Recommendations to Implement Further Locomotive and Railyard Emission Reductions

September 2009

California Environmental Protection Agency

Air Resources Board

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State of California
California Environmental Protection Agency
AIR RESOURCES BOARD
Stationary Source Division

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Table of Contents

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Recommendations to Implement Further Locomotive and Railyard Emission Reductions

EXECUTIVE SUMMARY

Locomotives and railyards are significant sources of emissions. Consequently, there have been various measures taken to reduce these emissions. Staff estimates that these measures will reduce diesel particulate matter (PM) emissions from all sources at railyards by about 50 percent by 2015 and 65 percent by 2020, even with a strong projected growth in rail operations (See Figure 2 in main report). Reductions have been achieved from every source at railyards – transportation refrigeration units, ultra-low sulfur diesel fuel use, drayage trucks, cargo handling equipment, and locomotives – either through U.S. Environmental Protection Agency (U.S. EPA) regulations, Air Resources Board (ARB/Board) regulations and agreements, or incentive funding. However, the analysis also shows that the remaining emissions, and associated public health risks, are still too high.

Therefore, at the April 2008 public meeting, the Board directed staff to develop a plan to further reduce emissions from locomotives and railyards. The emission reductions were to be beyond existing U.S. EPA regulations and ARB regulations and agreements. Additional emission reductions are primarily needed to:

- Address the significant remaining public health risks associated with the diesel particulate matter (PM) emissions around California's railyards; and

- Assist in meeting the State Implementation Plan (SIP) goals for attaining federal ambient air quality standards for ozone and fine particulate matter ($PM_{2.5}$).

Staff began this process by developing a Technical Options Report that evaluated 37 options to further reduce locomotive and railyard emissions.[1] The 37 options were evaluated based on the following criteria: technical feasibility, potential emissions reductions, costs, and cost-effectiveness. The data used in the Technical Options Report represent a snapshot in time. Elements such as locomotive fleet composition data are fluid and are influenced by many factors. In addition, other data used to evaluate technological feasibility, potential emission reductions, and costs are also fluid and subject to change. The staff expects to provide updates as technology developments and demonstration project results warrant.

Based on the Technical Options Report, staff is now recommending five locomotive measures as the highest priority options. In addition to these five options, the staff is also recommending a number of additional actions that collectively will achieve additional emission reductions from locomotives and railyards, facilitate longer term

[1] The Technical Options Report was released as a draft in December 2008. The report was revised and released again in August 2009. The Report is available at http://www.arb.ca.gov/railyard/ted/ted.htm.

regulation of locomotives, and improve our understanding of the emissions from locomotives and railyards.

A summary of these actions is presented below and discussed in more detail in the main body of this report.

Repower, Retrofit, and Replace Locomotives. The Technical Options Report identified five specific measures for reducing emissions from locomotives. In general, these measures involve replacing existing switch and medium horsepower locomotives with cleaner locomotives, retrofitting these locomotives with particulate matter (PM) and oxides of nitrogen (NOx) aftertreatment devices, and accelerating the introduction of Tier 4 line haul locomotives. These measures have staggered implementation dates that coincide with the development of the necessary advanced engines and aftertreatment technologies. Table ES-1 summarizes the five recommended locomotive measures.

Table ES-1
Recommended Locomotive Measures

Recommendations	Emission Reductions When Fully Implemented (tons per day) *						Carl Moyer Program Cost-Effectiveness ($ /lb)	Total Costs (millions)
	South Coast Air Basin		San Joaquin Valley Air Basin		Statewide			
	NO_x	PM	NO_x	PM	NO_x	PM		
Repower older switch locomotives: 2010 – 2012	2.8	0.14	0.9	0.03	6.6	0.3	$1.70-$2.80/lb	$230
Repower older MHP locomotives: 2011 – 2013	8.6**	0.47	4.3	0.21	23	1.25	$2.80-$4.60/lb	$400
Retrofit switch locomotives with DPF and SCR: 2012 – 2015	0.6	0.02	0.14	0.01	1.0	0.04	$0.80- $1.40/lb	$50
Retrofit medium horsepower locomotives with DPF and SCR: 2012 – 2016	2.6	0.07	1.1	0.03	6.8	0.18	$2.00–$3.30/lb	$200
Accelerate the introduction of Tier 4 line haul locomotives: 2015 – 2025	6.4	0.32	6.4	0.32	32.0	1.60	$4.00-$8.60/lb	$3,000
Total Statewide Emission Reductions	21.0	1.02	12.8	0.60	**69.4**	**3.37**	**$1.30-$4.00/lb**	**~$3,900**

* These reductions are calculated based on an analysis of the emissions reductions achieved on an individual locomotive basis.

** Note: Of the 8.6 tons per day of NOx reductions in the SCAB, the SCAQMD expects to get 3.0 tons per day from proposed SCR retrofits to 37 Metrolink MHP passenger locomotives.

As shown in Table ES-1, the measures are costly, but highly cost-effective. To implement these measures, the staff recommends that the ARB work with the U.S. EPA, the local air districts, the railroads, and the stakeholders to seek incentive funds for implementing these measures.[2]

The emission reductions are presented as the total tons per day that would be achieved upon full implementation of the measure. In general, these additional reductions would reduce statewide locomotive NOx and diesel PM emissions by about 30 percent by 2014, and by about 70 percent by 2020. As locomotives represent the major emissions at the railyards after the implementation of the existing regulations and agreements, the reduction in locomotive diesel PM emissions translates to a 65 percent reduction in potential cancer risks in communities surrounding railyards by 2015 and 85 percent reduction by 2020.

In addition to the pursuing the locomotive measures and seeking incentive funds, the staff is recommending the following actions:

- **Continue to Investigate and Implement Specific Railyard Measures** – Staff recommends that work continue to expeditiously identify and implement specific railyard mitigation measures that would reduce the emissions and public health risk around railyards. Railyard-specific mitigation measures could include erecting walls, growing trees, installing air monitoring stations, and installing indoor air filters in residential homes. Also, the hood technology could potentially reduce some stationary locomotive emissions at large locomotive classification and mechanical and servicing railyards. Each railyard has unique operations, meteorology, emissions density, and levels of residential exposure that would affect the costs and benefits derived from these types of measures.

  In addition, staff recommends that the local governments, railroads, and local communities continue to work together to identify legal and other approaches that could be used to further reduce emissions from railyards. Such actions might include changes in railyard operations, changes in traffic movements, and changes in land use around railyards.

- **Seek Changes in Federal Laws to Eliminate Federal Preemption** - In parallel with efforts to seek incentive funds, staff recommends that ARB work with stakeholders to seek changes in federal laws to provide California with clear authority to regulate locomotives. Staff has evaluated ARB's legal authority to regulate locomotives based on the federal Clean Air Act (CAA), U.S. EPA regulations, and the Interstate Commerce Commission Termination Act (ICCTA). While it appears as if there is some limited authority, staff believes that broader statutory and regulatory authority is necessary to effectively regulate locomotives to achieve the emission reductions necessary to address the public health and

[2] Possible Incentive funds could come from the following programs: federal Diesel Emissions Reduction Act, Proposition 1B, Carl Moyer, the Air Quality Improvement Program, and the Alternative and Renewable Fuel and Vehicle Technology Program.

welfare. A more detailed discussion of this issue is presented in the main report and in Appendix A.

- **Consider Additional Measures for Cargo Handling Equipment** – Staff is currently evaluating a measure for reduced idling of cargo handling equipment. Cargo handling equipment generally includes yard trucks, top and side picks, and rubber-tired gantry (RTG) cranes. In addition, there are ongoing test programs of emission control measures that, if implemented, would further reduce emissions from cargo handling equipment beyond the existing ARB cargo handling equipment regulation adopted in 2005. These test programs include diesel, liquefied natural gas, and hydraulic hybrid yard trucks. Staff recommends that ARB support these test programs. If the ongoing test programs are successful and appear to be cost-effective, staff recommends initiating a rulemaking effort to modify the existing cargo handling equipment regulation to incorporate such measures.

- **Participate in the California Environmental Quality Act (CEQA) Process for the ICTF and SCIG Projects** – Staff recommends that ARB participate in the review of proposals to rebuild the Union Pacific International Container Transfer Facility (ICTF) and build the Southern California International Gateway (SCIG) railyard. As part of the review, staff should work to ensure that the best available emission controls are incorporated into the projects and that a full assessment of potential off-site mitigation is conducted.

- **Support the San Pedro Bay Ports Clean Air Action Plan Update** – The two San Pedro Bay Ports are currently updating the clean air action plan. Staff recommends that the ARB support the San Pedro Bay Ports efforts to accelerate the turnover of cleaner switch locomotives consistent with ARB's recommendations in this report. In addition, the staff recommends that ARB support the San Pedro Bay Ports efforts to accelerate the turnover of cleaner Tier 4 line haul locomotives serving port properties as expeditiously as possible following their introduction in 2015, with the goal of 95 percent Tier 4 line haul locomotives serving the ports by 2020.

- **Seek Changes in Federal Regulations for Switch and Line Haul Locomotives** – The U.S. EPA has the regulatory authority to establish more stringent requirements for switch and line haul locomotives that would accelerate emission reductions prior to the full implementation of the Tier 4 locomotives. These actions include requiring more stringent emission controls upon remanufacturing and to require that locomotives be remanufactured at specified intervals. Again, staff proposes to work with stakeholders to seek changes in the U.S. EPA regulations.

- **Continue to Develop the Goods Movement Efficiency Measure** – Staff recommends that ARB continue to evaluate the efficiency of goods movement in support of California's Scoping Plan for reducing greenhouse gas emissions from

the goods movement sector. In addition to reducing GHG emissions, staff expects such efficiencies would results in further reductions in criteria and toxic air pollutants from the freight transport sector as a whole.

- **Evaluate Electrification of Rail as a Long Term Measure** – In the Technical Options Report, staff evaluated electrification of rail as one potential option. Staff recommends that efforts continue to evaluate rail electrification, particularly in the South Coast Air Basin, as a potential long term control measure.

- **Develop Improved Emission Inventories for Locomotives and Railyards** – The ability to evaluate and assess the impact of various measures on emissions is dependent upon accurate emissions inventories. Staff has developed significant new information based on the work done on the health risk assessments and the draft mitigation plans. In addition, previous growth projections may need revision. Therefore, staff recommends that efforts continue to improve the statewide emissions inventory and the region-specific emission estimates for the South Coast and San Joaquin Valley needed to assess progress towards achieving SIP targets.

- **Continue Support for Advanced Locomotive Research Programs** – There are a number of ongoing and proposed research projects directed at the development of advanced locomotives and the application of aftertreatment devices on locomotives, both from a retrofit and new build perspective. Staff recommends that ARB continue to support these programs. Summaries of these ongoing and proposed test programs are presented in the main report.

In implementing these recommendations, staff will need to work closely with the U.S. EPA, the local air districts, the railyards, the local communities, and other stakeholders. Successful implementation of these measures will significantly further reduce the emissions from locomotives and railyards.

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Recommendations to Implement Further Locomotive and Railyard Emission Reductions

This document provides staff recommendations to the Air Resources Board (ARB/Board) on how to further reduce emissions from locomotives and railyards. The timeframe considered in the document is generally 2010 through 2025. These emission reductions are to be beyond reductions that have been achieved or would be achieved from previously adopted U.S. EPA regulations and ARB regulations and agreements.

A. Why did staff prepare this report?

At the April 2008 public meeting, the Board directed staff to develop a plan to provide further locomotive and railyard emissions reductions. In response to the Board's direction, ARB staff released a draft report entitled *Technical Options to Achieve Additional Emissions and Risk Reductions from California Locomotives and Railyards* (Technical Options Report) in December 2008. A revised Technical Options Report that incorporated public comments and update information was released in August 2009.[3]

In the Technical Options Report, staff evaluated 37 options to achieve additional emission reductions from locomotives and railyards. The Technical Options Report evaluated each option for: (1) technical feasibility, based on the state of development and the ability to implement a particular technology or operational measure; (2) potential emission reductions; (3) costs; and (4) cost-effectiveness. The data used in the Technical Options Report represent a snapshot in time. Elements such as locomotive fleet composition data are fluid and are influenced by many factors. In addition, other data used to evaluate technological feasibility, potential emission reductions, and costs are also fluid and subject to change. The staff expects to provide updates as technology developments and demonstration project results warrant.

Using the information presented in the Technical Options Report, staff developed recommendations based on those measures that had the greatest potential for emission reductions, with consideration of technical feasibility, cost-effectiveness, cost, and implementation timeframe. These recommendations are scheduled to be considered by the Board at the September 2009 public meeting.

