BEACON Economics

CLEAN TRUCKS PROGRAM: AN ECONOMIC POLICY ANALYSIS

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Founding Principals

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List of Acronyms

AVL	Automatic Vehicle Locator
CAAP	Clean Air Action Plan
CARB	California Air Resources Board
CTP	Clean Trucks Program
DPF	Diesel Particulate Filter
DPM	Diesel Particulate Matter
EPA	Environmental Protection Agency
ERP	Emission Reduction Plan
IOO	Independent Owner Operators
LMC	Licensed Motor Carrier
MATES III	Multiple Air Toxics Exposure Study III
PMTS	Particulate Matter Trading Scheme
PTR	Port Truck Rule
RFID	Radio Frequency Identification
SCAQMD	South Coast Air Quality Management District
TEU	Twenty-foot Equivalent Unit

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BEACON ECONOMICS

EXECUTIVE SUMMARY

Together, operations at the Ports of Los Angeles and Long Beach have been identified as the largest single source of diesel emissions in the greater Los Angeles area. The trucks providing drayage services to the ports have been found responsible for roughly two thirds of the particulate matter resulting from port activity. The Clean Truck Program (CTP) is one proposal for significantly reducing diesel emissions and hence the impact of port activity on the communities surrounding the ports and along primary goods movement corridors. The goal of the program is to reduce emissions from port trucking by 80 percent over the next five years.

This is a classic externality problem. Through their normal functioning, the operations at the ports are imposing an excessive cost on individuals that do not otherwise participate in the industry. The standard strategy to deal with such problems would be to impose some form of pollution tax on the trucks that service the port. Unfortunately, such a plan would have little chance of success given the highly decentralized nature of the industry.

The CTP instead works to reduce emissions through changes in the way the port drayage industry works. While there are a number of provisions in the plan, the two provisions that are most important are the following:

1) trucks servicing the ports must meet or exceed a particular emissions standard
2) drivers must be employed by a motor carrier licensed to provide drayage services to the ports

This report makes three important points. The first surrounds the overall benefits and costs of the program. In general the program clearly has positive value. The financial benefits of improved health for local residents are clearly much higher than the increase in the cost of drayage. Still, we believe that previous studies have overestimated the true increase in

costs that will be seen due to a variety of efficiency factors not included. The second part compares the program to what we view as inferior alternatives. The final part discusses potential difficulties that the program might face that need to be addressed.

OVERALL BENEFITS AND COSTS OF THE CTP

The clean trucks program in effect centralizes the drayage sector in a relatively small number of organizations that operate many trucks each. Of the estimated 1,400 carriers arranging drayage services for the ports, many will not survive this consolidation as independent operators—instead they will be absorbed into this new mode of doing business. This consolidation will likely cause a substantial increase in the direct costs of transport. The costs that come with formal employment – workers compensation, unemployment insurance and the like - this will likely result in higher wages being paid to truckers. Purchasing and maintaining a set of new clean trucks will also increase the overhead of these entities.

- At the same time, this consolidation also holds the promise of encouraging a significant increase in the overall efficiency of the system. This includes, for example, less wait time at the ports to pickup and drop off containers, better matching of inbound and outbound loads, and other cost reductions that come from economies of scale.

- Other studies have estimated that the costs of drayage would increase by upwards of 80 percent. We believe these cost savings have the potential to offset most of this increase, leaving our estimate of the net increase in drayage rates to be between 20 and 25 percent.

- Additional benefits that come from consolidation of the LMC's would include better accountability. The port is going to face the problem of cheating on the clean truck policy. To prevent this problem the port will need to set up a set of guidelines and punishment procedures. Such a system will work much better in the context of

consolidated LMCs. Accountability will be difficult under a situation where equipment is owned by a broad swath of truckers.

- Finally, there is the issue of sustainability. Again common ownership of the capital at use—the clean trucks—is key. These trucks will eventually depreciate and have to be replaced. Equivalently new technology will be found to reduce emissions, or further cuts in emissions will be demanded by the local community. Through consolidation of motor carriers, the CTP helps to establish the capacity of the drayage sector to keep up with increasing emissions standards.

POLICY EVALUATION

The CTP is also compared to other potential solutions to the pollution problem. These solutions include a simple mandate at the ports that trucks meet emission standards accompanied by a heavy subsidy from the ports to facilitate the purchase of new clean trucks. A second alternative is a cap and trade system for emissions. These policies are compared on the basis of sustainability, ease of implementation and efficiency. Though it does not receive perfect marks and does not score the highest in any single category, the CTP receives good grades in each. The simple mandate scores very poorly in terms of sustainability and efficiency and the cap and trade system has significant issues with implementation. Overall, the CPT fares well relative to these alternatives.

PITFALLS

A significant reorganization of any industry is not without potential pitfalls. The CTP is subject to four, in particular.

- There is a risk of diverting substantial numbers of containers to other ports, significantly dampening growth at the San Pedro Bay ports. This risk, though real, is not significant given the very small contribution of drayage to the overall costs of moving containers. Indeed, estimates of the impact of even the worst case scenario of rate cost increases indicate the potential diversion of less than 1.5 percent of port

throughput, much smaller than the annual growth of traffic at the port over the last decade.

- There is a strong influence of unions at the ports and the potential for unionization among drivers once the CTP is in place. This could reduce potential efficiencies that would otherwise come from consolidation. In order for the potential efficiencies to be realized, there must be cooperation on the part of all actors.

- There is the potential for too much consolidation of the drayage sector. With consolidation comes market power. At its extreme, monopoly, there is again, the potential that the efficiency gains could be left unrealized. Any policy put into place must work to maintain competition among the LMCs.

- Last, there is the difficulty of implementing the clean truck program without leading to short-run but potentially significant disruptions in service. Were the program to be abruptly foisted upon the ports and the drayage sector, there is the potential for disruption. However, the program is likely to be phased in over the course of five years. This is more than ample time for these changes to be phased in and significant disruptions are not likely to result.

Clearly the current mode of operation at the port are not going to last—mitigating the pollution resulting from port activity is crucial to future growth. The Clean Truck Program is a valid policy prescription for significantly reducing the emissions from one element of port activity. Though complicated, and representing a significant alteration in the current functioning of the industry, it incorporates a set of changes that together significantly reduce emissions and have the potential to dramatically enhance efficiency.

Though significant pitfalls do present themselves, these pitfalls are no greater than those that might challenge other sustainable policy approaches. In this case, sustainability is closely linked to the collective interaction of the program's elements. Remove any of the

plans primary components and the system will be unlikely to have as significant of an impact on the problem.

The primary obstacle to this plan is perhaps the fear that change will be painful. Economic agents have proven themselves time and again to be agile adaptors to change. Witness, for example the PierPass program. There was enormous skepticism that this program would succeed. Quite to the contrary, it has been enormously successful with a significant percentage of port drayage happening in off hours. This is likely the case with the Clean Trucks Program as well. The significant skepticism currently being voiced will be proven to underestimate the capacity of those involved to respond appropriately. Never is the adaptability of an economy so questioned as when change is being prescribed.

I. INTRODUCTION

Over the past several decades, the ports of Los Angeles and Long Beach have evolved into the leading funnels of trade in the United States, and San Pedro Bay is now home to the world's fifth-largest container port complex. In 2007, the combined ports of Los Angeles and Long Beach handled in excess of 14.2 million twenty-foot equivalent units (TEUs) of containers.[1] The ongoing port activity plays an important role in the regional economy, generating significant numbers of jobs, facilitating the availability of inexpensive inputs for local producers, and providing a convenient outlet for local exporters.

The ports also play a tremendous role in facilitating trade for the rest of the nation. In all, more than 40 percent of the nation's containerized imports flow through these ports. It has been estimated that only 23 to 40 percent of the import containers are for local use, with the balance traveling outside of the region.[2] The ports therefore facilitate the distribution of inexpensive imported products around the country.

Moving trade to and from the ports requires trucks and drivers, making truck drayage a critical component for the success of goods distribution. The truck drayage industry drays, or hauls, containers inland from the ports to intermodal facilities, warehouses, and distribution centers. While there are alterative means of moving goods, such as trains through the Alameda corridor, the cost and speed advantage of trucks continue to make them the dominant carrier.

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[1] A TEU is the standard measure of throughput for container ports. Although 20-foot containers are often used, it is more common for containers to be 40 feet in length. Accordingly, the ports in San Pedro Bay handled something more than 7.1 million and significantly less than 14.2 million distinct containers.

[2] This figure is drawn from Leachman et al. (2005). It is estimated by analyzing the proportion of economic activity taking place within the region and allocating imports on that basis. As the local economy is likely to be relatively import intensive, the figure of 23 percent is a lower bound, with local imports being unlikely to exceed 40 percent. However, the proportion of imports for local use is generally believed to be substantially less than 50 percent.

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Since the Motor Carrier Act of 1980, a move to deregulate American trucking, barriers to entry into the market have collapsed. From 1980 to 1990, the number of competing operators servicing the port doubled.[3] Now, an estimated 16,800 trucks compete in the San Pedro Bay drayage industry, the majority of which are driven by Independent Owner Operators (IOO).

State laws and regulation mandate a set of environmental and safety standards for the fleet, but in reality there is little oversight of the industry beyond the occasional random stop by local police. The sheer intensity of traffic allows truckers to easily dodge these rules and a large grey market for repairs and parts exists. Thus, many of the trucks serving the ports are marked by weak maintenance and unnecessarily high emissions.[4] This is a classic externality problem—local residents are being forced to bear the burdens of unsafe roads and polluted air generated by business at the port.

Currently, five of the six pollutants used by the EPA to determine air quality exist within diesel emissions: ground-level ozone (O_3), nitrogen oxides (NO_x), carbon dioxide (CO_2), sulfur oxides (SO_2), and particulate matter (PM).[5] According to the Multiple Air Toxics Exposure Study III (MATES III) report, diesel particulate matter (DPM) presents the greatest risk by far to the Los Angeles region; it is five times more prevalent than the next four most toxic risks combined. It is also highly related to drayage. In its most recent investigation of California's pollution sources, the Southern California Air Quality Management District (SCAQMD) found diesel emissions highest in and around port areas.[6] Though in overall decline, emissions have become more clustered along transportation corridors emanating from the port, indicating a concentration of these emissions in the drayage sector. (See figure below.)

