South Coast Air Quality Management District

Container Movement Technology Forum and Roundtable Discussion

held January 26, 2007

Prepared by

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Connecting business, government, and the community

NOTE: The views and opinions expressed in this document are those of the session panelists and moderator, and do not represent the views of the staff or Governing Board of the South Coast Air Quality Management District.

Table of Contents

Executive Summary

On January 26, 2007, the South Coast Air Quality Management District held a Technology Forum and Roundtable Discussion on cargo container movement technologies. Panelists included experts on current container movement needs and practices and alternative technologies for moving containers, mainly those using electric propulsion systems.

A large proportion of the nation's marine cargo transits Southern California, and dramatic growth is expected. This movement generates large quantities of air pollution in an area whose air quality is already worst in the nation and well above standards. This air pollution is having demonstrable effects on public health, and must be reduced dramatically if standards are to be met. It is not clear how to make all the needed reductions, but the goods movement sector must contribute and various regulatory efforts are underway to achieve these reductions.

The Ports of Los Angeles and Long Beach have jointly adopted a Clean Air Action Plan, whose goal is to minimize public health risk from port operations. The plan will set port-wide, source-specific, and project-specific standards to accomplish this goal. Each type of goods movement pollution source will be addressed by a variety of measures. Over the next several months, the Ports are also jointly evaluating alternative cargo transportation technologies with the goal of funding a demonstration project.

In 2006 the Ports of Los Angeles and Long Beach together processed 15.8 million TEU. Containers are unloaded from vessels at marine terminals and may be moved from the ports either by direct (on-dock) rail, or by truck to a near-dock or off-dock rail facility or to a local warehouse, distribution center, or transload facility. About 41% of marine containers leave the region intact by rail. The Alameda Corridor is a freight rail "expressway" between the ports and off-dock facilities that has seen steady growth in train traffic since the start of operations in 2002.

Conventional diesel engines have been used to move freight because they get the job done cheaply and reliably. Alternatives – especially those that involve new technologies – will need to work with all elements of the current goods movement system in order to be effective. Another challenge is finding suitable right-of-way for such systems in Southern California. Our key needs are to reduce emissions and congestion, almost at any cost.

CargoRail trams are rubber-wheeled vehicles that can carry marine cargo containers at 75 mph on an elevated guideway or on local streets. On the guideway, they would be propelled by electricity via permanent magnet hub motors in the wheels. On local streets they could be fueled by clean fuel, such as CNG, to generate the electricity for the motors. This system could thus provide both line-haul and "last-mile" service. A demonstration in both Fort Worth, TX, and in Long Beach (at the dock) could be provided for $12 million.

Magnetic levitation (Maglev) technology is propelled by linear induction motors. General Atomics is developing two possible applications of the technology to freight movement. A Maglev system has been demonstrated to move a cargo container; an operational system could move cargo at 80 mph and would involve construction of new, elevated guideways and associated terminal infrastructure. A first-mile demonstration could be mounted at the ports for $80 million. LIM-Rail™ would involve retrofitting aluminum plates to existing rail cars or locomotives so that they could be propelled by linear induction motors placed in the track in areas where air pollution is of concern. This concept has not yet been demonstrated, but a one-mile demonstration could be mounted at the ports for $18-20 million.

The SAFE system consists of bi-directional freight shuttle units that would carry one marine container at a time at 35-40 mph along a guideway via linear induction technology. This system features a steel wheel on a steel plate; it is not levitated like Maglev. Energy needs for this system were estimated.

The SkyTech system would provide an automated, multi-modal option for moving freight from ship to off-site terminal or rail yard via LIM on elevated guideways. The use of elevated structures in the terminals can speed up the process of vessel loading and unloading, reducing vessel idling. The system could move 8,000 containers in 24 hours on a single track; six tracks could be constructed for a total capacity of 48,000 containers per day. Guideway construction cost was estimated at $15 million per mile, and a demonstration site was identified at the Hanjin terminal at the Port of Long Beach.

Locomotive emissions inventories in the South Coast air basin are incomplete. Locomotive emission regulation lags behind that for truck engines. EPA has promulgated Tier 2 standards, which are now in effect for new locomotives, but has not yet issued Tier 3 standards. In California the two major freight railroads have agreed to meet Tier 2 standards by 2010. New designs for switcher locomotives can effectively reduce emissions. Add-on controls are increasingly being developed for and applied to line-haul locomotives, and with changes in locomotive design, urea injection for NOx control through selective catalytic reduction may be cost-effective.

Strategies to reduce emissions from truck engines include refueling (changing to cleaner fuels); replacing older trucks with newer ones; retrofitting existing trucks with aftertreatment devices; repairing or rebuilding older engines; or reducing idling (an operational strategy). The relative cost-effectiveness of each of these measures still needs to be evaluated. Truck replacement programs can accelerate fleet turnover to trucks with emissions that can be as much as 99% cleaner for particulate matter, compared with a 1990 model truck. The effectiveness of aftertreatment devices, which must be certified, varies with a number of operating factors. It can be a challenge to reach truck operators to publicize programs to help them, and many still lack the financial resources to participate. Alternative fuels displace petroleum but do not burn much cleaner than 2007 model year engines.

Operational strategies can help to control emissions without applying new technology (except information technology, in some cases). These strategies can move truck traffic to less congested times of day or reduce the need for certain truck trips, possibly by diverting cargo from truck to rail. Impact fees could be used to encourage operational changes.

Alternative technology proposals must be able to get containers to their final destinations, not just provide an alternative fixed guideway. MegaRail's dual-mode trams and SkyTech's LIM system both address this issue. Impact fees could provide an incentive for the industry to change behavior by internalizing some costs. Alternatively, fees could be structured as direct incentives, such as tax breaks for selecting clean transportation options. It is important to identify the industry's self-interest in order to gain their support. Panelists agreed that public money should be provided to support prototype development and demonstration systems to help reduce risk for future private investors. Even if emissions from conventional technologies approach zero, the region still will suffer from expensive fuel, driver shortages, traffic congestion, noise, pavement damage, and continued dependence on fossil fuels.

Each provider discussed the initial costs of a demonstration system and attempted to include a discussion of how an entire system would work, including terminal operations, and right-of-way considerations. MegaRail could construct a production prototype for $12 million; this would not include a system study. The system would be constructed along existing railroad right-of-way. Maglev could be demonstrated for $80 million for the first mile, including a terminal demonstration; the system would require new right-of-way. LIM-Rail™ could be demonstrated for $18-20 million and would use existing railroad infrastructure. The SAFE Freight Shuttle could be mounted in a short commercial, not demonstration, system between the ports and near-dock intermodal yards for $40-50 million, along existing rail right-of-way; terminal concepts are proprietary. SkyTech could mount a technology and terminal demonstration for $10 million; the system could use existing rail right-of-way.

Standards for 2007 model year trucks will bring particulate matter emissions "near zero" and for 2010 will bring NOx emissions "near zero." However, in use emissions may vary due to equipment failure or maintenance issues, so these control levels are not guaranteed by EPA standards. Gasoline hybrid trucks are another viable option with no diesel particulate emissions.

SCR on a line-haul locomotive could reduce NOx 80-90% from uncontrolled levels and PM 50% or more. This will be demonstrated on a passenger rail locomotive with AQMD funding. DPF's could also (in theory) be retrofitted to locomotives. However, locomotive emissions cannot be brought "near zero" with aftertreatment devices.

The technology providers gave different types of estimates of their systems' energy consumption. It is not yet possible to directly compare energy consumption for different technologies on the basis of information presented at the forum. The

participants discussed the positive outlook for recovering energy from braking in line-haul systems.

Even though it is possible to reduce emissions dramatically from locomotives and trucks, a number of problems would persist if new technologies were not adopted. The region would still experience traffic congestion (particularly as freight movement grows), roadway damage from heavy vehicles, noise and vibration, safety issues for other motorists, grade crossing delays, continued dependence on fossil fuels, and likely rising fuel cost. Electric-powered alternatives provide an opportunity to control emissions in one place, at the point of power generation, rather than on thousands of dispersed mobile sources.

Four public commenters spoke. Community groups are in favor of the development of "zero-emission" technologies, and want to be consulted and included in public decision making about goods movement. The new technologies could help alleviate train parking and idling impacts in some locations, but probably not for five to ten years. There are currently not many incentives for the use of cleaner trucks at the ports – just the Gateway and Carl Moyer Programs.

I. Introduction and Background

The South Coast Air Quality Management District (AQMD) is charged with developing regulations and plans to meet federal and state health-based ambient air quality standards in Orange County and the urbanized portions of Los Angeles, Riverside and San Bernardino Counties. The agency is currently developing the 2007 Air Quality Management Plan (AQMP) to this end. The AQMD's air quality regulatory and planning efforts are supported by a Technology Advancement Office, which was created in 1988 to expedite the development, demonstration and commercialization of cleaner technologies and clean-burning fuels.

While a great deal of air quality progress has been made in the South Coast Air Basin, federal standards are growing more stringent and the region is still far from attaining all the health-based goals. One of the largest remaining contributors to the persistent air quality problem in Southern California is goods movement: the transportation of freight via ocean-going vessels, trucks, and rail. The ocean ships generally burn low-quality, high-sulfur bunker fuel, while nearly all land-based sources – trucks, locomotives, and cargo-handling equipment in ports and rail yards – are powered by diesel fuel. The extent of goods movement in Southern California has grown dramatically in recent years, and is anticipated to nearly triple by 2030 as demand soars for imported manufactured goods.

A number of technology options offer ways to reduce emissions from the goods movement sector. Diesel engines in trucks and other equipment can be retrofitted with emission control devices such as diesel oxidation catalysts or diesel particulate filters. They can be fueled with cleaner-burning fuels such as natural gas in various forms, and hybrid-electric motors can be used in trucking. Locomotives likewise can be and have been designed with emission control devices and alternative power plants that rely less on diesel fuel or operate more efficiently. Federal and state emission standards for both trucks and locomotives require that new units be designed to have lower emissions. However, these types of equipment are durable and fleets do not turn over quickly, so incentives are needed to accelerate retrofit or replacement of existing equipment.

Another promising technology avenue is the use of "zero-emission," electrically-based alternative technologies for moving containers. A number of options are in various stages of research, development, and demonstration. Low-friction magnetic levitation, or Maglev, technology has been successfully used in Japan, China and Germany for passenger operations and holds promise for freight application. Steel-on-steel linear induction motors also have a history of use in passenger movement and could be applied to cargo. Electric dual-mode trams have also been proposed; they would run on a fixed guideway or on local streets using rubber tires, and a production prototype is under construction in Texas as of early 2007.

This report summarizes the discussion and results of a Technology Forum and Roundtable Discussion on container movement options convened by AQMD on January 26, 2007. The goal of this forum was to assess the technology and policy options for

container movement throughout the South Coast basin. Participants in the forum included developers of the alternative technologies described above; experts on the available means of reducing emissions from trucks and locomotives; representatives from the ports and other transportation agencies in the region; and staff of the AQMD. Section II of this report provides more detail on the forum participants.

Section III provides a narrative based on the forum presentations, each of which is posted on the AQMD web site.[1] Section IV presents the content of the moderated Roundtable Discussion that followed the forum presentations. Section V presents conclusions and recommended next steps. The recorded web cast of the Technology Forum is also available on line.[2]

II. Forum Participants

The forum participants are listed below in the order in which they appeared in the agenda. The full agenda can be found in Appendix A, or on line.[3] Biographies of the presenters can be found in Appendix B, or on line at the same location.

A. AQMD Staff

Dr. Chung Liu, Chief Scientist and Deputy Executive Officer, Science and Technology Advancement, introduced the forum and its goals.

Peter Greenwald, Senior Policy Adviser, provided an introductory presentation on the challenges posed to the region's air quality and public health by the growing demand for goods and goods movement.

Dr. Matt Miyasato, Technology Demonstration Manager, assisted in facilitating the roundtable session.

B. Presenters

Thomas Jelenic, Senior Environmental Specialist at the Port of Long Beach, gave a presentation on the Clean Air Action Plan (CAAP) jointly adopted by the Ports of Long Beach and Los Angeles on November 20, 2006. He also discussed the Ports' joint Request for Proposals for an Advanced Cargo Transportation Technology Evaluation and Comparison (ACTTEC), which will shed additional light on the potential advantages of adopting alternative container movement technologies.

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[1] See http://www.aqmd.gov/tao/ConferencesWorkshops/Container_Forum-01-26-07/Container_Forum_Agenda.htm.
[2] See http://www.aqmd.gov/aqmd/webcast/webcast_calendar.htm. Please note that audio does not begin until about 10 minutes into the recording.
[3] See http://www.aqmd.gov/tao/ConferencesWorkshops/Container_Forum-01-26-07/Container_Forum_Agenda.htm.

Art Goodwin, Director of Planning for the Alameda Corridor Transportation Authority, gave an overview of current container movement quantities, practices and modes.

Dan Smith, Principal with consulting firm The Tioga Group, gave an overview of current goods movement system needs and the alternative technologies now available or under development.

Lee Henderson, with Micrin Technologies Corporation, presented the concept and design team for CargoTram, a dual-mode electric-hybrid tram that can run on either a fixed guideway or local streets.

Mike Simon, Director of Commercial Business Development for General Atomics, presented the Maglev concept for freight as developed by General Atomics, and also discussed LIM-Rail, a conceptual adaptation of linear induction to existing rail infrastructure.

Leslie Olson of the Texas Transportation Institute presented the SAFE Freight Shuttle concept, which is based on linear-induction technology.

Bruce Dahnke, President of SkyTech Transportation, presented a multi-modal system for vessel unloading, terminal automation, and regional transportation based on linear-induction technology.

Christopher Weaver, President of Engine, Fuels & Emissions Engineering, discussed options for reducing emissions from locomotive engines.

Mike Jackson, Senior Director with consulting firm TIAX, LLC, presented information on reducing emissions from truck engines.

