5}$ measured concentrations at monitoring stations in the South Coast to modeled concentrations at the nearest receptors.**

| $PM_{2.5}$ ($mg/m^3$) annual average | Average of all POCs (daily) | Average of 1hr | Closest Receptors (Modeled $PM_{2.5}$ $mg/m^3$, Receptor #) | | | |
|---|---|---|---|---|---|---|
| Long Beach (North) | 10.81 | - | 34.82 (1856) | 35.68 (1857) | 38.30 (1858) | 34.15 (1855) |
| Long Beach (South) | 12.82 | 14.56 | 51.57 (1874) | 48.44 (1876) | 59.88 (1900) | 58.13 (1901) |
| Long Beach-Route 710 Near Road | 13.87 | 15.02 | 24.01 (1825) | 24.80 (1826) | 22.29 (1827) | 22.35 (1824) |
| Anaheim | 11.05 | 13.62 | 15.30 (2602) | 14.34 (2604) | 16.13 (2601) | 14.17 (2588) |
| Compton | 13.24 | - | 18.05 (1683) | 18.41 (1677) | 18.96 (1685) | 18.03 (1684) |
| Pico Rivera #2 | 12.49 | - | 8.41 (1458) | 8.55 (1459) | 9.04 (1457) | 9.09 (1467) |
| Los Angeles-North Main Street | 11.69 | - | 7.28 (530) | 7.22 (491) | | |

### *Cancer Health Risk Assessment*

The cancer risk assessment also relies on a number data inputs and assumptions, starting with the estimates from the CalPuff modeling. Many of the inputs and assumptions are considerably conservative as they are meant to be health protective and are screening-level analyses. It is important to note that screening level analyses are often followed by more targeted analyses with refined parameters that are more site-specific and/or based on more realistic parameters in order to yield more realistic risk results. Importantly, the numerous levels of

**conservativeness in screening level analyses result in risk values that are often highly overestimated and do not necessarily reflect actual risks.**

**One key data input includes the exposure estimates, which are based on the CalPuff model inputs and a number of additional key assumptions. As noted above, based on Ramboll's check of the modeled DPM estimates, it is likely that these estimates are overestimating exposures, both due to overestimated emissions (see Section 1) contributing to overestimates of about least about 20-60%, in addition model assumptions that result in overestimates compared to measured estimates by as much as a factor of 4 (see comments above) at some receptor locations.**

**Exposure estimates are also based on updated methodology that also increases the risk estimates because of the application of high (95/80%) breathing rates and multiplicative factors for greater susceptibility in children. In addition, the risk assessment includes several conservative assumptions for estimating exposures including exposures across a residence time of 70 years[4] and assuming a person is home 24 hours a day over these 70 years. All of these conservative assumptions compound to generate highly inflated risks.**

**Another key input for the risk assessment is the use of a cancer potency factor (CPF). CARB relied on the estimate developed by OEHHA of 1.1 $(mg/kg\text{-}day)^{-1}$ or 3 x $10^{-4}$ per $\mu g/m^3$. This cancer potency value, which represents a 95% upper confidence interval of the lifetime risk, is dated and overly conservative compared to more recent evaluations of the literature on which the cancer potency is based.**

**At the time of the development of the cancer potency EPA deemed the evidence to be too uncertain to use for cancer risk assessment (US EPA 1994[5]). An HEI study (HEI 1995[6]) found similar limitations associated with the studies that were the basis of the OEHHA value. These limitations included (1) questions about the quality and specificity of the exposure assessments for diesel exhaust, (2) a lack of quantitative estimates of exposure to allow derivation of an exposure–response function, and (3) lack of adequate data to account quantitatively for individual other factors that might also be associated with lung cancer, such as smoking. In 2002, EPA[7] again concluded that data were too uncertain for developing a cancer potency, but using more qualitative methods determined the risk to be in the range of $10^{-5}$ to $10^{-3}$. Therefore, the risk could potentially be about 300 times lower than the OEHHA value.**