B. Why does California need more locomotive and railyard emission reductions?

California needs to accelerate and provide additional locomotive and railyard emission reductions for two main reasons:

- To address the significant remaining public health risks associated with the diesel particulate matter (PM) emissions around California's railyards; and

[3] The Technical Options Report is available at http://www.arb.ca.gov/railyard/ted/ted.htm.

- To assist in meeting the State Implementation Plan (SIP) goals for attaining federal ambient air quality standards for ozone and fine particulate matter ($PM_{2.5}$) by reducing emissions of oxides of nitrogen (NOx) and PM from locomotives.

In addition, there is an ongoing need to reduce greenhouse gas (GHG) emissions in support of the California Global Warming Solutions Act of 2006[4] and California's Scoping Plan[5] measure for improving the efficiency of goods movement within California. This document presents only a general consideration of GHG benefits, as a more detailed ongoing effort is underway to evaluate GHG emissions associated with goods movement.

Each of these reasons is discussed briefly in the following sections.

1. Reducing Diesel PM Emissions and Public Health Risks Near Railyards

Reducing the emissions of diesel PM is one of the Board's highest priorities. In 2000, the Board approved the Diesel Risk Reduction Plan that called for expedited diesel PM reductions within communities and an overall 85 percent reduction in diesel PM by 2020.[6] In 2006, the Board approved the Goods Movement Emission Reduction Plan (Goods Movement Plan) that further supported the need for diesel PM reductions and specifically focused on emissions related to goods movement.[7] In the Goods Movement Plan, the Board further identified the need to make every feasible effort to reduce localized risk in communities adjacent to major goods movement facilities, including railyards, as expeditiously as possible.

Over the last several years, ARB staff, in cooperation with Union Pacific Railroad (UP) and BNSF Railway (BNSF), completed 18 health risk assessments (HRAs) for 17 major railyards and one smaller railyard. These HRAs have clearly demonstrated that living around a railyard poses a significant public health risk resulting from the exposure to diesel PM, which is an identified toxic air contaminant. The HRAs found that over three million people are exposed to excess cancer risks of at least 10 chances per million due to diesel PM emissions from railyard-related sources within or near railyards.

2. Reducing NOx and PM from Locomotives to Meet SIP Targets

In September 2007, the Board adopted the 2007 State Strategy for the California State Implementation Plan (SIP) that included emission reduction targets for locomotives. These targets are a necessary part of the effort to meet health-based federal air quality standards for ozone and fine particulates ($PM_{2.5}$). Where necessary, the air pollution

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4 Assembly Bill (AB) 32, Chapter 488, Statutes of 2006, Division 25.5, California Health and Safety Code, Division 25.5, sections 38500 et seq.

5 Climate *Change Scoping Plan: A Framework for Change*, California Air Resources Board, December 2008.

6 Risk *Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*, California Air Resources Board, Stationary Source Division and Mobile Source Control Division, October 2000.

7 *Goods Movement Emission Reduction Plan*, California Air Resources Board, 2006.

control and air quality management districts (local air districts) in federal nonattainment areas incorporated the 2007 State Strategy into an attainment demonstration that includes an overall commitment to achieve the emission reductions necessary to achieve federal 8-hour ozone and $PM_{2.5}$ standards by the applicable attainment date.

The 2007 State Strategy targets specified emission reduction targets from locomotives in the South Coast and San Joaquin Valley – the two areas with the most extreme ozone and fine particulate matter attainment challenges. These targets were submitted to the U.S. EPA as an element of California's SIP. Other areas of California will benefit as emissions are reduced in these major upwind areas.

The SIP targets to reduce emissions from locomotives for the South Coast Air Basin and the San Joaquin Valley Air Basin are discussed below.

a. South Coast Air Basin (SCAB)

The 2007 State Strategy targets the need to reduce locomotive emissions to meet the federal ozone and $PM_{2.5}$ ambient air quality standards by the 2014 federally mandated attainment date. The emission reduction targets are 4.3 tons per day of NOx and 0.20 tons per day of directly emitted PM. The SIP also established a 2023 target emission reduction of 15.6 tons per day for NOx, with an interim NOx target of 13.4 tons per day in 2020. The 2007 SIP also calls on U.S. EPA to provide 10 tons per day of NOx emission reductions by 2014 from sources under its control. This target is also principally predicated on the potential to achieve emission reductions from cleaner Tier 4 line haul locomotives, thus bringing the total South Coast locomotive NOx reductions to 14.3 tons per day by 2014, 23.4 tons per day by 2020, and 25.6 tons per day by 2023.[8]

b. San Joaquin Valley Air Basin (SJVAB)

Locomotive emission reductions targets were also included in the 2007 State Strategy for the San Joaquin Valley 2007 Ozone Plan and 2008 $PM_{2.5}$ Attainment Plan. In the San Joaquin Valley, these targets would reduce line haul locomotive emissions by 7.2 tons per day and directly emitted $PM_{2.5}$ by 0.18 tons per day in 2014. The 2023 target for NOx was 16.4 tons per day, with interim NOx targets in 2017 and 2020 of 11.4 tons per day and 15.6 tons per day, respectively.

3. Reducing Greenhouse Gas Emissions from the Transportation Sector

Through the Global Warming Solutions Act of 2006, California has committed to reducing greenhouse gas (GHG) emissions to 1990 levels by 2020. Transportation produced about 40 percent of the state's total GHG emissions in 2004. A significant portion of GHG emissions from transportation activities comes from the movement of freight or goods throughout the State. Both the Goods Movement Plan and the 2007 State Implementation Plan (SIP) contain numerous measures designed to reduce the

[8] Substitution with NOx reductions from other federal sources is possible.

public health impact of goods movement activities in California. Proposition 1B funds, as well as clean air plans being implemented by California's ports, will also help reduce freight movement GHG emissions while cutting criteria pollutant and diesel PM emissions.

The Board adopted California's Scoping Plan to meet AB 32 requirements in December 2008. The Scoping Plan outlines the measures to be implemented to meet California's GHG reduction goals and calls on all sectors, including the freight transport sector, to reduce GHG emissions. Under the Scoping Plan, ARB is proposing to develop and implement additional measures to reduce greenhouse gas emissions due to goods movement from trucks, ports and other related facilities. The anticipated reductions would be above and beyond what is already expected from the Goods Movement Plan and the SIP. This effort should provide accompanying reductions in air toxics and smog forming emissions.

Measure T-6 in the AB 32 Scoping Plan, *Freight Transport Efficiency Measures*, is a broad-based and multi-faceted measure that will implement system-wide efficiency improvements to achieve a reduction in GHG emissions from the freight transport sector of at least 3.5 million metric tons of carbon dioxide equivalent by 2020.

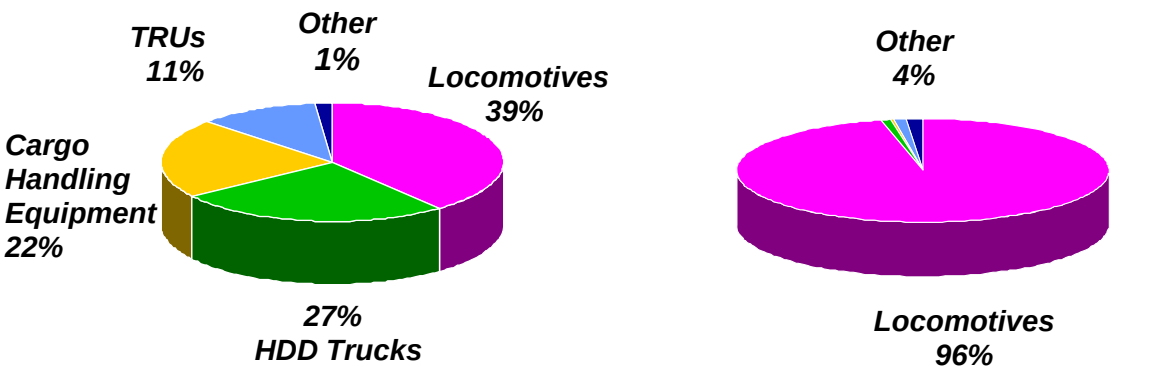
C. What are the emissions and emission trends from railyards and locomotives?

1. Railyards

Railyards are categorized as either classification railyards or intermodal railyards. In classification railyards, trains are formed by sorting and separating railcars in a bowl of multiple tracks and then are connected with a group of locomotive to form outbound trains. Classification railyards are also where railroads generally operate major maintenance facilities and large fueling stations. Intermodal railyards are designed to shift containers and trailers from trains to trucks and vice versa. Of the 18 California railyards with completed HRAs, ten were classification yards and eight were intermodal yards.

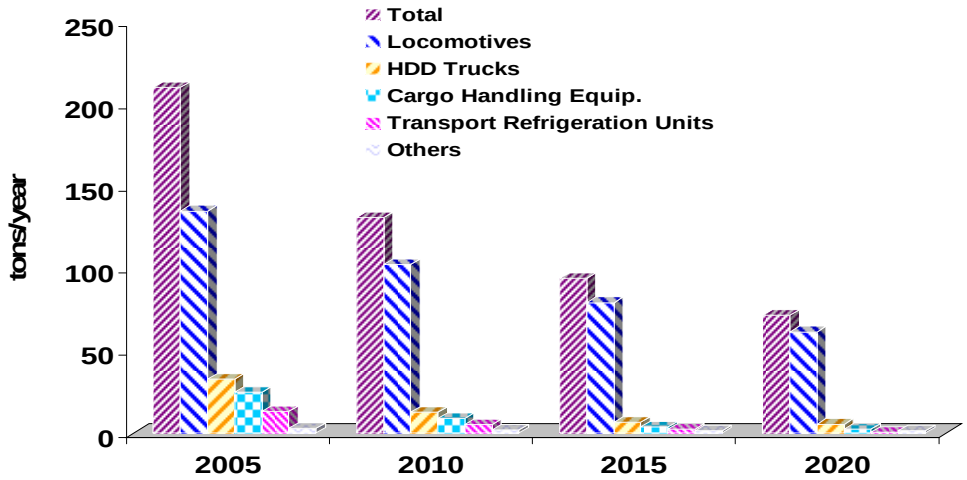
Emissions at the ten classification yards come almost exclusively from locomotives. At the eight intermodal railyards, locomotives accounted for about 40 percent of the emissions, with the balance coming from heavy-duty diesel trucks, cargo handling equipment, and transport refrigeration units (TRUs) operating at the railyards. Figure 1 presents the breakdown of emissions at classification and intermodal railyards in California.

Figure 1
Distribution of Railyard Diesel PM Emission Sources
(2005)



As shown in Figure 2, staff estimates that diesel PM emissions from all sources at railyards will be reduced by about one-third by 2010, about half by 2015, and about two-thirds by 2020, even with a strong projected growth in rail operations. These reductions have been achieved from every source at railyards using a variety of measures. The sources include transportation refrigeration units, ultra-low sulfur diesel fuel use, drayage trucks, cargo handling equipment, and locomotives. These reductions in railyard diesel PM emissions are expected to occur in large part due to U.S. EPA regulations and ARB regulation and agreements, including the 1998 railroad agreement, rather than any new initiatives at specific railyards.

Figure 2
Estimated Total Railyard Diesel PM Emissions From 18 Major Railyards
With Implementation of Existing
U.S. EPA Regulations and ARB Regulations and Agreements



Estimated Emission Reductions from 2005:	37 Percent	55 Percent	66 Percent

As shown in Table 1, the diesel PM emission reductions from existing regulations and agreements would also lower population exposure above ten in a million excess cancer risks from three million residents in 2005 to about one million residents in 2015.

Table 1
Estimated Population Exposure From Diesel PM Emissions
At 18 Major Railyards

Year	Diesel PM Emissions (tons per year)	Population Exposure Excess Cancer Risks (> 10 in a million)
2005	210	3,000,000
2010	131	1,700,000
2015	94	1,000,000
2020	72	850,000

To put these tons in perspective, the estimated annual diesel PM emissions in 2005 were 7,800 tons in the South Coast Air Basin, 1,760 tons in the San Pedro Bay Ports, and 130 tons at the combined railyards in the South Coast Air Basin.

Table 2 presents an estimate of the potential cancer risks at each railyard through 2020 based on reductions in emissions that will be achieved from measures that have been adopted or have been implemented as part of agreements with the railroads.

The maximum individual cancer risk (MICR) is defined as the estimated probability of a potential maximally exposed individual contracting cancer as a result of exposure to toxic air contaminants: the exposure is over a period of 70 years for for residential receptor locations, and 40 years for worker receptor locations. As shown in Table 2, for all but two of the smaller railyards, the estimated MICR in 2005 exceeded a potential risk of 100 per million, with five of the railyards having a potential cancer risk of at least 500 per million for a subset of the population.[9] One small residential location near the railyard gate at the San Bernardino railyard had a peak potential cancer risk of approximately 2,500 per million.

