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Mr. Kurt Karperos
Assistant Division Chief, Planning & Technical Support
California Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

RE: Vision for Clean Air: A Framework for Air Quality and Climate Planning

Dear Mr. Karperos:

The Association of American Railroads, BNSF Railway and Union Pacific Railroad (collectively referred to as "the Railroads") appreciate the opportunity to comment on the "Vision for Clean Air: A Framework for Air Quality and Climate Planning" and its accompanying appendices (herein referred to as the "Vision Document"). The Railroads have closely followed the development of the document and look forward to working cooperatively with ARB as it moves into the next phase of its "Vision process."

ARB Staff summarizes the purpose of the Vision Document as follows[1] (emphasis added):

1. It is intended to <u>outline a framework</u> for exploring common strategies for achieving both air quality and climate goals, and to support the development of the needed comprehensive clean air strategies in ways that enhance both the economy and environment.
2. The vision framework is <u>a prelude to plans and not itself a plan</u>.
3. The goal is to <u>use the Vision process in planning going forward</u>, including SIPs required by the federal Clean Air Act, AB 32 Scoping Plan updates, and freight transport planning.
4. Those detailed planning efforts will include <u>refined analyses of costs and benefits</u>.

The Railroads recognize the considerable challenge to achieve California's air quality and climate goals, and applaud the Air Resources Board, the South Coast Air Quality Management District, and the San Joaquin Valley Air Pollution Control District for providing a framework to start the discussion. While the scenarios in the Vision Document may serve as "a projection of what could be possible" and "a 'what if' story that provides context for and informs decision-

[1] California Air Resources Board Workshop Notice. Public Workshops for *Vision for Clean Air: A Framework for Air Quality and Climate Planning*. August 9, 2012. Page 1.

making,"[2] the Railroads also agree with ARB that the scenarios are not "[a] prediction of the future," not "a list of SIP-ready control measures," and not "a policy choice that favors certain technologies and fuels over others."[3]. As ARB moves ahead with the Vision process, the Railroads have the following concerns:

1. Locomotive Scenario 1 does not provide any detail about the programs currently being implemented or about adopted regulations and standards with future implementation dates.[4]
2. Neither the Vision Document, nor the appendices, provides sufficient analysis to support ARB's claim that Locomotive Scenarios 2 and 3 are possible.[5]
3. ARB should revise its timeline to scope, develop, demonstrate, and deploy various "potential zero-emission technologies" to be more realistic, given the state of technology development.
4. ARB's estimates of locomotive emissions and emission reductions from railroads are inconsistent with other ARB analyses.
5. ARB needs to be careful not to assume emission reductions from certain battery or hybrid locomotive technologies since some of these emissions may merely be shifting to other areas.
6. Significant further analysis is needed before ARB uses the Vision Document to develop locomotive measures in actionable air quality plans.

Each of these concerns is more fully discussed in Attachment 1. The Railroads may submit further comments as we learn more about ARB's "Vision Process," and we look forward to working with ARB and other agencies in the coming years to improve the robustness and factual underpinnings of the Visioning Document.

Sincerely,

Kirk Marckwald, Principal

[2] California Air Resources Board Presentation Materials: "Vision for Clean Air: A Framework for Air Quality and Climate Planning" San Joaquin Valley Workshop, August 21, 2012, slide 10. Also reiterated in presentation materials at workshops in Sacramento on August 22nd (see slide 10), and at the South Coast on August 23rd (see slide 10).

[3] California Air Resources Board "Vision for Clean Air: A Framework for Air Quality and Climate Planning" San Joaquin Valley Workshop, August 21, 2012, slide 11.

[4] See Appendix to the June 27, 2012 Draft Vision for Clean Air: A Framework for Air Quality and Climate Planning. Scenario Assumptions and Results. August 20, 2012." Page 30

[5] See Appendix to the June 27, 2012 Draft Vision for Clean Air: A Framework for Air Quality and Climate Planning. Scenario Assumptions and Results. August 20, 2012." Pages 31-33 and 34-37.

cc: Michael Rush, Association of American Railroads
Michael Stanfill, BNSF Railway
Russell Light, BNSF Railway
Lanny Schmid, Union Pacific Railroad
Melissa Hagan, Union Pacific Railroad

Attachment 1 – Current Concerns Regarding Visioning Document

As referenced in the cover letter, the Railroads have the following concerns regarding the draft Vision Document.