The combined ports of Los Angeles and Long Beach therefore represent the largest single source of emissions in the South Coast Air Basin.[7] And while trucks only represent 10

[3] Wikipedia, "Motor Carrier Act of 1980."
[4] LA Times article
[5] Monaco 2007.
[6] MATES III.
[7] South Coast Air Quality Management District, 2007 AQMP.

percent of the emissions at the port, they account for 66 percent of DPM emissions resulting from all port-related activity (throughout California).[8] Around the San Pedro Bay Basin, heavy-duty diesel trucks only constituted 3 percent of California's on-road vehicle traffic in 2000 and only 5 percent of California total vehicle miles traveled, however they released 36 percent of total NO_x (secondary diesel particulate matter) and 50 percent of diesel particulate matter.[9]

Figure 1.

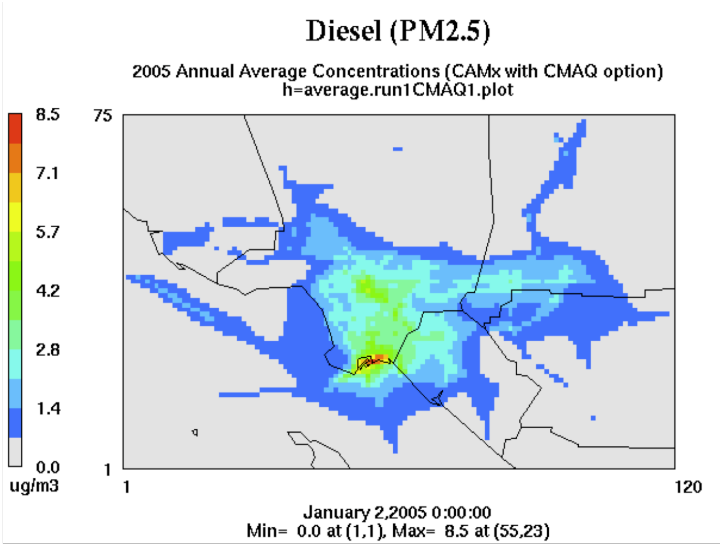
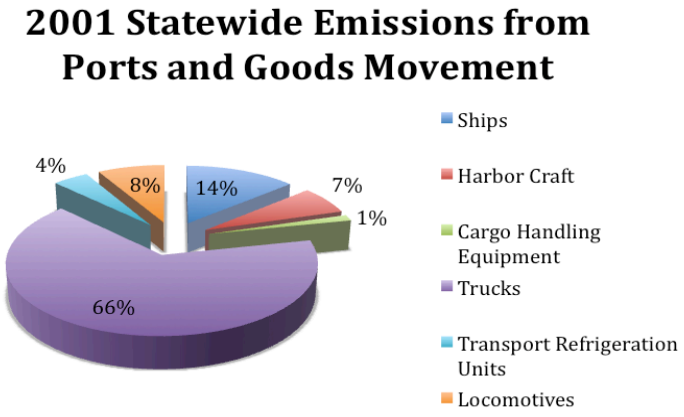


Figure 2.



The DPM emissions from trucks significantly affect public health. These emissions constitute 86.4 percent of the major cancer-causing pollutants released into California's atmosphere, and in 2005 they contributed to approximately 2,400 premature deaths, 2,830

[8] California Air Resources Board Emission Reduction Plan for Ports (2006).
[9] California Air Resources Board Vehicle Emissions.

hospital admissions, 360,000 missed workdays, and 1,100,100 missed days of school.[10] The economic impact of the problem is therefore significant. According to a CARB study, reducing DPM emissions through the mandates of the Clean Trucks Program (CTP) could yield a reduction of 230 to 1,450 premature deaths between 2008 and 2025.[11] A similar study by the South Coast Air Quality Management District (SCAQMD) determines the range to be slightly lower, from 180 to 1,110 deaths. Thus, assuming the value of an avoided death to be $8.2 million (in 2007), the resulting cumulative economic benefits have been estimated to be between $4.7 billion and $5.9 billion.[12] However, this number is almost entirely a reflection of the value of lives retained. These are underestimates of the total cost as they do not take into account the resulting nonfatal illnesses, hospitalizations, and lost days of work. In addition, truck movement and other port-related activities can lead to traffic congestion and declines in property values in the surrounding areas.[13]

Accordingly, the ports have come under a great deal of pressure from local communities to take measures aimed at reducing these costs. Though not exclusively responsible for this pressure, the tremendous pollution footprint has received the lion's share of attention. In response, the ports of Los Angeles and Long Beach approved the Clean Air Action Plan (CAAP) in November 2006. Because it has a large and readily apparent impact on local communities, cleaning up the trucking (drayage) activity in and around the ports is a point of emphasis in the CAAP.

One proposed means of changing the trucking system is the Clean Trucks Program, which calls for a dramatic reorganization of the drayage industry. Among the most salient features of the program are mandates that a Licensed Motor Carrier (LMC) employ the drivers of the trucks servicing the ports, and that these trucks meet strict emissions and safety standards. There is little debate that improving the environmental impact of the trucking industry on the local community has a positive net value—the value of reducing

[10] California Air Resources Board (2006).
[11] Taken from Husing (2007).
[12] The value of an avoided death is based on wage premiums for fatality risks associated with various jobs and the risks of accidental death.
[13] ICF International (2008) finds trucks to account for 45-60% of traffic in Caltrans district 7, and a third of the causal sources of collisions.

the negative health impact of drayage is clearly much larger than the cost of the program. On the same note, the overall cost of drayage is very small relative to the overall value of the goods being carried (considerably less than 1 percent), and even a significant increase in costs would have a minimal impact on the overall cost of imported goods. Nevertheless, there is the fear that significantly raising the costs of moving goods through these ports could cause shippers to choose alternate routes for moving goods into the United States. As such there is interest in finding the least disruptive and lowest cost way of meeting the public mandate.

Given the significance of the changes required by the Clean Trucks Program, it is important to understand the economic effects and market sway of its implementation. We provide a synthesis of known facts regarding the drayage sector in Southern California and draw on current economic expertise to analyze and predict the likely results of implementing the CTP on drayage costs. We also analyze the efficacy of the CTP relative to several other potential policies for cleaning up the ports.

The report is organized as follows. We first provide an overview of the Clean Trucks Program. The next section presents an evaluation of the program's likely economic effects. To offer a broader understanding of the economic tradeoffs involved, we follow our economic assessment of the CTP with an evaluation of the program's merits relative to other policies that would also reduce emissions from drayage activity. We then discuss issues surrounding the transition path between the current configuration of the drayage industry and that proposed by the CTP. A final section provides a summary of our findings.

Our findings revolve around four different considerations: the importance of the dual nature of the CTP program in regards to the minimum standards for trucks and the need for consolidation among the carriers, how the CTP might affect the long-term economics and market structure of the drayage sector, how the CTP as a policy for emissions reductions stacks up against a pair of alternatives, and how a transition from the current relatively laissez-faire drayage sector to one that is substantially more regulated might be managed.

- We believe that the dual nature of the CTP program is necessary for the success of the program. That is to say consolidation of truck ownership is a necessary condition for the successful implementation and maintenance of the minimum pollution and safety standards. This is due to the fact that monitoring a fleet made up of literally thousands of small operators will be nearly impossible, not to mention the basic economies of scale that are also important for operating and sustaining the program. There are a number of potential pitfalls to consolidation, but with proper management we believe that the negative impact of these pitfalls can be minimized.

- There is a downside to consolidation—the potential for the direct costs of drayage to rise primarily due to the formalization of employment for the truckers along with the potential greater impact of unionization on wages. According to other studies, these increased wages and other overhead requirements for motor carriers under the LMC could increase drayage rates by up to 80 percent.[14] However, we expect these cost increases to be accompanied by significant improvements in efficiency if the trucking firms are consolidated into fewer and larger entities. Combined, the increased costs and efficiencies may well cancel each other out to a large extent, leaving the drayage price increase in the range of 20 to 25 percent.

- In terms of policy options, we evaluate the merits of the CTP relative to two alternatives in terms of sustainability, efficiency, and ease of implementation. The alternatives explored include a simple mandate by the ports that trucks providing drayage services meet some emissions standard, and a cap and trade pollution-permitting regime. None of these policies receive top marks in every category, and the CTP is in no single dimension the optimal policy prescription. However, the CTP does represent a reasonable compromise between these competing characteristics and fares well in this respect vis-à-vis the other two policies.

[14] Husing (2007)

The transition from a regime of low and loosely monitored safety and emissions standards to one with tight controls on each, combined with an employment requirement, is a complicated matter. The difficulties associated with such a transition could potentially include significant supply disruptions and accompanying price spikes, as well as the dislocation of significant numbers of industry workers if the situation is not handled well. Yet these are challenges that must and can be met given the need for a clean truck program that is both effective and sustainable. The proposed phased-in implementation strategy, combined with efforts to facilitate job matching between dislocated workers and the remaining industry participants, can help to significantly ease the transition, keeping the ports running smoothly and reducing any potential disruptions to goods movement.