C. Additional Panelists

The following expert panelists joined the discussion following the presentations:

Dr. Ken James of California State University at Long Beach contributed insights based on his work on maglev systems at the Center for the Commercial Deployment of Transportation Technologies (CCDoTT) at the University.

Philbert Wong, Transportation Planning Manager at the Los Angeles County Metropolitan Transportation Authority, contributed from the planning perspective of that agency.

Jerry Wood, representing the Gateway Cities Council of Governments, contributed insights from a subregion that is home to the Ports of Los Angeles and Long Beach and much of the landside infrastructure that serves them.

A representative from the California Air Resources Board (CARB or ARB) was scheduled to participate as an additional expert panelist, but had a late conflict and was unable to participate.

D. Moderator

Nancy Pfeffer, President of consulting firm Network Public Affairs, moderated the roundtable discussion and the public comment period that followed.

III. Forum Presentations[4]

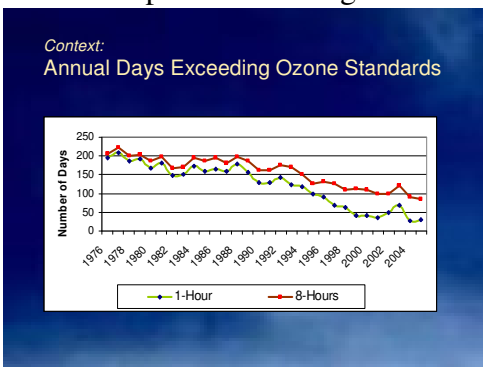
A. Technical Issues and Background

Presentations in this portion of the program provided background on current practices in goods movement in the South Coast and their impact on air quality and public health.

1. Peter Greenwald: Air Quality, Health, and Regulatory Challenges

Summary: A large proportion of the nation's marine cargo transits Southern California, and dramatic growth is expected. This movement generates large quantities of air pollution in an area whose air quality is already worst in the nation and well above standards. This air pollution is having demonstrable effects on public health, and must be reduced dramatically if standards are to be met. It is not clear how to make all the needed reductions, but the goods movement sector must contribute and various regulatory efforts are underway to achieve these reductions.

Forty-four percent of the nation's containerized goods transit the Ports of Los Angeles and Long Beach.[5] Almost all the functions of moving each container are performed using diesel-fueled equipment. The burning of diesel fuel produces emissions of nitrogen oxides (NOx) and particulate matter (PM), as well as air toxics and other pollutants.

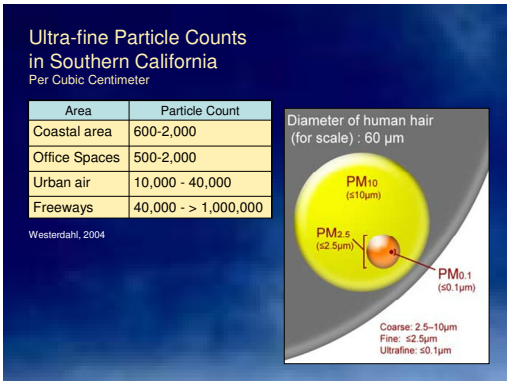


At the same time, the Los Angeles area has the worst air quality in the nation, and recent data shows that past improvements may be leveling off. The health impacts of air pollution are becoming better understood through research. For example, a study by the University of Southern California published in 2004 indicated that lower lung-function growth rates in children are associated with PM_{10} and $PM_{2.5}$,[6] among

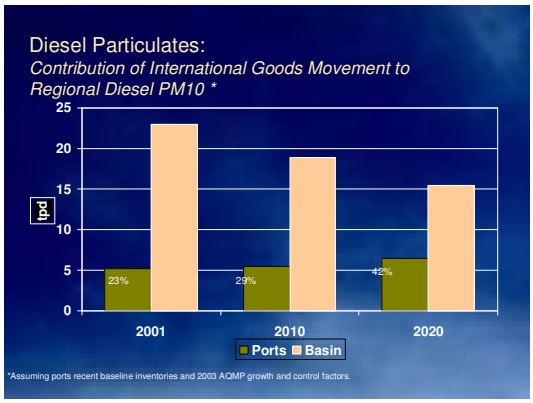
[4] In general, the statements made by presenters have not been independently verified, though in some cases, annotations have been provided to clarify statements made.
[5] This is the nationwide share of imported containers.
[6] Particulate matter with aerodynamic diameters of 10 microns and 2.5 microns, respectively.

other pollutants. The study concluded that "by age 18, lungs of many children growing up in smoggy areas are underdeveloped and will likely never recover."

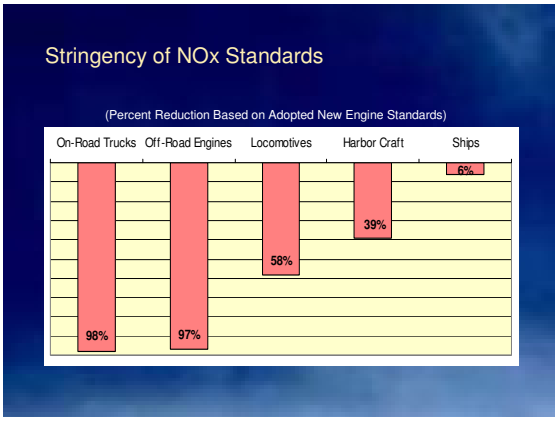
Overall, air quality impacts are generally greatest in inland areas. AQMD's MATES II study showed that when diesel sources are included, areas of high impact generally follow transportation routes. This study also indicated that 70% of excess lifetime cancer risk in the South Coast basin is attributable to diesel emissions. CARB published data in 2005 indicating that air pollution from goods movement in California is responsible for 2,400 premature deaths each year, statewide. Roughly half of these are in Southern California. This pollution also results in thousands of hospitalizations and millions of lost work- and school-days each year. CARB has also estimated localized cancer risk near a northern California rail yard at 500 in a million, and estimates that near the Ports of Los Angeles and Long Beach, over a million people are within a zone of risk over 100 in a million, and 53,000 in a zone where risk exceeds 500 in a million. Ultra-fine particles (less than 0.1 micron in diameter) are now being recognized as an additional source of health impacts, and one that is especially hard to control. In Southern California, ultra-fine particle counts are elevated near freeways, by a factor of 25 of more compared to urban background levels. CARB and other health studies also show that proximity to emission sources is an important factor in whether health effects are observed.



Goods movement sources create substantial emissions of major criteria pollutants, and the sector is growing dramatically. In the South Coast air basin, international goods movement is estimated to have contributed 23% of the PM_{10} emissions in 2001, and is projected to contribute 29% in 2010 and 42% in 2020 given current trends and control plans. International goods movement could use up the region's entire carrying capacity for ozone, creating a challenge in reaching federal standards even if attainment deadlines are extended. For example, a 50% reduction in NOx would be needed beyond 2020 control levels to reach the ozone standard. Given the size of the goods movement sector, some of this reduction must come from goods movement sources.



A number of regulatory and control initiatives are under way at the federal, state, and regional levels to address the emissions and health concerns related to goods movement. The U.S. Environmental Protection Agency is developing rules, for example, to tighten emission standards for new locomotive engines. The ARB is developing several new rules affecting vessel and truck emissions. The State Goods Movement Action Plan adopted in January 2007 includes measures to reduce emissions from a variety of goods movement sources, and state infrastructure bonds approved by voters in November 2006 included $1 billion for environmental improvements related to goods movement. Locally, in November 2006 the Ports of Los Angeles and Long Beach adopted an unprecedented Clean Air Action Plan that sets ambitious 5-year and later goals for reducing emissions by a variety of methods. AQMD and the Southern California Association of Governments (SCAG) are currently collaborating to develop the 2007 AQMP, which incorporates the best control measures from both state and local plans.

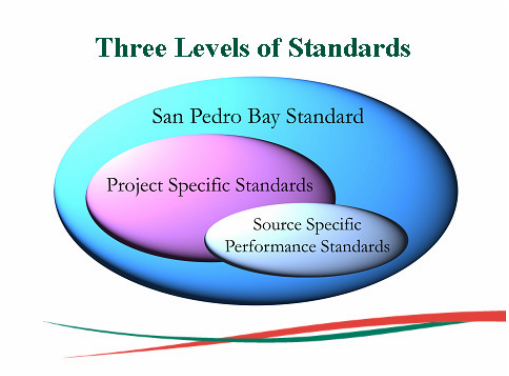


2. Thomas Jelenic: San Pedro Bay Ports' Clean Air Action Plan and Alternative Cargo Transportation Technology Evaluation

Summary: The Ports of Los Angeles and Long Beach have jointly adopted a Clean Air Action Plan, whose goal is to minimize public health risk from port operations. The plan will set port-wide, source-specific, and project-specific standards to accomplish this goal. Each type of goods movement pollution source will be addressed by a variety of measures. Over the next several months, the Ports are also jointly evaluating alternative cargo transportation technologies with the goal of funding a demonstration project.

The CAAP jointly adopted by the Ports of Los Angeles and Long Beach seeks to minimize public health risk from port operations by setting consistent standards for tenants. In this way, the Harbor Commissioners hope to enable further port development as cargo demand grows. Together, the ports contribute the greatest single share of basin-wide SOx emissions (45%) because sulfur has been largely removed from most other fuels. Without action, this share would grow to 70% by 2020.

In March 2006, a Clean Air Summit was held involving both ports, the U.S. EPA, CARB, and AQMD, and these agencies formed a working group to continue developing clean air strategies for goods movement. Currently, ocean-going vessels dominate port emissions, but cargo handling equipment, heavy-duty vehicles, and locomotives also contribute.



The CAAP proposes a set of nested standards, including port-wide, project-specific, and source-specific standards. The port-wide standards are intended to help the ports do their part in achieving ambient air quality standards, as well as to reduce public health risk. The project-specific standards include a requirement that each project meet a 10 in a million threshold for excess cancer risk. The source-specific standards described below apply to several source categories.

A key source-specific standard is the goal to replace the antiquated, privately-owned truck fleet serving the port with newer, lower-emitting models in the next five years. To meet this goal, the ports and AQMD have committed a total of $206 million to this effort, which would include infrastructure for liquefied natural gas (LNG) fuel for trucks and terminal equipment.

CAAP measures for ocean-going vessels in the next five years include expanding the participation rate and geographic reach of an existing program to slow vessels near shore, which reduces emissions. Both ports will expand their facilities for shore power for docked vessels, also called "cold ironing": 15 berths at POLA and between 10 and 16 at POLB are to be equipped in 5 years. Additional goals are to reduce fuel sulfur to 0.2% or less in main and auxiliary vessel engines, and to implement add-on controls for NOx and PM emissions from new and existing vessels. The ports' total funding commitment to vessel-related measures is nearly $202 million.

The two ports and AQMD have committed a total of $21 million to 5-year efforts to implement standards for locomotives in use in switching and line-haul service in existing and any new rail facilities. In general, locomotives will need to meet Tier 3 standards, while additional operational controls will be negotiated with the railroad companies.

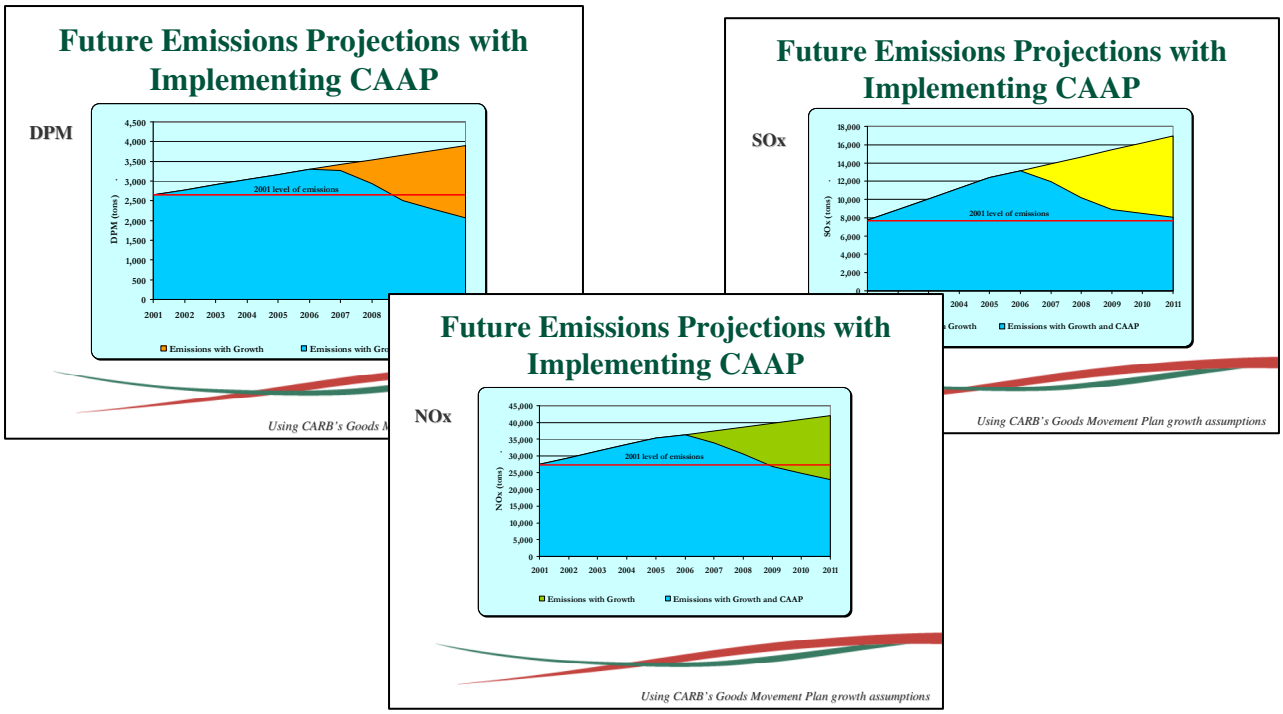
The CAAP also calls for implementing standards for cargo-handling equipment at port terminals that are equivalent to 2007 standards for on-road diesel engines. For harbor craft, the commitment is to turn over the fleet first to Tier 2 and then to Tier 3 equivalent levels.