Concern 1: Freight and Passenger Locomotive Scenario 1 does not provide any detail about the programs currently being implemented or about adopted regulations and standards with future implementation dates.

Scenario 1, the business as usual scenario, is meant to reflect the "programs currently being implemented as well as adopted regulations and standards with future implementation dates."[6] Unfortunately, the Vision Document contains no details for Scenario 1 (such as the assumed penetration rate of new locomotives; or the configuration of locomotive fleets that serve in California), so the Railroads are unable to analyze the assumptions and provide comments. The Vision Document should be revised to identify the assumptions used in Scenario 1.

Concern 2: Neither the Vision Document, nor the appendices, provide sufficient analysis to support ARB's claim that Locomotive Scenarios 2 and 3 are possible.

Scenarios 2 and 3 in the Vision Document contain possible scenarios for Railroad activity through 2050. ARB Staff selected Scenario 3 as an example of "Federal actions, in addition to actions by state and local agencies and governments, to help clean-up sources that travel nationally and internationally such as trucks, ships, locomotives and aircraft."[7] While ARB identifies "possible" technologies, and provides a four-phase timeline to scope, develop, demonstrate, and deploy various "potential zero-emission technologies," [MP-citation needed] the Railroads question whether ARB's analysis demonstrates that any of the selected measures are technically, operationally, fiscally, or otherwise possible. Additionally, the Railroads believe these time estimates are inaccurate (see Concern 3 below for more information).

Scenario 3 assumes four technology changes:

1. Accelerated deployment of Tier 4 locomotives starting in 2015 at a rate where 50% of the California fleet will meet the Tier 4 standard by 2025.
2. Accelerated introduction of Tier 5[8]/battery hybrid locomotives starting in 2025. It is also assumed that a Tier 5/battery hybrid locomotive could operate 30% of its duty cycle in zero-emission mode in 2025, escalating to 40% zero-emission mode by 2040.

[6] "Appendix to the June 27, 2012 Draft Vision for Clean Air: A Framework for Air Quality and Climate Planning. *Scenario Assumptions and Results*." August 20, 2012. Page 30.
[7] See Appendix to the June 27, 2012 Draft Vision for Clean Air: A Framework for Air Quality and Climate Planning. Scenario Assumptions and Results. August 20, 2012." Pages 34-37.

[8] ARB should note in the revised Vision Document that "Tier 5" locomotives do not exist and that EPA has not promulgated standards for "Tier 5" locomotives. The term "Tier 5" has been created by ARB to facilitate the identification of an unknown future locomotive emissions standard.

Furthermore, 95% of the fleet is assumed to be a mixture of Tier 4 and Tier 5/battery hybrid by 2032, and 95% of the fleet is assumed to be Tier 5/battery hybrid (or grid based advanced technology in the South Coast) by 2050.

3. Development and introduction of advanced grid-based technologies in the South Coast to extend zero-emission miles in the post 2035 to 2050 timeframe. This could include battery tender cars with grid based charging or use of wayside power. Two percent of locomotive activity in the South Coast is powered by grid-based electricity in 2040, expanding to 20% by 2050.
4. The use of cleaner renewable fuel such as LNG and renewable diesel fuel.

ARB has not demonstrated that the accelerated introduction of Tier 4 or Tier 5 locomotives is possible. The accelerated introduction of Tier 4 locomotives is infeasible because Tier 4 represents a revolutionary, not evolutionary, leap in technology that will be harder to acquire and integrate in the allotted time (i.e., 50% statewide by 2023). The development of Tier 4 locomotives under the U.S. EPA regulatory timeline is a difficult challenge for locomotive and after-treatment manufacturers. An unprecedented re-design of the locomotive engine, exhaust gas recirculation, cooling systems, fuel management systems, after-treatment devices (i.e., filters and catalysts), and computer electronics are all needed within a very short timeframe. The manufacturers must develop and install new emission reduction components and configure them to fit within the limited existing space in a locomotive. Furthermore, on-the-rails durability testing must occur for multiple years to demonstrate real-world, heavy freight operational and emissions performance, and to ensure that Tier 4 locomotives meet or exceed the current reliability and fuel consumption levels of existing Tier 3 locomotives. In fact, the changes needed to meet Tier 4 standards are so revolutionary that at least one major locomotive manufacturer may not be able to go into production of Tier 4 locomotives by the 2015 EPA deadline. In contrast, Tier 2 and Tier 3 technology requirements were evolutionary and comprised mainly of internal engine and cooling system modifications on a much smaller scale compared to changes needed for Tier 4.