**Another important issue in extrapolating results from older epidemiology studies, as OEHHA did, is that diesel exhaust exposure in these studies is based on diesel exhaust composition that is very different compared to more contemporary diesel exhaust, and also quite different from marine vessel emissions (as these studies evaluated exposures in railroad workers and truck drivers). Specifically, because of the long latency period for lung cancer, epidemiology studies need to examine workers whose exposures started more than 20 years earlier. These particular studies are based on exposures from the 1950s and 1960s. However, the US EPA and CARB have progressively tightened standards for particulate emissions from diesel engines, including marine engines, resulting in the development of new technology diesel engines with significantly lower emissions and also likely different composition. Because these**

[4] A 30 year residence time is considered to be a more realistic residence time period.
[5] US EPA. Health Assessment Document for Diesel Emissions (External Review Draft, 1994) - Volume 1. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/8-90/057Ba (NTIS PB95192092)
[6] HEI. Diesel Exhaust: A Critical Analysis of Emissions, Exposure, and Health· Effects. 1995. Diesel Exhaust New Scan.pdf (healtheffects.org)
[7] U.S. EPA. Health Assessment Document for Diesel Engine Exhaust (Final 2002). U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, DC, EPA/600/8-90/057F, 2002

**changes have resulted in not only quantitative reduction in mass emitted, but have also resulted in differences in the composition with respect to size and chemicals associated with the exhaust (e.g. Hesterberg et al. 2011[8]). The epidemiology studies based on old generation engines may not be applicable to current emission conditions.**

**Even if the epidemiology data were deemed robust enough for use in quantifying the cancer risks of DPM, the uncertainty suggests that cancer risks could be over 100 fold lower than estimates by CARB, which would bring the cancer risks into an acceptable range by US EPA and California standards (i.e., $10^{-6}$ to $10^{-4}$) under the current regulations, without the need for application of the proposed regulations.**

**At a minimum, CARB should provide a more detailed discussion of the uncertainties noted in these comments and the impact on the estimated risks, which we note are likely highly inflated. The cumulative impact of application of multiple conservative assumptions needs to be acknowledged.**

## 2.2 Regional $PM_{2.5}$ Mortality and Illness Analysis for California Air Basins

**CARB used two different methods to estimate the impacts of the Proposed Amendments to the CHC Regulation on mortality and other health effects (hospital admissions for cardiovascular and respiratory diseases and emergency department visits for asthma). The first method relies on the modeled estimates for the two air basins (San Francisco Bay and South Coast) and the second method is a reduced form analysis that is applied to other air basins as well as to impacts from reductions in NOx.**

**While the CARB health analysis is based on standard methodology used by EPA to calculate health impacts, we were not able to check the results based on the data provided by CARB as many of the model inputs were missing. Also, even though the methods appear to be applied correctly, given what we were provided for review, the approach taken by CARB is unconventional. First, CARB is using two different methods to calculate health impacts, one based on modeled results and a second based on a reduced-form method with large simplifying assumptions. Both methods are subject to large uncertainties, but the reduced-form method has significantly more uncertainty.**

**Also, the way the CARB approaches the health analysis is also significantly different from the way EPA and others have conducted similar analyses (i.e., using BenMAP). CARB essentially is computing effects based on changes in $PM_{2.5}$ modeled estimates (or PM emission reductions) for each year starting in 2023 and up to 2038 between the current regulations and the proposed amendments. The impacts are summed across air basins for each year, and then summed across all years. To our knowledge, this type of cumulative assessment of health benefits across a long time period in the future has not been conducted previously using the methods CARB is using. We welcome other examples where this has been done.**

**The implications are that these impacts are cumulative over time. In addition, the impacts actually increase over the years (presumably as the difference in emissions or concentrations increase between current and proposed regulations).**

[8]Hesterberg, T. W., Long, C. M., Sax, S. N., Lapin, C. A., McClellan, R. O., Bunn, W. B., & Valberg, P. A. (2011). Particulate Matter in New Technology Diesel Exhaust (NTDE) is Quantitatively and Qualitatively Very Different from that Found in Traditional Diesel Exhaust (TDE). *Journal of the Air & Waste Management Association*, *61*(9), 894–913.