II. Clean Trucks Program - A Brief History

The Current State of the Industry

The loose organization and highly competitive configuration of the drayage sector is largely a product of deregulation measures over the past three decades. In hopes of stimulating productivity in the American economy, President Carter signed the Motor Carrier Act into effect in 1980. This effectively erased barriers to entry in the trucking industry and removed direct rules that had reduced price competition. However, interstate commerce was still highly regulated, prompting passage of the 1995 Interstate Commerce Commission Termination Act. As a result of these two acts the number of trucking companies increased over 27 times between 1975 and 2000 and prices fell rapidly. Deregulation created an estimated $60 billion savings in national income, and reduced prices caused trucking's share of the freight market revenue to expand 80 percent.[15]

Today it is estimated that approximately 16,800 trucks provide drayage services to the San Pedro Bay ports.[16] Though not always the case, these trucks are generally operated by independent operators working through a distributor. The distributor primarily plays the

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[15] U.S. Department of Transportation, Freight Management Operations, "Regulation: From Economic Deregulation to Safety Regulation" (2005) (http://ops.fhwa.dot.gov/freight/theme_papers/final_thm8_v4.htm#_ftn1)

[16] Goodchild (2008).

role of an information middleman between the drivers and shippers. Otherwise they have little role in coordinating operations at the port. Current rates run from $100 for a short haul to more than $700 for destinations further away from the port. In general, drivers are able to make between two and four turns a day, with a mean of just over 3. A "turn" in this context represents a single round trip between the port and the drop-off or pickup point for a given container. Under these conditions, IOOs working just over 11 hours per day make an average hourly wage of just under $12 net of operating costs.[17] For the average driver, this translates into an average annual income of just under $34,000.

According to data from the Bureau of Economic Analysis, only slightly less than one third of all employees in the trucking industry were self-employed in 2006 (approximately 650,000 out of 2.15 million) although it is a slightly higher proportion for drivers alone. Why they dominate port traffic is more than an interesting question; it becomes the central issue for the CTP program. The reason is likely due to the volume of traffic at the ports. Most trucking activity needs some degree of centralized coordination due to the wide geographic distribution of activity, and the variance in load sizes. At the far end of the spectrum from this perspective would be Fedex or UPS where millions of small packages are moved between millions of different locations. Without the centralized coordination of the various trucks these carriers could never achieve the efficiency necessary to make their operations affordable to their clients. Economies of scale dominate. An independent trucker could never make a living in this market.

There is an offset to economies of scale—labor costs. Larger firms pay a higher hourly wage to their drivers. There are many potential reasons for this. Wage employment regulation (workers comp, overtime pay, etc) is one. Another reason is to offset the moral hazard problem of separating ownership from management as occurs when a driver operates a truck owned by someone else—the firm they are hired by. Firms have an incentive to overpay (or in economics literature, pay an efficiency wage) the worker (an 'efficiency wage') in order to give them something to lose if they should behave

[17] These figures are drawn from Grobar and Monaco (2004), but they are adjusted for inflation to 2007. The inflation factor for Los Angeles between 2003 and 2007 is 1.135.

irresponsibly. Lastly there is the threat of unionization. Large firms are subject to a degree of capture by unions who, through collective bargaining, can raise wages above the market level. These issues can give the independent trucker a cost advantage if economies of scale do not dominate.

Deregulation in trucking ushered in a new era where the independent trucker dominated the industry. Yet over the past fifteen years there have been waves of consolidation as information technology has increased the economies of scale aspect of the industry. The labor cost advantages of the IOO have been slowly eroded over time. This is not obvious at the ports, however. Here the independent trucker is still the rule rather than the exception.

The ports represent one single location where there are many large loads that need to be delivered, each to a single location. Here the independent trucker can find guaranteed work as they can be as 'efficient' as a large trucking operation from a logistical standing. Because the only barriers to entry in the port drayage market are the purchase or lease of a truck, the acquisition of the relevant driving credentials, and a connection to one or more distributors, it is highly competitive. This is a benefit to shippers and consumers since it implies that drayage costs fall to low levels.

Unfortunately there are a number of distinct disadvantages to such powerful competition as well.

- It is not uncommon for drivers to take shortcuts to maintain their income, particularly among the IOOs. These shortcuts include inadequately maintaining their rigs (compromising both safety and emissions), driving in an unsafe manner (overloaded), or accepting a chassis from the terminal operator that is in a state of disrepair.[18] Larger firms are less likely to take such short cuts, as the potential legal and financial liability from a subsequent accident could end up being much larger than simply the value of the lost truck. Indeed in a worst case scenario a lawsuit could very well bankrupt the company. For an independent trucker there is little to

[18] According to Monaco and Grobar (2004), nearly 50% of drivers in their survey reported receiving a chassis that was not roadworthy in the 30 days prior. 22% of these reported taking it on the road. Anecdotally, she found that several drivers were hassled for refusing to take bad chasses too often.

lose outside of the truck itself. This in turn tends to give the IOO's a considerable pricing advantage over larger competitors, reinforcing the problem.

- Because independent truckers dominate port traffic, there is a serious lack of coordination between inbound and outbound deliveries. Only 12 percent of the trucks flowing into ports carry loaded containers for export, even though exports make up a full third of overall traffic by weight.[19] Many of the arriving and departing trucks don't even carry an empty container. Over 40 percent of the arriving trucks carry nothing ('bobtail in') and over 40 percent leave the port with nothing ('bobtail out'), presumably en route to pick up an export, an empty container, or a chassis. In 2003, Le Dahm Hahn found that only about 2 percent of empty containers are reused for local export, and Goodchild finds that only 18.7 percent of truck trips match imports with exports.[20] So what we see is a system in which many container trips to and from the port require four turns—two to deliver the container out and return bobtailing, and two to bobtail out and return with an empty container.

- This lack of coordination causes port efficiency to be further hampered by time spent waiting, both at the gate and within a terminal. Hayden et al. (2006) find that trucks wait on average 10.19 minutes to enter the port. After entry, the amount of time it takes a truck to complete its business and leave the port depends on its operation. At the Port of Los Angeles, Hayden finds a time range from 40 minutes to 60 minutes, while at the Port of Long Beach it takes between 20 minutes and 70 minutes. In her survey of drivers, Monaco finds a much larger number—2.2 hours of average waiting time.[21]
- A final issue that arises from the structure of competition as it currently stands is that the trucking fleet serving the two San Pedro ports is likely among the oldest in the

[19] Goodchild (2007), Bureau of the Census data on goods trade
[20] Similarly, Tioga (2002) finds that in 2000, only 3% of empty container movements in Southern California were between facilities outside the port, further indicating the lack of coordination.
[21] Waiting time is calculated as 48% of total trip time, the median of which falls at 4.6 hours.

nation.[22] Of the number of truck miles driven in providing drayage service to the ports, more than half are provided by trucks that are at least 10 years old (see figure 3).[23] This means that their emissions represent, at best, the standard prevailing in 1997. However, without proper maintenance, emissions rise significantly as the vehicle ages, so even a 1997 vintage vehicle is unlikely to perform at 1997 emissions standards. The reason for this is that the IOO's are far less likely to have the incentive or ability to invest in new equipment. Capital costs for small firms are higher, making the purchase of new trucks more expensive. Moreover large firms are hardly going to want to leave expensive new trucks idling for hours on end at the ports. They would much rather use it in a capacity where the cost of capital can be spread out over more productive activities.

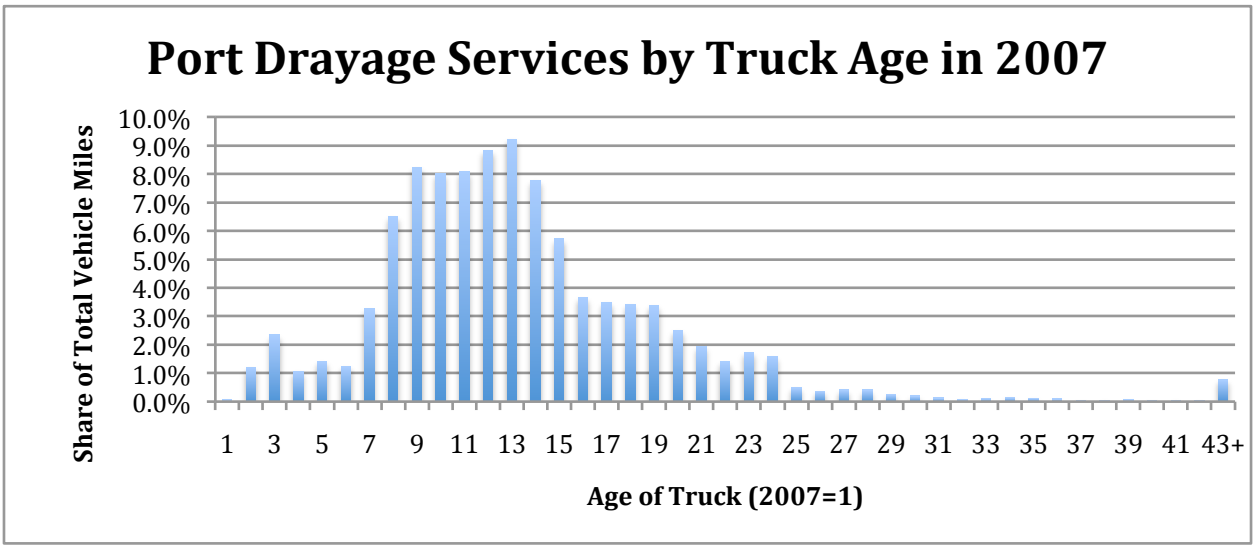

Figure 3.

With all these problems, it is hardly surprising that the trucking fleet that services the port represents one of the larger environmental challenges in the region.

Here is the fundamental quandry: Information technology has had an enormous impact on the logistics industry. In many ways the IOO's should be pushed out of the port business

[22] Monaco (2007) finds a preference among drivers to buy used trucks. In her survey she finds the model year 1996 as the industry median; on average drivers bought their trucks used and 7 years old. The mean price for these trucks was $24,177 (unadjusted), and the most common financing option for the trucks was a high interest rate loan (with a median interest rate of 14 percent), though many had paid that off. Among those still paying for their trucks, the mean monthly payment was $892—less than half the monthly cost of lease payments.
[23] The long-haul trucking sector generally turns its fleet over every 48 months.

as the ability to coordinate trips through the port should have allowed consolidated operators a cost advantage, particularly in this time of high fuel costs. Yet they are not able to capitalize on such economies because of the competition at the ports — caused in large part by the preponderance of independent truckers — a vicious cycle that has become self perpetuating. Large firms are unable to leverage their economies of scale to offset their higher labor costs because of the intense competition between IOOs, allowing small firms to be competitive even without the investments necessary to exploit economies of scale. In short, operations at the port have become mired in an inefficient way of doing business. The ports themselves do not directly incur most of the costs of these inefficiencies—but the local community does.