While Table 2 shows that there is a continuous reduction in risk at each railyard from 2010 to 2020, the population exposures and remaining risk levels are still too high, and additional emissions reductions are necessary to reduce public health risks around railyards to acceptable levels. Note that the Table 2 emissions estimates are based on a one percent annual growth rate. The charts are presented as an indication of the effect that existing measures have on emissions. This growth estimate is the same as

[9] The potential cancer risk is expressed as the maximum individual cancer risk per million people exposed.

that used in the Goods Movement Plan. As discussed in the section below, these estimates are likely overestimates of the growth for the current economy. This issue is discussed further in the following section.

Table 2
Estimated Maximum Individual Cancer Risks (MICR)
At 18 Major Railyards to Be Achieved by Actions Already Implemented
(2005 to 2020)

Railyard	MICR (chances in a million)			
	2005	2010	2015	2020
BNSF Hobart	500	210	160	120
BNSF Sheila Mechanical	40	30	20	15
BNSF Commerce Eastern	100	35	30	20
BNSF San Bernardino	2,500	1,340	910	605
UP Commerce	500	225	155	120
UP ICTF	800	400	215	185
UP Oakland	460	240	165	130
UP City of Industry	450	200	135	105
UP Colton	150	120	105	85
UP LATC	250	160	110	90
BNSF Barstow	450	445	325	245
BNSF Stockton	120	110	75	65
BNSF Watson	175	115	85	65
BNSF Richmond	100	55	35	25
BNSF San Diego	70	65	40	25
UP Stockton	150	60	50	40
UP Mira Loma	100	55	40	35
UP Roseville	645	505	375	250

Note: MICR estimates for 2005 are based on emission inventories in the railyard HRAs. For 2010, 2015, and 2020, MICR estimates are based on estimated emission reductions for each railyard in the draft UP and BNSF railyard mitigation plans. For UP Roseville Railyard, 645 in a million is the average risk in the >500 in a million risk zone, and is the MICR for the entire railyard based on 2000 data.

2. Locomotives

For purposes of this analysis, we have divided locomotives into three groups: interstate line haul locomotives; medium horsepower (MHP) locomotives that are mostly in California or regional service; and switch locomotives. The groupings represent three generally different uses for locomotives within California. Specific details on these types of locomotives are presented in the Technical Options Report. In general, the use of these locomotives is summarized below.

- **Interstate Line Haul Locomotive** are generally newer (built 1995 and later) and high horsepower (greater than 4,000 hp) locomotives that typically operate over long distances and many states. On a typical trip, such as between Chicago and Los Angeles, an interstate line haul locomotive may operate in California only about 10 to 20 percent of the trip.

- **Medium Horsepower (MHP) Locomotives** are typically, older locomotives that may have once served in interstate line haul service, but are now used in regional service. Applications include large switching operations and local road service (2,301 hp to 2,999 hp), helpers and short haul service (3,000 hp to 3,299 hp), or intrastate line haul service (3,300 hp to 4,000 hp). This category also includes passenger locomotives, which typically are 3,000 hp to 3,600 hp.

- **Switch (Yard) Locomotives** are typically used to push railcars together to form trains within railyards, but can also be used to power local and regional service trains. They use engines that produce between about 1,000 hp to 2,300 hp.

In 2005, California's locomotive NOx and PM emissions were about 160 and 4.8 tons per day, respectively. As shown in Table 3, interstate locomotives account for about 63 percent of the emissions from locomotives. MHP locomotives account for about 22 percent, with passenger and switch locomotives accounting for about 15 percent combined. Similar data are presented in Tables 4 and 5 for the South Coast Air Basin and the San Joaquin Valley Air Basin, respectively.

Table 3
2005 Locomotive NOx and PM Emissions
Statewide

Statewide Sources	NOx (tons/day)	Percent	PM (tons/day)	Percent
All Locomotives	158*	---	4.8	---
Contribution to Statewide NOx and Locomotive Emissions				
Interstate Line Haul Locomotives	103.0	63%	3.2	67%
Medium HP Locomotives	34.5	22%	1.2	25%
Switch Locomotives	9.4	6%	0.2	4%
Passenger Locomotives	10.3	9%	0.2	4%

* Numbers do not add precisely due to rounding.

Table 4
2005 Locomotive NOx and PM Emissions
South Coast Air Basin

South Coast Sources	NOx (tons/day)	Percent	PM (tons/day)	Percent
All Locomotives	32.3*	---	0.94	---
Contribution to South Coast NOx and PM Locomotive Emissions				
Interstate Line Haul Locomotives	17.8	55%	0.56	60%
Medium HP Locomotives	5.9	18%	0.20	21%
Switch Locomotives	4.6	14%	0.10	11%
Passenger Locomotives	3.9	13%	0.08	8%

* Numbers do not add precisely due to rounding.

Table 5
2005 Locomotive NOx and PM Emissions
San Joaquin Valley Air Basin

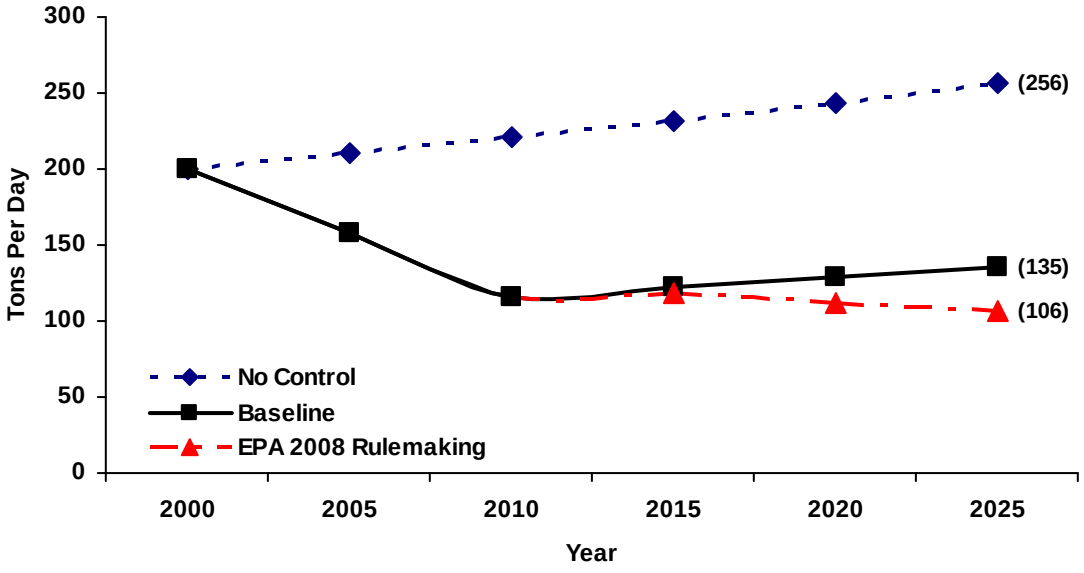
San Joaquin Valley Sources	NOx (tons/day)	Percent	PM (tons/day)	Percent
All Locomotives	23.6	---	0.66*	---
Contribution to San Joaquin Valley NOx and PM Locomotive Emissions				
Interstate Line Haul Locomotives	15.7	67%	0.46	69%
Medium HP Locomotives	5.3	22%	0.15	22%
Switch Locomotives	1.9	8%	0.04	6%
Passenger Locomotives	0.7	3%	0.02	3%

* Numbers do not add precisely due to rounding.

The 1998 ARB/UP/BNSF Locomotive NOx Fleet Average Agreement, the 2005 ARB/UP/BNSF Statewide Railroad Agreement, the 1998 U.S. EPA locomotive rulemaking, and the ARB diesel fuel regulation for intrastate locomotives provide substantial statewide locomotive NOx and PM emission reductions between 2000 and 2010. After 2010, without further controls, the ARB locomotive emission inventory assumes that growth will begin to erode the benefits of the existing measures, with a slight and gradual increase in statewide locomotive emissions occurring from 2010 to 2025. However, the recent 2008 U.S. EPA locomotive rulemaking will provide further NOx and PM emission reductions that should offset the reductions lost because of growth. Under the 2008 rulemaking, Tier 4 emission standards will begin to take effect in 2015, significantly reducing NOx and PM emissions for new locomotives. The 2008 rulemaking remanufacturing requirements provide relatively limited NOx reductions, but potentially significant PM reductions.

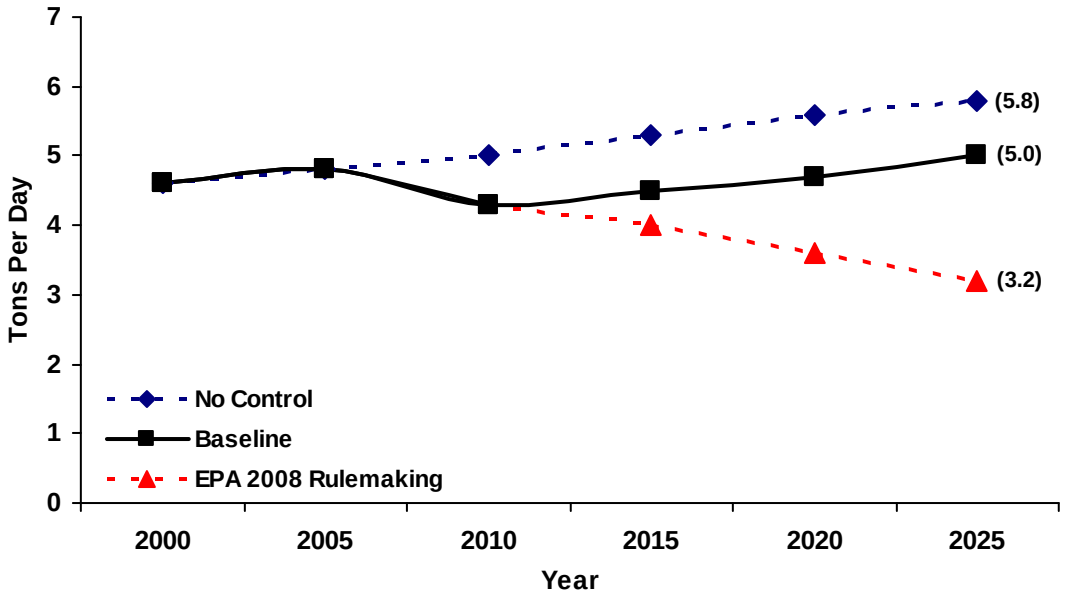
Figures 3 and 4 present ARB staff estimates of locomotive emission trends from 2010 through 2025.[10] Again, these estimates are based on a one percent annual growth rate. As the graphs show, the projections show little benefit from U.S. EPA's 2008 rulemaking through 2015 for NOx, although there is some reduction in PM due to remanufacturing requirements. However, the potential NOx benefits in California are about 30 tons per day, or about a 20 percent statewide NOx reduction, by 2025. For PM, the potential statewide PM locomotive emissions could be reduced by about 35 percent in 2025, from the 5.0 tons per day baseline to 3.2 tons per day.

Figure 3
Estimated Statewide Locomotive NOx Emissions
(Assumes 1 Percent Annual Growth Rate, 2010 to 2025)



[10] These forecasts are based on locomotive emission control factors, UP and BNSF national diesel fuel consumption data, California diesel fuel dispensing data, and an assumed annual growth rate of one percent.

