

# SHIPPING → CLEAN ↑ GROWING GREEN

COALITION FOR  
**CLEAN AIR**

How  
companies  
are **earning more**  
by **polluting less**  
at California  
ports

A report by the  
Coalition for Clean Air  
May 2011



# SHIPPING → CLEAN ↑ GROWING GREEN

How companies are **earning more**  
by **polluting less** at California ports

by Luis Cabrales and Monique Lopez

The Coalition for Clean Air (CCA) is a nonprofit organization that helps improve California's air quality, in part through research and analysis of the policy and decision-making challenges facing public and private sectors. CCA strives to ensure high standards for research quality and objectivity, and its publications do not necessarily reflect the opinions of its donors.

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With offices in Sacramento, Los Angeles and Fresno, the nonprofit Coalition for Clean Air (CCA) has worked to restore clean air to California since 1971. CCA is dedicated to reducing emissions and improving public health through advocacy, outreach and education.

# CONTENTS

Foreword by Los Angeles Councilwoman Janice Hahn	4
Introduction	5
Port Economies on the Rebound	6
GHG Emissions from the Port and Freight Transport Sector	7
GHG Emission Inventory at the San Pedro Bay Ports	7
Climate Change Impacts on Port and Freight Transport	8
AB 32: The Global Warming Solutions Act	9
Port Policy	9
Trucks	10
Heavy-Duty Vehicle Aerodynamic Efficiency	10
Port Drayage Trucks	11
Medium- and Heavy-Duty Vehicle Hybridization	12
Ocean-Going Vessels	13
Ship Electrification at Ports	13
Clean Ships	14
Vessel Speed Reduction	14
Cargo Handling Equipment	15
Rail Locomotives	17
Harbor Craft	18
Recommendations	19
AB 32 Measures	19
Port GHG Plans	19
Alternative Fuels	20
Zero-Emission Container Movement Systems	22
Fair Marketplace and Economic Justice	23
Resources	24
Conclusion	25
References	26

# FOREWORD



**Janice Hahn**  
Los Angeles City Councilwoman

I represent a district that includes the largest port in the nation, the Port of Los Angeles. Together with its neighbor, the Port of Long Beach, they are the seventh-largest port complex in the world. They are economic engines for the region and commercial gateways for the country. They have also come to be known by residents and workers alike as a “diesel death zone.”

Decades of unmitigated environmental damage from port operations had become a barrier to growth, threatening to stall the many construction projects designed to deal with rising international trade. In response, the two ports set ambitious clean air targets in the Clean Air Action Plan, and in 2008, I negotiated policies and mitigation programs that allowed the TraPac expansion project to proceed, the first such project in six years. Today numerous projects are underway, and more are in the queue.

*Shipping Clean, Growing Green* outlines policies, technologies and resources available to ports today so they can continue to flourish while simultaneously improving the quality of life in communities most impacted by freight transportation. The California example—and the examples highlighted in this report—help ports and industry leaders around the country pair environmental and economic goals.

Good jobs to districts like mine, a more sustainable economy, and further innovation—these promises of “green growth” describe my experience with the Port of L.A.’s Clean Trucks Program. It’s a model now being adopted by other ports across the country.

As long as Americans continue importing and exporting, the ports around the country will continue growing. We must ensure this growth is sustainable. Indeed, we fail to clean up port operations at our own risk. The climate crisis threatens our port economies. Rising sea levels will strain our infrastructure and maintenance budgets. Some ports may face upheaval if sea changes disrupt recreational and commercial fishing stocks.

Projects that simultaneously improve freight efficiencies and reduce environmental and health impacts should be first in line for federal transportation funding and other public resources. After all, these resources—and the ports themselves—are held in the public trust.

I look forward to continuing to support environmental and economic sustainability in the port and freight transport industry.

A handwritten signature in black ink that reads "Janice Hahn". The signature is fluid and cursive.

Janice Hahn, Los Angeles City  
Councilwoman, 15<sup>th</sup> District

# INTRODUCTION

Jobs and new markets are being created throughout California as a result of efforts to reduce greenhouse gas (GHG) emissions. This is illustrated by the port and freight transport sector, which is experiencing a strong rebound from the effects of the recent economic downturn. Those who operate and manufacture cleaner technologies are simultaneously battling climate change and strengthening our workforce. They are the companies behind California's growing green economy.