The CTP

In November 2006, the ports of Los Angeles and Long Beach approved the Clean Air Action Plan (CAAP) in hopes of reducing port emissions. In theory, the CAAP will realize a reduction in pollution of at least 45 percent in five years.[24] A significant component of the proposal is the CTP, a combination of regulatory measures aimed at cleaning up the drayage industry. In addition to reducing pollution, however, the CTP would in its current form restructure both trucking operations and the relationship between port terminals and trucks.

For the purposes of this report, two general elements of the CTP are particularly relevant. These elements include:

1) Demonstrated compliance with specific emissions and safety standards for all trucks. All drivers are required to be properly insured.
2) Trucks providing drayage services must be under the legal control (functional ownership) of a Licensed Motor Carrier. The LMC's will pay a one-time concession activation fee and an annual permit fee per vehicle.

[24] "The Road to Shared Prosperity: The Regional Economic Benefits of the San Pedro Bay Ports' Clean Trucks Program."

Enforcement will exist at port gates, where trucks adherent to the CTP will be filtered from those that are not. In order to reduce emissions, only 'clean trucks'—trucks manufactured in 2007 or later, retrofitted trucks manufactured after 1996, or trucks that have been replaced through the Gateway Cities Truck Modernization Program—will be allowed entry after a gradual adjustment period running from 2008 to 2012.[25] During this period, groups of the oldest trucks servicing the port will be banned, while trucks falling between the bottom bracket and compliance will be charged a Truck Impact Fee (TIF) upon each entry. The funds raised by the fee will then contribute to the Gateway Cities Program, which provides financial aid for the fleet's modernization.

In order to service the ports, motor carriers that currently coordinate trucks and port activity will be required to buy a concession and own the trucks that work under them, thereafter acquiring the title of Licensed Motor Carrier (LMC). The trucks may also be leased by an LMC at market rates from its employee owner. By rule there will no longer be independent truckers operating at the port—any driver will have to be employed by the firm that owns the truck. In a sense this rule is a bit redundant—as it is unlikely that a driver of a truck owned by a third party firm could be classified as anything else given how labor laws regarding employment read. Similar to the adjustment period for truck upgrades, each year between 2008 and 2012 will see stricter enforcement of driver employment within Licensed Motor Carrier (LMC) firms, until the 100 percent goal of 2012.

These two elements alone represent a dramatic restructuring of the drayage industry serving the San Pedro Bay ports. While this may seem like regulation well above and beyond wat is necessary to clean up port trucking, each element provides a critical link in fully realizing the potential for maximal emission reductions. There are essentially two reasons for this.

- Accountability: As noted independent truckers have a real economic interest in dodging the rules regarding environmental and safety standards. After all, the cost

[25] See www.cleanairactionplan.org/about_caap/clean_trucks.asp

of these standards accrue to the driver while the benefits are spread out over the local population. The ability for the ports to maintain the programs relies on them being able to effectively identify those breaking the rules and meting out sufficient punishments in order to dissuade others from taking the same shortcuts. This process will be much easier with a reduced number of owners, each with a larger fleet. Monitoring fewer owners is simply cheaper, and the fact that getting caught cheating with one truck may idle many, substantially reduces the incentive to cheat.

- Sustainability: All trucks will need substantial upkeep during their operating life to maintain standards and will eventually need to be replaced. Larger firms have substantial economies of scale in maintaining their equipment and have lower capital costs, making continued reinvestment in their stock more affordable. Larger firms will also coordinate the use of capital better (see below), further reducing the cost of capital to the firms. Lastly, firms will have a longer investment horizon than an IOO for no other reason than the discount rate for an individual is higher than it is for a firm. The net result is that the plan is likely to be more sustainable with the basic restrictions on ownership. Otherwise the stock of new clean trucks is likely to depreciate rapidly, leaving the ports with little choice but to again subsidize fleet turnover in 5 years time.

It seems clear that the consolidation of truck ownership would significantly reduce the ports' cost of running the program, and improve its overall success at reducing emissions. Yet consolidation is also one of the most controversial parts of the plan because of the employment provisions that are likely to raise wages. It has been viewed by many as simply a back door method of unionizing the trucking industry that operates out of the port. Still, the Teamster Union has pushed hard to implement the full version of the program.

In any case these fears are largely overblown if a consolidation plan is run properly, as we discuss below.

III. Economic Implications of the CTP

Implementing the Clean Trucks Program

The Clean Trucks Program imposes a new set of constraints on the functioning of the drayage industry. As noted, two constraints in particular would have a significant impact on trucking operations, the requirement that trucks meet minimum and strict emissions standards and the requirement that drayage companies acquire a license from the port. Under the terms of this license, they must employ their drivers and take responsibility for the maintenance of the trucks. Both of these requirements raise costs.

For the industry to acquire trucks that meet the emissions standards of 2007 or later will be an obvious challenge. The cost of a new diesel tractor is approximately $100,000, depending on the truck specifications. Leasing a new truck generally costs $2,000 per month and $0.06 per mile (which often includes maintenance). It is fairly clear that independent truckers have little desire and less financial ability to make such a large investment. Initially, the ports will clearly need to subsidize the upgrading of equipment, particularly for independent truckers.

In a survey of driver preference for subsidization schemes, Monaco (2007) finds the strongest support for a grant-based program among drivers. However, the response for the grant-based program was also the most polarized, possibly due to the caveat of signing a contract for five years' work with the port in return for the grant. The next most popular option was a subsidized interest rate loan that only tied drivers to two years' work at the port. However, given the truckers' reluctance to enter into a contractual obligation with the port in return for financial aid for a new truck, they may be inclined to work for an LMC who, through economies of scale, could afford lease payments for new trucks.

In short, consolidation may be a byproduct of the technology upgrade and as such may not need to be specifically written into the rules. Per se, the ports may not be able to avoid the issue of higher labor costs that come along with consolidation. Nevertheless, functionally putting these rules into place will ease the process of integrating the program into the day-to-day operations at the port.

In one of the most significant changes in the functioning of the drayage industry, the new LMCs will have an intensified incentive to use drivers and trucks more efficiently. This is intensified by the higher cost of capital wrapped up in newer, more expensive trucks.[26] Although drayage companies do currently have incentives to use drivers and trucks efficiently—more efficiency means more containers moved and more profits—maximizing the efficiency of the drivers and trucks requires an investment in time and equipment. Given the very competitive nature of the industry, the payoff to making these investments is not currently high enough. Perhaps only through consolidation of the industry will these investments be profitable.

This increased incentive has a variety of implications for the ports' drayage sector, not the least of which may be the need for far fewer trucks. There are at least five ways in which these new incentives could manifest themselves if given a chance:

1) Increased matching of inbound and outbound loads.
2) Increased pressure on terminal operators to reduce wait times.
3) Higher safety standards, both in maintenance and operation.
4) More slip-seating (trucks driven more than one shift by more than one driver).
5) Better use of off-peak pickup and drop-off opportunities.

Each of these changes is derived from one of two complementary and new sets of interests:

1) Maximizing the return on a truck.

[26] The airlines represent the extreme example of this force—with millions of dollars of capital wrapped up in each plane the airlines have an incentive to maximize the value of that capital by running it as much as possible in the course of a day or week. On the other end of the spectrum a carpenter does not feel the need to use a $3 hammer 24 hours per day and may well leave it untouched for days at a time.

2) Maximizing the hourly output of each driver.

The new LMCs will want to maximize the return on every truck in order to be able to take full advantage of their economies of scale, and their incentive will be further enhanced in that the useful life of a truck has now been shortened by the CTP. If the CTP aspires to long-term sustainability, the minimum emissions standards will necessarily increase over time. Accordingly, a new truck purchased in 2007 may not meet emissions standards in 2013. The LMC will thus be maximizing the return on the truck investment during a window of only five years, rather than the 10 years to 15 years the truck might otherwise be used. Maximizing the return on investment requires that the truck be put to use as many hours per day as possible, moving as many containers as possible in the finite time that it can service the port.

In the current configuration, the useful life of the truck is unknown, with emissions standards playing little or no role. Although it is not uncommon for drivers to share a truck, it is not the rule. Under the CTP, the same truck will likely be in service most of the 24 hours in a day, provided there is a load available for it to move. An important implication of this incentive is that fewer trucks will be necessary to meet a given level of port demand. And with fewer trucks on the road, a beneficial side effect for the local economy will be reduced traffic on the highways that service the ports.

As noted, consolidation will likely be accompanied by higher labor costs. Yet here there is also a beneficial side effect—the firms will want to maximize the hourly output of each driver. This is synonymous with minimizing turn times. On average, a driver currently makes just over three turns in an 11-hour day.[27] The time it takes for each turn depends on a variety of factors. Consider an import container. Starting outside the port gates, the duration of the turn depends on the following:

1) How long the truck takes to get onto the terminal.
2) How long the truck takes to get loaded once inside the terminal's gates.

[27] Grobar and Monaco (2004).

3) The amount of congestion on the roads between the port and the container's destination.
4) The likelihood of the truck being involved in an accident or delayed by mechanical failure.

Points 1 through 3 are each related to minimizing average turn times. Avoiding congestion by driving at night and in the middle of the day can reduce turn times. Though this is not entirely at the discretion of the LMCs, they will likely pay more attention to the time at which containers are traveling between the ports and their ultimate destination. In so doing, they can reduce wait times at the ports and travel times between the ports and container destinations.

There are thought to be some 1,400 different entities currently coordinating activities between the terminal operators and the IOOs. This large number of dispatchers is possible only because all that is required to enter the business is (1) a telephone, (2) knowledge of who to call at the port (a terminal operator), and (3) the phone number of a truck driver. These are remarkably low barriers to entry. And as a result even if a smart entrepreneur wanted to create a more efficient way of providing drayage services to the ports, they would be unable to capitalize on their organizational advantages due to the overall mass of unorganized operators that create long lines and waiting times.