Figure 4
Estimated Statewide Locomotive PM Emissions
(Assumes 1 Percent Annual Growth Rate, 2010 to 2025)

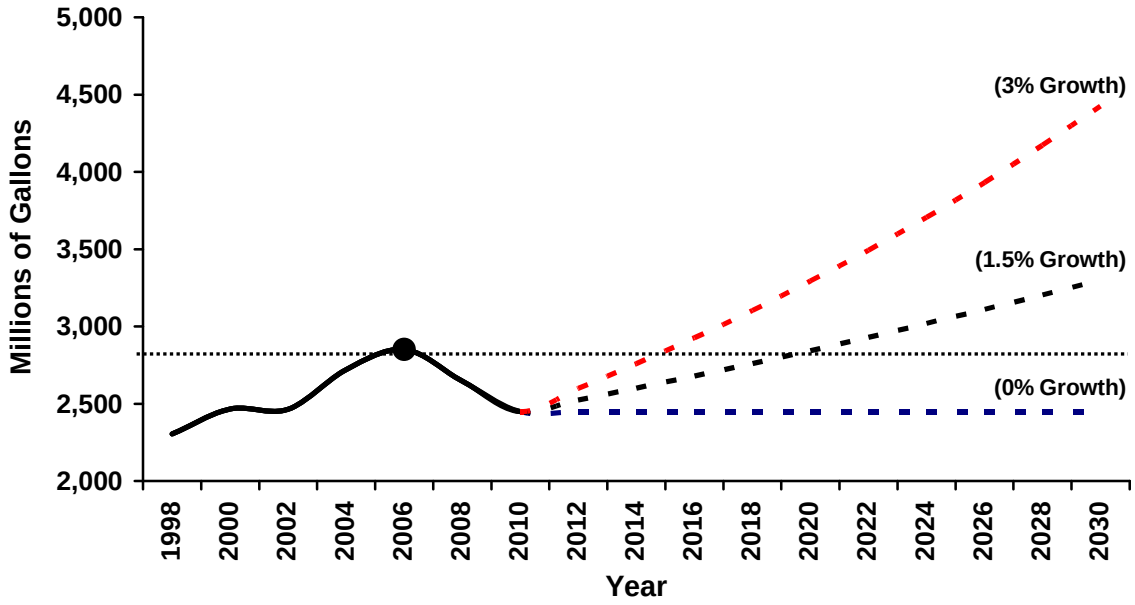


Figures 3 and 4 are presented to provide a graphic illustration of the potential impacts of existing measures on estimated NOx and PM emission reductions. However, it should be noted that the forecasts from 2010 to 2025 are based on updated control factors, UP and BNSF national diesel fuel consumption data, California diesel fuel dispensing data, and an assumed annual growth rate of one percent.[11] Further emission inventory work is underway to improve region-specific emission estimates for SIP purposes.

Figure 5 presents historic and projected growth rates of diesel fuel consumption for UP and BNSF from 1998 through 2030. Overall, from 1998 through 2008, UP and BNSF national diesel fuel consumption increased at an average annual rate of about 1.5 percent. Since 2006 (peak year) through 2009, UP and BNSF locomotive national diesel fuel consumption system wide has dropped by more than seven percent, partly due to the combined effects of fuel conservation efforts, the increased use of more fuel efficient locomotives, and the downturn in the economy.

[11] Current ARB emission inventories include a higher growth rate. Efforts are underway to update the ARB emissions inventories.

Figure 5
UP and BNSF Locomotive Diesel Fuel Consumption (1998 to 2009)
and Forecast Scenarios (2010 to 2030)



In California, economic conditions have led to less goods being transported by rail, especially imports, and a greater reduction in fuel consumption in California. Staff estimates that locomotive diesel fuel consumption may have decreased more than 20 percent since 2006. As shown in Figure 5, if fuel consumption begins to increase at peak rate of three percent per year, staff estimates fuel consumption could return to peak year (2006) levels as early as 2015; if fuel consumption begins to increase at an average rate of 1.5 percent per year, fuel consumption could return to 2006 levels around 2020. The realized and projected downturns in fuel consumption will also lower the emission estimates presented. Therefore, it will be important to reassess the emissions inventory estimates and projections to reflect the latest economic conditions.

D. What priority options does staff recommend to reduce emissions?

Due to the high diesel PM risk in and around railyards and the need to meet SIP targets by 2014, ARB staff is recommending specific options focused on upgrading the locomotive fleet to achieve reductions by 2014. In addition, staff recommends that ARB continue to focus on emission reductions that can be achieved at specific railyards and regions by phasing in advanced technology control measures. Long-term emission reduction efforts would be directed at measures that would begin to be implemented in 2015 and continue through 2020 and beyond.

Implementation of these options could substantially reduce emissions and public health risk in and around railyards and will help meet SIP targets by reducing locomotive emissions. In addition, the recommended options will help set the stage for reductions necessary to meet new federal standards. The recommended options are presented on a statewide basis, as well as specific recommendations for the South Coast and San Joaquin Valley Air Basins. All of the recommended measures are designed to achieve reductions over and above those that are to be achieved with existing State and federal regulations and State agreements.

The following sections present the staff's recommendations.

1. Repower Switch and Medium Horsepower Locomotives

The Technical Options Report identified significant emission reductions that can be cost-effectively achieved by repowering older switch and medium horsepower locomotives. These are the highest priority options. Full implementation of these two measures by 2014 can reduce statewide switch and medium horsepower locomotive NOx emissions by about 70 percent and diesel PM emissions by about 80 percent on average. Table 6 shows the number of switch locomotives and medium horsepower locomotives that must be replaced to achieve the emission reductions by 2014.

Table 6
Potential Total Number of Switch and Medium Horsepower Locomotives
To be Repowered by 2014
(2007 Data)

Region	No. of Switch Locomotives	No. of Medium Horsepower Locomotives
South Coast Air Basin	63	150*
San Joaquin Valley Air Basin	28	67
Rest of the State	61	183
Total	**152**	**400****

* The SCAB total includes 37 Metrolink and 15 Amtrak MHP passenger locomotives. In 2008-2009, Metrolink purchased 15 additional passenger locomotives that are not included in these data.

** Includes 110 passenger locomotives.

Table 7 shows the overall emission reductions, costs, and cost-effectiveness of repowering these locomotives. The costs are based on the repowering of switch locomotives at a cost of $1.5 million per switch locomotive, and the repowering of

medium horsepower locomotives at $1.0 million per locomotive.[12] The cost-effectiveness is calculated based on the methodology presented in the Carl Moyer Program guidelines. As Table 7 shows, repowering of the locomotives is very cost-effective, ranging from about $0.8 to $3 per pound. For comparison, the typical Carl Moyer cost-effectiveness for approved projects is approximately $1 to $3 per pound, with a cap of $8 per pound.

Table 7
Emission Reductions and Costs of Replacing or Repowering Switch and Medium Horsepower Locomotives by 2014

Recommendations	Emission Reductions in 2014 (tons per day)*						Carl Moyer Program Cost Effectiveness ($ /lb)	Total Costs (millions)
	South Coast Air Basin		San Joaquin Valley Air Basin		Statewide			
	NO_x	PM	NO_x	PM	NO_x	PM		
Repower older switch locomotives: 2010-2012	2.8	0.14	0.9	0.03	6.6	0.30	$1.80 - $3.00/lb	$230
Repower older MHP locomotives: 2011-2013	8.6	0.47	4.3	0.21	23	1.25	$0.80 - $1.30/lb	$400
Total Emission Reductions in 2014	**11.4**	**0.61**	**5.2**	**0.24**	**29.6**	**1.55**	**$0.80 - $3.00/lb**	**$630**

* These reductions are calculated based on an analysis of the emissions reductions achieved on an individual locomotive basis. Staff has assumed that there will be no increase in the number of these types of locomotives through 2015.

** Note: Of the 8.6 tons per day of NOx reductions in the SCAB, the SCAQMD expects to get 3.0 tons per day from proposed SCR retrofits to 37 Metrolink MHP passenger locomotives.

ARB has limited authority to directly establish emission standards for locomotives (See Appendix A and discussion, infra, at pages 20-21.). Therefore, staff recommends that ARB work cooperatively to combine investments from the railroads with a mix of federal and state incentive programs to achieve the emission reductions. The most likely sources of incentive funding are the federal Diesel Emissions Reduction Act (DERA), the American Recovery and Reinvestment Act (ARRA), and Proposition 1B, with additional funds possibly available through the Carl Moyer Program, or other potential sources such as the local air districts. Assembly Bill 118 established the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program: a component of this program is the ARB's Air Quality Improvement Program. Funds can be sought from both programs.

For the 2007-2011 fiscal years, DERA authorizes $200 million per year in incentive funding for diesel projects. ARRA authorizes an additional allocation of $300 million in

[12] For a medium horsepower locomotive repower the engine is replaced, whereas for a switch locomotive repower nearly the entire locomotive is rebuilt (except for the chassis); hence the higher cost for the switch locomotive repower.

2009. Proposition 1B authorizes $1 billion in total to fund emission reductions programs. Of the $1 billion, the Board has targeted $100 million for potential use for upgrading or replacing locomotives.

Table 8 presents a targeted incentive program by year to achieve the necessary emission reductions. This proposal is based on a 50 percent match from participating railroads. Clearly, the Board will need to work closely with the U.S. EPA, the local air districts, the participating railroads, and other stakeholders to solicit funding opportunities.

In July 2009, the U.S. EPA awarded ARB almost $9 million for the replacement of at least eight switch locomotives in the South Coast Air Basin. These funds, which must be matched by at least $3 million from participating railroads, were released through DERA via the ARRA of 2009. A solicitation for proposals is currently in preparation, and should be released in September 2009. Two other proposals for use of locomotive funds in California were not approved.

Table 8
Potential Amount of Incentive Funds Necessary
To Achieve Emission Reductions from Repowering of
Switch Locomotives and Medium Horsepower Locomotives

Funding Source	Funds Needed (millions) [a]				
	2009	2010	2011	2012	2013
Incentive Funds	9	100	100	60	49
Railroad Matching Funds[b]	3	100	100	60	49
Total	12	200	200	120	98
Cumulative Total	**12**	**212**	**412**	**532**	**630**

[a] Funds are rounded. In 2009, DERA grant provided about $9 million in incentive funds.
[b] Matching funds assumed to be 50 percent, except for 2009.

2. Retrofit Switch and Medium Horsepower Locomotives with Aftertreatment Devices

The Technical Options Report identified that significant emission reductions can be cost-effectively achieved by retrofitting switch and medium horsepower locomotives with advanced aftertreatment devices. As discussed in the previous section, there are a number of ongoing research projects devoted to the development and application of this technology. Implementation of these two measures by 2014 in the South Coast Air Basin and San Joaquin Valley would reduce NOx and PM emissions from switch and medium horsepower locomotives beyond the reductions achieved by repowering: the NOx emissions would be further reduced by about 15 percent, and diesel PM emissions

would be further reduced by about 10 percent. Table 9 shows the number of switch locomotives and medium horsepower locomotives that must be replaced; priority would be placed on repowering the locomotives in the South Coast Air Basin and San Joaquin Valley to help meet 2014 SIP goals; Table 10 shows the overall emission reductions from and costs of repowering these locomotives.

The cost to retrofit a switch locomotive is approximately $200,000 and the cost to retrofit a medium horsepower locomotive is approximately $500,000 per locomotive. The cost-effectiveness of the measure is based on the Carl Moyer Program guidelines and assumes no matching funds in the calculation. The use of matching funds would improve the program's cost-effectiveness. As Table 10 shows, retrofitting of the locomotives is very cost-effective, ranging from $0.8 to $3.30 per pound with no matching funds. For comparison, the typical Carl Moyer cost-effectiveness for approved projects is approximately $1 to $3 per pound, with a cap of $8 per pound.

Table 9
Potential Total Number of Switch and Medium Horsepower Locomotives To Be Retrofitted by 2016
(2007 Data)

Region	No. of Switch Locomotives	No. of Medium Horsepower Locomotives
South Coast Air Basin	139	150*
San Joaquin Valley Air Basin	28	67
Rest of the State	77	183
Total	**244**	**400****

* The SCAB total includes 37 Metrolink and 15 Amtrak MHP passenger locomotives. In 2008-2009, Metrolink purchased 15 additional passenger locomotives that are not included in these data.

** Includes 110 passenger locomotives.

Table 10
Emission Reductions and Costs to Retrofit DPF and SCR on All Switch and Medium Horsepower Locomotives

Recommendations	Emission Reductions (tons per day)*						Carl Moyer Program Cost Effectiveness ($ /lb)	Total Costs (millions)
	South Coast Air Basin		San Joaquin Valley Air Basin		Statewide			
	NO_x	PM	NO_x	PM	NO_x	PM		
Retrofit switch locomotives with DPF and SCR: 2012 – 2015	0.6	0.02	0.2	0.01	1.0	0.04	$2.00 - $3.30/lb	$50
Retrofit MHP locomotives with DPF and SCR: 2012 – 2016	2.6	0.07	1.1	0.03	6.8	0.18	$0.80 - $1.40/lb	$200
Total Emission Reductions	**3.2**	**0.09**	**1.3**	**0.04**	**7.8**	**0.22**	**$0.80 - $3.30/lb**	**$250**

* The emission reductions are based on full implementation. For the South Coast and San Joaquin Valley, this is assumed to be 2014; for statewide, the estimates are for 2016.

As with the repowering option, the recommended implementation mechanism would be contributions from the participating railroads combined with incentive funds. Again, the most likely source of incentive funding is the federal DERA, although other sources of incentive funds may be available.