In addition, the ports have committed a minimum of $15 million to a new Technology Advancement Program designed to accelerate the availability of new technologies to reduce emissions. The focus will be on new and emerging technologies that will achieve the requirements described above and contribute to the realization of a "green" container transport system. Funds will also be used to help improve emissions inventories. An advisory

committee consisting of the ports, EPA, CARB, and AQMD will consider solicited and unsolicited proposals as well as port-generated projects for funding. These decisions will be based on emission reductions of several pollutants, including greenhouse gases and ultra-fine particles, as well as on cost-effectiveness.

The overall impact of the CAAP will be to reduce emissions of diesel particulate matter and NOx below 2001 levels. SOx emissions will come close, but will not go below 2001 levels by 2011, unless the ports successfully implement a tariff to require greater use of low-sulfur fuels.
In sum, the two ports and AQMD have committed $464.9 million to the CAAP implementation over the next five years. The ports will seek an additional $1.6 billion for implementation through a combination of impact fees, state bond funds, tariffs and other sources.

Progress on the CAAP will be monitored by several means, including expanding the current air monitoring network around the ports, updating port emissions inventories regularly, and reporting to the Harbor Commissions at least annually.



In August 2006 the ports issued a joint Request for Proposals to provide an Alternative Cargo Transportation Technology Evaluation and Comparison (ACTTEC). The goal of this effort is to conduct a systems analysis of ways to move containers between the ports and so-called "near-dock" intermodal container yards within 5 miles of the ports. The performance of alternative technologies is to be compared with conventional drayage under various

scenarios of adoption of clean fuels or fleet turnover to newer, cleaner engines. The performance measures to be used in the evaluation include (among others):

- Reduction in truck trips
- Reduction in truck miles of travel
- Reduction in criteria and toxic pollutants
- Changes in noise and aesthetic impacts
- Capital costs
- Operating costs
- Cost-effectiveness
- Unit costs
- System capacity
- Reduction in truck accidents
- Reduction in health care costs
- Impacts on safety

In addition to this port-funded evaluation, a portion of the funding dedicated by several regional agencies (including the ports) to the EIR/EIS for the I-710 project will be devoted to a similar evaluation for that corridor. Also, SCAG will be funding a comparable evaluation for a regional cargo transportation system.

3. Art Goodwin: Container Movement Process

Summary: In 2006 the Ports of Los Angeles and Long Beach together processed 15.8 million TEU. Containers are unloaded from vessels at marine terminals and may be moved from the ports either by direct (on-dock) rail, or by truck to a near-dock or off-dock rail facility or to a local warehouse, distribution center, or transload facility. About 41% of marine containers leave the region intact by rail. The Alameda Corridor is a freight rail "expressway" between the ports and off-dock facilities that has seen steady growth in train traffic since the start of operations in 2002.

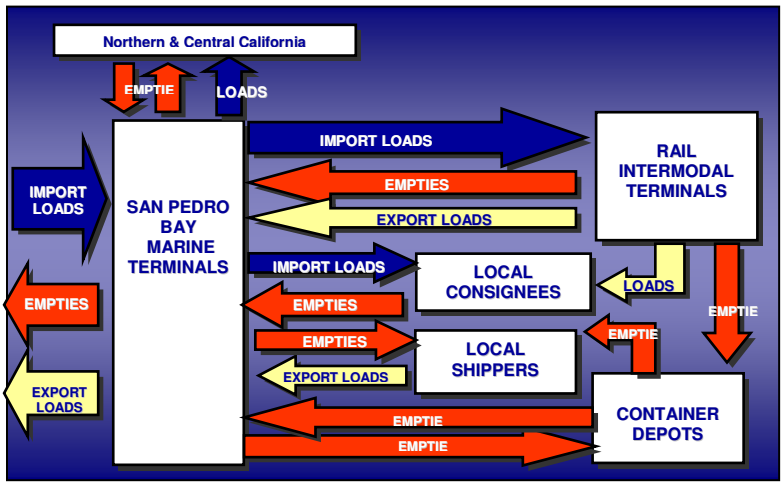
Each of the Ports of Los Angeles and Long Beach has eight terminals, with one at each port under renovation or reconstruction. Between the two ports, ten terminals have on-dock rail facilities operating today. In 2006 the ports handled a combined total of 15.8 million twenty-foot equivalent units, or TEU, a new record. Empty containers amounted to 5 million TEU of this total. Rail operations are counted in "lifts" of a container between truck and rail. Since most containers are 40-foot rather than 20-foot, one TEU is equivalent to 1.85 lifts.

Between four and six cranes typically work alongside a docked vessel to unload and load it, depending on size. Containers stacked on top of sealed hatches must come off first. Outgoing containers are stacked with loaded

containers on the bottom and empties on top for stability during sailing. This process can take 36 to 72 hours.

Containers fall into two general categories: those going via intermodal transfer (i.e., truck to rail), which are about 25-30% of the total, and the remainder that are bound for local or regional distribution or transloading facilities. The intermodal containers are stored above vessel hatches, and go directly to on-dock rail if possible. Otherwise, they may be drayed (trucked) directly out of the terminal gate to either the near-dock Intermodal Container Transfer Facility (about 3 miles from port) or the Hobart intermodal facility east of downtown Los Angeles. Alternatively, they may be stacked in the terminal for later transport.

Some containers destined for local and regional facilities may go directly out the gate, but the vast majority go to terminal storage awaiting drayage to a local warehouse or distribution center.



Of 6.5 million intermodal TEU handled in 2006, 3.9 million went directly to on-dock rail, 1.3 million were trucked to a near-dock facility, and another 1.3 million were drayed to the off-dock yards near downtown. In all, about 41% of TEU transited the region intact via rail in 2006. Because containers can change modes, it is difficult to track precisely how many are moved by truck in the region.

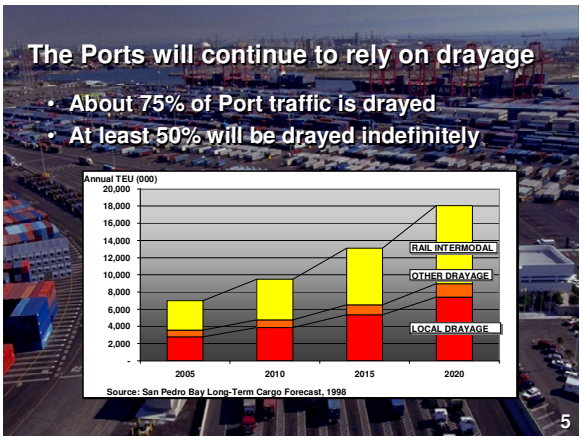
The Alameda Corridor is a consolidated freight rail facility connecting the ports (on-dock and near-dock rail) to the East Los Angeles rail yards, which began operation in 2002. From 39 trains a day in that year, the facility has grown to an average of 55 trains a day in 2006; some days it handles over 70 trains. The railroads and terminal operators have increased on-dock loading, achieving 24% growth in the number of containers moving on-dock in the past year, and 20% in the previous year. It is important to note that the railroads pay the same fee for a loaded container whether it is moved on the Alameda Corridor or trucked to a downtown railyard, so there are no "disincentives" to use the Corridor because of the fees charged to use it. Since the number of TEU/day has been about constant, the percentage of trucked containers vs. those moving by rail is going down.

4. Dan Smith: Overview of Clean Technology Options

Summary: Conventional diesel engines have been used to move freight because they get the job done cheaply and reliably. Alternatives – especially those that involve new technologies – will need to work with all elements of the current goods movement system in order to be effective. Another challenge is finding suitable right-of-way for such systems in Southern California. Our key needs are to reduce emissions and congestion, almost at any cost.

The region's ability to handle projected cargo growth depends not only on mitigating the environmental and community impacts of that growth, but also on reducing the impacts from current and past practices. Because there are capacity constraints at nearly all ports, cargo can't easily go elsewhere – we would simply be exporting congestion and pollution to other cities. Standardized containers are both a boon and a burden. Their interchangeability among modes – ocean, rail, and truck – enabled growth of "landbridge" service, in which an overland rail move replaces a vessel move, and thus the growth of trade and its impacts in Southern California. However, the standardization also enables consideration and development of new technologies.

Thanks to this growth, our legacy highway and rail system is extremely crowded. Moreover, due to the large population base, roughly half of the cargo will stay here in any event. At least 50% of port cargo can be expected to continue to move by truck indefinitely; given the anticipated growth, this means more truck trips will be made in future than today. We use conventional diesel tractors to move freight because they are flexible and cheap to operate, get good fuel economy and are extremely durable. With overhauls, they provide us a "million-mile engine"; the mean truck fleet age in our region is 8-12 years. Many of the tractors now in port service are hand-me-downs from long-haul service that are not efficient or well-suited to the job they now do.

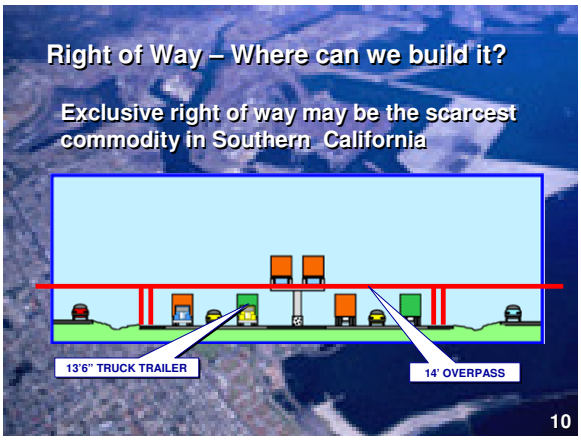


The alternatives available to us to handle the complex flow of containers through the region are to clean up what we have; shift more cargo to rail (though short-haul rail requires operating subsidies); adopt new systems; and make operational improvements. New technologies, such as dual-mode trams, Maglev, or linear induction motors, also imply adoption of automation. Notably, electric-powered alternative systems can concentrate emissions at

power plants where they can be controlled more readily than from dispersed, individual sources.

We can also improve currently used truck and rail technologies. Gasoline-powered hybrid-electric trucks also offer an attractive alternative power source.

It is important to note that while existing or advanced line haul technologies can be made clean, safe, and quick, all other elements of the goods movement system need to be able to work with them. This presents particular challenges for alternative or advanced cargo movement options, which are not part of the legacy system. Another key challenge for siting the infrastructure for new technologies is that exclusive right-of-way is very hard to find in Southern California.



To meet the growth challenges, inland terminal sites are needed. To improve efficiency, we also need to think about adopting a container throughput model more like Hong Kong's, where containers are stacked up rather than spread out. As mentioned earlier, the need will always persist for local trucking. Overall, we need a package of solutions that primarily reduce emissions and congestion, with cost lower on the priority ladder.

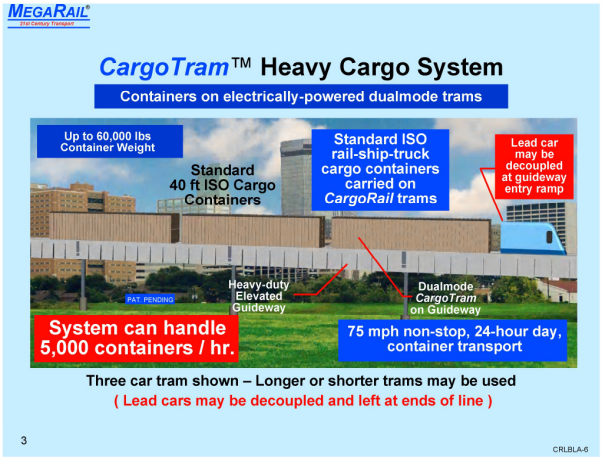
B. Alternative Technologies

1. Lee Henderson: Electric Dual-Mode Trams

Summary: The CargoRail trams are rubber-wheeled vehicles that can carry marine cargo containers at 75 mph on an elevated guideway or on local streets. On the guideway, they would be propelled by electricity via permanent magnet hub motors in the wheels. On local streets they could be fueled by clean fuel, such as CNG, to generate the electricity for the motors. This system could thus provide both line-haul and "last-mile" service. A demonstration in both Fort Worth, TX, and in Long Beach (at the dock) could be provided for $12 million.

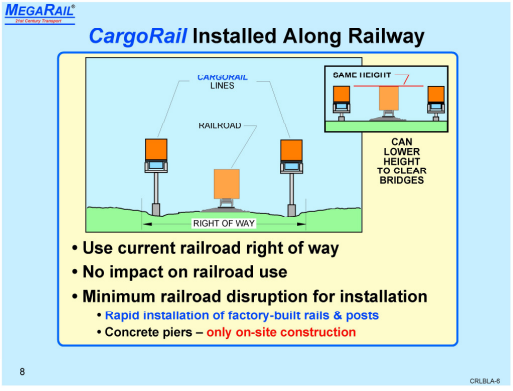
Lee Henderson of Micrin Technologies described the proposed CargoTram™ electric dual-mode trams, which could carry containers on a fixed elevated guideway or on local streets, moving on rubber tires. MegaRail, the sponsoring company, and its partners are building a production prototype in Fort Worth, Texas, as of February 2007.

The system can carry 5,000 containers per hour in each direction at 75 miles per hour, 24 hours per day. A "tram unit" is the unit underneath the container, while "CargoRail" is the term for the entire system. The technology could, but does not have to, replace current dockside operations, and does not require any new terminal equipment.



The line-haul (guideway) operation is fully electrified and would not generate any emissions at the source. Off the guideway at terminals, the tram is a hybrid that would be fueled by compressed natural gas (CNG). The guideway is steel rather than concrete, and is bolted together on site. The only site construction is concrete support piers; all other components are factory-built and brought to the site.

Compared to a truck, the CargoTram could carry 1-6 trams per load. The trams can be operated by a driver or by a computer, meaning that up to 60% fewer drivers might be needed. The guideway can be built with ramps to city streets to enable transport over the "last mile" to the warehouse or retail store door. The system itself can be sited along existing railroad right-of-way, with "no impact on rail use". This is not new technology, but a different application of existing technology.