At the moment the only pressure exerted on terminal operators to quicken turn times is from the shippers themselves. As terminal efficiency is still wanting, this pressure is clearly not sufficient. The Clean Trucks Program should improve efficiency by providing more leverage from fewer dispatchers. With the requirements that are necessary to participate in the market as an LMC there will likely be far fewer "dispatchers" than are currently in operation. This will create a balance of competitive forces between the port operators and drayage firms—to the benefit of shippers and the local community.

Under the CTP, each LMC will be larger on average than is currently the case. In order to maximize their profits, the LMCs will serve efficient terminals first. LMCs will seek business from terminals with quick turn times, servicing slow terminals only when there is excess

capacity in their fleet. In order for the terminal operators to attract the necessary drayage trucks, they will either have to find an LMC that is willing to let their truck sit idle for an extended period of time, or they will have to offer higher drayage rates. This could happen explicitly through negotiations with the LMCs or implicitly as the market would make it necessary for less efficient terminals to pay more. This market mechanism will therefore serve to encourage efficiency at the terminals above and beyond the current configuration.[28]

The dispatcher currently has little reason to be concerned if the truck, having dropped off a container at a warehouse, returns empty, with a single or a set of chassis, with an empty container, or with a container for export. The large number of bobtail trucks entering and exiting the port gates demonstrates the low level of attention to coordinating activity. The current lack of incentive to maximize the value of either the truck's time or the driver's time stems from the dispatcher's easy access to both; the dispatcher neither pays for repairs owing to empty miles driven nor pays for the cost of driving the truck back empty.

Under the Clean Trucks Program, the incentives would change. Because the LMC will be responsible for maintenance and fuel, they will want each mile driven to count. Depending on the compensation structure for the drivers, they will also want each minute behind the wheel to count. As a result, LMCs will likely take greater care in matching loads. If one of its trucks is headed for the Inland Empire, the LMC will invest time and money in finding a return load for the truck. In this way, it will maximize profits and return on investment.

This same profit motive will enhance the safety of the vehicles. In particular, a truck sitting by the side of a road with a flat tire is not making the LMC any money. It also seems likely that an LMC with a bad record of accidents will suffer in terms of having its license renewed.

Realistically these changes will take some time to come about. One might wish that the CTP also contained more direct incentives to help move the process forward. For example

[28] Indeed, Monaco and Grobar (2004) found in their terminal survey a relationship between a large motor carrier and a terminal that was dramatically more efficient than common drayage operations.

the ports could be required to create a centralized drayage order system to facilitate the more efficient use of truck and worker time by reducing wait times. Fees could be assessed in such a way as to promote backhauling—for example assessing a special bobtail fee. Port operators might be asked to operate in a way that would facilitate the flow of trucks—for example staggering break periods to prevent the complete shut down of operations during the course of a normal business day. Of course these ideas raise their own set of legal issues.

LONG-TERM PRICING IMPLICATIONS

The primary long-term concern regarding the Clean Truck Program is the impact that it will have on drayage rates. Low drayage rates are important for allowing traffic through the ports to continue to grow, while significant increases have the potential to divert containers to alternative ports. At the same time, however, current drayage rates are artificially low because of the lax standards that are applied to drayage vehicles.

There are competing influences on drayage rates that arise from the CTP. The most obvious effects include the increased LMC costs that arise from the provisions discussed above. First, employing drivers is clearly more costly than making use of independent contractors.[29] Also, additional costs arise from the need to obtain a license from the port and the requirement that LMCs be responsible for the maintenance of their trucks, as well as provide space for parking the trucks. At the same time, there is significant scope for improving the efficiency of drayage operations. These efficiency improvements will serve to offset the increase in costs, mitigating the increase in drayage rates.

[29] There has been a case made that that wages will have to rise to maintain or increase the number of drivers. In particular, surveys suggest that the pool of drivers may be substantially diminished because of this requirement. Husing (2007). From our perspective the specter of a labor shortage caused by a labor shortage is largely inconceivable. It would seem silly to imagine that a driver would turn down higher wages and insurance due to some base desire to be self employed. Also, there are roughly 60,000 people employed directly in the trucking industry in the greater Los Angeles area, not to mention the number of drivers employed in other industries from retail to wholesale to manufacturing. There is an enormous pool to draw from. Finally, truck driving is a relatively low skilled occupation. The only requirement is a special license that can be obtained by anyone able to pass a basic test with the DMV. Given the plentiful supply of unskilled workers in the region, attracting new drivers should seem easy.

In what follows, we present results from a model of drayage pricing that will illustrate the impact of the CTP on drayage rates. Examples of the rates paid to IOOs are presented in Table 1.

TABLE 1: EXAMPLE DRAYAGE RATES: IOO COMPENSATION

Destination	Fee	Distance (Miles)
Carson	$90	9
Commerce	$125	40
Ontario	$165	52
Riverside	$176	60
Bakersfield	$310	136
Fresno	$420	245
Sacramento	$710	409

These rates clearly vary by distance. Indeed, taken collectively, they can be broken down into a fixed portion and a variable portion. That is, a set amount per round trip, the fixed portion, and a per mile charge, the variable portion. In fact, a fixed portion in the amount of $89 and a variable portion of $1.50 per mile very closely approximates a set of rates for more than 178 destinations.[30] Whether this two-part tariff is intentional or merely the result of market forces is unknown to the authors. Regardless, this turns out to be a very useful framework for modeling drayage rates.

Understanding the implications of the CTP for drayage rates depends on the influence of its various pieces on these fixed and variable costs. In this section, we present the results of a variety of simulation exercises that help to inform the discussion of the effects on drayage rates and hence on the diversion of container traffic away from the San Pedro Bay ports.

[30] These portions were estimated using simple linear regression analysis. The regression results and standard errors are: Pay = 88.98 (.999) + 1.5038(.013) * distance. This simple regression explains 99 percent of the variability in rates.

The rates mentioned above are assumed to have been driven by the direct cost of drayae. With a large number of drivers and dispatchers, the market very closely resembles perfet competition. With perfect competition, prices are determined by costs including drive income, maintenance for the truck, and fuel. Each of these costs will have an impact on the fixed or variable portions of the schedule, or on both. The drayage company's fee is assumed to add an additional 30 percent to the cost of moving a container; this fee is above and beyond the two-part tariff that is paid to drivers.

The fixed portion of the driver compensation appears to roughly approximate a payment to drivers for their time. This includes the time waiting at the terminal gate to pick up a container and the time driving an average distance. The variable rate includes components that vary specifically with the number of miles between the port and the container's destination. These include fuel, maintenance, and a component that appears to reflect, to some extent, the inefficiencies associated with poor matching of inbound and outbound loads.[31]

These cost categories give us a starting point for understanding how the CTP might affect drayage rates. Drivers currently make in the neighborhood of $12 per hour. It has been estimated that under the CTP, wages may increase to $20 per hour (Husing 2007). This increase would have a predictable impact on drayage rates under our framework. In particular, it would raise labor costs by approximately two-thirds. While it seems likely that the increase in wages may be overstated, we will use this figure in our calculations for lack of a better estimate.

Similarly, with new trucks, fuel efficiency will likely increase. The trucks currently in service likely average about 5.5 miles per gallon of diesel fuel. Newer trucks will use fuel more efficiently, perhaps reaching 8 miles per gallon. This type of efficiency improvement lowers the overall fuel costs and would hence lower the variable portion of the two-part rate structure.

[31] An appendix detailing the relative contributions of these components to the current rate structure is available from the authors.

The first step in implementing our model is to rationalize the payment schedule. The current schedule appears to compensate drivers by accounting for wages in the fixed part of the schedule and fuel and other associated maintenance costs in the variable portion. The fixed portion of the schedule is approximately equal to what the driver would earn if his or her time were paid by the hour for a 4.6 hour turn plus about $30. We interpret this $30 to represent driver compensation for inefficiencies in the system. The remainder of the schedule, the variable part, is roughly equal to our estimated fuel and maintenance costs.

Given that part of the driver's time is spent waiting and part is spent driving, his or her time should be compensated both through the fixed and the variable part of the schedule. Because drivers will be employees and the LMCs are more concerned with time, we believe that this type of rationalization would occur under the CTP. Using the estimates of the wage rate from Monaco, and our own estimates of fuel and maintenance costs, we can determine a rate schedule that more appropriately charges shippers for the distance over which their container is to be hauled. The old and new rates are presented in Table 2.

TABLE 2: AVERAGE DRAYAGE RATES

Distance (miles, one way)	Average Current Charges	Average Rationalized Charges	Percentage Change
0-50	191	171	-10.4
50-100	390	296	3.1
100-150	457	429	10.1
150+	758	907	15.6
All Distances	346	373	7.6

On average, rates would increase 7.6 percent. The averages presented in this table are simple averages across destinations and are not weighted by the actual number of containers hauled each distance. Given that most containers are hauled a relatively short distance, were we to weight these averages by the number of containers, we would find that the overall average amount charged per container, and overall drayage charges,

would fall. There is clearly a bias in the current rates toward longer routes. As drivers have been compensated according to the average distance of a trip, which is less than 30 miles, longer-distance hauls are being implicitly subsidized under the current rate structure.

With this new rationalized fee structure in hand, we can turn to an evaluation of cost increases and efficiency enhancements and their overall impact on drayage rates. In what follows, we evaluate seven changes to the drayage structure and the impact that each change will have on drayage rates. We also include an eighth scenario in which the efficiency gains fully offset the cost increases. The changes include:

1) an increase in wages from $12 per hour to $20 per hour
2) an increase in total motor carrier costs sufficient to raise rates by 80 percent over their current level (Husing 2007)
3) an increase in fuel economy from 5.5 miles per gallon to 8 miles per gallon
4) a 20 percent reduction in the cost of fuel resulting from wholesale rather than retail purchasing
5) a reduction in wait time per turn from 2.6 hours to 1.5 hours
6) a reduction in matching inefficiency by one-third
7) an increase in speed traveled by 1 mile per hour
8) a scenario that eliminates the rate increases, bringing rates down to the level experienced under the rationalized case by using
    a. an increase in speed traveled by 3 miles per hour
    b. a reduction in wait time per turn to 1 hour
    c. a 50 percent reduction in matching inefficiencies
    d. a savings of 25 percent on fuel purchases

The associated changes in costs are illustrated in Table 3.