Even after the new locomotives become available, it is unlikely that a sufficient number could be purchased at a rate necessary to satisfy the specified accelerated turnover levels. BNSF and UP would need to purchase approximately six thousand locomotives within an 8 to 10 year period to achieve the 50% statewide fleet suggested by the scenario.

Regarding Tier 5 locomotives, ARB has provided no justification for the timeframe or emission reductions of such as-yet undeveloped locomotives. Where Tier 4 represents a revolutionary change to the entire locomotive, as described by ARB, Tier 5 will require a revolutionary change to both locomotive engines and railroad operations. The Vision Document provides no support to the claim that locomotive acceleration is possible.

- Did ARB determine how locomotive operations would need to change to accommodate Tier 5 technology?
- What is the basis for the expected emission reductions? Have the projected emission reductions been discussed with, or confirmed by, the locomotive manufacturers?
- How will such a technology impact railroad operations and efficiency?

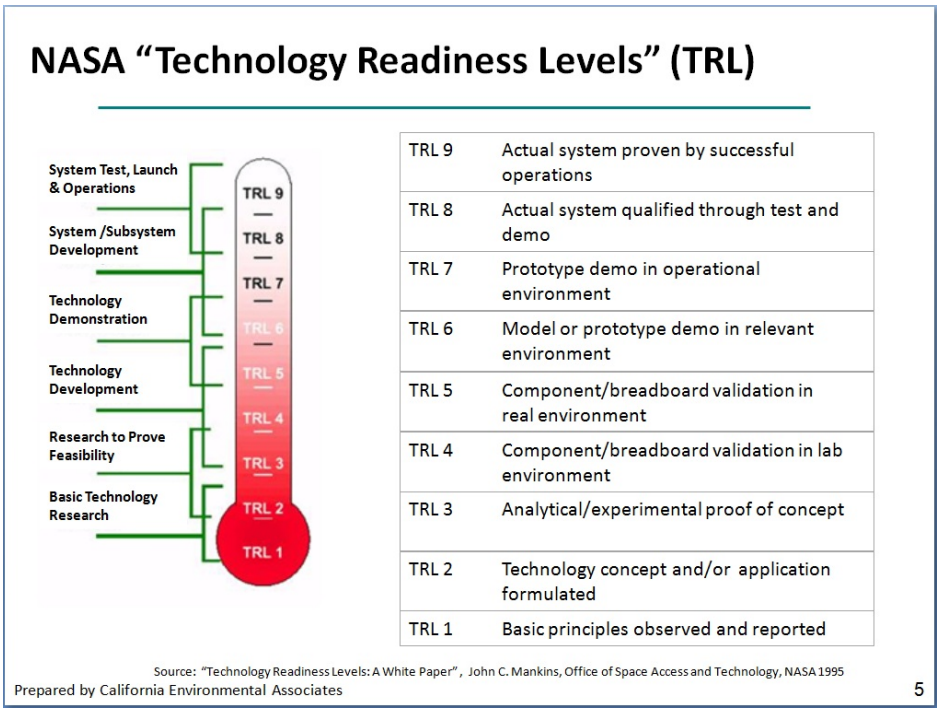
ARB should refrain from claiming that the accelerated introduction of new locomotive technology is possible without first providing significant analysis, and then confirming this analysis with both the Railroads and locomotive manufacturers.

Concern 3: ARB should revise its timeline to scope, develop, demonstrate, and deploy various "potential zero-emission technologies" to be more realistic, given the state of technology development.

The Railroads support the need to continue to develop cleaner technologies. While the Railroads have considerable doubts about some technologies, such as linear synchronous motors (LSM) and dual-mode locomotives, and have concerns regarding the operational and cost barriers associated with catenary electric systems, the Railroads do support a comprehensive, fact-driven assessment of various clean technologies, including battery tender cars, hybrid locomotives, or LNG technology, as presented in the Vision Document.