Low-noise heavy-duty rubber truck tires run on flat steel in this system. The trams can go up grades, in all weather types, and have no turning limitations. The propulsion system is in each tram unit wheel: permanent magnet hub motors such as are used in some electric buses. Power is delivered via side rails that are enclosed to ensure safety. The overhead structure has an open design so as not to block light beneath it. The company has built and tested guideway. The steering and switching are vehicle-based – known technology – rather than guideway based, which might require new technology development.

As applied to the I-710, the system would consist 20 miles of dual-lane elevated guideway originating at the Port of Long Beach, assuming the availability of former Union Pacific (UP) rail right-of-way for the construction. No right-of-way acquisition cost is included in a total cost estimate for this operating segment of $927 million to $1.27 billion. Per-mile guideway cost is estimated at $6 - $10 million per direction, while the carriers cost $120,000 each. This segment would require 40 lane-miles (20 in each direction) at $240 million,[7] plus another $100-200 million for overpass structures, and 5,700 carriers at $684 million.

As applied to the State Route 91/Interstate 605 corridor, which would provide a route from UP and Burlington Northern & Santa Fe (BNSF) East Los Angeles intermodal yards to BNSF's San Bernardino intermodal yard, the system would include 45 miles of dual-lane guideway for a total of $976 million to $1.08 billion (again without right-of-way cost). This segment would include 90 lane-miles of guideway at $540 million, plus $100-200 million for overpass structures, and 2,800 carriers at $336 million.

The line could also be used to carry containers from the Port of Los Angeles via Ocean Boulevard and the UP right-of-way to near-dock intermodal facilities. An additional 3,000 trams would be needed to include this option, at $360 million.

Financing could come from state or local revenue bonds that could be retired from system revenues, which could also be used to cover system maintenance and operating costs. A half-mile demonstration could be mounted in Fort Worth, with a dock demonstration in Long Beach, in 26 months for $12 million.

2. Mike Simon: Maglev and LIM-Rail™

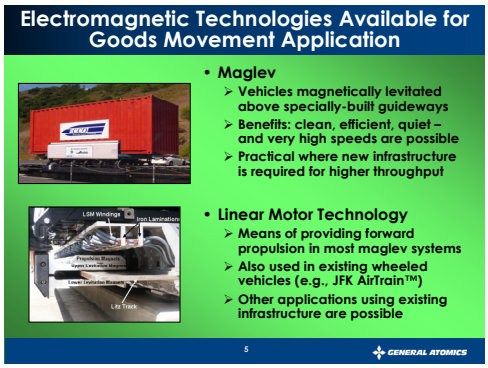
Summary: Magnetic levitation (Maglev) technology is propelled by linear induction motors. General Atomics is developing two possible applications of the technology to freight movement. A Maglev system has been demonstrated to move a cargo container; an operational system could move cargo at 80 mph and would involve construction of new, elevated guideways and

[7] Cost estimates in this section are as given in the presentation, which was based on a per-mile cost of $6 million.

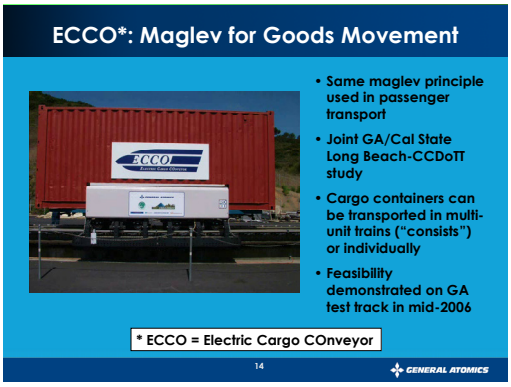
associated terminal infrastructure. A first-mile demonstration could be mounted at the ports for $80 million. LIM-Rail™ would involve retrofitting aluminum plates to existing rail cars or locomotives so that they could be propelled by linear induction motors placed in the track in areas where air pollution is of concern. This concept has not yet been demonstrated, but a one-mile demonstration could be mounted at the ports for $18-20 million.

Linear induction motors (LIM) are part of Maglev systems, not different technologies. They provide the propulsion for Maglev, which has zero emissions at the source. Maglev, a contraction of "magnetic levitation," is quiet and frictionless because the vehicle is elevated above the track due to magnetic repulsion; it has no wheels. Maglev runs on an elevated guideway, so it does not create highway congestion.

Examples of Maglev systems include high-speed, such as that developed by Transrapid for long-distance passenger service, and urban Maglev technologies, which are slower and use a "passive maglev" technology, where the motors are in the track rather than on the vehicle. A "Halbach array" of powerful permanent magnets, developed by Lawrence Livermore Laboratory, magnifies the repulsive force. The vehicles automatically levitate about 1 inch at 5 miles per hour. Maglev technology also has military applications, such as aircraft launching. Passive Maglev means lighter cars and therefore a lighter structure, reducing construction costs compared to a standard LIM system.



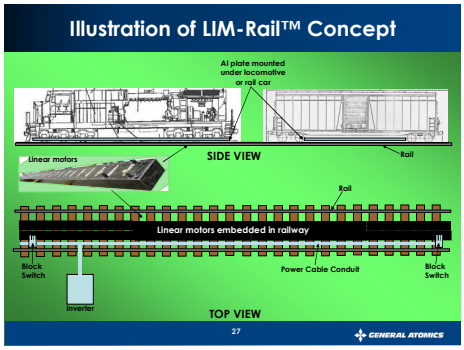
A test track was completed in late 2004 in La Jolla, near San Diego, and a cargo container was moved by Maglev on that track in mid-2006 (a video was shown demonstrating this move). This system has been dubbed "ECCO" for Electric Cargo COnveyor, and the demonstration was developed in collaboration with the Center for Commercial Deployment of Transportation Technologies, or CCDoTT, based at California State University, Long Beach.



The same team did a study in 2006 for the Port of Los Angeles that assessed potential routes to inland intermodal facilities. The study assumed a cargo carrying capacity of 5,000 40-foot containers per day (2,500 in each direction) and 24-hour operation at a top speed of 90 miles per hour and an average of about 80 miles per hour with a

20-second headway. The team estimated that engineering, construction and commissioning would take about 4 years to complete (without considering the environmental process). Costs were estimated at about $45.5 million per mile for a single track. Operation and maintenance costs were estimated at $13 million annually, which would equate to about $13/container for operation of a system reaching about five miles from the ports. Potential farther-ranging routes were conceptually addressed.

A new concept, called "LIM-Rail™," would put linear motors in existing railroad tracks. There is currently no test track for this concept, though the principles have been applied in other systems. A magnetic field moving along the linear motor in the track propels the vehicles by inducing a current in an aluminum plate attached to the bottom of a car (even though aluminum itself is not magnetic).



Most LIM systems work using a motor on the vehicle that reacts against a plate in the track, but this requires a high-powered electromagnet on the vehicle. With LIM-Rail, the motors are placed along the track and are safely encased. There is no need to run high-voltage power along the track. Existing rail stock can be modified at low cost by bolting an aluminum plate to the bottom of either a locomotive or a rail car. At the end of the LIM section of track, a diesel locomotive can resume pulling the train. In some applications, a locomotive might not be necessary.

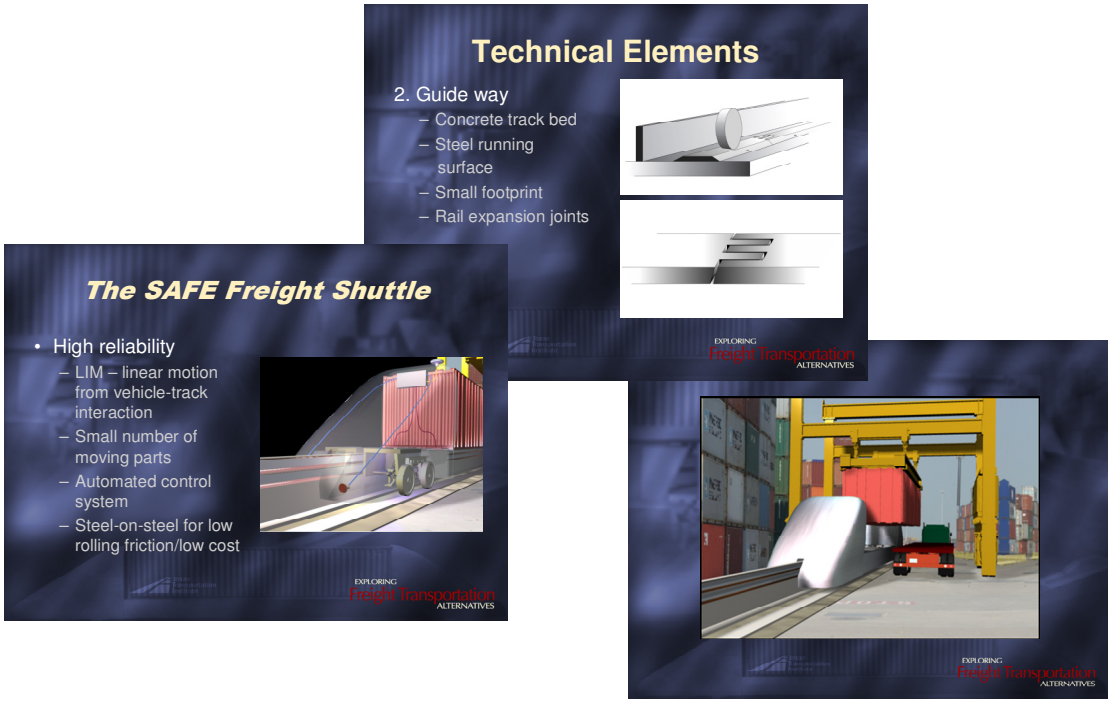
Track segments containing linear motors have already been built for military purposes. A video was shown, indicating higher acceleration than would be required for cargo container movement. An engineering feasibility study could be done in 6 months and a full working demonstration, involving retrofitting of one mile of existing rail, developed in about 2 years for about $20 million.

NOx reductions for either Maglev or LIM-Rail™ were estimated at over 99% (assuming power generated by a plant complying with year 2000 standards), compared to a line-haul locomotive complying with U.S. EPA's Tier 2 standards. Fuel savings were estimated at $2 million per year – deducting for the cost of power and assuming $2.50 per gallon of diesel and transport of a million cargo cars annually over a 10-mile route.

3. Leslie Olson: SAFE Freight Shuttle Linear Induction Motor System

Summary: These bi-directional freight shuttle units would carry one marine container at a time at 35-40 mph along a guideway via linear induction technology. This system features a steel wheel on a steel plate; it is not levitated like Maglev. Energy needs for this system were estimated.

The "SAFE" (Secure, Automated, Fast, Environmentally clean) Freight Shuttle concept has been developed by the Texas Transportation Institute to meet the varied needs of a cargo transportation system. The system is electrically powered and runs on a fixed guideway system using a linear induction motor to move one container at a time. The active part of the motor is on the vehicle and the passive element, an aluminum-steel plate, is in the track. Thus the active element needs to be only as long as the vehicle. The only moving part in the system is a smooth steel wheel on a steel plate, so the system is low-maintenance. The wheel is not flanged so it does not make the noise associated with traditional rail when going around curves, though it is not silent. The LIM keeps the unit centered on the guideway via centripetal energy.



The vehicles have aerodynamic front and back ends (they are bi-directional) and would move about 35-40 miles per hour. The guideway is laid on a concrete base and is not envisioned as an elevated structure in this system. Communications run to and from the vehicles through the energy source on the guideway. The specifics of terminal design would be determined based on desired use – no general layout has been determined.

The SAFE Shuttle runs on a conveyor belt system – one direction on each guideway. It could carry as many shuttle units as you want to put on it; at 40 miles per hour, a unit could be launched every 15 seconds to 1 minute. Assuming a 14,000-lb shuttle unit plus a cargo container weighing 71,500 lb, acceleration to 40 miles per hour would require about 8,800 Btu and to 70 miles per hour would require about 22,000 Btu. Continuous running energy at

speed is estimated at about 1,400 Btu per mile for 40 mph and 2,900 Btu at 70 mph. Based on the average of acceleration and running energy, moving 240 units per hour (equivalent to one every 15 seconds) at 40 mph would require a constant electrical capacity of 106 kW (or 218 kW for 70 mph).

4. Bruce Dahnke: SkyTech Transportation Linear Induction Motor System

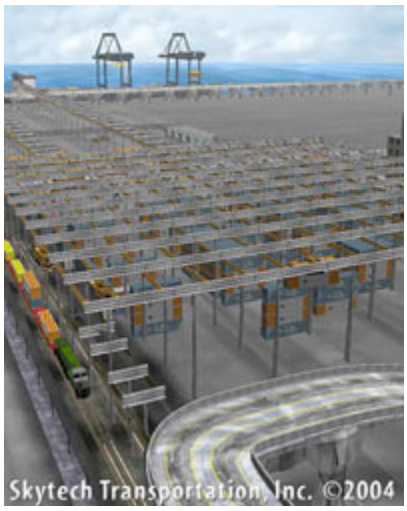
Summary: The SkyTech system would provide an automated, multi-modal option for moving freight from ship to off-site terminal or rail yard via LIM on elevated guideways. The use of elevated structures in the terminals can speed up the process of vessel loading and unloading, reducing vessel idling. The system could move 8,000 containers in 24 hours on a single track; six tracks could be constructed for a total capacity of 48,000 containers per day. Guideway construction cost was estimated at $15 million per mile, and a demonstration site was identified at the Hanjin terminal at the Port of Long Beach.

The SkyTech system would automate the multi-modal transportation system from ship to warehouse. An associate in developing the system is aeronautical engineer George Scelzo, who is also working with NASA at the Marshall Space Flight Center to apply LIM technology to rocket launching, and with the French and British navies to launch planes using LIM technology.