TABLE 3: EVALUATING DRAYAGE RATE CHANGES UNDER

ALTERNATIVE ASSUMPTIONS REGARDING THE EFFECTS OF THE CTP

	Average Percentage Change in Drayage Rates by Distance				
Scenario	All Distances	0-50	50-100	100-150	150+
Current ($)	346	191	287	390	758
Rationalized	7.6	-10.4	3.1	10.1	19.6
1) Wage Increase	37.0	27.0	34.5	38.4	43.6
2) Cost Increase	79.9	66.8	76.6	81.7	88.6
3) Fuel Economy	66.0	59.4	64.3	66.9	70.4
4) Lower Fuel Price	60.4	56.5	59.4	61.0	63.1
5) Wait Time Reduced	36.9	13.7	31.1	40.1	52.3
6) Better Matching	23.0	6.3	18.8	25.3	34.1
7) Speed up 1 mph	21.6	5.6	17.5	23.7	32.2
8) No Net Change	-0.1	-19.7	-5.1	2.5	12.8

According to the net result of this exercise, the most likely change in drayage rates is on the order of 22 percent. To start, we have allowed wage and other LMC cost increases to indicate an increase in drayage rates of 80 percent. On top of this exercise, we have superimposed changes that would likely result from the implementation of the CTP that reduce costs. The first reduction in cost comes in line (3) and presents the results of an increase in fuel efficiency from 5.5 miles per gallon to 8 miles per gallon.[32] This improvement comes about first from the use of newer trucks, on average, and second from the greater level of care and maintenance that the trucks are likely to experience. We find this simple change to be sufficient to shave 14 percentage points off the 80 percent rate increase.

[32] Actual mileage for the existing fleet and a newer fleet are subject to some speculation. We have rerun these simulations with a variety of different average levels, maintaining the percentage improvement, and the results are not qualitatively different.

Second, we hypothesize that LMCs will find it economical to purchase diesel fuel wholesale, rather than retail. With the need for parking lots and maintenance facilities, it is plausible that some will opt to install diesel fuel tanks from which to fill the tanks for their trucks. We suggest that this could lead to more than a 20 percent reduction in fuel costs. Evidence on the ratio of on-highway diesel prices and wholesale prices indicate that the ratio of the two fluctuates somewhat but that wholesale prices are often between 25 percent and 35 percent less than retail prices. We believe that we are being conservative when we suggest that purchasing diesel wholesale will lead to a 20 percent reduction in fuel costs and a further reduction in drayage rates of 6 percentage points to 60.4 percent of current rates.

Third, we hypothesize that increases in efficiency at terminals could result in a drop in wait times per turn of just over one hour, from 2.6 hours to 1.5 hours. Through the adoption of technology, the better use of appointment systems, and the greater use of off-hours pickup and drop-off, it seems plausible that significant reductions in wait times could be experienced. Our scenario results in just under a 23.5 percentage point drop in cost increases because of this factor, leaving drayage rates 37 percent higher than they are currently. This reduction is primarily a result of better use of the driver's time, leading to a significant reduction in the fixed portion of the drayage rate.

Fourth, we suggest that the CTP will lead to a better matching of outbound container deliveries and inbound container flows. There is potentially enormous inefficiency if matching is not incorporated into the flow of containers. From our model, we estimate that the matching cost is on the order of 1.2 extra miles traveled for every 2 miles a container is drayed. This indicates that a significant amount of matching is already occurring, but that there remain significant inefficiencies in the system. In our results above, we assume that one-third of these extra miles are eliminated through better matching. Although far from maximally efficient, leaving 0.8 miles of extra driving per container delivery, this remains a significant improvement. With this assumption, we find that increases in drayage rates would fall to just 23 percent of current rates.

Finally, we believe that under the CTP, more use would be made of the off-peak hours for container pickup and drop-off. Not only would this reduce average wait times but it would

also potentially increase the speed with which the trucks deliver containers. Here, we have simulated the results of a 1 mile per hour increase in the speed with which trucks travel. In our model, an increase in speed lowers primarily the cost of labor. In principle, it would also lower fuel costs, but we have not incorporated lower fuel costs into this portion of the model. Simulations indicate that for each one mile per hour faster that the trucks travel, there is a reduction in drayage rates of 1.4 percent.

In addition to analyzing these individual changes, we explore a scenario in which the efficiency gains fully offset the cost increases that result from the CTP. Although we are skeptical that this level of efficiency will be achieved, the results are not out of the question. There are an infinite number of combinations of the efficiency improvements discussed above that could eliminate the increases in costs. For brevity, we present the results from only what we think to be the most plausible. This scenario increases truck speeds to 3 miles per hour above current levels, reduces wait time to one hour, further reduces inefficiencies in matching to 50 percent of their current levels, and increases the savings on fuel purchases to 25 percent.

The LMCs have the incentive to seek out and exploit these efficiency gains to an extent that the current system does not provide. Once the drivers are employees and the LMCs own or are legally responsible for the trucks, the incentive to maximize their utilization will be much stronger. By employing routing or scheduling software, something that is not common today, drivers will be able to accomplish the same number of container movements in less time while putting fewer miles on the trucks. By cooperatively pursuing technology solutions to the long waits at terminals, they will be able to encourage the terminal operators to enhance the efficiency with which they dispatch containers. We believe that our evaluation of the potential efficiency gains in this section is conservative. At the same time, we find it hard to believe and do not intend to imply that the CTP will result in a reduction in drayage rates. We merely report that no net increase in drayage rates is within the realm of possibility. The implications of this exercise are the following:

1) Over the long term, the CTP will enhance efficiency of goods movement.

2) There need not be a significant increase in drayage rates because of the incentives to eliminate current inefficiencies.
3) The changes in drayage rates favor shorter distance trips.

THE LIMITS OF CONSOLIDATION

As noted, the consolidation of truck ownership is essential for the successful implementation of the CTP. However, there are potential problems that might result from this consolidation. In particular, the potential exists for LMCs to obtain significant market power. The smaller the resulting numbers of LMCs, the more likely it is that they will be able to exert influence over the terminal operators. The number of LMCs in the market will largely be a function of the licensing fee. The higher the licensing fee and the annual truck fee, the smaller the number of market participants. If the number of LMCs is too small, less than 10 for example, each carrier could possess a degree of market power and drayage rates will start to exceed costs. At the extremes, a monopolist in the drayage industry will have the ability to dramatically increase rates. Further, extreme consolidation of the industry would also provide much leverage to the unions, and increase their ability to absorb rents and potentially curtain industry efficiency.

Consolidation doesn't necessarily lead to such problems, nor will the unionization of drivers necessarily cause the massive problems in the drayage industry as in past times. The regulatory environment that existed in the logistics industry in past years and caused such inefficiencies was rooted in two features—the prevention of price competition by trucking firms and the effective barrier to entry into the industry. While consolidation may be an important feature of the CTP program, as long as the various firms are allowed to compete on the basis of price and entry into the drayage industry is effectively open as long as an LMC can pay the basic service fees and meet a minimum fleet requirements (in terms of emissions and size of the fleet), there is no reason that competition cannot still be a salient feature of the industry. Indeed shippers may ultimately benefit as larger firms may be able to offer a wider range of secondary services to their clients.

Even in the absence of market power, however, it is likely that a heavily consolidated drayage sector will be able to effect efficiency improvements. In the current configuration, there is little incentive for terminal operators to respond to calls for shorter wait times, because there is little room for prices to decline in response. Following the implementation of the CTP, however, it has been demonstrated that costs could increase by as much as 80 percent. Given the inefficiencies that exist, and the greater room for price response to efficiency enhancements, even a large group of large LMCs should be able to make compelling arguments to terminal operators that efficiency improvements will pay off for all players involved.

IV. Exploring Policy Alternatives

In order to evaluate the merits of the Clean Trucks Program objectively, it is useful to weigh it against the most realistic policy alternatives. Many approaches can achieve the goal of reducing pollution, but the ripple effects following implementation must be predicted, analyzed, and assessed to inform decision-making. We believe the two most reasonable policies for this exercise are (1) a strict barrier to entry policy, in which ports mandate all trucks entering the gates meet desired emissions levels and financially assist the transition, and (2) a cap and trade system. In this section we will first describe these two measures and then compare them with the CTP in light of the three most significant metrics of success: sustainability, efficiency, and ease of implementation.

Strict Barriers

In essence, the 'strict barrier' option requires the emissions reductions of the CTP with no demands on the drayage industry's structure. It is embodied by the California Air Resources Board's (CARB) Port Truck Rule (PTR), containing two phases. The first requires all drayage trucks to install a diesel particulate filter (DPF) and meet 1994 or later emissions standards by 2009. The second phase, in 2013, raises this barrier to 2007 or later emissions standards. Its enforcement mechanism would be a decal scheme similar to the CTP, whereby ports only allow access to trucks displaying the decal, and motor carriers

would be fined for dispatching noncompliant trucks. Currently 30 percent of the miles traveled per year by drayage trucks are undertaken with truck models from pre-1994.[33] A significant number of trucks will therefore have to be removed from the drayage fleet very quickly.

In order to smooth the shock of transition, grants would be made available for the truck upgrades. Inevitably these would be raised from some combination of public funds, the ports, and other sources. Husing estimates the cost to be $1.1 billion. In contrast with the CTP, the PTR's regulated area extends beyond the ports of Los Angeles and Long Beach to include the rest of California, the idea being both to reduce pollution throughout California and limit container diversion in the face of locally rising drayage costs. It is a 'big push' measure that attempts to solve the pollution problem quickly, while introducing none of the CTP's industry restructuring provisions.