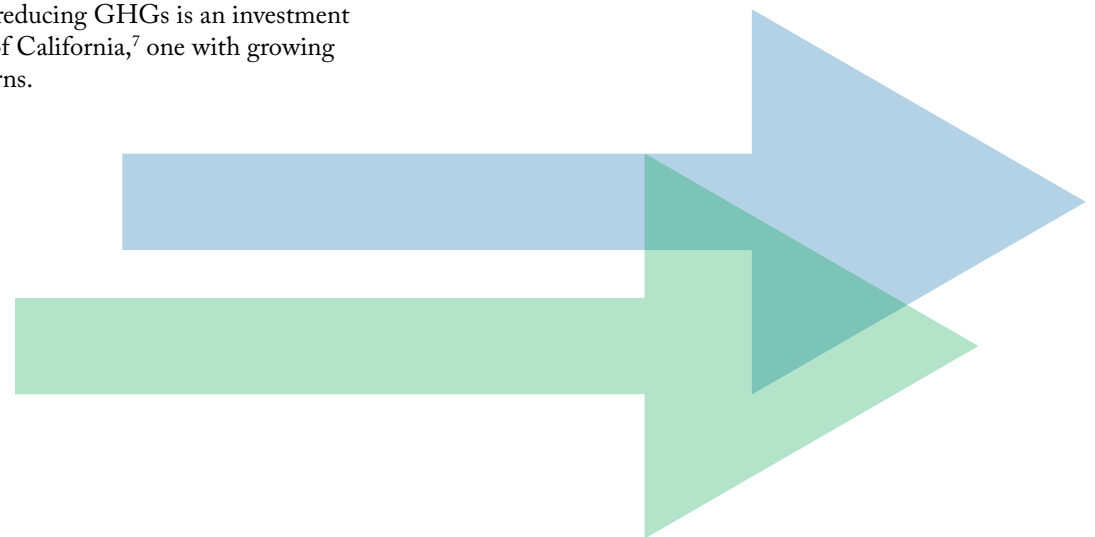
The Ports of Los Angeles (POLA) and Long Beach (POLB), also known as the San Pedro Bay (SPB) Ports, are the primary locations highlighted in this paper because of their significant activity levels. The SPB Ports receive 43 percent of all the shipping traffic in the United States.<sup>1</sup> Although this activity provides an important source of employment to the region, it also produces emissions that pose a tremendous health risk. Such emissions include particulate matter (PM), fine soot particles that cause respiratory and heart problems;<sup>2</sup> nitrogen oxides (NO<sub>x</sub>), which contribute to the formation of ground-level ozone and fine particle pollution and are linked with a number of adverse effects on the respiratory system;<sup>3</sup> and sulfur oxides (SO<sub>x</sub>), which can combine with other compounds in the atmosphere to form small, lung-penetrating particles that aggravate heart disease and contribute to respiratory diseases such as emphysema and bronchitis.<sup>4</sup> Furthermore, port and freight transport activity produces GHG emissions, which contribute to climate change.

Different types of technologies are readily available to reduce these harmful emissions. Some of the companies that have pioneered clean technologies are located in California, and they have significantly bolstered the economy by creating manufacturing and sales jobs. Furthermore, the implementation of these technologies has the potential to reduce health care costs as air pollution is decreased.<sup>5</sup>

According to the California Air Resources Board (ARB), "Successful implementation of the ARB emission reduction plan will depend upon actions at all levels of government and partnership with the private sector. No single entity can solve this problem in isolation."<sup>6</sup> This is especially true in our rebounding economic climate. Thus, it is imperative that government agencies and the private sector work together to reach GHG-reduction goals in the port and freight transport sector, as set by the Global Warming Solution Act of 2008 (AB 32). That partnership is vital for our climate and our economy, and it is the focus of this paper. The following stories illustrate that an investment in reducing GHGs is an investment in the people of California,<sup>7</sup> one with growing economic returns.