**The amount of uncertainty associated with this analysis is very large and propagated across all the steps in the risk assessment process including 1) emissions estimation, 2) modeling and scaling of PM concentrations (which rely on emission inputs), 3) deriving PM from diesel PM, 4) assumptions regarding conversion of NOx to PM, 5) application of health functions from epidemiology studies, and 6) estimation of baseline health statistics and population statistics for future years. The magnitude of the uncertainty and the impact on the direction of bias has not been evaluated by the CARB, but our analysis, based on available data, suggest that the magnitude is quite large (and larger than expressed by the 95% confidence intervals provided by CARB) and most likely are overstating the health benefits of the proposed amendments.**

**In light of the significant amount of uncertainty in the health analysis, we strongly suggest that CARB present the findings so that they are more transparent and in a way that acknowledges the level of uncertainty, as well as amount of confidence that can be placed on the results. For example, we don't think it is appropriate to present the combined results for the health analysis based on modeled data and those based on the IPT methodology, because the IPT results would tend to be much more uncertain and less reliable. Also, instead of presenting a total number of deaths as the sum across air basins and years, CARB should present results as a range on potential annual impacts for each air basin, separately. This again, with the acknowledgement that year to year there is uncertainty and the numbers could be more or less than estimated depending on many different model assumptions at every step in the risk assessment process.**

**Some of the key limitations and sources of uncertainty of these two methodologies for estimating the potential health impacts from the Proposed Amendments are discussed below.**

### *Analysis for the San Francisco Bay and South Coast*

**As is the case for the cancer health risk assessment, the PM mortality and illness analysis relies on a number of model inputs and assumptions, many that are associated with significant uncertainty that tends to overstate the risks.**

**In interpreting the mortality and illness results, it is important to consider that the health impacts are based on a single population-based epidemiological study that infer statistical associations between health effects and air pollution exposures, but that cannot provide definite evidence of a cause and effect. This is because these studies have important limitations that preclude definite conclusions regarding a causal link between PM and mortality or illness, including uncertainty regarding the exposure estimates, the potential role of other pollutants or factors that might explain the effects, and evidence that there is likely a threshold below which health impacts are unlikely. In addition, the components of PM that may be associated with adverse health effects are yet unknown, but the analyses assume that all PM is equally toxic, making it a very conservative analysis.**

**The epidemiological studies that form the basis of the health study, including the mortality study by Krewski *et al*. (2009)[9] rely on data from central-site monitors to estimate personal exposures. This results in exposure measurement error because central-site monitors may not accurately capture population mobility, the uneven distribution of PM exposure attributable to local sources, pollution patterns that can be affected by terrain features and weather, and daily variations in PM concentrations or composition that may differ from variations experienced by**

[9] Krewski, D. et al., 2009. Extended Follow-up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality Report. Health Effects Institute, 140 https://www.healtheffects.org/system/files/Krewski140.pdf

**individuals. These factors can bias the results of an epidemiology analysis in either direction. The direction and magnitude of the bias depends on the type of measurement error. For $PM_{2.5}$, however, because of the spatial variability of air pollutant concentrations the bias is likely to result in effects being overestimated (e.g., Goldman *et al*., 2011[10], Rhomberg *et al*. 2011[11]).**

**The bias associated with confounding effects is particularly difficult to address in epidemiology studies because it is challenging to account for all potential confounding factors. A confounder is a factor that is associated with both an exposure and an outcome, and may make it appear that the exposure is associated with (or caused) the outcome. In PM mortality studies there is evidence that co-pollutants can confound the PM mortality association, especially because many of the pollutants are strongly correlated, and disentangling the effects of any single pollutant (if any) is difficult. Even if potential confounders are accounted for in studies, there may still be issues of how well the confounding variables are measured and controlled for. For example, in the study by Krewski *et al.* (2009), which is used by CARB for the mortality estimates, data on potential confounders such as smoking and body mass index were determined at the beginning of the study for all participants, but were not re-evaluated over the follow up study period. Changes in these variables over time could alter confounding effects. The issue of confounding relates to both the assumption of causality, where another factor may actually be the causal agent, and to the magnitude of the association, where a co-factor may account for some of the observed risk. In either case, ignoring the effects of confounding results in overstated effects estimates.**