PARTICULATE MATTER TRADING SCHEME

A second alternative to the CTP is for the ports to enact a Particulate Matter Trading Scheme (PMTS).[34] Though controversial in Southern California after the failure of the RECLAIM program, there are merits to such a mechanism. If its design followed the learned experiences of past and current carbon markets, it could potentially constitute the most sustainable and efficient of these three alternatives. Its initial construction would cap emissions at any level of efficiency desired, in this case the maximum benefit conferred by the CTP. Credits for the emissions would then be auctioned off for a certain amount of particulate matter-per-credit each year.

If the program incorporated the structural reformation of the drayage industry in the CTP, the credits would only be available to firms who employ their drivers. Similarly, all truckers entering the ports would have to be certified members of an LMC participant to the program. Over time, demand for the credits would fall as older trucks are replaced with newer models. Thus, each year the base credit price at auction would have to be increased

[33] CARB Spreadsheet.
[34] This is exactly the same as the commonly discussed Carbon Trading System, but refers to limiting particulate matter emissions rather than carbon.

accordingly. The drawback to this program, however, is the degree of coordination and oversight necessary for enforcement.

COMPARISON

Each program has the flexibility to reduce emissions as far as technology will allow; therefore, we do not draw a comparison on the grounds of pollution. Rather, it is the structural impact to the port economy in terms of physical, financial, and human capital that most clearly differentiates these policies. We will examine and compare the sustainability, efficiency, and ease of implementation of these policies.

Sustainability is judged here as the capacity of a policy to continue to achieve its goals over the long term without requiring additional attention. Ideally, once the policy is in place, market forces will be set in motion sufficient to continue generating pollution reductions without significant turbulence. Unwelcome turbulence could take the form of temporary price spikes or an insufficient supply of trucking services, or, more likely, both.

From an efficiency perspective, the most desirable policy will achieve the stated goals at the lowest cost possible. This requires that the parameters of the program encourage the market participants to seek out solutions to the problem that perhaps go beyond the exact specifications of the program.

Finally, ease of implementation is judged by the monitoring or administrative component of the program. Even a perfect program will require basic infrastructure to monitor the extent to which market participants are adhering to the program's parameters. The ease with which monitoring can be carried out is crucial in judging each program.

SUSTAINABILITY

The particulate matter trading plan is the policy with the strongest capacity to function long-term. It is highly flexible and provides a significant incentive for market participants to minimize their emissions, while not binding itself to specific requirements regarding the emissions of trucks. This is useful as it permits the system to function in perpetuity without

revision, allowing market forces to coordinate inefficiencies. Temporary shortages can therefore be met by bringing trucks and drivers into the ports who might otherwise be providing their services elsewhere. The incentive to maintain a clean fleet is clear: the cleaner the vehicle, the higher the profit margin.

By contrast, the Clean Trucks Program requires greater attention down the line. Its ability to sustain itself in the longer term is largely ensured by the market alteration resulting from its own provisions. The creation of LMCs and the employment provision will shake the failure of the market to incentivize investment. When deregulation collapsed barriers to entry, competition exploded as a natural result. The huge increase in competition forced market participants into short-sighted planning, precipitating a race to the bottom—both in terms of emissions and in terms of safety. With repairs that are more often patches than fixes, the safety of the current fleet remains suspect, and stability is achieved by reliance on a steady supply of older, cheaper vehicles.

As the CTP imposes a barrier to entry, LMCs will be able to make long-term plans and avoid the aggressive pricing behavior that currently exists. Rather than undercutting each other, they will be cognizant of the totality of their costs in setting or accepting any given pricing schedule. Moreover, industry consolidation will raise stability and smooth supply issues. It is commonly suggested that the CTP will likely result in driver shortages. In the short term, this may well be a problem.[35] Over the longer term, however, LMCs will actively participate in the market, encouraging their current drivers to work more hours, and actively recruiting and training new drivers. If the increase in demand for drayage services continues, these LMCs will be in a much better position to expand the number of trucks in service than the current independent operators or existing motor carriers.

The potential for sustainability is not as clear with the strict barrier policy. The short-term shock of such a steadfast imposition and short adjustment period would be too significant. Heavy subsidization from the port, local community, and other sources, would be an absolute necessity which, even if successful, would result in a fleet of trucks meeting the

[35] See the section below on the transition period for further analysis of the short-term problems associated with the CTP.

standard of today, but not tomorrow. The current incentive scheme would remain in place, and over time, fewer and fewer of these trucks would continue to meet emissions standards.

If the strict barrier policy were enacted, we would expect periodic reductions in supply and the need for heavy continued subsidization of the industry on a regular basis to prevent price spikes and supply disruptions each time standards increase. Market failures would erupt around truck maintenance, the source of financing, and the ability of the industry to retain an adequate number of drivers.

EFFICIENCY

Each of the measures aims to reduce pollution to the greatest degree possible while allowing trade to continue flowing smoothly. But, of the three, the cap and trade system is easily the most efficient policy. It incorporates the benefits of market freedom through a flexible pricing mechanism, thereby attacking the pollution problem directly. For example, the CTP and strict barrier policies impose uniform costs on the industry, promoting drivers to use more efficient trucks, while the PMTS would impose direct costs, pushing drivers to use their trucks efficiently. They are free to choose how to best reduce emissions, but they will pay for every bit of particulate matter emitted regardless of their choice.

The CTP is not necessarily as efficient as a particulate matter market could be, but the program is promising nevertheless. The chaotic nature of the industry in its current form harbors many inefficiencies. As it stands, there is a surprising lack of accountability surrounding goods movement. Drivers' backgrounds are unknown, as are the routes they follow. It is not even known how many drivers service the port, or how many brokers coordinate them. Without a buffer like LMCs between truckers and ports, implementation of measures like the Transportation Security Agency's 'Transportation Worker Identity Credential' (TWIC) would be very difficult.

Another efficiency-enhancing aspect of the CTP is operational coordination. Goodchild (forthcoming) estimates that the average time for truckers at terminals is about 50 minutes, and that only 18.7 percent of trips in which goods are transported from the port

elsewhere are matched by exports brought from elsewhere to the port. LMC firms will quickly act toward combining import trips with exports and demand the information necessary for doing so.[36] Similarly, the mandated installation of an Automatic Vehicle Locator (AVL) and Radio Frequency Identification (RFID) in each truck promises feedback and LMC oversight of truck routes and automatic recognition at the port gate. Should a bottleneck arise at port gates as a result of slow terminal adaptation to these technological improvements, terminal operators are more likely to hear from LMCs than from truck drivers in the current IOO status.

The strict barrier option is, again, the weakest of the three. Such a measure would yield little effect on the structural inefficiencies of the current practice, for example on idling, route planning, and container traffic coordination. Worse, it releases truckers from any incentive toward maintaining their trucks. Thus the ports will inevitably find it necessary to repeat grant programs to buoy the industry. And while some of the money will have to evolve out of the shipping industry itself, a significant proportion of the billion dollars needed would inevitably have to be raised from the public sector.

This is a classic example of a negative externality. Because the San Pedro Bay ports are the biggest trade portals in the United States, Americans around the country will benefit from San Pedro Bay port activity, while the public funds supporting truck financing would likely come from local and state government. Thus, the cost of industry change is not reflected in the final price of goods, but rather in the tax rates for the communities of Los Angeles and Long Beach. Moreover, the costs of healthcare necessitated from living in the communities surrounding the ports are a form of subsidy paid by communities surrounding the ports for the transportation of goods into the American economy. Meanwhile, shippers can market their products across the country at a cost that discounts that impact of pollution on the San Pedro Bay region. Thus, the port financing approach to emissions reduction is neither financially sustainable nor structured in a manner to distribute its cost equitably.

EASE OF IMPLEMENTATION

[36] The internet-based 'Virtual Container Yard' is an internet-based means of doing so (ICF International, 2008).

A policy's ease of implementation is the final criterion ports should take into account. In this case, the strict barrier policy ranks highest. In principle, it is the simplest of the programs to administer. Aside from the likely need to periodically subsidize the purchase of new vehicles, a task which imposes an enormous administrative burden, the policy simply requires that any truck servicing the ports display a sticker certifying that it meets the required emissions standard. Ports could easily unload the monitoring of such standards to independent organizations with expertise in checking emissions.

Here again, the Clean Trucks Program ranks second, as there are continued licensing efforts that must be maintained in perpetuity, in addition to the monitoring required of the strict barrier. Following licensing, verification of the employment relationships between drivers and LMCs is necessary. Where there are economic agents acting rationally, there will be those playing fast and loose with the regulations in an effort to gain a competitive edge. The need to monitor both the emissions characteristics of the vehicles, the employment relationship of the drivers, and other performance criterion on the part of the LMCs imposes some fairly strong administrative requirements on the CTP.

The particulate matter trading scheme loses the lion's share of its promise in view of its implementation burden. The difficulty of implementation arises from the need to match a truck's emissions with the permits purchased. The notion behind this program is that each driver or motor carrier will purchase permits allowing the release of certain quantities of pollution. Enforcing this arrangement means accounting for the emissions released by each truck and matching them to a permit. One could imagine a system that measures emissions at the exhaust pipe or that measures the intake of fuel. Verification of the quantity of emissions is extremely complex. Monitoring diesel input is a possibility, but this input must then be reconciled with the other characteristics of the vehicle. Ensuring that all emissions are accounted for and reported requires a significant administrative effort. It is also the case that a system of auctioning off the permits on a periodic basis is necessary, requiring another layer of administrative activity.

When we compare these policies, it becomes clear that the Clean Trucks Program is not necessarily the most efficient or sustainable program, nor is it the easiest policy to

implement. Rather, it finds the comfortable middle ground in all categories. Each of the three policies requires some accompanying infrastructure. A simple mandate is clearly the easiest to implement, but the Clean Trucks Program is not far behind. A cap and trade system is clearly the most cumbersome. The CTP is at a disadvantage to a simple mandate because of the accompanying employment and other performance requirements that must be verified for an LMC to keep its license.