A visual demonstration of the system was shown,[8] demonstrating operations both within a terminal and on a docked vessel. The system is designed to use cranes that capture gravitational energy back when containers are lowered. Containers are transferred by crane onto an I-beam for travel; the demonstration shows the structure built above existing railroad tracks for efficient land use. If the container is transferred to a truck tractor, the truck itself can also be carried on a LIM structure to eliminate pollution, then drive off at the far end. Each overhead structure has three tracks above and below, and containers can switch between different tracks to reach various destinations. A proposed automated lattice or grid system for container storage adds capacity and offers a way to double or triple current container throughput, while eliminating roadways within the terminals.

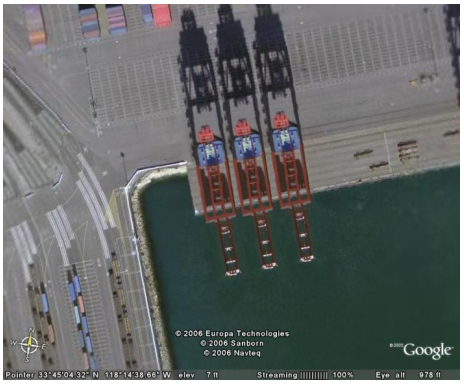
[8] The demo presentation can be accessed on line at http://www.animagraph.com/content/skytech.html.

At port-side, automation can reduce vessel idling and the associated pollution by speeding the loading and unloading process. Moving the containers from an elevated structure saves time in the lifting process, which is now done from ground level. Import containers can be moved directly on-dock, while export containers could be loaded either from the rail head or from a "race track" serving the grid storage system in a terminal.



This is a linear induction system, with motors in the vehicles. It runs on 220-volt power. Linear induction motors are not a new system but a demonstrated technology: the subway running under the U.S. Congress is powered by LIM. A former LIM rail at the fairgrounds in Pomona, California, ran for many years and withstood a 4.0 earthquake. The system uses only the energy it needs, instead of keeping a third-rail power source energized at all times.

Construction cost would be about $15 million per mile for a six-track system that could move 8,000 containers per track every 24 hours, or a total of 48,000 containers per day. Projected volumes for the local I-710 Freeway, which carries the bulk of container traffic to and from Los Angeles and Long Beach today, are about 60,000, indicating the need for more than one track. Also, each container lift takes between 30 seconds and a minute, so an operation designed to load directly to and from vessels could be more efficient than a point-to-point operation like a traditional railroad. The LIM system could also be built above waterways or utility rights-of-way. An unused rail track next to the water at Hanjin's terminal at the Port of Long Beach would make an ideal demonstration location without disrupting regular operations.



5. Additional Alternative Technologies

Summary: Additional alternative technologies are briefly described here that were not presented at the forum.

The technologies presented at the forum have been the focus of previous presentations in Southern California. However, several additional related and unrelated alternatives could hold promise for freight movement in this region.

The following is a representative and informational, but not exhaustive, list of additional technologies[9]:

- Transrapid Maglev: Transrapid, a joint venture of German firms Siemens and Thyssen-Krupp, has developed passenger Maglev technology with a linear motor in the guideway. A system now in revenue service between Shanghai and its airport was built in two years and operates with 99.98% reliability, and a similar airport connection is now being planned in Munich. The "Freightrapid" concept would move marine freight containers in open cars at up to 112 miles per hour, and a concept has been developed for terminal operations.

- Aeroscraft Freight: Aeros, based in Tarzana, California, has proposed transporting marine cargo containers by blimp. The company has two designs, the D-4 and D-8, that it says can carry up to 1.6 million pounds.

- Auto-Go: Developed by New Jersey-based Titan Global Technologies, this is a proposed automated system for moving cargo containers suspended from an overhead monorail using LIM technology.

- Automated Guided Vehicles: This concept would have automated trucks traveling in platoons along a dedicated right-of-way. A similar process is used, at low speed, within a marine terminal at the Port of Rotterdam.

- CargoMover: This proposal, being developed and tested by Siemens, would have automated vehicles carry containers via conventional railroad tracks. The vehicles could also be self-loading and -unloading.

- KACI: This concept by Ohio-based KACI Intermodal would position rail cars in a zig-zag pattern that would allow much faster loading and unloading of containers or roadway vehicles, compared to conventional rail intermodal. This method could be used with any type of rail-based system, including Maglev or LIM.

- Tubular Rail: This concept, being developed by a Texas firm, would place the rails on the vehicle, which would be propelled by electric motors across a series of elevated support stanchions. This design eliminates the need for a continuous guideway. Current concepts include design of a multi-container vehicle with the potential for self-loading and unloading.

- Barge: Clean-fueled or electric-powered barges could be used for container transport along existing or modified waterways to locations close

[9] For further information on some of these technologies, see the draft South Coast Air Quality Management Plan, Appendix IV-C, October 2006 (http://www.aqmd.gov/aqmp/07aqmp/draft/AppIV_C_Rev.pdf).

to the Ports of Los Angeles and Long Beach, as a modal alternative to trucking.

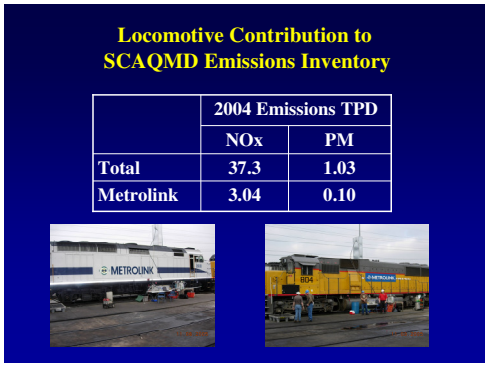
Evaluation and comparison efforts funded by the Ports of Long Beach and Los Angeles, the Southern California Association of Governments, and the Los Angeles County Metropolitan Transportation Authority and its project partners on the I-710 Freeway EIS/EIR[10] will help to shed more light on the potential value of each of these technologies for alleviating the air quality, congestion, and other burdens of goods movement.

C. *Conventional Technologies*

1. Christopher Weaver: Reducing Emissions from Locomotives

Summary: Locomotive emissions inventories in the South Coast air basin are incomplete. Locomotive emission regulation lags behind that for truck engines. EPA has promulgated Tier 2 standards, which are now in effect for new locomotives, but has not yet issued Tier 3 standards. In California the two major freight railroads have agreed to meet Tier 2 standards by 2010. New designs for switcher locomotives can effectively reduce emissions. Add-on controls are increasingly being developed for and applied to line-haul locomotives, and with changes in locomotive design, urea injection for NOx control through selective catalytic reduction may be cost-effective.

Locomotive emissions come not only from line haul operations, but also from local trains that provide service to large plants, such as refineries, that handle materials in rail cars. Switching locomotives operate in rail yards, marine terminals, and industrial plants. Maintenance services can also result in emissions since locomotives often idle during this time. Line haul locomotives can spend 40% of their time idling and switchers as much as 90%. The two-stroke engines used in many diesel locomotives produce substantial emissions from lubricating oil.



Freight rail generates about 90% of the total rail emissions inventory for NOx and PM in the South Coast Air Basin. Many locomotives in service in the basin were new in the 1950's and 60's; they have been gradually retired to short-haul and finally to switching service as they get less reliable. Thus they may not be well-designed for the tasks they now perform.

Locomotives can be built taller now that most right-of-way accommodates double-stack container transportation, which may allow room for implementing add-on emission controls. Railroads prefer to use fewer,

[10] Environmental Impact Statement/Environmental Impact Report

higher-horsepower locomotives to reduce maintenance cost and improve fuel economy. Emission standards for locomotives are behind those for truck engines. "Tier 2" standards now in effect are comparable to what trucks had to meet in 1991. "Tier 3" standards have not yet been adopted, but could be comparable to truck standards applicable to 2007 or even 2010 models. New locomotive standards take effect slowly because the equipment fleet does not turn over quickly.

Current emission inventories underestimate idling emissions because they do not account for the build-up of particulates in the exhaust ducts. EF&EE's testing for South Coast AQMD has shown that this fraction can account for 25-50% of PM emissions during idling. It is difficult to account for the emissions contributions of privately-owned industrial locomotives because they are not regulated as stationary sources and don't have permits.

To address locomotive emissions, the U.S. EPA and CARB have signed a Memorandum of Understanding (MOU) with UP and BNSF, the two railroads serving Southern California, requiring them to achieve average emissions that meet Tier 2 standards by 2010. The penalty provisions may allow for fines that are less costly than compliance. The MOU also contains a provision that any further regulation cancels the effect of the MOU.

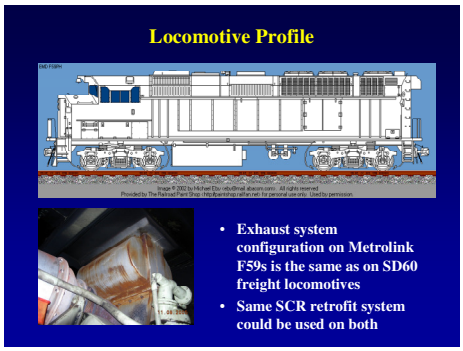
A commercially available solution for dedicated switcher locomotives is the "Green Goat" diesel/battery-electric hybrid. Another, good for more power-intensive use, is designed with a series of 500-700-horsepower non-road engines, which come on sequentially in response to power demand. These locomotives have modern emission controls, and since the engines run under high load, they are better candidates for add-on emission controls like selective catalytic reduction (SCR) or diesel particulate filters (DPF).

At rail yards, it is possible to concentrate emissions from maintenance operations and treat them with stationary source control systems. This approach was demonstrated at UP's Roseville rail yard in Northern California.

For line haul locomotives, EPA may define Tier 3 emission controls to include DPF or SCR, though fleet turnover still will be slow. Demonstration projects are underway to retrofit existing locomotives with diesel oxidation catalysts (DOC), SCR, and DPF. Another option is to use an "ultra-clean" shuttle simply to remove cargo from the ports to clean-air areas like Barstow, Mojave, or Phoenix. These locomotives would be dedicated to service in the South Coast basin

rather than spending much of their time elsewhere. A small motor running to keep locomotive batteries charged can help reduce idling needs while using little power. Alternative fuels and electric traction are not recommended due to their relative cost-ineffectiveness in these applications.

SCR is common on stationary sources and has been proposed for locomotives since 1994, but has not been adopted due to concerns about cost and the space required to mount and operate it. At Roseville, the stationary source system resulted in 99% NOx control, though it incurs substantial energy cost to reheat the exhaust to achieve this level. More compact SCR systems being developed in Europe for use on trucks could be applicable to locomotives here, and possibly to harbor craft. Tests on marine engines indicate that the systems reduce not only NOx but also PM, functioning as a DOC and burning the organic component of the PM.



For Metrolink passenger locomotives, the cost-effectiveness of SCR was estimated to be about $3,000 per ton of NOx reduced. These systems could be cost-effective for locomotives because the (expensive) urea reagent can be injected only in areas where NOx control is needed, which would be a small part of the time for a transcontinental locomotive. The SCR systems also have the effect of reducing PM emissions even when urea is not being injected.

2. Michael Jackson: Reducing Emissions from Truck Engines

Summary: Strategies to reduce emissions from truck engines include refueling (changing to cleaner fuels); replacing older trucks with newer ones; retrofitting existing trucks with aftertreatment devices; repairing or rebuilding older engines; or reducing idling (an operational strategy). The relative cost-effectiveness of each of these measures still needs to be evaluated. Truck replacement programs can accelerate fleet turnover to trucks with emissions that can be as much as 99% cleaner for particulate matter, compared with a 1990 model truck. The effectiveness of aftertreatment devices, which must be certified, varies with a number of operating factors. It can be a challenge to reach truck operators to publicize programs to help them, and many still lack the financial resources to participate. Alternative fuels displace petroleum but do not burn much cleaner than 2007 model year engines.

California currently uses many strategies for truck emission reduction. Available alternative, cleaner-burning truck fuels include ultra-low-sulfur diesel and liquefied natural gas. Programs are in place to accelerate truck fleet turnover to newer vehicles with lower emissions. Older trucks can be retrofitted with control devices when they are not good candidates for replacement. Truck emissions can also be reduced operationally, by

improving the efficiency of logistics operations involving trucks, shifting trucking to less-congested times of day, or shifting freight to rail, which has lower emissions per ton-mile.

To enforce these reductions, ARB has stepped up truck inspections near ports and is developing a rule to further control emissions from trucks in port service. The AQMD also may seek to regulate truck fleets.

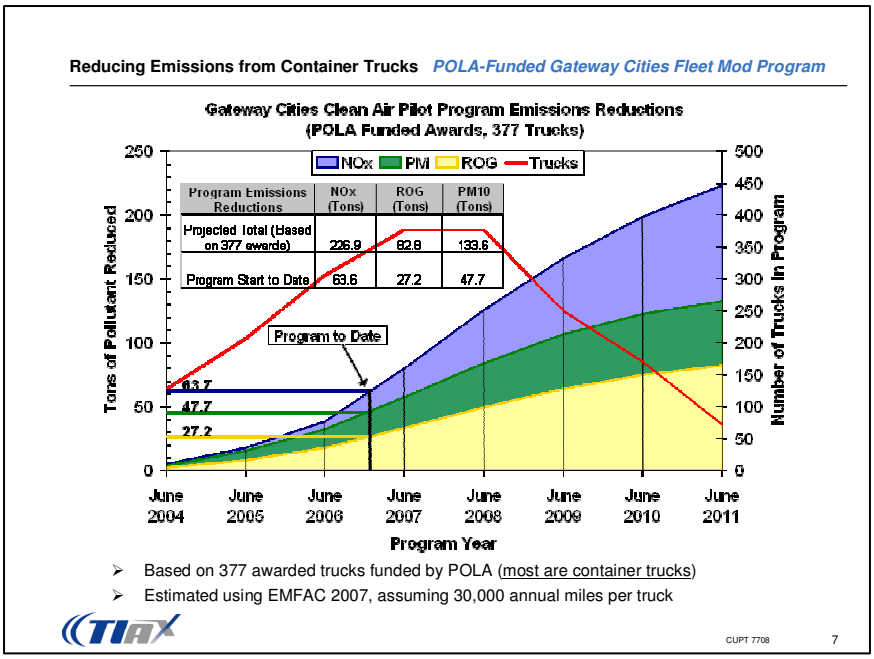
The control of emissions from container trucks presents special challenges. The trucks often belong to independent owner-operators, many of whom don't speak English as a first language and may be hard to target with outreach about available programs. Port drayage can be a harsh vocation, with no benefits and per-trip pay limited by congestion and terminal conditions. Drivers may have limited financial ability to maintain vehicles properly (which can reduce emissions) or to consider an expensive replacement.