Table 11 presents a targeted incentive program by year to achieve the necessary emission reductions. This proposal is based on a 50 percent match from participating railroads. The Board will clearly need to coordinate with the U.S. EPA, the local air districts, the participating railroads, and the other stakeholders to solicit funding opportunities.

Table 11
Potential Amount of Incentive Funds Necessary To Achieve Emission Reductions from Retrofit of Switch Locomotives and Medium Horsepower Locomotives

Funding	Funds Needed (millions) [a]					
	2011	2012	2013	2014	2015	2016
Incentive Funds	10	25	25	25	20	20
Railroad Matching Funds[b]	10	25	25	25	20	20
Total	20	50	50	50	40	40
Cumulative Total	**20**	**70**	**120**	**170**	**210**	**250**

[a] Funds are rounded.
[b] Matching funds assumed to be 50 percent.

3. Accelerate the Introduction of Tier 4 Interstate Line Haul Locomotives

The last high priority recommendation is the acceleration of deployment of Tier 4 line haul locomotives in California rail operation. The U.S. EPA has recently promulgated a new rule that requires any new locomotive to meet Tier 4 standards beginning in 2015, with a two year extension under certain conditions. The Tier 4 standards require very clean locomotives with both NOx and diesel PM aftertreatment devices. The Technical Options Report discusses the new federal rulemaking. The accelerated replacement of existing line haul locomotives with Tier 4 locomotives has the potential to achieve significant reductions.

Staff estimates that up to 1,200 interstate line haul locomotives will operate in California on any given day by 2020. To meet this number of locomotives under current operating scenarios, staff estimates that UP and BNSF will need a national pool of up to 5,000 Tier 4 interstate line haul locomotives to ensure that up to 1,200 Tier 4 interstate line haul locomotives will be able to operate in California. This estimate assumes that there is no change in the operation of the railroads.

Based on prior experience, it may take more than 30 years (i.e., to 2045) for national interstate fleets to turn over to the new Tier 4 interstate line haul locomotives and fully realize the Tier 4 emission benefits. In 2020, for analyses purposes in this report, we assumed all line haul locomotives operating in California would be Tier 2, so we have assumed only the emissions differences between Tier 2 and Tier 4 locomotives in California by 2025. If Tier 2 baseline emissions are assumed, a statewide Tier 4 interstate line haul locomotive fleet of 1,200 locomotives could provide up to 32.0 tons per day of NOx and 1.3 tons per day of PM emission reductions, respectively. The emission reductions, cost, and cost-effectiveness are presented in Table 12.

Table 12
Emission Reductions and Costs for Accelerating the Replacement of Interstate Line Haul Locomotives

Line Haul Locomotive Recommendation	Time Frame	Emission Reductions (tons/day) in California by 2025		Cost-Effectiveness* ($/lb NO_x+20xPM)	California Share of Capital Costs*** (in millions)
		NOx	PM		
Procure up to 5,000 Tier 4 interstate line haul locomotives**	2015 – 2025	32.0	1.3	$2 – 8.6/lb (10 - 30 years)	$3,000

* Carl Moyer cost-effectiveness methodology.
** To ensure 1,200 Tier 4 interstate line haul locomotives operate in California on any given day.
*** Total costs are $15 billion. California's share of the capital cost would be about 20 percent, or about $3 billion.

A national pool of up to 5,000 UP and BNSF Tier 4 interstate line haul locomotives would cost approximately $15 billion. This estimate is based on an approximate cost of $3 million per locomotive. Staff assumed that the line haul locomotives operate in California about 20 percent of the time; therefore, California's fair share of the cost would be about $3 billion.

The implementation mechanism or mechanisms for this measure are uncertain. The staff's preferred option is to implement this program through a combination of railroad and incentive funds. To pursue this effort, staff recommends that ARB form a coalition comprised of local air districts, local governments, other states, the railroads, and other stakeholders to seek additional incentive funds.

However, other potential implementation mechanisms include: federal action to provide states greater authority to regulate existing locomotives (see discussion below); an amendment to U.S. EPA regulations for locomotives; or an enforceable agreement with the railroads and other stakeholders. As required by Board Resolution 05-40, any enforceable agreement must be initiated by being formally announced and authorized by the Board at a public meeting. Staff is not requesting that such an effort be initiated at this time, pending the success of the other efforts noted above.

E. What additional actions does staff recommend?

1. Continue to Investigate and Implement Specific Railyard Measures

Staff recommends that ARB continue to work with local air districts, the local communities, and the railroads to expeditiously identify and implement specific railyard mitigation measures that would reduce the emissions and public health risks around railyards. Each railyard has unique operations, meteorology, emissions density, and levels of residential exposure that would affect the costs and benefits derived from these types of measures. Additional time is needed to conduct site specific analyses would need to be performed to assess the potential benefits of individual railyard-specific measures.

Railyard-specific mitigation measures could include erecting walls, growing trees, installing air monitoring stations, and installing indoor air filters in residential homes. Also, hood technology could potentially reduce some stationary locomotive emissions at large locomotive classification and mechanical and servicing railyards.

In addition, staff recommends that the local governments, railroads, and local communities continue to work together to identify legal and other approaches that could be used to further reduce emissions from railyards. Such actions might include changes in railyard operations, changes in traffic movements, and changes in land use around railyards.

2. Seek Changes in Federal Laws to Eliminate Federal Preemptions

Staff has evaluated ARB legal authority to regulate locomotives based on the federal Clean Air Act (CAA), U.S. EPA regulations, and the Interstate Commerce Commission Termination Act (ICCTA). Section 209(e)(1) of the CAA expressly preempts states from adopting emission standards for new locomotives, and section 209(e)(2) implicitly preempts all states other than California from adopting independent emission standards for non-new locomotives. Under section 209(e)(2)(A), California may, however, adopt and enforce its own emission standards for locomotives not directly preempted under section 209(e)(1), upon receiving authorization from the Administrator of the U.S. EPA.[13]

In 1998, U.S. EPA adopted a final rule that interpreted "new" to mean the time that a locomotive is initially manufactured or remanufactured and that the preemption against state regulation ran through 133 percent of the locomotive's useful life (approximately 10 years).[14] Under the federal rule, Class I and II railroad[15] locomotives that were manufactured prior to 1973 and have not been upgraded (remanufactured) after 2000 or locomotives initially manufactured in or after 1973 but have exceeded their useful lives since initial manufacture or last manufacture, whichever is later, are not preempted.[16] The remanufacturing of a locomotive effectively re-starts the "useful life" clock and preemption.

The railroads could avoid state requirements by electing to remanufacture older pre-Tier 0 and Tier 0 locomotives to the Tier 0 remanufacturing standard, or to replace non-preempted locomotives with locomotives that have been remanufactured to the Tier 0 standard and are still within their useful lives.

Based on staff's recent estimates, Table 13 shows that there are a significant number of locomotives operating in California that have not been remanufactured, or that have been remanufactured but not for at least 10 years, and could be governed by ARB regulation. These locomotive counts are subject to change. However, staff is not proposing to adopt standards that would apply to these locomotives, because doing so would likely lead to replacing existing units with remanufactured locomotives only with Tier 0 emission levels. A more detailed discussion of legal authority is presented in Appendix A.

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[13] Once California has received authorization, other states may elect to adopt emission standards and other requirements identical to those adopted by California. (CAA section 209(e)(2)(B).)

[14] 63 Fed. Reg., 18978 (April 16, 1998).

[15] The Surface Transportation Board defines a Class 1 railroad as a railroad with annual operating revenues (in inflation-adjusted 1991 dollars) of $250 million or more; a Class 2 railroad has annual operating revenues between $20 million and $250 million in inflation-adjusted 1991 dollars.

[16] 63 Fed. Reg., 18978 (April 16, 1998).

Table 13
Summary of Potential Number of Older
Switch and Medium Horsepower Locomotives By Region

Type of Older Locomotives	Status	Statewide	South Coast	San Joaquin Valley
Switch Locomotives	Pre-Tier 0 (Potentially Subject to State Regulation)	103	43	15
	Remanufactured to Tier 0	49	20	7
	Total Older Switch Locomotives	**152**	**63**	**22**
Medium Horsepower Locomotives	Pre-Tier 0 (Potentially Subject to State Regulation)	360	135	61
	Remanufactured to Tier 0	40	15	6
	Total Older MHP Locomotives	**400**	**150**	**67**

* The percentages of NOx and PM emissions are presented in Table 3, Table 4, and Table 5.

As stated, the restart of a locomotive's "useful life" clock under the U.S. EPA rulemaking, by remanufacturing it to Tier 0 emission standards, potentially limits states' abilities to regulate emissions from older locomotives. If the railroads were able to limit the state's authority to require non-preempted locomotives to meet the most stringent emission standards achievable by remanufacturing such locomotives to Tier 0 levels, relatively small emission reductions, on the order of about 30 percent for NOx and 50 percent for PM, would be achieved. Staff believes California needs to pursue a strategy that will result in the repower and retrofit of locomotives to Tier 4 levels or by requiring that new Tier 4 locomotives be put into service, as opposed to a strategy that would likely produce only small, incremental Tier 0 level emissions reductions.

ICCTA provides another set of legal challenges. ICCTA preempts state regulations which can cause an undue burden on railroad operations, especially interstate operations. All locomotives, even those that may operate for longer periods of the time within the state – such as switch and MHP locomotives – will often ultimately cross states lines periodically. Although ARB has authority under State law to regulate locomotives, any regulation would need to be harmonized with both the CAA preemption. To the extent that ARB has authority under the CAA, that authority would need to be harmonized with ICCTA's proscriptions.

Another concern relates to the 1998 Locomotive NOx Fleet Average Agreement (Agreement) in the South Coast Air Basin. The Agreement has a termination clause

which could be potentially invoked by the railroads if the ARB approved a locomotive regulation. Were the 1998 Fleet Average Agreement to be terminated, staff believes that significant emission reductions would be foregone in the South Coast Air Basin starting as early as 2010. In addition, as these locomotives move through the San Joaquin, Salton Sea, and Mojave air basins, emissions benefits from the Agreement would be lost in these areas as well.

Therefore, the staff's preferred option is to implement this program through a combination of railroad and incentive funds. However, incentive funds are uncertain. Therefore, staff is proposing to work with the local air districts and other stakeholders to seek changes to federal laws that would provide clear authority for the ARB to adopt emission controls for existing locomotives that would avoid all federal preemption issues under either the CCA or ICCTA. While such an effort is unlikely to yield results in the near term, initiating this activity now may facilitate acceleration of the introduction of line haul locomotives.

3. Consider Additional Measures for Cargo Handling Equipment

Staff is currently evaluating a measure for reduced idling of cargo handling equipment. Cargo handling equipment generally includes yard trucks, top and side picks, and rubber tired gantry (RTG) cranes. In addition, staff recommends that the Board support ongoing test programs of cargo handling equipment that seek to achieve emission reductions beyond the reductions being achieved under the existing ARB cargo handling equipment regulation adopted in 2005. Current test programs include diesel, liquefied natural gas (LNG), and hydraulic hybrid yard trucks. If the ongoing test programs are successful and appear to be cost-effective, staff recommends initiating a rulemaking to modify the existing cargo handling equipment regulation to include such emission requirements.

4. Participate in the CEQA Process for the ICTF and SCIG Projects

Staff recommends that ARB participate in the review of the CEQA reports for rebuilding the Union Pacific International Container Transfer Facility (ICTF) and building the Southern California International Gateway (SCIG) railyard. As part of the review, staff should work to ensure that the best available emission controls are incorporated into the projects and that a full assessment of potential off-site mitigation is conducted.

5. Support the San Pedro Bay Ports Clean Air Action Plan Update

The two San Pedro Bay Ports are currently updating their clean air action plan. Staff recommends that the ARB support the San Pedro Bay Ports efforts to accelerate the turnover of cleaner switch locomotives consistent with ARB's recommendations in this report. In addition, the staff recommends that ARB support the San Pedro Bay Ports efforts to accelerate the turnover of cleaner Tier 4 line haul locomotives serving port properties as expeditiously as possible following their introduction in 2015, with the goal of 95 percent Tier 4 locomotives serving the ports by 2020.

Based on 2007 data, ARB staff estimated that UP and BNSF had about 150 trains per day entering and exiting the South Coast Air Basin (SCAB). Current data suggest that, on average, UP and BNSF typically use about four locomotives to pull trains as they enter and exit the SCAB. As the economic downturn has continued, staff estimates that line haul locomotive activity in the SCAB may have decreased by as much as 33 percent, to about 100 trains per day.