## How to Use this White Paper

This paper showcases economic advancements made by companies implementing clean technologies. It aims to encourage more aggressive steps by others to ensure that the port and freight transport sector reaches its GHG-reduction goals. Other industries will also find use in these examples, noting the interrelationship between policies and regulations, efficiencies and fuel savings, and workforce development. Policymakers and community members should be bolstered to defend and extend regulatory protections that are creating new markets in a green economy and to consider ways of working together with business interests to implement them. California serves as an example for the rest of the country—not only to reduce air pollution from growing port activities, but also to improve ports' surrounding economies by increasing green jobs. •



## Port Economies on the Rebound

Like all sectors of the economy, the port and freight transport sector was hit hard by the recent recession. But growth is quickly returning, and West Coast ports are experiencing a speedier, stronger rebound than East and Gulf Coast ports.

According to Port of Long Beach Executive Director Richard Steinke, 2010 saw the biggest year-to-year increase in the Port's 100-year history.<sup>8</sup> Port of Oakland Executive Director Omar Benjamin described a similar rebound: "In 2010, total container volume increased 14 percent to approximately 2.3 million TEUs, bringing us almost all the way back to pre-recession peak levels. Our export volume was the second-highest in our history."<sup>9</sup>

"The growth last year at the Ports of L.A. and Long Beach was extraordinary," says John Husing, founder of consulting firm Economics & Politics Inc. An improving

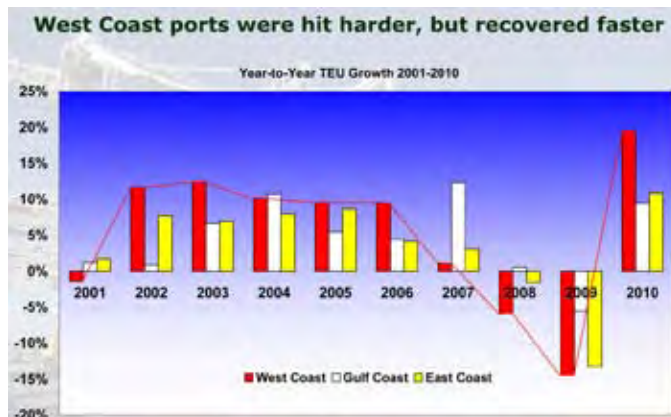
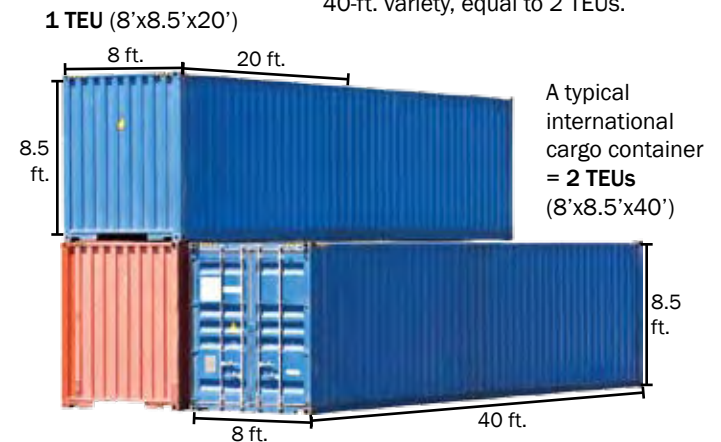
U.S. economy "augurs very well for records at the two ports in the next two or three years, pretty much guaranteed."<sup>10</sup>

Shipping lanes are again filling up, and cargo traffic is rising. Forward-thinking companies should be investing in new technology rather than dragging out old equipment that may have been mothballed during the downturn. Indeed, now is the time for ports and regulators to insist that the next phase of growth fully incorporate the cleanest technologies.

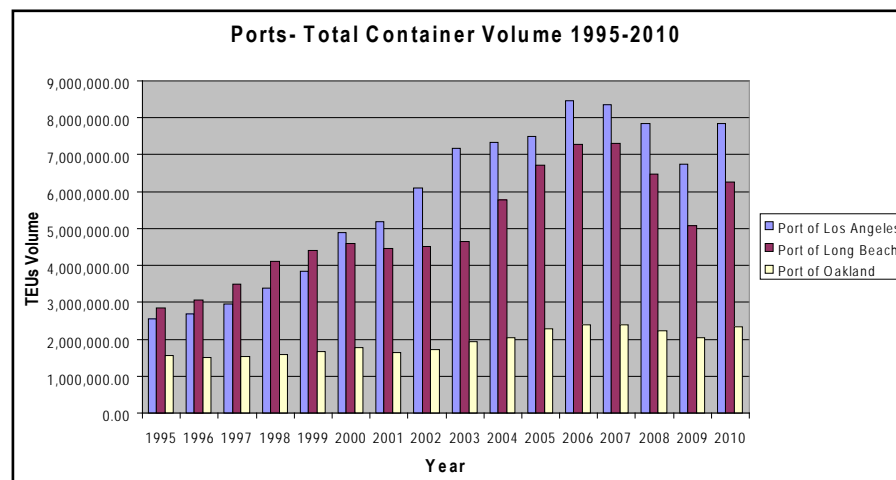
California cannot risk taking a step backward in the work we have done to clean the air. As the economic engine of port trade returns to full speed, it must run on clean fuel.