The Railroads believe that all of these systems and approaches, including catenary electric freight locomotives, will require additional study, research, design, and especially proof-of-concept testing. In addition, substantial and comprehensive small and full-scale demonstrations are needed in order to advance the technology for freight and passenger applications within southern California and to identify technical, financial, operational, and/or legal obstacles for each technology studied.

NASA Technology Readiness Scale: To aid in this type of analysis, NASA has developed a system for determining the readiness of new technologies within complex systems. The rating system (see next page) illustrates the spectrum of technology readiness from an initial principal (TRL 1) to a proven operational system (TRL 9). The Railroads believe that the most developed of the locomotive technologies presented in the Vision Document, such as catenary electric systems, are currently at a TRL level of 3 or 4. The Railroads believe that significant additional study and experimental proof-of-concept testing will be necessary to develop the technology for battery tender cars and hybrid locomotives beyond TRL levels of 2 or 3.



Study by the Ports of Long Beach & Los Angeles: The Vision Document should build on the study completed in August, 2011 by the Ports of Los Angeles and Long Beach that examined the readiness of various zero-emission technologies based on the following criteria:[9]

- Emissions & Health Risk Reduction – including cost-benefit ratio
- Constructability – ability to integrate system into existing infrastructure
- Technology Readiness – demonstrated reliability, durability, and commercial availability
- Operations Compatibility – integration into ongoing port operations and duty cycles and compatibility with existing operations
- Regional Scalability – including incremental expansion
- Cost and Economic Sustainability – including need for subsidies/incentives and potential to become economically competitive
- Timeline – from demonstration through commercialization and regional expansion

The Ports of Los Angeles and Long Beach concluded, "[n]one of the zero emission technology options considered to date is ready for full-scale implementation."[10]

[9] *Roadmap for Moving Forward with Zero Emission Technologies at the Ports of Long Beach and Los* Angeles, Port of Long Beach and Port of Los Angeles, August 2011 p. 15-16.
[10] Ibid, p. 2.

Availability of Tier 5 Locomotives: The Railroads believe that locomotive manufacturers have focused much of their high-level engineering resources on developing the new technologies needed to comply with the EPA Tier 4 emissions standards by 2015. Progressing through concept development, design, prototype development, two years of extensive field service testing on a limited number of units[11], and, finally, production in 2015 will require significant focus. This will leave little room for manufacturers to work on possible new zero-emissions technologies for locomotives.

While aspects of ARB's proposed initiative may be technically feasible in the distant future, the Railroads believe that significant further development and maturation of battery technology for heavy haul freight transport is required, and that ARB's timeline for the development and deployment of Tier 5 technology is too short and should be significantly expanded. Furthermore, in the Railroads' opinion, since the distance that a locomotive could travel on battery power is dependent on many factors such as the weight of the train, the location and grade, and the duty cycle, ARB should not assume that a locomotive can operate for 30 miles in battery-only mode, with no emissions from the engine, while in the basin.[12]

LSM Technology: Diesel locomotives perform three essential functions: tractive effort for acceleration or movement uphill, dynamic braking using traction motors or generators, and air braking supported by air compressors, which serves as the primary means of stopping or slowing a train on steep grades. The Railroads have significant concerns that LSM rail cars will not have dynamic braking power or air compressors. Until the fundamental issue of braking is addressed by LSM proposals, the Railroads do not believe that this technology is a viable option for consideration at this time.

The Railroads request that ARB revise the time estimates for the evaluation, deployment, prototype testing, initial deployment, and operational demonstration of the various technologies identified in the Vision Document. In addition, the Railroads request that ARB remove the proposals to continue to study dual-mode locomotives and LSM technology for the reasons identified above. At a minimum ARB should acknowledge that significant additional research and development will be required to evaluate the technology.

Timing of Phases for New Technology: The Vision Document proposes a four-phase process to develop, assess, and implement new locomotive technologies. The Railroads note that this process is similar to the timeline developed in SCAG's 2012 RTP. The four phases proposed in the Vision Document are:

- Project scoping and evaluation of existing work (2012-2013)

[11] Field testing will likely occur in 2013 and 2014.
[12] Vision for Clean Air: A Framework for Air Quality and Climate Planning. Appendix: Actions for Development, Demonstration, and Deployment of Needed Advanced Technologies. Page 20.