The range of truck emission reduction strategies can be summarized as follows:

- Refuel
- Replace
- Retrofit
- Repair or rebuild
- Reduce idling.

The ports' CAAP discusses the use of cleaner or alternative truck fuels, such as LNG, synthetic or gas-to-liquids diesel fuels that burn cleaner, or electric drive, in certain applications. A truck replacement program further discussed below has replaced over 500 older vehicles with newer ones that emit less per mile. Engines can be retrofitted with a flow-through catalyst, a particulate filter, or in some cases both devices to remove both NOx and PM. Repair or rebuilding involves reflashing engine calibration to reduce NOx emissions, but a challenge remains how to capture trucks for this service. Various measures including legislation and operational changes have been used to reduce truck idling.

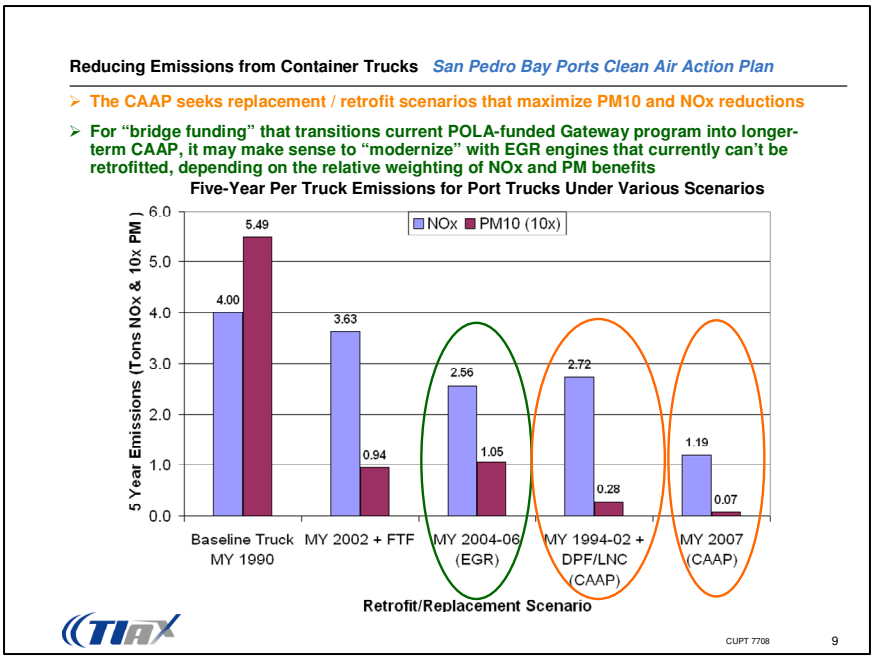
Gateway Cities COG has been conducting a fleet modernization program for several years. The program generally has replaced pre-1989 engines with 2002 engines. However, since the newer trucks have higher horsepower, they must be derated so as not to negate some of the emissions benefits. Emission benefits are about 2/3 ton of NOx per truck and 1/3 ton of PM per truck over five years. Emissions benefits will continue if the trucks run longer.



The ports' CAAP calls for replacing or retrofitting a large number of trucks. For model year (MY) 1994 and earlier, the goal is to replace with 2007 trucks, which meet stringent NOx and PM standards. For newer trucks, the goal is to retrofit with DPF or a combination of NOx and PM control. A chart was presented comparing 5-year emissions totals for various types of retrofit or replacement measures. NOx emissions from a 2007 truck – the cleanest option – would be 70% lower than for a 1990 model, while PM would be reduced by nearly 99%. Ultimately, it is likely that a combination of strategies will be needed.

Another strategy is the use of LNG fuels. A supply system is available now and natural gas engines are expected to be certified in mid-2007. This fuel produces similar emissions to those from a 2007 diesel engine, so apart from displacing petroleum use, there is not a significant advantage to this approach. In the long run, we may need to move to battery-electric or hybrid-electric engines, or hydrogen fuel cells.

When retrofitting aftertreatment devices, it is necessary to use a CARB-verified device. Fewer such devices exist for newer model-year engines than for older ones. An example was shown that contrasted replacement of an older truck combined with retrofit of emission controls, which increases reliability and saves the driver substantial fuel cost, with retrofitting a newer truck, which has the opposite effect on fuel cost.



Another issue is knowing the duty cycle, which determines the exhaust temperature profile. A certain minimum temperature is needed to ensure soot emissions are effectively captured and controlled. Port trucks operate at a variety of loads, and it's difficult technologically to control emissions effectively across the entire duty cycle, which varies from idle to fully loaded. Testing done by TIAX indicated that the long, uninsulated exhaust pipes on many of the larger tractors in port service allow exhaust temperatures to drop. However, TIAX concluded that adding insulation would likely not be practicable for these trucks.

Thus, passive DPF's will be most effective with screening to identify candidate trucks with appropriate duty cycles and exhaust systems. Active DPF systems are not yet readily useful due to concerns with available space to add them and the need to plug them in at night. All the potential control measures still need to be evaluated for cost-effectiveness.

D. Operational Strategies

Summary: Operational strategies can help to control emissions without applying new technology (except information technology, in some cases). These strategies can move truck traffic to less congested times of day or reduce the need for certain truck trips, possibly by diverting cargo from truck to rail. Impact fees could be used to encourage operational changes.

Operational changes offer additional means of controlling goods movement emissions by reducing the need for container movement or the likelihood of truck idling. These examples of major operational strategies were described at the start of the roundtable discussion by Dan Smith of Tioga Group.

One strategy is to encourage truck moves at less congested times of day. The PierPASS OffPeak program, instituted by the industry in mid-2005, charges a fee for containers moved during daytime shifts, providing an incentive to use new night or weekend shifts when roadways are less crowded.[11] Estimates are that 35% to 40% of trucking has been diverted to off-peak hours as a result of this program. Another benefit is that port infrastructure is used more efficiently: some 12-16 hours of the day. The OffPeak program's recordkeeping also provides a management tool that could help, for example, track clean-fuel trucks. The program has raised some concerns about safety and about the demands of night work, but in general the program is regarded as a success.

A precursor to the PierPASS program was the implementation of appointment systems and on-line information systems, such as E-Modal and Voyager Track. In this arrangement, a driver can check the status of a container before pickup and, in theory, can transit the terminal quickly because the shipment will be ready. Truck dispatchers can thus plan work flow better if, for example, they know in advance that a container has not cleared customs.

Virtual container yards offer direct reuse of empty containers for export movements, and could reduce regional port-related truck trips by about 5%. Typically a trucker will take a loaded container to a location where it is emptied, then bring back the empty, while another trucker needing an empty container will have to retrieve one from the port terminal. Containers are physically, but often not commercially, interchange-able, and Southern California has a substantial import/export imbalance, compounding the challenge. An internet-based system would allow truckers to post availability of containers to other truckers.

Other institutional arrangements have been made to facilitate re-use of empty containers through streamlined agreements between trucking companies and ocean carriers. Most marine containers are leased, and stored when they are not needed. They may sit for 1-2 weeks at the port before going back into service, but an agreement allowing container storage at a depot rather than returning it to the port can save two truck trips.

Another option is to encourage more use of on-dock rail so as to avoid truck drayage over public streets. The adoption of this strategy has been limited by the current infrastructure at both ports, as well as by issues of scale. For major inland destinations such as Chicago, whole trains are assembled to one location, but containers bound for smaller destinations often are still trucked.

A current study is evaluating the possibility of developing rail shuttle service to an "inland port" (or several such facilities) in order to reduce truck travel. This option is not commercially viable and would require operating subsidies. Also, implementation would require additional infrastructure, because the region's existing rail lines accommodate not only growing freight traffic but also increasing passenger rail service. Recently passed state bonds may help address this need.

[11] For more information, see http://www.pierpass.org/.

Christopher Weaver suggested considering imposing an air quality impact fee on trucking, rail, and marine service to capture external costs. Trucking rates, for example, are very low in part because the related public health costs are not internalized. Such a fee would provide an incentive to reduce emissions and truck trips.

IV. Roundtable Discussion

Summary (initial session only – see also Sections A-E below): Alternative technology proposals must be able to get containers to their final destinations, not just provide an alternative fixed guideway. MegaRail's dual-mode trams and SkyTech's LIM system both address this issue. Impact fees could provide an incentive for the industry to change behavior by internalizing some costs. Alternatively, fees could be structured as direct incentives, such as tax breaks for selecting clean transportation options. It is important to identify the industry's self-interest in order to gain their support. Panelists agreed that public money should be provided to support prototype development and demonstration systems to help reduce risk for future private investors. Even if emissions from conventional technologies approach zero, the region still will suffer from expensive fuel, driver shortages, traffic congestion, noise, pavement damage, and continued dependence on fossil fuels.

The discussion began with brief remarks from each of the three additional expert panelists (see Section II.C on page 4).

Dr. Ken James represents CCDoTT, an incubator of small industry and academic programs focused on goods movement projects, such as a jet engine designed for marine service in high-speed shipping. CCDoTT has been looking at Maglev technology to move containers. Another relevant project was an operational demonstration at the Port of Tacoma with Hyundai, the railroads and the unions to block-load the ship and improve efficiency of terminal operations by a factor of 2-3. PierPASS developed in response to legislative pressures – the goods movement industry may have a lot of inertia in changing operational practices.

Philbert Wong of Los Angeles County Metropolitan Transportation Authority emphasized that Metro recognizes the importance of goods movement. The Multi-County Goods Movement Action Plan is a collaborative effort of Metro, SCAG, and the surrounding counties (see the program web site[12] for technical memoranda on environmental and economic impacts, existing conditions, and a survey). A Metro Board workshop on goods movement is scheduled for January 29, 2007, and is intended to be a policy discussion.

Jerry Wood represents the Gateway Cities Council of Governments (GCCOG), which consists of 27 cities in Southeast Los Angeles County and is home to 2.2 million people. The subregion could be called "ground zero" for goods movement, having

[12] http://www.metro.net/projects_programs/mcgmap/

essentially both ports in the area. The I-710 project will enter the EIR/EIS phase soon, but every freeway has similar truck volumes: 20-25,000 trucks a day, headed to 50-60,000 if nothing changes. GCCOG is working with neighboring subregions and counties on solutions, including alternative technologies. A major question is how effective a new technology could be at both ends of the system. Also, a fixed guideway system cannot provide the flexibility of an individual truck in reaching a final destination, and it probably will not be possible to use existing right-of-way.

In response to the suggestion about impact fees, Mr. Wood observed that GCCOG is pursuing a beneficial approach with private industry to develop a program that they want to participate in. The program is designed to identify where, besides I-710, "cargo movement corridors" can be established and how they will benefit the goods movement industry.

Lee Henderson addressed the destination problem by advocating a dual-mode approach – their vehicle can be driven off the guideway onto local streets by an operator.

Bruce Dahnke agreed that it is important to know where your destination (distribution) centers will be. Hence his proposal is a multi-modal system, in which containers can make intermediate stops for transloading to larger containers, then resume travel on the system to avoid truck travel to inland points. The whole country is watching what we do here, and the national economy depends on what we do here. He suggested that public research money be put up for prototype development.

Chris Weaver pointed out that notwithstanding the interest in substituting electricity for diesel use in trucks and locomotives, by 2010, truck emissions will be "near zero." If we could hasten the use of this technology by trucks, the air quality problem would essentially be resolved. Congestion, noise, and pavement damage, however, provide additional reasons to consider alternatives. We also need to be sensitive to the desire of the industry for low-cost (or lowest-cost) operation.

Bruce Dahnke responded that cleaning up truck emissions does nothing for congestion, fossil-fuel use reduction, or the cost of fuel for drivers or for the fleet they drive in. New, cleaner engines may actually have lower fuel economy, and the cost of moving goods will continue to go up as fuel cost rises. Also, it is easier to control emissions at a centrally located power plant providing electricity than from a number of individual, dispersed mobile sources. Furthermore, there is already a driver shortage nationally, which cannot be expected to improve, and new federal security requirements could restrict driver supply even further by requiring legal residence or immigration status.

Chris Weaver responds that we are not charging drivers for the resources they are using, which could ensure they are used efficiently. Such charges could provide an incentive to upgrade equipment. Voluntary compliance is not likely to occur where it would mean a substantial increase in operating cost.

Mike Simon pointed out that there is plenty of demand for both fixed-guideway and roadway service. He also suggested that fees could be structured as incentives, such as a tax credit of a dollar per ton-mile for choosing clean shipping options. He agreed that research and development funds should be provided by government, especially for new systems where the risk is too high to attract private investors. General Atomics would like to build a 1-mile demonstration system at a cost of $50-80 million. The best role for government is not building and operating a system but seeking out projects on which to co-invest with private entities.

A. Demonstration System Needs and Costs

Summary: Each provider discussed the initial costs of a demonstration system and attempted to include a discussion of how an entire system would work, including terminal operations, and right-of-way considerations. MegaRail could construct a production prototype for $12 million; this would not include a system study. The system would be constructed along existing railroad right-of-way. Maglev could be demonstrated for $80 million for the first mile, including a terminal demonstration; the system would require new right-of-way. LIM-Rail™ could be demonstrated for $18-20 million and would use existing railroad infrastructure. The SAFE Freight Shuttle could be mounted in a short commercial, not demonstration, system between the ports and near-dock intermodal yards for $40-50 million, along existing rail right-of-way; terminal concepts are proprietary. SkyTech could mount a technology and terminal demonstration for $10 million; the system could use existing rail right-of-way.