Line haul locomotive activity at the San Pedro Bay Ports is a part of the total line haul locomotive activity within in the SCAB. In 2007, activity along the Alameda Corridor was about 50 trains per day combined for UP and BNSF. Staff estimates that UP and BNSF employ an average of about 3.5 locomotives per Alameda Corridor train, which is equivalent to about 175 locomotives per day, or about 30 percent of all the line haul locomotives that operate in the SCAB. As economic conditions have led to a decrease in goods movement, activity along the Alameda Corridor has also decreased. The Alameda Corridor Transport Authority has reported the average daily train counts to be 36 trains per day as of mid-2009, a nearly 30 percent decrease from 2007 levels.

When Tier 4 locomotives become available, Class I railroads can introduce Tier 4 models into national service at the same pace as they are currently introducing Tier 2 models. We expect the Tier 4 locomotives will be available beginning in 2015. This accelerated incentive program could provide sufficient locomotives to ensure that at least 95 percent of all interstate line haul locomotives operating on port properties would comply with Tier 4 standards, without a dedicated Tier 4 fleet in California. Given that there are about 175 line haul locomotives per day along the Alameda Corridor, there would need to be about 700 Tier 4 locomotives in the national fleet to dedicate 95 percent Tier 4 locomotives to the San Pedro Bay Ports. Staff will continue to work with the San Pedro Bay Ports, the South Coast Air Quality Management District, and other stakeholders to develop, support, and implement this measure.

6. Seek Changes in Federal Regulations for Line Haul and Switch Locomotives

The U.S. EPA has the regulatory authority to establish more stringent requirements for line haul and switch locomotives that would accelerate emission reductions prior to the full implementation of the Tier 4 locomotives. Additional reductions could be mandated by the U.S. EPA if the agency were willing to modify the current regulations for locomotives. For example, the following actions could produce accelerated emission reductions:

- Require a 50 percent reduction of NOx for each tier level in the 2008 locomotive emission standards for remanufacture of existing line haul and switch locomotives. This recommendation would include retention of the current 2008 PM locomotive remanufacture emission standards, which represent about a 50 percent reduction for each tier level from existing line haul and switch locomotives.

- Require that Class I railroads remanufacture existing line haul and switch locomotives, at specified intervals, to meet the existing PM and the proposed NOx emissions standards (i.e., about 50 percent reduction for each tier level on remanufacture). Only pre-1973 model year line haul and switch locomotives would be exempted from the proposed remanufacture requirements.

To pursue this effort, staff recommends that ARB form a coalition comprised of local air districts, local governments, and other states impacted by locomotive and railyard diesel PM and NOx emissions, associated cancer risks, and associated non-cancer health effects. This coalition would recommend that U.S. EPA provide greater and earlier emission reductions from interstate line haul locomotives, thereby providing significant air quality benefits to other states and regions impacted by locomotive emissions. As part of the process, ARB would solicit input from all stakeholders in a public process.

7. Continue to Develop the Goods Movement Efficiency Measure

Staff recommends that efforts to evaluate the efficiency of goods movement continue in support of California's Scoping Plan for reducing greenhouse gas emissions from the goods movement sector. In addition to reducing GHG emissions, staff expects that such efficiencies would result in commensurate reductions in criteria and toxic air pollutants.

8. Evaluate Electrification of Rail as a Long Term Measure

In the Technical Options Report, staff evaluated electrification of rail as one of the options. Staff recommends that efforts continue to evaluate the long term potential of rail electrification, particularly in the South Coast Air Basin, as a long term measure.

9. Develop Improved Emission Inventories for Locomotives and Railyards

The ability to evaluate and assess the impact of various measures on emissions is dependent upon accurate emissions estimates. Staff has developed significant new information based on the work done on the health risk assessments and the draft mitigation plans. There is also an ongoing effort to reassess the emissions inventory for locomotives based on average fuel consumption data by line segment. In addition, growth projections may need revision, and actual in-use locomotive emissions may be less than anticipated due to the use of cleaner diesel fuels. Therefore, staff recommends that efforts continue to improve the statewide emissions inventory and the region-specific emission estimates for the South Coast and San Joaquin Valley needed to assess progress towards achieving SIP targets.

10. Continue Support for Advanced Locomotive Research Programs

The technology already exists to implement the first recommended option, the repowering of 152 older switch locomotives with gen-set engines. However, there is

additional development work that needs to be done for the implementation of the other recommendations – e.g., the repowering of MHP locomotives and the incorporation of aftertreatment devices. Much of this work is underway, and in some cases, is supported by ARB funding. These efforts are critical in being able to develop the technology needed to implement the other locomotive recommendations.

Therefore, ARB staff supports ongoing test programs of switch, medium horsepower, passenger, and interstate line haul locomotives to evaluate advanced emissions controls and advanced technologies to set the stage for additional near term or medium term emission reductions. A summary of the ongoing test programs is presented below.

Approved and Ongoing Test Programs

- Retrofit Diesel Particulate Filters (DPF) on a National Railway Equipment Company (NREC) existing gen-set switch locomotives powered by Cummins engines (Fall 2009 to Fall 2010);

- Retrofit DPFs on Railpower existing gen-set switch locomotives powered by Deutz engines (Fall 2009 to Fall 2010);

- Repower a medium horsepower (MHP) Tier 2 Caterpillar/Progress Rail engine and retrofit selective catalytic reduction (SCR) and diesel oxidation catalyst (DOC) aftertreatment to meet Tier 4 NOx and Tier 3 PM standards (Fall 2009 to Fall 2010);

- Repower a MHP ultra low-emitting locomotive (ULEL) engine (Fall 2009 to Fall 2010);

- Support efforts of Alternative Hybrid Locomotive Technologies (AHL-TECH) to develop a prototype ethanol-hybrid locomotive; and

- Support BNSF efforts to research and demonstrate a fuel cell-powered hybrid switch locomotive that will be conducting field demonstration testing in Los Angeles in the fall of 2009.

Proposed Test Programs Pending Funding

- Retrofit SCR and DPF on an existing gen-set switch locomotive (Spring 2010 to 2012);

- Retrofit a DPF on to the MHP Tier 2 Caterpillar/Progress Rail engine repower with retrofit of SCR and DOC to meet Tier 4 NOx and Tier 4 PM standard (Fall 2011 to 2012);

- Support a University of California, Irvine research team on the development of a solid oxide fuel cell/gas turbine hybrid locomotive;

F. What are the overall benefits of implementing the recommendations?

1. Railyards

Implementation of the five locomotive recommendations is expected to substantially reduce diesel PM emissions around railyards and thus substantially reduce the potential cancer risks. Table 14 presents an estimate of the potential cancer risks around each railyard if the five locomotive recommendations are implemented. This table shows that the remaining potential cancer risks would be reduced on average by about 85 percent by 2020. The table also shows that only four railyards would have a remaining risk of greater than 100 chances per million. As recommended previously, staff will continue to work with the railroads, the local air districts, and the local communities to address specific railyard mitigation measures to further reduce the risk.

Table 14
Estimated Maximum Individual Cancer Risks (MICR)
At 18 Major Railyards with Cleaner Locomotives
(2005 to 2020)

Railyard	MICR (chances in a million)			
	2005	**2010**	**2015**	**2020**
BNSF Hobart	500	210	135	65
BNSF Sheila Mechanical	40	30	20	10
BNSF Commerce Eastern	100	35	20	5
BNSF San Bernardino	2,500	1,340	770	285
UP Commerce	500	225	145	95
UP ICTF	800	400	190	135
UP Oakland	460	240	110	60
UP City of Industry	450	200	125	75
UP Colton	150	120	55	30
UP LATC	250	160	55	25
BNSF Barstow	450	445	290	130
BNSF Stockton	120	110	50	20
BNSF Watson	175	115	65	25
BNSF Richmond	100	55	25	15
BNSF San Diego	70	65	40	10
UP Stockton	150	60	35	15
UP Mira Loma	100	55	35	15
UP Roseville	645	505	265	135

Note: MICR estimates for 2005 are based on emission inventories in the railyard HRAs. For UP Roseville Railyard, 645 in a million is the average risk in the >500 in a million risk zone, and is the MICR for the entire railyard based on 2000 data. For 2010, 2015, and 2020, MICR estimates are based on estimated emission reductions for each railyard achieved with cleaner locomotives, in addition to the emission reductions in the draft UP and BNSF railyard mitigation plans.

2. Locomotives

Based on estimated annual diesel fuel consumption, implementing the five locomotive recommendations is expected to reduce NOx and diesel PM emissions from locomotives by about 70 percent on a statewide basis by 2020. These reductions are shown graphically in Figures 6 and 7.

Figure 6
Estimated Statewide Locomotive NOx Emissions with Locomotive Emission Reductions Recommendations
(Assumes 1 Percent Annual Growth Rate from 2010-2020)

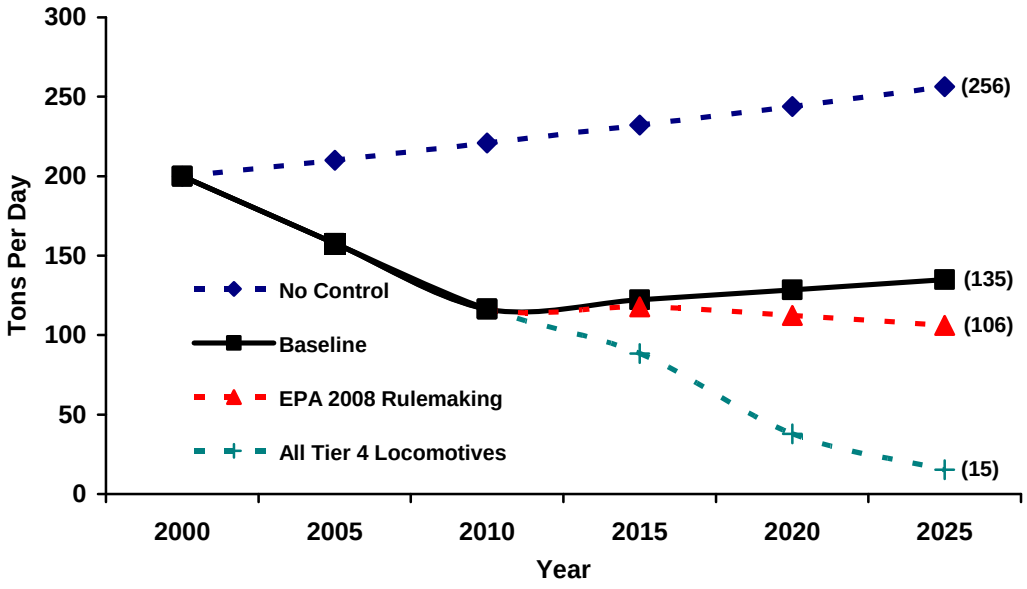
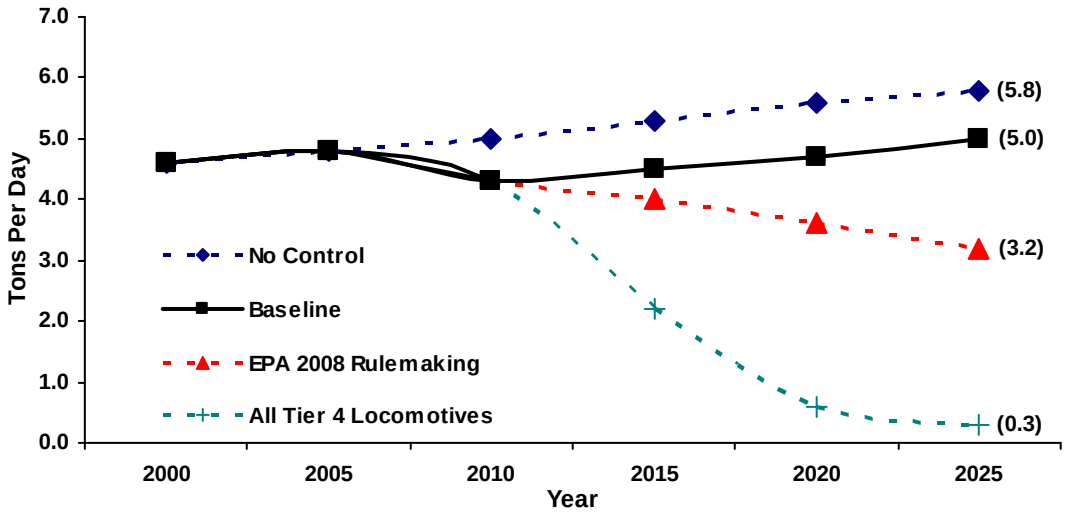


Figure 7
Estimated Statewide Locomotive PM Emissions with Locomotive Emission Reductions Recommendations
(Assumes 1 Percent Annual Growth Rate from 2010-2020)



In the South Coast Air Basin, implementation of the recommendations by 2014 should reduce NOx and diesel PM emissions by about 40 percent; for 2020, implementing the recommendations would reduce NOx emissions by about 50 percent and diesel PM emissions by about 80 percent over today's projection of emissions. For the San Joaquin Valley, implementation of the recommendations by 2014 should reduce NOx emissions by about 30 percent and diesel PM emissions by about 40 percent; for 2020, implementing the recommendations would reduce NOx emissions by about 40 percent and diesel PM emissions by about 70 percent over today's projection of emissions.