- Evaluation, development, and prototype testing (2012-2014)
- Initial deployment and operational demonstration (2015-2016)
- Full scale demonstrations, commercial deployment, and infrastructure construction, if wayside power is needed (2018+)

The Vision Document assumes a planning process totaling six years for project definition, conceptual design, railroad and utility agreements, access rights, regulatory approvals, funding planning, funding commitments, environmental studies and documentation for CEQA and NEPA, final design, bid, and award. For a project of this size and complexity in Southern California, is this timeframe realistic? What other types of engineering projects did the consultant team draw upon to reach this six-year estimate?

At this point, the Railroads believe that the timeframe for identification, development, and testing of near-zero technologies, as presented in the Vision Document, is too short. Historically, the development of new effective diesel locomotive technology has taken about 7-8 years. ARB's estimation of two to four years for evaluation, development, prototype testing, initial deployment, and operational demonstration is unrealistic.

While we recognize that the document is meant to only provide "what if" scenarios, ARB should at least provide a rudimentary analysis to demonstrate that the "what if" scenarios are possible within the time period suggested.

Concern 4: ARB's estimates of locomotive emissions and emission reductions from railroads are inconsistent with other ARB analyses.

While it is difficult to analyze the model spreadsheets because much of the data is hard-coded and does not show the formulas used to derive many of the values, it appears ARB's estimates of locomotive emissions and emission reductions from railroads is inconsistent with other ARB railroad analysis – such as the railyard HRAs, statewide locomotive inventories, and ARB reports, such as the Technical Options document. The Railroads request that ARB technical staff either meet with the Railroads to discuss the methodology used in the Vision Document or provide the assumptions and detailed calculations and commit to revising the emission estimates, if needed.

Concern 5: ARB needs to be careful not to assume emission reductions from certain battery or hybrid technologies since some of these emissions may merely be shifting to other areas.

While it is difficult to analyze the model spreadsheets, it appears that ARB may be improperly assuming emission reductions from certain battery or hybrid locomotive technologies. With hybrid locomotives, all of the work necessary to move the train is generated by the locomotive engine (presumably diesel). Even though it may be able to operate for some, yet-to-be-determined periods on battery-only power, at some point the batteries must be recharged by

the engine within California. For grid-based locomotive operations, it does not appear that the emissions associated with electricity generation are added into the locomotive emissions in Scenario 3.

Concern 6: Significant further analysis is needed before ARB uses the Vision Document to develop locomotive measures in actionable air quality plans.

ARB has said that "[t]he vision framework is a prelude to plans and not itself a plan."[13] Future planning efforts will need to rely on significant additional study beyond what is contained in the Vision Document. Such analyses must answer many questions, some of which are summarized below, before the technologies and the assumptions in the Vision Document can be relied upon.

1. Is the vision tool the right tool for the freight transportation sector? The Railroads are concerned that the vision tool may be too simplistic, and may not account for the complex interaction of shippers, locations, commodities, transportation mode choices, and other variables.
2. Who has the authority to implement the strategies identified in the Vision Document?
3. Who will fund the major infrastructure changes needed for near-zero and zero-emission transportation systems?
4. How will the various state, federal, and local agencies provide additional uninterruptable electricity to support a near-zero and zero-emission transportation system? At what cost?
5. How would a system that is partially electric and partially non-electric ensure an adequate supply of locomotives during a spike in activity or in an emergency situation in a particular region? The Railroads would potentially be at risk of having a surplus of electric locomotives that could not be shifted to other parts of the system, having a shortage of diesel locomotives in the non-electrified system, or both. Consider the following scenario: weather causes disruptions on a mainline electrified system due to flooding. This in turn results in diversion of freight flows to non-electrified parts of the system. As a result, the Railroads have electrified locomotives they cannot use, and an insufficient number of diesel locomotives to handle the diverted freight. Diesel locomotives can be shifted across and around the network. Electric locomotives are inoperable outside of the electrified zone.
6. How can the transportation system continue to serve its customers and at the same time transition to new technologies? What emission changes would result from freight shifting to trucks during the construction period on the Railroads' tracks?

[13] California Air Resources Board Workshop Notice. Public Workshops for *Vision for Clean Air: A Framework for Air Quality and Climate Planning*. August 9, 2012. Page 1.

7. How can implementing agencies ensure that emissions from one geographic region are not shifted to another?