Dan Smith pointed out that the viability of the line-haul technologies is not really in question. What is at issue is a system description: how will the terminals work, and what rights-of-way will be used? How could any of these systems serve 16 terminals spread over 5 miles of waterfront in both ports?

MegaRail (Lee Henderson): A demonstration would require $12 million for a production prototype that can haul a full container at speed on an elevated guideway. This could be done on a short line at port. This cost would not address an entire system study. The full system is envisioned to use existing railroad right-of-way, and the line haul operation is fully electric. The dual-mode vehicles would use roadways for last-mile deliveries, and could use currently available fuels to generate the power to run on where air quality is not a major concern. The system would serve various terminals with individual feeder lines, since there is little room for a central collector at the ports.

Maglev (Mike Simon): For Maglev, General Atomics could build a new, fully elevated first-mile demonstration system for $80 million, or a shorter track for $40-50 million. The goal would not be to prove the technology works, but to demonstrate what it will cost at operating scale and how long construction will take, so that private investors can be attracted.

Ken James of CCDoTT added that they have looked at putting a Maglev demonstration line at port terminals that do not now have on-dock rail. There is one

candidate each at the Port of Los Angeles and the Port of Long Beach, where both terminal and railhead operations could be demonstrated.

The LIM-Rail system uses existing infrastructure and current railroad operational practices. A first-mile demonstration could cost $18-20 million, with a subsequent construction cost of $10 million/mile.

Mike Simon suggested that perhaps all demonstrations should be required to include a terminal demonstration, and suggested setting up a test center for all technologies, possibly even at a facility used by the Association of American Railroads (AAR) in Colorado. He also pointed out that there may be some "show-stopper" issues to be aware of before committing demonstration funds. For example, if railroads own the right-of-way being considered for these systems, they may not want to foster competition.

SAFE Freight Shuttle (Les Olson): Mr. Olson pointed out that he is employed by the Texas Transportation Institute and not the Freight Shuttle Development Corporation. He understands that the Corporation has been in discussions with BNSF about serving their proposed near-dock intermodal facility north of the Ports of Los Angeles and Long Beach. Construction cost for a commercial system, not a demonstration, to serve this facility would be $2 million per mile to lay track along existing BNSF rail, assuming no cost for the right-of-way. Assuming a 7-mile system to the near-dock facility, the track cost would be $28 million. Fifty vehicles would cost an additional $10 million and a command and control system approximately $7-10 million, for a total cost between $40 and $50 million. This does not include the cost of a utility contract for power, which would be a need for any of these demonstrations. Mr. Olson said the Corporation's terminal concepts were proprietary and he could not comment on them.

SkyTech (Bruce Dahnke): SkyTech could mount a demonstration prototype at the Hanjin terminal for $11 million, including constructing a small section of grid above the track. On the rail, they would put a reaction plate down to demonstrate moving a container on the track and verify cost per mile. This estimate includes $1 million for an operating system that provides anti-collision measures, among others. He also suggested using the AAR test site in Colorado. In commercial service, the system could use an existing short line from the ports to the location of the near-dock intermodal facilities.

B. How Clean Can Trucks Become?

Summary: Standards for 2007 model year trucks will bring particulate matter emissions "near zero" and for 2010 will bring NOx emissions "near zero." However, in use emissions may vary due to equipment failure or maintenance issues, so these control levels are not guaranteed by EPA standards.[13] *Gasoline hybrid trucks are another viable option with no diesel particulate emissions.*

[13] AQMD held a technical forum on in-use emissions from diesel engines September 20, 2006; see http://www.aqmd.gov/tao/ConferencesWorkshops/techforum.htm for forum details.

Chris Weaver and Mike Jackson both contributed to an overview of this question. Standards for 2007 model year engines being sold today represent a 98% reduction in PM – "near zero" – and a 90% reduction in NOx, compared to an uncontrolled engine. In 2010 the NOx standard will be reduced another tenfold, bringing those emissions also near zero. However, in use, aftertreatment devices can fail, in which case emissions will not be "near zero." Warranties are often for 500,000 miles, while engines may go for a million. Institutional arrangements and careful monitoring can reduce this risk. Hybrid trucks are a viable option: these engines are in use now in Long Beach city buses and are well suited to stop-and-go driving conditions such as trucks face. These engines have no diesel PM emissions because they are gasoline hybrids. Emissions of NOx resemble those from a passenger pickup truck.

In regard to the warranty issue, Les Olson observed that EPA regulations will ensure that trucks meet standards for their model year. Chung Liu mentioned an earlier forum on in-use emissions and affirmed that they are of concern; moreover, he said, the AQMD's current position is that the EPA certification process is not an adequate safeguard. He also pointed out that the truck fleet will still grow in size and continue to cause roadway congestion, and it is still likely that the oldest, most polluting trucks will be used in short-haul port service, irrespective of emission standards.

C. How Clean Can Locomotives Become?

Summary: SCR on a line-haul locomotive could reduce NOx 80-90% from uncontrolled levels and PM 50% or more. This will be demonstrated on a passenger rail locomotive with AQMD funding. DPF's could also (in theory) be retrofitted to locomotives. However, locomotive emissions cannot be brought "near zero" with aftertreatment devices.

Chris Weaver estimated that it will take $500,000 to retrofit one Metrolink locomotive with SCR and demonstrate its use for a year. These funds are being provided by South Coast AQMD and the State of Texas. To demonstrate a similar system on a consist of 3-4 locomotives that could shuttle between the ports and inland locations such as Barstow or Mojave would require $1.5 million. The resulting NOx emission reduction is projected to be 80-90% over the duty cycle (compared to uncontrolled), though it may be necessary to reduce idling to achieve this. Particulate emissions could be reduced 50%, even up to 70% from uncontrolled for a two-stroke engine. There is no current technology to put DPF on such large engines, but to do so would be a straightforward extension of past efforts and could reduce particulates by as much as 90%.

For line-haul applications, we cannot really get emissions "near zero" without a new locomotive. The stringency of EPA Tier 3 standards remains to be seen. Peter Greenwald emphasized that the timing of these standards is also critical given the nearness of attainment deadlines for $PM_{2.5}$ standards. For switching locomotives, we can get close to zero with some of the technologies described earlier.

D. Energy Requirements for Alternative Technologies

Summary: The technology providers gave different types of estimates of their systems' energy consumption. It is not yet possible to directly compare energy consumption for different technologies on the basis of information presented at the forum. The participants discussed the positive outlook for recovering energy from braking in line-haul systems.

MegaRail (Lee Henderson): Permanent magnet wheel motors are 95% efficient at converting electric energy into motion – only 5% is lost to heat (compared with trucks which lose 75% of input fuel energy to heat). The energy efficiency of line haul operations depends on the speed of travel (i.e., acceleration needs) and how much of the travel is on the fixed guideway (no figures were provided).

Maglev (Mike Simon): Conventional rail is already very efficient: it gets 400 ton-miles per gallon of diesel fuel, thanks to very low rolling resistance. The electric power needed to move LIM-Rail would be about 1/3 as much. Based on preliminary, conservative estimates of energy efficiency, Maglev may not be much more efficient than steel wheels on steel rail depending on the balance between magnetic lift and magnetic drag. Ken James added that in theory, magnetic drag may be less than the rolling resistance of conventional rail at speeds over 30 mph. The chief attraction of Maglev is not the absence of wheels but the ability to elevate the structure due to the distribution of weight.

SAFE Freight Shuttle (Les Olson): At 40 mph, average energy consumption is a little less than 0.5 kWh to move 85,500 pounds (a 14,000-lb shuttle plus a loaded container at 71,500 lbs) 1 mile. At 70 mph, average energy use for this weight and distance is 0.9 kWh.

SkyTech (Bruce Dahnke): The LIM motor is approximately like a washing machine motor in terms of power consumption. Also, it is possible for cranes to reclaim energy from the gravitational acceleration of a dropping container. Mike Simon confirmed that it is possible to recapture 30% to 40% of the vehicle's energy during braking. Ken James pointed out that a design plan for the Cajon Pass is to capture energy from braking during downhill travel for use on the uphill run. Mike Simon suggested that for LIM-rail, it would similarly be possible to place track magnets more densely in downhill sections of track for the same purpose.

E. Why Invest In Alternatives?

Summary: Even though it is possible to reduce emissions dramatically from locomotives and trucks, a number of problems would persist if new technologies were not adopted. The region would still experience traffic congestion (particularly as freight movement grows), roadway damage from heavy vehicles, noise and vibration, safety issues for other motorists, grade crossing delays, continued dependence on fossil fuels, and likely rising fuel cost. Electric-powered alternatives provide an opportunity to control emissions in one place, at the point of power generation, rather than on thousands of dispersed mobile sources.

Jerry Wood said that for GCCOG, emissions and congestion are both issues, especially with projections of 50-60,000 trucks per day. Technology alternatives are attractive if they can reduce that truck traffic. Their ability to load and unload efficiently and handle both short- and long-haul traffic must be demonstrated. Community-based solutions are critical, especially when establishing right-of-way and identifying "cargo movement corridors." Once the corridors are established, technologies can compete to occupy them.

Les Olson and Lee Henderson agreed that congestion is a major remaining concern. Lee added that electrically based systems provide the opportunity to control emissions at the power plant source, and also observed that friction braking (as on conventional technologies) contributes to groundwater contamination. Mike Simon added that fossil fuel supply is not unlimited and we will eventually need to seek alternative energy sources, particularly as conventional fuels become more expensive.

In separate communications, panelists added the following observations:

- Newer trucks and locomotives will still have higher emissions than electric-powered alternative technologies, at least for the foreseeable future.

- Because conventional technologies will continue in use even as alternatives are developed, we must continue to invest in reducing their emissions.

- The continued use of trucks represents a future commitment to the further construction and use of freeways, which have other social impacts such as accidents and fatalities, blight and division of communities, noise, and costly ongoing maintenance, especially where truck traffic is high.

- The continued use of conventional rail portends increasing delays in passenger rail service in this region, where tracks are shared.

- The technologies discussed at the forum could also be described as "existing infrastructure" solutions and "new infrastructure" solutions – rather than "conventional" and "alternative."

- It is conceivable that in our children's lifetimes, internal combustion engines will become a thing of the past, and the economy will rely on what we now think of as alternative energy sources. The sooner we invest in this future, the better off we will be when fossil energy begins a sharp decline.

- Southern California, as a gateway for much of the nation's trade and commerce, must address its congestion and air quality problems in order to minimize the risk of nationwide economic disruption.

F. Public Comment

Summary: Four public commenters spoke. Community groups are in favor of the development of "zero-emission" technologies, and want to be consulted and included in public decision making about goods movement. The new technologies could help alleviate train parking and idling impacts in some locations, but probably not for five to ten years. There are currently not many incentives for the use of cleaner trucks at the ports – just the Gateway and Carl Moyer Programs.

Jesse Marquez, Coalition for a Safe Environment, emphasized how his interest in goods movement has grown over the last five years as a resident of Wilmington. As the only paid staff for his small organization, he has done extensive research on technologies and pointed out that community members strongly support investments in research and development of these alternatives to current practice. He understands that transitional fuels will be used as new technologies develop, and suggested that underground rights-of-way can be pursued, as well as use of freeway infrastructure. He asked an engineering class at USC to conduct an evaluation and comparison of these technologies, and their report was recently delivered. He asked the panelists what he and community members can do to help promote these technologies.

Mike Simon welcomed the political support for research and incentives. Dan Smith asked Jesse to independently investigate the analyses of these systems in order to educate and help build community acceptance for solutions. Jesse now has grant funding in hand to help disseminate the USC report, and plans to establish a web site to share information about these technologies. Lee Henderson asked communities to help define the government decision making process and maintain pressure so that progress is made.

Rachel Lopez of Mira Loma, representing the Center for Community Action and Environmental Justice, explained that there are over 100 warehouses now in their community. "Community" is often not at the table when decisions are being made, so the true concerns are not heard.

Jim Winder, Mayor Pro Tem of City of Yorba Linda, Orange County, asked how this technology could affect efficiency at Hobart Yard (BNSF's intermodal facility east of downtown Los Angeles) in the near future. Trains awaiting access to the yard are parked and idle near his community. Ken James answered that safety concerns keep trains from moving regularly through the Cajon Pass and acknowledged the difficulty at Hobart Yard. He explained that these alternative systems could offer a way to displace railheads to locations outside the LA basin, thus avoiding the movement of long trains for short distances, an operation that is not profitable for the railroads. However, the time frame is 5-10 years for these changes to occur.

Mr. Winder also asked that if trains will still be around for 5-10 years, what is the timeline for emission reductions? Chris Weaver responded that if trains are truly parked, a stationary treatment system of the type used in Roseville might be feasible, if not cost-effective. Mike Jackson added that TIAX's study of the economics of the system will be

out in about a month. Anti-idling technology might also be useful. Chung Liu added that AQMD is pressuring EPA to act more quickly on the next tier of locomotive standards.

Jerry Wright, a consultant with "green" technology startups, asked panelists to clarify whether there are indeed currently no incentives for "green" trucks to operate in the ports, apart from the GCCOG replacement program. Chris Weaver added that the Carl Moyer Memorial Air Quality Standards Attainment program may offer such incentives, as long as the technologies are cost-effective.

V. Conclusions and Next Steps

As mentioned above, three separate efforts will be funded in the coming year to objectively evaluate the claims and promise of alternative technologies for freight movement:

- Ports of Los Angeles and Long Beach ACTTEC Study (see page 8): This study will focus on the applicability of alternative technologies for short-haul service between the ports and near-dock intermodal facilities (less than 5 miles from the ports). The effort will compare these technologies with each other and with various drayage fleet scenarios (e.g., accelerated turnover, baseline or current operations, and others). The effort should be completed by about the end of 2007.

- Los Angeles County Metro and its project partners, which include the Ports, GCCOG, and SCAG, among others, are funding an evaluation of alternative goods movement technologies as part of the EIS/EIR for the I-710 freeway. The geographic scope of this study will encompass the freeway corridor, approximately 18 miles from the port area to East Los Angeles. This study should be conducted as one of the early steps in a two-year environmental process that could begin about mid-2007.