**Another source of uncertainty is the assumption of a log-linear response between exposure and health effects, without consideration for a threshold below which effects may not be measurable. The issue of a threshold for $PM_{2.5}$ is highly debated and can have significant implications for health impacts analyses as it requires consideration of current air pollution levels and calculating effects only for areas that exceed threshold levels. Without consideration of a threshold, effects of any change in air pollution below or above the threshold are assumed to impact health. Interestingly, although EPA traditionally does not consider thresholds in its cost-benefit analyses, the NAAQS itself is a health-based threshold level that EPA has developed based on evaluating the most current evidence of health effects. Most epidemiological studies do not indicate that a threshold exists, but these studies often do not have the statistical power to detect thresholds. Some studies that have employed different statistical methods have shown evidence of a threshold for PM-mortality effects. For example, Abrahamowicz et al. (2003)[12] found evidence for a $PM_{2.5}$ threshold at about 16 □g/m³ below which mortality effects were not observed. Considering a threshold for PM effects would mean that effects would occur only when threshold levels of PM is exceeded.**

**Sensitivity analyses are often warranted using different health functions from different studies in order to evaluate the potential variability and/or uncertainty in health estimates. For example, some epidemiological studies have reported no mortality impacts from $PM_{2.5}$**

[10] Goldman, GT; Mulholland, JA; Russell, AG; Strickland, MJ; Klein, M; Waller, LA; Tolbert, PE. 2011. "Impact of exposure measurement error in air pollution epidemiology: Effect of error type in time-series studies." *Environ. Health* 10 (1) :61. 211-5049

[11] Rhomberg, LR; Chandalia, JK; Long, CM; Goodman, JE. 2011. "Measurement error in environmental epidemiology and the shape of exposure-response curves." *Crit. Rev. Toxicol.* 41 (8) :651-671. 211-7617

[12] Abrahamowicz M, Schopflocher T, Leffondré K, du Berger R, Krewski D. Flexible modeling of exposure-response relationship between long-term average levels of particulate air pollution and mortality in the American Cancer Society study. J Toxicol Environ Health A. 2003 Aug 22-Oct 10;66(16-19):1625-54.



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**exposures (Beelen et al., 2009[13]; Enstrom, 2005[14], Lipfert et al., 2006[15]). This means that if the BenMAP analyses used different concentration-response functions, the actual impacts may be very different from those reported in this analysis and could include a zero effect.**

**One additional important uncertainty stems from the assumption that all $PM_{2.5}$, regardless of composition, is equally potent in causing health effects such as mortality. This is important because $PM_{2.5}$ varies significantly in composition depending on the source, and this is particularly important because the composition of particulate matter from diesel has also changed over time as a function of changes in both diesel fuel composition as well as the use of emission controls. Several reviews have evaluated the scientific evidence of health effects from specific particulate components (e.g., Rohr and Wyzga 2012[16]; Lippmann and Chen, 2009[17]; Kelly and Fussell, 2007[18]). These reviews indicate that the evidence is strongest for combustion-derived components of PM including elemental carbon (EC), organic carbon (OC) and various metals (e.g., nickel and vanadium), however, there is still no definitive data that points to any particular component of PM as being more toxic than other components. EPA also stated that results from various studies have shown the importance of considering particle size, composition, and particle source in determining the health impacts of PM (US EPA, 2009[19]). Further, EPA (2009) found that studies have reported that particles from industrial sources and from coal combustion appear to be the most significant contributors to PM-related mortality, consistent with the findings by Rohr and Wyzga (2012) and others. Therefore, by not considering the relative toxicity of PM components, BenMAP analyses are likely to be conservative.**

### *Analysis Using the IPT methodology for Other Air Basins (and NOx)*

**In addition to the analysis conducted on modeled $PM_{2.5}$, CARB applied a reduced-form methodology (IPT) to estimate additional health impacts for other air basins and from $PM_{2.5}$ derived from NOx emissions. These reduced-form analyses involve important simplifying assumptions that can greatly affect the reliability of the estimated health impacts.**