V. TRANSITION

The Clean Trucks Program brings about fundamental changes in the port drayage industry. This document has been primarily concerned with the long-term effects of the Clean Trucks Program. In the short run, however, there is the difficult task of transforming the industry.

The transition from a regime of low and loosely monitored safety and emissions standards to one with tight controls on each, combined with an employment requirement, is a complicated matter. The difficulties associated with such a transition include significant supply disruptions (with accompanying price spikes) and the dislocation of significant numbers of industry workers. The dislocation of workers in the drayage industry is inevitable. Some drivers have indicated that they will not work as employees of motor carriers, and some motor carriers will be forced out of the market. A phased-in implementation strategy, such as has been proposed, combined with efforts to facilitate job matching between dislocated workers and the remaining industry participants, can help to significantly smooth the transition. As all of the fundamental pieces of the program are in place, save for the clean trucks, a significant subsidization of the fleet turnover and significant pricing flexibility on the part of LMCs and terminal operators will be crucial to a smooth transition.

The possible supply disruptions during this transition could be severe unless financial assistance is made available and the transition is phased in gradually. Supply disruptions could result from either the emissions standards requirements or from the employment provision.

The first major potential for supply disruption is in the need to upgrade or replace a significant portion of the fleet. In the first year of transition, trucks representing just over 13 percent of the mileage driven by drayage vehicles in 2007 will be banned from the port. This problem is made more serious in the second year when fully one-fifth of all truck miles must be replaced.

TABLE 4: FLEET REMOVAL BY TRANSITION YEAR UNDER CTP

Year of Transition	Truck Models Affected	% of Current Fleet Miles (2007)[37]
2008	Pre-1989	13.1%
2009	1989-2003	19.7%
2010	1994-1995	17.0%
2011	1996-2003	45.6%
2012	2004-2006	4.61%

Even though the need to upgrade and replace a portion of the fleet certainly brings with it the potential for supply disruptions, this will not likely be the case. The ports have put in place a container fee that will provide significant funding for retiring old vehicles and purchasing new ones. Although some critics have speculated that the fee will not generate sufficient funds quickly enough to stave off a shortage, this problem can be addressed through revenue bonding. With a sure source of revenues, floating such bonds will not be difficult. Bonds can be floated to the extent that they are necessary for subsidizing this first round of fleet retirements. The fee can then remain in place until the bonds are retired. Following the initial turnover of the fleet, the remaining LMCs will incorporate the need to maintain, upgrade, and replace their fleet into their pricing decisions.

At first glance, the disruptions resulting from the changes in the employment relationship seem easier to manage than the disruptions resulting from the new emissions standards.

[37] Based on VMT, source: CARB.

Currently, the majority of IOOs work closely with one or another of the existing drayage companies. In principle, some paperwork is all that is needed for the employment transition. However, this is an overly simplistic view of the matter for two reasons. First, there are significant costs associated with hiring a large number of workers. Not only are there wage payments, but there are premiums for workers' compensation and unemployment as well as social security contributions. Second, there will be dislocation among the 1,400 drayage companies.

The first problem is one of startup capital. As has been pointed out in Husing, not all LMCs are companies with significant financial resources. This could significantly delay the ability of LMCs to hire their first workers. In some cases, rather than hire even the first driver, the owner may opt to leave the business, resulting in the second problem, that of LMC dislocation. This dislocation necessitates the matching of the dislocated driver with a new LMC. The market will eventually solve this problem as LMCs that intend to stay in business will be interested in increasing their market share and will seek out these drivers.

In our drayage pricing model, we have taken as given that the hourly wage of truckers will have to increase by two-thirds, from roughly $12 per hour to $20 per hour. It is our belief that such an increase in wages will not be necessary. The transition is taking place in a region that has an abundance of low-skilled, low-income workers.[38] These workers present a ready supply of new truckers to be trained. Moreover, the Clean Trucks Program is being put in place at a very auspicious time. According to a Global Insight study (2004) trucking's chief competitors for labor supply are the construction and manufacturing industries. Over the course of the last year, both the construction and manufacturing sectors in the Los Angeles-Long Beach-Glendale metropolitan statistical area have shed over 5,000 jobs. This represents a ready supply of drivers. The only requirement to match them with jobs is an interested party posting help wanted posters. In the new LMCs, we have such interested parties.

[38] Husing (2004)

The saving grace of the Clean Trucks Program is the five years over which LMCs are required to achieve 100 percent employment of their drivers. This allows drivers interested in higher wages, steady employment, regular hours, and employment insurance to opt in right away, while permitting those drivers not interested in being employees to continue sering the ports for a number of years. This buffer period provides more than ample time for the reaining LMCs to attract and train new drivers.

An additional concern stemming from the transition is the dislocation of individuals currently employed in the drayage sector who may find that they are put out of work because of the CTP. These workers come from three different groups. First, some drivers will not be inclined to work as employees to an LMC. Survey results suggest that this may be a nontrivial proportion of the trucking population. As the overall demand for drivers will only increase, these drivers will be unemployed by the program purely because of their own employment preferences and because they have better options available.

A second group of drivers will become detached from the sector because the particular motor carrier employing them will choose to leave the market. There is clearly scope for assistance in terms of matching these drivers with carriers that intend to remain under the CTP.

A third group is the so-called back office workers at defunct motor carriers. There is no way of knowing in advance what proportion of the motor carriers that stop servicing the ports will go out of business. Instead, they may find alternatives that keep them in business, keeping in their employ much of their back office staff. Clearly some significant number of carriers will shutter their doors, leaving their back office staff unemployed. Here there is a clear role for providing a job matching service. For each of the carriers that go out of business, there is a carrier that is picking up market share. These remaining carriers will be in need of enhanced back office staff. However, the number of back office staff per driver declines with the size of the motor carrier, so it is unlikely that all of these workers will find gainful employment at another carrier. Here, some form of assistance in directing them toward the available resources for unemployed workers is clearly in order. These are individuals who have been displaced in pursuit of a greater good. Providing them with

some measure of assistance is an important contribution to the transition of the industry to the CTP.

Finally, there are local businesses that have formed to service the drayage industry. Small repair shops, and perhaps gasoline stations, will experience significant declines in activity. Unfortunately, these businesses are likely spread throughout the greater Los Angeles region and into the Inland Empire. Some will no doubt latch on with an LMC and continue to provide services much as before, but others will surely lose their livelihood. Regrettably, other than setting aside a significant pool of resources to aid these individuals through the transition, there is relatively little than can be done.

VI. CONCLUSION

This report discusses the Clean Trucks Program proposed to reduce emissions from port drayage activity resulting from container movements at the San Pedro Bay ports in Los Angeles. Of primary concern are the short-term transition challenges and the long-term sustainability of the program at drayage rates that do not result in a severe diversion of container flows to alternative ports of entry and exit.

Over the long term, the CTP is a very effective means of reducing emissions from port drayage. It is more effective than the alternatives, such as a port-subsidized emission standard, in that it also has positive efficiency properties. That is, along with mandating cleaner trucks, the CTP will generate incentives that permit these cleaner trucks to be used more efficiently. Although the implementation of this program brings with it additional costs that have the potential to increase drayage rates, the results presented in this report indicate that there may well be accompanying cost savings with the potential to fully offset the increase in costs.

The cost savings of the Clean Trucks Program results from the new employment relationship and the obligation of the Licensed Motor Carriers to take ownership or control of the trucks. This relationship strengthens the vested interest of motor carriers in the efficient use of both drivers and trucks. The competitive nature of the current industry is such that the investment in infrastructure necessary to raise efficiency does not pay off.

Under the CTP, the benefits will accrue directly to the LMC, rather than be shared with the truckers, making these investments more likely. Further, the consolidation of the industry will increase the pressure on terminal operators to invest in efficiency-enhancing equipment at the ports.

If a policy is implemented that merely mandates cleaner trucks, but does not tie the truck and driver more closely to the motor carrier, these efficiency gains will be left on the table.

With regard to the transition period, the CTP does represent a major overhaul of the industry. If implemented abruptly, it has the potential to result in significant supply disruption at the ports. These may result from either a shortage of clean trucks or a shortage of drivers. With the five-year phase-in period, and the heavy subsidization of new trucks that is being proposed, it is unlikely that such a disruption would occur. Maintaining an adequate supply of trucks will not be difficult in the first year of the program, as it only phases out trucks accounting for 13 percent of the drayage miles traveled. In the second year, a more significant proportion of the current fleet is at risk. Given that new trucks can be leased for $2,000 per month, and that the ports have secured a means of funding the fleet turnover, the supply of trucks should not be a problem. It has been argued that the Truck Impact Fee will raise revenues too slowly to turn the fleet over as quickly as is mandated by the CPT. This may be true if the ports had to rely on the stream of revenue as it is generated, but this is a near-perfect case for the use of revenue bonds. With a guaranteed steady stream of containers through the ports, the revenue source is solid enough to make revenue bonds feasible.

The difficulty with the transition therefore likely comes from issues surrounding the employment provisions in the CTP. If these provisions were implemented suddenly, there could be a substantial supply disruption. However, with the five-year phase-in period, there is ample time for the LMCs to replace the fraction of the current force of drivers who are not interested in steady work, higher wages, regular hours, and health insurance. It is also the case that the program is being proposed at a time when there is a relatively large supply of potential drivers. Given the state of the local economy, and in particular the declines in the construction and manufacturing sectors, the pool of labor from which the

LMCs have to choose is currently abnormally large. Both the construction and the manufacturing sectors in the Los Angeles-Long Beach-Glendale metropolitan statistical area have shed between 5,000 and 6,000 jobs. Port drayage would be a plausible destination for many of these unemployed workers.

The bottom line is that although the Clean Trucks Program may not be the perfect mechanism for bringing about emissions reductions, it represents a happy medium between policies that are easy to implement but difficult to sustain and policies that are easy to sustain but difficult to implement. It is also the case that without each of its major provisions the Clean Trucks Program is likely to lack long-term sustainability and unlikely to achieve its considerable potential.

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