### What is a TEU?

Cargo containers are measured in twenty-foot equivalent units (TEUs), which is equivalent to a container measuring 20' (l) x 8' (w) x 8.5' (h). Most containers used today are the 40-ft. variety, equal to 2 TEUs.



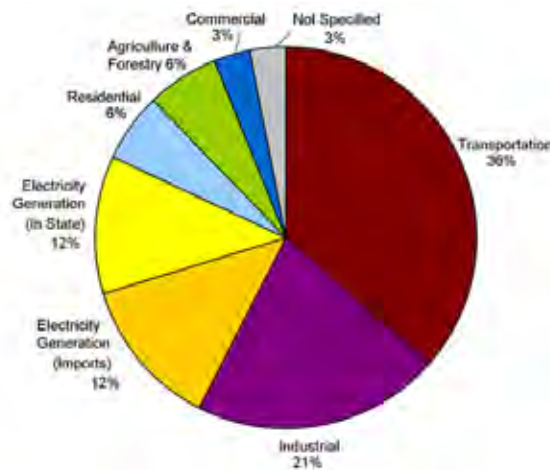
From "Pulse of the Ports 2011: Peak Season Outlook," presented March 30, 2011, by Daniel Smith of The Tioga Group, Inc.



## GHG Emissions from the Port and Freight Transport Sector

Transportation accounts for approximately 36 percent of California's GHG emissions, with about 73 percent of that coming from passenger vehicles. Port and freight transport produces roughly 25 percent of transportation-related carbon dioxide (CO<sub>2</sub>)\* emissions. Of that amount, 20 percent comes from heavy-duty trucks, 3 percent from ships and commercial boats, 3 percent from aviation (intrastate), 2 percent from rail—together equaling 41.63 million metric tons a year. It would take more than a billion tree seedlings 10 years to offset the amount of carbon emitted by these sources in just one year.<sup>11</sup>

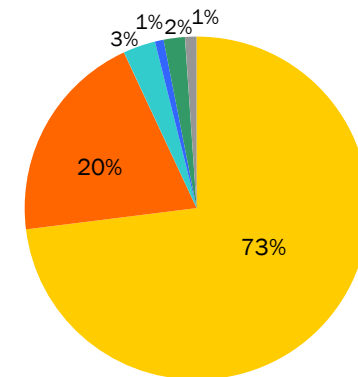
### 2008 California GHG Emissions<sup>12</sup> 477.7 MMT CO<sub>2</sub>e\*



\*Throughout this report, CO<sub>2</sub> is used interchangeably with carbon dioxide equivalent (CO<sub>2</sub>e).

### Transportation: 2008 California GHG Inventory<sup>13</sup> Million metric tons of CO<sub>2</sub> equivalent (MMT CO<sub>2</sub>e)\*

Passenger Vehicles	128.51	73%
Heavy-Duty Trucks	34.79	20%
Ships & Commercial Boats	4.32	3%
Aviation (Intrastate)	2.42	1%
Rail	2.52	2%
Unspecified	2.44	1%
<b>Total</b>	<b>174.99</b>	



## GHG Emission Inventory at the San Pedro Bay Ports

Due to the vast portion of shipping traffic that the SPB Ports receive, their activities contribute large amounts of global warming emissions compared to other California or U.S. ports. Of the SPB Ports' GHG emissions, heavy-duty vehicles account for 43 percent, ocean-going vessels 32 percent, cargo handling equipment 13 percent, rail locomotives 7 percent, and harbor craft 5 percent.<sup>14</sup>