There are a number of factors that affect estimates of the specific emission reductions. As indicated in the recommendations, staff is proposing to continue to update the emissions inventory, including growth assumptions, in order to improve the emissions inventory as well as determine progress towards SIP targets.

3. GHG Benefits

Assembly Bill (AB) 32, the California Global Warming Solutions Act of 2006, mandates that California reduce its GHG emissions to 1990 levels by 2020. Transportation is the single largest contributor to California's GHG emissions, producing about 39 percent of the state's total GHG emissions in 2004, including the emission sources of locomotives operated in California.

Locomotives have historically been efficient in moving goods on land due to the amount of tons a locomotive can pull and the lower fuel consumption on a gallon per ton-mile basis. These efficiencies result in relatively fewer GHG emissions compared to most

other modes of freight transportation because a train's wheel steel-on-steel resistance is much lower than rubber wheels subject or road resistance.[17] Trains continue to be about three or more times more fuel efficient than trucks on a gallon per ton-mile basis. Improved rail efficiencies should result in even greater GHG reductions.

a. National Locomotive Diesel Fuel Consumption

According to American Association of Railroads (AAR) data for 2007, the nation's seven major railroad companies reported moving 1.77 trillion ton-miles of freight and consuming 4.06 billion gallons of diesel fuel for freight trains and trains in switching yards. This gives an average national locomotive fuel efficiency of 436 ton-miles per gallon of diesel fuel in 2007. The 2007 average national locomotive fuel efficiency includes a 3.1 percent increase from the 423 ton-miles per gallon reached in 2006.

The railroad industry suggests the factors for such significant reductions in diesel fuel consumption are:

- Using newer, larger horsepower, and more fuel efficient locomotives to pull longer trains
- Double stacking of container cars, and other system efficiencies
- Training engineers to operate locomotives to conserve fuel
- Using computers to assemble trains more efficiently in the yard and to plan trips more efficiently to avoid congestion
- Reducing the amount of time engines are idling with manual procedures and installation of idle reduction devices

b. Tier 2 Interstate Line Haul Locomotive Diesel Fuel Savings

Both General Electric (GE) and Electro Motive Division (EMD) developed new advanced technology line haul locomotives to meet the U.S. EPA Tier 2 locomotive emissions standards in 2005. These 4,300 horsepower new line haul locomotives have advanced engine design and timing, cooling systems, and traction systems that reduce diesel fuel consumption by as much as 3 to 5 percent in comparison with older line haul locomotives (3,000 to 4,000 horsepower)

Over an expected 20 year service life, a Tier 2 line haul locomotive can reduce diesel fuel consumption by up to 300,000 gallons, which is equivalent to about one year's diesel fuel consumption.

c. Ultra Low Emitting Switch Locomotive (ULESL) Diesel Fuel Savings

National Railway Equipment Company (NREC) and Railpower (RP) have developed gen-set and electric hybrid switch locomotives (about 2,000 horsepower equivalent).

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[17] G. Gould and D. Niemeier, *Review of Regional Locomotive Emission Modeling and the Constraints Posed by Activity Data,* Research Report, UCD-ITS-RP-09-19, University of California, Davis, June (2009).

These locomotives can provide reductions of 20 to 60 percent in diesel fuel consumption and GHG emissions. Switch locomotives typically operate in and around railyards, and consume an average of about 50,000 gallons of diesel fuel annually.

With CO_2 emissions estimated at 22.4 pounds per gallon of diesel fuel[18], a 20 percent reduction (about 10,000 gallons annually) in diesel fuel consumption would provide more than 100 tons per year of GHG reductions per gen-set switch locomotive. UP and BNSF currently operate about 76 gen-set switch locomotives, 12 electric hybrid, and four liquefied natural gas (LNG) captive switch locomotives in California.

d. California Locomotive Diesel Fuel Savings

Within California, total annual locomotive diesel fuel consumption for UP, BNSF, passenger, and smaller railroads is estimated at about 200 million gallons: approximately 30 million gallons for Class I and Class III/military industrial switch locomotives, and approximately 170 million gallons for line haul, MHP, and passenger locomotives.

The following assumptions are made for diesel fuel savings:

- 3 percent for Tier 2 line haul, MHP, and passenger locomotives
- 20 percent for ULESLs

The annual savings in diesel fuel would then be an estimated 7.5 million gallons. With CO_2 emissions estimated at 22.2 pounds per gallon of diesel fuel, an annual savings of 7.5 million gallons of diesel fuel corresponds to an annual savings of 84,000 tons of CO_2 emissions, or about 230 tons of CO_2 per day.

[18] http://www.eia.doe.gov/oiaf/1605/coefficients.html

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APPENDIX A

LEGAL ANALYSIS OF ARB AUTHORITY TO REGULATE LOCOMOTIVES

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ARB's Authority to Adopt Emission Standards and Other Emission-Related Requirements for Locomotives and Other Railyard Sources: A Legal Review of Proposed Options[1]

To determine the extent of the ARB's authority to adopt emission standards for railyard sources, including locomotives, the Board must review and consider state and federal law; specifically, one must carefully consider ARB's authority in relation to the authority granted to ARB under the Health and Safety Code and the federal Clean Air Act (CAA) and the constraints imposed by the preemptions of state regulation under the CAA and the Interstate Commerce Commission Termination Act of 1995 (ICCTA).

ARB Authority under California Law

Under California law, the Air Resources Board (ARB) is the designated state agency responsible for preparing state implementation plans (SIPs) under the federal Clean Air Act (CAA). (Health & Saf. Code § 39602.) It has also been entrusted by the California Legislature to adopt emission standards, regulations, and airborne toxic control measures for off-road engines and vehicular and nonvehicular sources that use such engines, including locomotives, unless preempted under federal law. (Health and Saf. Code §§ 39650 et seq., 43013, and 43018.)

ARB Authority under the CAA

Under CAA § 110, each state must adopt and submit to the United States Environmental Protection Agency (U.S. EPA) SIPs that provides for the implementation, maintenance, and enforcement of the national ambient air quality standards (NAAQS) for each air quality control region (or portion thereof) within the state. Among other things, the SIP must include "enforceable emission limitations and other control measures, means, or techniques . . . as may be necessary or appropriate to meet the applicable requirements of [the CAA]." As stated, ARB is the designated state agency responsible for preparing, adopting, and forwarding SIPs to U.S. EPA.

The 1990 amendments to the CAA entrusted U.S. EPA with authority to regulate and adopt emission standards for new nonroad engines including locomotives and locomotive engines. (CAA § 213.) Concurrently, Congress expressly preempted all states, including California, from adopting emission standards and other requirements related to the control of emissions from new locomotives and engines and new nonroad engines less than 175 horsepower used in farm and construction vehicles and equipment. (CAA § 209(e)(1).) The Supreme Court has concluded that the term "standard" as used in Title II of the CAA – of which section 209(e) is a part – refers to the emission characteristics of a vehicle or engine and can include a numerical

[1] This review addresses only the authority of the ARB and makes no representations as to the authority of local air quality management districts to adopt emission control requirements.

emission requirement that limits the amount of a pollutant that a vehicle or engine can emit or a requirement that a vehicle or engine be equipped with a certain type of pollution-control device or some other design feature related to the control of emissions. (*Engine Manufacturers Association v. South Coast Air Quality Management District* (2004) 541 U.S. 246, 253, 124 S.Ct. 1756.). Requirements related to the control of emissions were found by the D.C. Circuit to mean "certification, inspection, or approval" requirements which are related to the control of emissions and are conditions precedent to the initial retail sale, titling, or registration of a nonroad engine or vehicle." (*Engine Manufacturers Association v. U.S. EPA* (D.C. Cir. 1996) 88 F.3d 1075, 1093 (*EMA*).

In addition to the express preemption under CAA section 209(e)(1), the CAA impliedly preempts states from adopting emission standards and other emission related requirements for other new and non-new nonroad engines, including locomotive engines and other engines not otherwise preempted under section 209(e)(1). (CAA § 209(e)(2).) However, CAA section 209(e)(2)(A) effectively provides California with a waiver from the implied preemption, so long as it obtains authorization from U.S. EPA. The Administrator is required to grant California authorization, unless she specifically finds that conditions identified in section 209(e)(2)(A) that require denial of California's request to exist. [2]

In 1994, U.S. EPA promulgated final rules interpreting CAA section 209(e) and establishing emission standards for new compression-ignition engines greater than 37 kilowatts. (*Air Pollution Control; Preemption of State Regulation for Nonroad Engine and Vehicle Standards*, 59 Fed. Reg. 36969 (July 20, 1994) (*Final 209(e) Rule*): *Control of Air Pollution; Determination of Significance for Nonroad Sources and Emission Standards for New Nonroad Compression- Ignition Engines At or Above 37 Kilowatts, 59 Fed.Reg. 31306* (June 17, 1994) (*37 kW Rule*).) In that rule, U.S. EPA defined "new" and the effective scope of the expressed preemption for new nonroad engines, other than locomotives, covered under section 209(e)(1). "New" was found to mean "showroom new" – that is engines and vehicles the equitable or legal title to which has not been transferred to an ultimate purchaser. (*Final 209(e) Rule*, 59 Fed.Reg. at 39672.)

With regard to the scope of preemption, U.S. EPA found that it may actually go beyond the transfer to an ultimate purchaser and may cover state regulations that directly relate back to the design and manufacture of such engines and impose a burden on manufacturers. (*Final 209(e) Rule*, 59 Fed.Reg. at 36973, relying on *Allway Taxi v. City of New York* (S.D.N.Y.) 340 F. Supp. 1120 , aff'd, 468 F.2d 624 (2d Cir. 1972); *EMA* 88 F.3d at 1086, 1090.) Additionally, U.S. EPA interpreted CAA 209(e) to not preempt states from adopting in-use operational control requirements such as hours of operation limits, daily mass emission limits, and fuel specification standards. (*37 kW Rule*, 59 Fed.Reg. at 31313.)

[2] Once California has received authorization, other states may elect to adopt emission standards and other requirements identical to those adopted by California. (CAA section 209(e)(2)(B).)

In its 1998 final locomotive rule, U.S. EPA interpreted the scope of the new locomotive preemption under CAA § 209(e)(1) and distinguished locomotives from other nonroad engines; specifically finding that "new," as it applies to locomotives and locomotive engines, means both original manufacture of locomotives and engines and their subsequent remanufacture.[3] (*Emission Standards for Locomotives and Locomotive Engines*, 63 Fed.Reg. 18978, at 18994 (April 16, 1998) (1998 *Final Locomotive Rule*).) Additionally, U.S. EPA found that states are preempted from adopting emission standards for new locomotives and engines for 133 percent of their useful lives (estimated to be about ten years or longer). The *1998 Final Locomotive Rule* also clarified that a locomotive or locomotive engine owned by a Class 1 railroad would not be considered either new or preempted if it was manufactured prior to January 1, 1973 and has not been upgraded (remanufactured) to Tier 0 or higher emissions standards after January 1, 2000. (*Id*., at 18999) Finally, the *1998 Final Locomotive Rule* set forth specific requirements, including but not limited to, emission standards, mandatory fleet average standards, certification requirements, aftermarket equipment requirements, and nonfederal in-use testing requirements that it determined to be categorically preempted because of their significant effect on the design and manufacture of new locomotives and locomotive engines. (40 Code of Federal Regulation (CFR) Part 1074, §1074.12; *1998 Final Locomotive Rule*, 63 Fed.Reg., at 18993-18994.) In listing what it considered to be categorically preempted, U.S. EPA impliedly recognized that certain in-use operational control requirements that do not affect the design and manufacturer of the locomotive are not preempted.

In summary, as interpreted by U.S. EPA in the *1998 Final Locomotive Rule*, the express preemption of CAA section 209(e)(1) preempts all states, with limited exceptions, from adopting emission standards for locomotives and locomotive engines. Those locomotives and locomotive engines that are not preempted include those that were manufactured prior to 1973 and have not been upgraded (remanufactured) after 2000 and all locomotives that have exceeded 133 percent of their useful life since original manufacture or remanufacture, whichever is later.