- SCAG will fund a study of alternative freight technologies with a regional systems emphasis. This study also should begin in 2007 and may be complete in early 2008.

The results of these studies will do a great deal to further the regional understanding of the advantages, if any, to be gained by investing in demonstrations of alternative technologies. The evaluations will look at air quality benefits, health concerns, energy, and the full range of operational issues to ensure that these technologies really will serve and be accepted by the goods movement industry. The studies also are likely to shed light on which technologies could be demonstrated sooner and which may hold longer-term promise. It is also possible that the evaluation studies will indicate there is little or no advantage to the pursuit of alternative technologies.

It is likely that another finding will emerge from these studies: that no one technology is going to provide a complete solution. These technology proposals have both common and disparate elements, and the region's goods movement system likely

can benefit most from selecting the best combination of features. For example, many of the proposals involve electric propulsion, elevated line-haul or terminal operations (or both), and automation, or the potential for it. A key factor in their adoption is the ability to phase them in without disrupting existing operations, whether at terminals or on line-haul segments. The most adoptable technologies will be the most adaptable to current practice and most amenable to phasing in. The best options will also be those with achievable costs and the ability to attract investors and create revenue streams to help finance them.

Following completion of the studies over the next year, it is possible that a consortium of public and private investors will emerge, with the goal of funding engineering studies and demonstrations of terminal and line-haul operations based on the best elements of the alternative technology proposals. State and federal funding may also be available to support these efforts, particularly given Southern California's economic importance as a national trade gateway to the world.

Appendix A: Forum Agenda

Container Movement Technology Forum and Technical Roundtable Discussion Agenda

Friday, January 26, 2007
AQMD Headquarters
21865 Copley Drive
Diamond Bar, CA 91765
Main Auditorium

9:00 a.m.	Welcome	**Barry Wallerstein, D.Env.** Executive Officer, AQMD
9:05 a.m.	Self-Introductions	Panelists
	Context and Framing of Issues	
9:15 a.m.	Technical Issues and Background	**Peter Greenwald** Senior Policy Advisor, AQMD
	Forum Presentations	
9:30 a.m.	San Pedro Bay Ports Clean Air Action Plan and Technology Evaluation	**Thomas Jelenić** Senior Environmental Specialist, Port of Long Beach
9:45 a.m.	Container Movement Process	**Art Goodwin** Director of Planning, Alameda Corridor Transportation Authority
10:00 a.m.	Clean Technology Options – Overview	**Dan Smith** Principal, Tioga Group
10:15 a.m.	**Break (15 minutes)**	
	"Zero-Emission" Alternative Technologies	
10:30 a.m.	Electric Dual-mode Trams	**Lee Henderson** Member of Management Team, Micrin Technologies Corporation
10:45 a.m.	MagLev	**Mike Simon** Director of Commercial Business Development, General Atomics
11:00 a.m.	Linear Induction	**Leslie Olson** Texas Transportation Institute
11:15 a.m.	Linear Induction	**Bruce Dahnke** President and CEO, SkyTech Transportation

	Reducing Emissions from Traditional Technologies	
11:30 a.m.	Railroad & Locomotives	**Christopher Weaver** President, Engine, Fuel, & Emissions Engineering, Inc.
11:45 a.m.	Truck Engines	**Michael Jackson** Senior Director, TIAX LLC
12:00 p.m.	**Lunch (60 minutes)**	
	Roundtable Discussion	
1:15 p.m.	Moderator: **Nancy Pfeffer**, President, Network Public Affairs, LLC Roundtable Participants: • **All morning speakers** • **Ken James**, California State University at Long Beach • **Philbert Wong**, Los Angeles County Metro • **Jerry Wood**, Gateway Cities Council of Governments	
3:30 p.m.	Public Comments Summary and Next Steps	**Nancy Pfeffer**, moderator

Agenda Updated January 25, 2007

Appendix B: Biographies of Presenters

ARTHUR B. GOODWIN, P.E.
Director of Planning
Alameda Corridor Transportation Authority

Art is a registered professional engineer in California with over 35 years of experience in transportation planning and engineering, primarily with rail freight and intermodal terminal layout and development. Art initiated a planning concept study in 1980 that lead to the Intermodal Container Transfer Facility or ICTF. As the ICTF Project Manager he was responsible for planning, negotiating the rail agreements with Southern Pacific, assisted in obtaining project financing, and supervised design and construction. Today the ICTF is the largest international intermodal terminal in the US.

After six years as the Intermodal Marketing Manager for the Port of Los Angeles, Art has been working on the Alameda Corridor program for the past seventeen years. Art was the Assistant Director of Construction and Engineering where he provided oversight and direction to the engineering and construction of the over $1 Billion Corridor construction program.

In June 2004 he was promoted to Director of Planning where he is currently planning for future regional freight rail and transportation projects, with an emphasis on traffic congestion relief and the expansion of rail access and capacity to the Ports of Long Beach and Los Angeles and Southern California now that the Corridor is complete and operational.

PETER M. GREENWALD
Senior Policy Advisor, Executive Office
South Coast Air Quality Management District

Peter Greenwald has over twenty years of experience in air quality law and policy. He holds a Bachelor's Degree in economics from the University of California at Los Angeles, and a Juris Doctor Degree from the University of Santa Clara School of Law, where he was an editor of the Law Review. Mr. Greenwald currently serves as SCAQMD Senior Policy Advisor.

Mr. Greenwald joined the SCAQMD in 1980 as a staff attorney and subsequently held positions with increasing levels of responsibility, ultimately being appointed General Counsel and heading up a legal staff of over thirty attorneys, investigators and support personnel. Among his accomplishments, Mr. Greenwald was centrally-involved in developing precedent-setting regulatory programs, he drafted legislative proposals that were adopted by Congress and the state legislature, and he represented the SCAQMD in a wide range of judicial and administrative cases. From 2000 through fall of 2003, Mr. Greenwald engaged in private consulting practice assisting regulatory agencies including air quality districts throughout California and the United States Environmental Protection Agency. This work involved a wide range of policy and legal issues, including pollutant transport between air basins, federal approvability of air quality rules in Houston Texas, emission credit supplies, and legislation.

Mr. Greenwald serves on the editorial board of the Lexis/Nexis publication *California Environmental Law Reporter.* He has lectured regarding environmental law and policy at numerous colleges, universities and law schools, spoken at state bar and other conferences, authored published articles regarding environmental issues, and served as membership chair of the Environmental Law Section of the Los Angeles County Bar Association.

LEE HENDERSON
Micrin Technologies Corporation

Lee Henderson is a member of the management team of Micrin, a key manufacturing partner company for MegaRail. He also serves as a part-time staff member of MegaRail, where he provides highly essential technical support.

Micrin is one of the key partners to MegaRail in that they manufacture most of the metal parts of vehicles plus the electronic control systems for both the vehicles, guideway and stations. Micrin is also producing the entire at-grade test guideway for CargoRail and will provide most of the large cut steel parts for use in production of the guideway beams.

MICHAEL D. JACKSON
Senior Director, Transportation Technology, TIAX LLC

Michael D. Jackson is Senior Director of Transportation Technology at TIAX LLC (formerly Acurex Environmental). He is responsible for transportation policies and technologies to improve air quality and energy diversification. In this role, he directs a group of engineering and economic consultants with specialized expertise in transportation, energy, and emissions technologies. The work performed by the Transportation Technology program area includes fuel economy and emissions research; engine and vehicle design, development and demonstration; economic and air quality impacts and assessments; policy analyses; and implementation strategies. The Transportation Technology group has played a key role in demonstrating the viability of cleaner fuels in the transportation sector and more recently is helping to establish both supply and demand side measures to encourage the use of these fuels. Clients include California and federal agencies, local air districts, industrial users, and public and private fleets.

Over the past 34 years, Mr. Jackson has been working on feasibility studies and full-scale demonstrations of alternative fuels and energy systems, including prototype engine and vehicle development, advanced diesel and gasoline technologies, advanced coal conversion processes, and solar energy. He is internationally recognized for his work on low-emission heavy-duty engines and vehicles. He recently worked with California agencies to develop a cost benefit analysis to determine goals to reduce California's dependence on petroleum and to help develop the California Hydrogen Highway Network. In addition, he has provided expert testimony to Congress and to California

legislative entities. He holds B.S. and M.S. degrees in Mechanical Engineering from the University of California, Berkeley. He is a member of American Society of Mechanical Engineers, the Society of Automotive Engineers, the American Association for the Advancement of Science, and the Air and Waste Management Association. Currently, he serves on the International Organizing and Scientific Committee for the International Symposium on Alcohol Fuels (ISAF).

THOMAS JELENIĆ
Environmental Specialist, Port of Long Beach

Thomas Jelenić serves as an Environmental Specialist for the Port of Long Beach. He received his Bachelor of Science degree in Civil Engineering and Environmental Engineering from the University of California, Irvine. Thomas has been with the Port for over seven years and his responsibilities include short- and long-range planning for issues related to air quality improvement programs. Thomas has been responsible for the development of the Port's Diesel Emission Reduction Program and Emissions Inventory. More recently, he was responsible for the development of environmental covenants covering new and amended leases and was one of the key developers of the Clean Air Action Plan.

NANCY PFEFFER
President, Network Public Affairs, LLC

Network Public Affairs provides public policy analysis and communications services to public and private sector clients, focusing on environmental and transportation issues. Before founding NPA, Ms. Pfeffer spent seven years working for the Southern California Association of Governments (SCAG). Between 2004 and 2006 she was the manager of SCAG's Goods Movement Program, which she developed into an influential force in the region on this critical policy issue. From 2002 to 2004 she coordinated the public outreach effort for the 2004 Regional Transportation Plan, also known as Destination 2030. From 1999 to 2002 she coordinated SCAG's environmental justice program, developing it into a national model that was recognized by the Transportation Research Board. Before joining SCAG, she worked as an environmental policy analyst and compliance specialist for ARCO, and previously she worked for an environmental consulting firm and as a compliance specialist for an aerospace company. She has been a resident of Long Beach for fifteen years.

MICHAEL SIMON

Director of Commercial Business Development
Electromagnetic Systems Division, General Atomics

Michael Simon is responsible for developing commercial and civil applications for General Atomics' electromagnetic technologies, including magnetic levitation ("maglev") rail systems. Due to their high speed, energy efficiency, and environmental advantages, maglev is rapidly gaining favor as a transportation solution for both passenger and goods movement. Mr. Simon has more than 25 years of experience in engineering, management, and business development, all related to transportation and energy systems. He sits on the Board of Directors of ISE Corporation, a leading supplier of electric and hybrid-electric propulsion technologies for large vehicles. Mr. Simon helped found ISE in 1994 and then served as its Chairman and Co-CEO for 11 years. Prior to this, Mr. Simon worked as an aerospace engineer and project manager for 15 years, including 11 years at General Dynamics and 2 years with NASA. During this period, Mr. Simon received awards for his role in commercialization of the U.S. launch vehicle industry, and led a project to launch a 4-foot facsimile of a Pepsi can into space. He also authored a book and more than a dozen technical papers dealing with space technology. Mr. Simon holds a Masters degree in Engineering from Stanford University, where he also studied economics and political science, and taught an undergraduate course on Space Colonization during the 1970s.

DANIEL S. SMITH

Principal, The Tioga Group, Inc.

Daniel Smith has over 25 years of consulting experience in freight transportation strategy, policy, and planning, with particular emphasis on truck, rail, and marine intermodal transportation. His major clients have included ports, railroads, shippers, leasing companies, industry associations, and government agencies.

Mr. Smith has been a frequent contributor to trade journals and industry conferences, and is often quoted in industry publications. In March of 2000, he testified before the House Judiciary Committee on anti-trust issues and economic conditions in the world shipping industry. Mr. Smith has previously been a Senior Associate in the Transportation Group of Mercer Management Consulting, and Manager of Rail and Intermodal projects at Manalytics, Inc. He holds a BA in Mathematics from the University of California at Berkeley. He received his master's degree from the Graduate School of Public Policy at UC Berkeley, and did further postgraduate work in transportation economics and policy. He is a former Adjunct Professor at Golden Gate University in San Francisco, where he taught introductory courses in transportation.

CHRISTOPHER WEAVER, P.E.

President, Engine, Fuel, & Emissions Engineering, Inc.

Mr. Weaver, the founder and President of Engine, Fuel, and Emissions Engineering, Inc. is an automotive engineer with more than 18 years of experience in the areas of internal combustion engine technology, fuels, combustion, emissions, and emission controls, and in the formulation and evaluation of environmental policies. As a consultant to the U.S. EPA, Mr. Weaver played an important role in the establishment of heavy-duty diesel emissions standards, sulfur and aromatic limits on diesel fuel, and the phase-out of leaded gasoline in the U.S. A preliminary study of emissions control for off-highway vehicles for EPA led to the inclusion of regulatory authority over such vehicles in the 1990 Clean Air Act amendments. More recently, Mr. Weaver served as an expert witness for the Justice Department in its landmark "defeat device" case against the major heavy-duty diesel engine manufacturers, and directed studies to assess technology for the proposed 2004 and 2007 heavy-duty engine emission standards. As a technical consultant to the World Bank, Mr. Weaver played an important part in designing the Mexico City Transport Air Pollution Control Program, as well as similar efforts in Bangkok, São Paulo, Santiago, Buenos Aires and Colombo, Sri Lanka. Mr. Weaver also authored comprehensive reviews of mobile-source NOx and VOC emissions and control technology for EPA, and of natural gas vehicle emissions and technology for the Gas Research Institute and NGV Coalition. He has made substantial contributions to the worldwide phaseout of leaded gasoline – most recently, as the author of a "Lead Phaseout Manual" to be distributed by the U.S. EPA and U.S. AID. He has also designed and managed numerous vehicle emission testing programs, and is the inventor of EF&EE's patented **"ride along" emission sampling system (RAVEM)** for mobile-source emission measurements.