According to recent emission inventories, both POLB and POLA showed significant reductions in PM, NO<sub>x</sub> and SO<sub>x</sub>, and smaller reductions in GHGs, due in part to the SPB Ports' Clean Air Action Plan (CAAP).<sup>15</sup> But as we celebrate this clean air milestone, we must acknowledge the part that the economic downturn played in decreasing port traffic.<sup>16</sup> While emissions are down from 2005 levels, so are ship calls; and while "the decline in emissions exceeded the decline in trade," says *The Cunningham Report*,

"an upward trend in cargo volume may undercut some of the air quality numbers in the future."<sup>17</sup>

More must be done to reduce GHGs in particular. Accounting for changes in throughput due to the recent economic recession, emissions per 10,000 twenty-foot equivalent units (TEU) handled show that POLB's GHG pollution actually increased by 4 percent from 2005 to 2009, when it emitted the equivalent of 778,000 metric tons of CO<sub>2</sub>.<sup>18</sup> POLA experienced a 1 percent increase in GHG emissions per TEU between 2008 and 2009, when its operations emitted the equivalent of more than 900,000 metric tons of CO<sub>2</sub>.<sup>19</sup> It would take more than 23.3 million tree seedlings 10 years to offset the amount of carbon POLA emitted in a single year.<sup>20</sup>

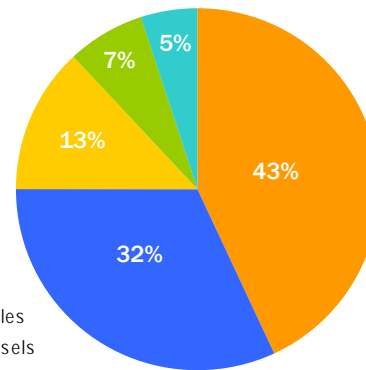
That GHGs are not declining in correlation to other pollutants illustrates the need for ports to immediately establish specific and

comprehensive GHG emission-reduction plans for their operations. The Ports of Los Angeles, Long Beach and Oakland are developing GHG plans but have not released them. Uncertainty about AB 32 measures at the state level has reportedly contributed to the ports' delay. Indeed, ARB is behind schedule in implementing AB 32 measures for the port and freight transport sector. Meanwhile, CAAP measures designed to reduce criteria pollutants have not yet maximized their potential for also reducing GHGs.

### 2008 SPB Port GHG Emissions<sup>21</sup>

Contributions by source category

- Heavy-Duty Vehicles
- Ocean-Going Vessels
- Cargo Handling Equipment
- Rail Locomotives
- Harbor Craft



## Climate Change Impacts on Port and Freight Transport

Due to technological improvements in the port and freight transport sector, some proactive businesses are already doing their part to reduce GHG emissions and contribute to the California economy, with the potential to impact the industry worldwide. Nevertheless, until drastic changes are made in this sector, it will continue contributing to climate change through excessive GHG emissions.

Climate change is altering the frequency, intensity and incidence of weather events and will impact the transportation sector in the following ways:<sup>24</sup>

- Increased temperatures will lead to more heat waves, which will cause thermal expansion of bridge joints and rail track deformities.
- Sea levels will rise; increased storms will flood coastal roadways and tunnels, swamp marine terminals, and erode bridge bases and roads; increased rain (causing floods and landslides) and wildfire will further delay air and ground traffic.
- The frequency of hurricanes will increase.

According to a recent study by the National Research Council, *Potential Impacts of Climate Change on U.S. Transportation*, "The transportation infrastructure was designed for typical weather patterns and environmental conditions, reflecting local climate and incorporating assumptions about a reasonable range of temperatures and precipitation levels. It will be affected most by those climate changes that cause environmental conditions to extend

### Port Emissions 2005-2009

Changes in tons per 10,000 TEU

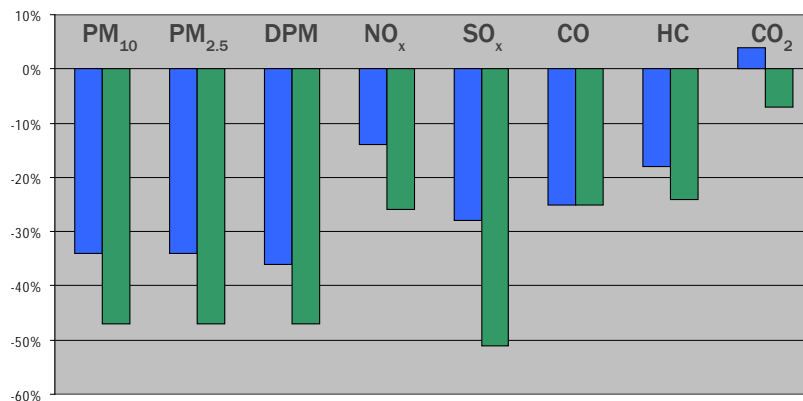
Year	PM <sub>10</sub>	PM <sub>2.5</sub>	DPM	NO <sub>x</sub>	SO <sub>x</sub>	CO	HC	CO <sub>2</sub>
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#### Port of Long Beach<sup>22</sup>