Authority of States, in General, to Regulate under the ICCTA

In 1995, Congress enacted the ICCTA, 49 U.S.C. § 10101, et seq., which effectively deregulated the rail industry. As generally interpreted by the courts and the Surface Transportation Board (STB) – the administrative agency entrusted by Congress to implement and interpret the ICCTA – the legislation preempts states from adopting rules that impermissibly burden national railroad transportation. Section 10501(b) sets forth the jurisdiction of the STB over rail carriers that are part of an interstate rail network and the scope of preemption as it applies to the states. Its jurisdiction over the following is characterized as being exclusive:

[3] In 1994, U.S. EPA adopted its first rule regulating new nonroad engines. In that rule, it defined "new," as it applies to nonroad engines other than locomotives, as "showroom" new and that once a vehicle or engine leaves the showroom, it is no longer new. (*37 kW Rule.*)

(1) transportation by rail carriers, and the remedies provided in this part with respect to . . . rules (including car service, interchange, and other operating rules), practices, routes, services and facilities of such carriers; and
(2) the construction, acquisition, operation, abandonment, or discontinuance of . . . switching, or side tracks, or facilities, even if the tracks are located, or intended to be located, entirely in one State, is exclusive. Except as otherwise provided in this part, the remedies provided under this part with respect to regulation of rail transportation are exclusive and preempt the remedies provided under Federal or State law. (Emphasis added.)

Courts and the STB have recognized that the ICCTA does not foreclose states and local jurisdictions from all regulation that affects railroads, recognizing that local governments have certain authority to regulate matters of traditional local concern, including matters related to public health and safety, under their traditional police powers. To this end, courts and the STB have held that ICCTA does not preempt all state regulation that affects transportation by a rail carrier. Among the factors considered in determining whether a local regulation is preempted is whether the regulations discriminates against and unduly burdens rail transportation. The courts have further found that although the ICCTA preemption is broad, it does not per se deprive states and local jurisdictions of authority to regulate under previously existing federal statutes, including environmental statutes such as the CAA, and that the rights and obligations granted to states under such laws should be weighed against preemption under ICCTA where possible.

Harmonizing ARB's Authority under the CAA and the ICCTA Preemption

Options Affecting Locomotives

To the extent that ARB has authority under the CAA to adopt emission standards for locomotives manufactured prior to 1973 and non-new locomotives that have exceeded 133 percent of their useful lives, that authority must be harmonized with the purposes and intent of the ICCTA preemption. Harmonization involves a factual inquiry. Based on the facts and rationale summarized below, ARB staff believes that ARB likely possesses authority to establish emission standards for switcher and medium horsepower locomotives that principally operate in intrastate service. On balance, the strong federal directives under the CAA to achieve attainment of NAAQS and the express authority given to California to regulate non-preempted locomotives, the limited regulation of such intrastate locomotives, as described below, would seem to outweigh any potential undue impairment to railroad operations.

The Union Pacific Railroad Company (UP) and BNSF Railway Corporation (BNSF) operate 244 switcher locomotives that operate within California at any point in time. Although these locomotives may principally operate intrastate, they are part of a larger western regional pool and may be moved outside of the state for maintenance or other reasons and replaced by other switchers that from other states. Of the 244 switcher

locomotives, UP and BNSF have upgraded 92 switchers to ultra low emission levels. Of the remaining 152 older switchers, UP and BNSF have remanufactured 49 to meet federal Tier 0 emissions standards and 103 are pre-Tier 0 (i.e., unregulated switch locomotives). Of the 103 unregulated switch locomotives, about 40 were built before 1973, which are exempt from U.S. EPA regulations and are not covered by the CAA new locomotive preemption. Sixty-three of these switchers were built between 1973 and 1999, with most of them estimated to have been initially manufactured between 1973 and 1980.

ARB has authority under the CAA to adopt standards for all CAA non-preempted locomotives. Undisputedly under the CAA, this would include the 40 pre-1973 switchers that have not been remanufactured after 1999. Additionally, it is extremely likely that the 63 switchers that were built on or after 1973 and have not been remanufactured to Tier 0 levels are not preempted in that they likely exceed 133 percent of their useful lives since original manufacture. Of the 49 locomotives that have been remanufactured, preemption would depend upon when they were last remanufactured and whether they have exceeded 133 percent of their useful life since remanufacture.

MHP locomotives are used both in freight and passenger locomotive operations, with UP and BNSF operating 290 or more intrastate and captive freight MHP locomotives statewide. An additional 110 MHP locomotives are operated as passenger locomotives statewide. ARB has determined that these locomotives engage significantly in intrastate operations, with the caveat similar to that for switchers, that they are part of a larger western regional pool and may be moved outside of the state for maintenance or other reasons and replaced by other MHP locomotives from other states. We believe that a significant portion of the approximate 400 MHP freight and passenger locomotives were manufactured prior to 1973 or exceed 133 percent of their useful lives since manufacture or last remanufacture and would fall outside of the CAA preemption.

To the extent that switcher and MHP locomotives are not preempted under the CAA, ARB has authority under California law to adopt emission standards for these in-use locomotives. As stated, whether these locomotives are preempted under ICCTA is a factual question. One issue that would need to be considered is whether individual locomotives operate exclusively or principally in intrastate service or are routinely moved out-of-state and could be considered engaged in interstate operations. The more a locomotive operates intrastate, the less likely regulation of such locomotives would impair interstate operations. Also, a factual inquiry would have to be made as to whether regulation of all non-CAA preempted locomotives that come into the state as part of a larger pool of western regional locomotives would impose a significant burden on railroad operations. A third factual question would be the cost of the proposed regulation. To the extent that ARB could arguably only require locomotives to be remanufactured to federal remanufacturing standards under the CAA – and then the locomotive once again falls under the CAA preemption – the costs of the regulation would be relatively low and not overly burdensome to railroad operations.

In contrast to intrastate switcher and MHP locomotives, ARB staff believes that locomotives that are engaged in line-haul interstate operations may be preempted under the CAA in that they were likely manufactured on or after 1973 and are within 133 percent of their useful lives since initial manufacture or subsequent remanufacture. To the extent that they are not preempted under the CAA, it could be argued that the interstate nature of these locomotives makes adoption of state emission standards unduly burdensome to railroad operations and, therefore, preempted under ICCTA.

Similar potential preemption issues under the CAA and ICCTA arise for other of the proposed locomotive options considered in the final Technical Options Report. For example, although ARB has authority to establish fuel specification requirements under the CAA, it could be argued that the proposal to require interstate locomotives be fueled with CARB diesel before entering California is unduly burdensome and preempted under ICCTA. Other proposed options include requirements for ethanol-fueled or hydrogen fuel cell locomotives, linear induction motor retrofits, and electrification of major freight rail lines in the South Coast Air Basin. These options may be preempted under the CAA in that they potentially require modifications that affect the design and manufacture of locomotives. They may also arguably be preempted under ICCTA, in that upon review they may be found to impose overly burdensome requirements that may impair railroad operations.

Options Affecting Other Railyard Sources

The other 28 options considered by staff involve local railyard sources and intrastate activities. These options do not apply to new nonroad engines under 175 horsepower used in farm and construction and are therefore not preempted under CAA section 209(e)(1). ARB thus has authority under California law and CAA section 209(e)(2) to adopt emission standards for most, if not all, of the sources covered by the options. ARB staff believes that, upon harmonizing ARB's authority under the CAA with the ICCTA preemption, ARB would likely be able to regulate these sources so long as the regulations are not unduly burdensome. In evaluating the burdensomeness of a proposed regulation, ARB would consider, among other things, the cost-effectiveness of any proposed regulation.

Conclusion

For the reasons stated above, ARB staff recognizes that its authority to regulate locomotives and other sources under California law is circumscribed in varying degrees by the CAA and ICCTA. To the extent that ARB has authority to adopt regulations under the CAA, its authority must be harmonized with the ICCTA preemption.

SUMMARY OF PUBLIC INCENTIVE FUNDING PROGRAMS

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APPENDIX B

SUMMARY OF PUBLIC INCENTIVE FUNDING PROGRAMS

Implementation of the recommendations for switchers and medium horsepower (MHP) locomotives could occur through a number of mechanisms including the use of public incentive programs, railroad agreements, ARB regulations, voluntary actions on the part of UP and BNSF, or some combination thereof. However, based on the ARB legal analysis (see Appendix A) staff recommends that ARB pursue a voluntary agreement or a regulation, combined with a formal public incentive funding program. An agreement or regulation, in combination with the use of public incentive funding, could commit UP and BNSF to specific targets for locomotive repowers and aftertreatment retrofits.

Regarding acceleration of Tier 4 interstate line haul locomotives operating into California, staff believes UP and BNSF will need a national pool of up to 5,000 Tier 4 interstate line haul locomotives to ensure that up to 1,200 Tier 4 interstate line haul locomotives are operating in California on any given day. Staff believes ARB could enter into an agreement with UP and BNSF, similar to the 1998 Locomotive NOx Fleet Average Agreement, to direct 1,200 Tier 4 locomotives to operate in California on any given day. Staff believes multiple states or national funding should be provided for this effort, since the Tier 4 interstate line haul emission reductions benefits will be spread over UP's 23-state and BNSF's 28-state operating system.

These are the various public incentive funding programs that could potentially be available to complement a California locomotive repower, retrofit, and replacement program:

A. Diesel Emissions Reduction Act (DERA)

DERA, signed into law in August 2005, establishes a voluntary national and state-level grant and loan program to reduce diesel emissions. Specifically, DERA:

- Authorizes $1 billion over 5 years ($200 million annually)
- Authorizes EPA to oversee the expenditure of 70 percent of funds
- Allocates 20 percent of funds to states to develop retrofit programs with an additional 10 percent as an incentive for states to match federal dollars
- Establishes project priorities (for public fleets and projects that are more cost-effective and affect the greatest number of people)
- Includes provisions to stimulate the development of new technologies, encourage more action through non-financial incentives and require program accountability

The American Recovery and Reinvestment Act (ARRA), signed into law February 2009, include an additional stimulus DERA allocation of $300 million in 2009.

B. Goods Movement Emission Reduction Program (GMERP, Proposition 1B)

GMERP, approved by California voters in 2006, is a partnership between the ARB and local agencies (such as air districts and seaports) to achieve quick reductions in air pollution emissions and health risk from freight movement along California's trade corridors. Local agencies apply to ARB for funding; those agencies then offer financial incentives to owners of equipment used in freight movement to upgrade to cleaner technologies. Projects funded under this Program must achieve early or extra emission reductions not otherwise required by law or regulation.

Proposition 1B authorizes $1 billion in total to fund emission reductions programs. ARB has allocated $100 million of the $1 billion to clean up diesel freight switch and line haul locomotives. The availability of these funds depends on California's ability to sell bonds.

C. Carl Moyer Program (CMP)

This program, created by the State legislature in 1998, provides incentive grants for cleaner-than-required engines, equipment and other sources of pollution providing early or extra emission reductions. Eligible projects include cleaner on-road, off-road, marine, locomotive and stationary agricultural pump engines. The program achieves near-term reductions in emissions of NOx, PM, and reactive organic gas, which are necessary for California to meet its clean air commitments under the SIP.

Legislative changes enacted in 2004 provided increased and continued funding for the CMP and other incentive programs – up to $141 million a year statewide through 2015. This funding is available to UP and BNSF if funding is not available through the Proposition 1B program (e.g., for areas in California that are outside the Goods Movement Trade Corridors).

D. California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 and the ARB's Air Quality Improvement Program (AQIP, AB 118)

Assembly Bill (AB) 118 created the *California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007*. One component of AB 118 is a California Energy Commission program that administers $120 million per year for alternative fuel projects, which can potentially include locomotives. In addition, the ARB administers the AQIP, which is funded for $50 million per year for clean vehicle and equipment projects. Funds can be sought from both programs.

The ARB's AQIP program has the following key elements:

- Clean vehicle and equipment projects which reduce criteria and toxic air pollutants,
- Research on the air quality impacts of alternative fuels, and
- Workforce training.

The AQIP is funded through 2015 at $50 million annually.

In April 2009, the ARB Board approved guidelines for administering the program and an AQIP funding plan for fiscal year 2009/10. The funding plan serves as the blueprint for expending the funds that will be appropriated to ARB in the fiscal year 2009/10 state budget, and includes up to $2 million for locomotive demonstration projects to demonstrate technologies that are nearly ready for commercial production. The AB 118 locomotive demonstration projects may include the use of DPFs on gen-set switch locomotives and the demonstration of MHP locomotive engine repowers and aftertreatment retrofits.

On an annual basis, the AQIP funding plan will be updated and brought to the Board for its consideration. As advanced emission control technologies for locomotives become commercially available, ARB would consider them for future AQIP funding.