**The uncertainties described in the previous section also apply to the development of the IPT factors that are used to estimate the impacts for other air basins. Additional uncertainty is introduced when applying these IPT factors to the estimated emissions for this rulemaking. The IPT factors are based on a specific time period, and therefore important variability due to meteorological changes and or spatial differences are not accounted for. Most of these uncertainties were not discussed or considered by CARB. Importantly, a large majority of the assumptions and uncertainties likely result in overestimated benefits, particularly when considering the compounding effects of the uncertainties in the various modeling inputs, starting with the emissions estimates, on the final calculation.**

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[13] Beelen, R; Hoek, G; van den Brandt, PA; Goldbohm, RA; Fischer, P; Schouten, LJ; Jerrett, M; Hughes, E; Armstrong, B; Brunekreef, B. 2008. "Long-term effects of traffic-related air pollution on mortality in a Dutch cohort (NLCS-AIR Study)." *Environ. Health Perspect.* 116 (2) :196-202

[14] Enstrom, JE. 2005. "Fine particulate air pollution and total mortality among elderly Californians, 1973-2002." *Inhal. Toxicol.* 17 (14) :803-816. 209-6826

[15] Lipfert, FW; Wyzga, RE; Baty, JD; Miller, JP. 2006. "Traffic density as a surrogate measure of environmental exposures in studies of air pollution health effects: Long-term mortality in a cohort of US veterans." *Atmos. Environ.* 40 (1) :154-169. 206-7558

[16] Rohr A.C., R.E. Wyzga, 2012. Attributing health effects to individual particulate matter constituents. *Atmos Environ.*, 62, 130-152. doi:10.1016/j.atmosenv.07.036.

[17] Lippmann, M., L.C. Chen, 2009. Health effects of concentrated ambient air particulate matter (CAPs) and its components. *Crit. Rev. Toxicol.*, 39, 865e913.

[18] Kelly, F.J., J.C. Fussell, 2007. Particulate Toxicity Ranking Report. Report Number 2/07. Environmental Research Group, Kings College, London.

[19] U.S. EPA. Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2009). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-08/139F, 2009



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**As noted previously, we don't believe it is appropriate for CARB to combine the results from this analysis with the analysis for the two air basins, for which modeled estimates are available. In addition, the estimated range of annual impacts for each air basin should be reported instead of summing the cumulative results across years.**

## 2.3 Conclusions

**The health risk assessments conducted by CARB are subject to a significant number of uncertainties that are propagated through the risk assessment steps and that we have shown to overestimate the health impacts. We first show that emissions estimates are inflated (see Section 1) and these estimates are inputs to the CalPuff modeling used to estimate exposures and risks for the Bay Area and South Coast Air Basins. We also note that CARB did not validate the model estimate against measured levels of $PM_{2.5}$ . Our preliminary analysis indicates that the modeled estimates are overestimating the measured levels for receptors near monitoring stations, particularly in highly impacted areas. Lastly, we highlight many of the risk assessment model assumptions that will also contribute to overstated health impacts in both the cancer risk assessment and the mortality and illness assessment.**

**Specifically, in the cancer risk assessment the use of highly conservative exposure assumptions (e.g., high breathing rates, 70 years of exposures 24 hours a day), application of sensitivity factors, and use of a highly conservative cancer slope factor all add up to highly inflated cancer risks. Similarly, in the mortality and illness analysis, risks are also likely to be overstated because of assumptions related to the choice of epidemiological study as the basis of the analysis, as well as the assumptions regarding the year to year changes in emissions across the air basins. Importantly, because the two methods used by CARB are associated with significantly different amount of uncertainty, the mortality and illness results should be presented as annual effects, and shown separately by air basin and by methodology, noting that results using the IPT approach will be more uncertain that those based on modeled results.**

**Overall, CARB needs to provide a more robust validation of modeled assumptions, a more thorough discussion of the underlying uncertainties and impact on the results, and a more transparent representation of the study results.**



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