2005	1.6	1.4	1.5	23.2	10.0	4.8	1.2	<b>1,630.0</b>
2009	1.1	0.9	0.9	20.0	7.2	3.6	1.0	<b>1,688.8</b>
Change (%)	-34%	-34%	-36%	-14%	-28%	-25%	-18%	<b>4%</b>

#### Port of Los Angeles<sup>23</sup>

2005	1.42	1.21	1.30	22.46	7.42	5.47	1.16	<b>1,452</b>
2009	0.76	0.65	0.69	16.66	3.60	4.11	0.89	<b>1,349</b>
Change (%)	-47%	-47%	-47%	-26%	-51%	-25%	-24%	<b>-7%</b>



outside the range for which the system was designed.”<sup>25</sup> The report further explains that “Sea level with respect to dock level is an important consideration at both wet and dry docks, general cargo docks, and container berths for clearance of dock cranes and other structures. Changes due to increased intense precipitation and sea level rise could require some retrofitting of facilities. At a minimum, they are likely to result in increased weather-related delays and periodic interruption of shipping services.”<sup>26</sup>

It is clear that the port and freight transport sector could experience a negative economic impact through delays and strained transportation infrastructure due to climate change. That is why the proactive steps of those companies manufacturing and using clean technology products is so important for today’s economic benefits, as well as tomorrow’s economic stability.

## AB 32: The Global Warming Solutions Act

Under AB 32, California set GHG emission-reduction targets to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050.<sup>27</sup> ARB’s Scoping Plan aims to reduce GHG emissions down to 422 million metric tons of CO<sub>2</sub> a year by 2020.<sup>28</sup> However, if the state proceeds in a business-as-usual fashion, the projected CO<sub>2</sub> emissions for 2020 could equal as much as 596 million metric tons a year. It would take almost 15.3 billion tree seedlings 10 years to offset that amount of carbon.<sup>29</sup>

ARB has set a reduction target of 3.7 million metric tons of CO<sub>2</sub> by 2020 for the port and freight transport sector.<sup>30</sup> This roughly equals

the carbon offset of 95 million tree seedlings over 10 years.<sup>31</sup> Reduction measures would include ship electrification at ports, efficiency improvements, vessel speed reduction, less-polluting ships, regulation of port drayage trucks, commercial harbor craft maintenance and design efficiency, cargo handling equipment anti-idling, and energy efficiency and cold storage prohibition for transport refrigeration units.<sup>32</sup> These measures and regulations will have great environmental benefits and positive economic implications for California.

## Port Policy

The SPB Ports have developed a CAAP to begin addressing health impacts from PM, NO<sub>x</sub> and SO<sub>x</sub>. Likewise, in 2009, the Port of Oakland adopted its Maritime Air Quality Improvement Plan.<sup>33</sup> Both of these plans aim to reduce health risks to the surrounding communities by 85 percent from 2005 baselines. Although these plans are a positive step forward in reducing certain pollutants and health risk, they do not directly address GHG emissions. While likely to achieve some associated GHG reductions, these plans alone will not address many issues important to controlling GHGs, such as land-use planning, overall fuel consumption, or indirect emissions from electricity use.

The Ports of Los Angeles, Long Beach and Oakland have each promised to establish plans to tackle GHG emissions. Unlike the CAAP, which the SPB Ports crafted jointly, POLA and POLB have said they will develop separate plans for reducing GHG emissions. One reason is that Los Angeles and Long Beach have different GHG

targets. Long Beach’s GHG-emission target for city facilities and operations is to reduce CO<sub>2</sub> 15 percent from 2007 levels by 2020.<sup>34</sup> Los Angeles, on the other hand, has set a target of reducing CO<sub>2</sub> 35 percent below 1990 levels by 2030.<sup>35</sup>

Like the pollution reductions outlined in the CAAP, GHG reductions will come from a combination of port policies, incentives, voluntary measures, and state and federal regulation. Concession arrangements and leases are among the important tools California ports can use to reduce GHGs. Terminal leases are valuable and often in place for decades, so establishing strong environmental expectations within them is essential to reaching long-term air quality goals. The recent revision of the CAAP acknowledged this importance:

*One benefit of the lease strategy is that placing a requirement in a lease provides a legally binding mechanism for ensuring that the desired action is achieved and provides remedies for noncompliance (because noncompliance would constitute a breach of the lease terms). Another benefit is that, since leases are negotiated on a terminal-by-terminal basis, the mix of requirements can be tailored to terminal-specific considerations... A limitation of this strategy is that all leases have different renewal dates and terms, so the implementation is phased over time as leases come due or are renegotiated.*<sup>36</sup>

Port staff and advocates alike should be alert to the opportunity of lease renegotiations. In the 2010 CAAP Update, the SPB ports noted the due dates of current leases.<sup>37</sup> •

# TRUCKS

Heavy-duty vehicles account for 43 percent of the SPB Ports' GHG emissions—by far the leading contributors. Great strides have been made with the ports' Clean Trucks Program (CTP), which banned pre-1998 trucks in 2007 and progressively bans all trucks that do not meet 2007 emission standards by 2012; but more must be done. The use of alternative fuels or engine hybridization can significantly reduce GHG emissions beyond what a CTP-compliant diesel truck can do.

AB 32 contains three main measures that address GHG emissions from trucks in port and freight transport operations:

1. Heavy-duty vehicle GHG emission reductions through increased aerodynamic efficiency
2. Requirement of newer, cleaner models of port drayage trucks
3. Medium/heavy-duty truck hybridization to lower GHG emissions through fuel efficiency



Tractor-trailer with aerodynamic drag at the rear (TrailerTail), side skirt and wheel covers  
Photo courtesy of ATDynamics

## Heavy-Duty Vehicle Aerodynamic Efficiency

**REGULATION:** This measure requires trailer trucks to be retrofitted with the best available ARB-approved technology.<sup>38</sup> In December 2008, ARB adopted a regulation to reduce GHG emissions through the improvement of fuel efficiency of heavy-duty tractors that pull 53-foot or longer trailers. Fuel efficiency is improved by use of ARB-approved trailer and tractor aerodynamic technology and low rolling-resistance tires.<sup>39</sup>

Phase-in of this measure began in 2010 and requires 100 percent compliance by 2014. Additionally, all 2011 and later tractors and trailers sold or serviced in California require certification for aerodynamic efficiency.<sup>40</sup> Because the rule applies to all trucks in circulation in California, even if they do not belong to California-based companies, the estimated GHG reduction potential by 2020 is 6.4 million metric tons of CO<sub>2</sub> nationwide. Approximately 15 percent of the national emission reductions would occur in California.<sup>41</sup> In California alone, this measure would equal the amount of carbon offset by nearly 24 million tree seedlings over for 10 years.<sup>42</sup> The necessary capital investment to meet the requirement is \$521 million.<sup>43</sup>

**INNOVATION:** Advanced Transit Dynamics (ATDynamics), located in San Francisco, California, is a local leader in making such reductions possible. The company is “one of very few California-based manufacturers that provide products for compliance with state regulation governing greenhouse gas emissions from heavy-duty vehicles,” according to Steven Rodger,

vice president of marketing and operations. ATDynamics manufactures technologies that increase the fuel efficiency of tractor-trailers, and it works with freight carriers throughout North America to lower fuel costs, limit foreign oil imports, and reduce vehicle emissions. Founded in 2006, ATDynamics came to California in 2007; most of its components are manufactured in-state as well.

ATDynamics focuses primarily on eliminating the aerodynamic drag at the rear of tractor-trailers. One of the company's products, the TrailerTail,<sup>®</sup> won CONNECT's 2007 Most Innovative New Product Award in Clean Technology. The fuel-efficient performance of ATDynamics technologies has been tested and validated by the U.S. Environmental Protection Agency (EPA). Rodger explains: “We conduct test track runs to show how much fuel our devices save at highway speeds of 62 miles per hour. The TrailerTail<sup>®</sup> achieves more than 6 percent fuel savings, while our side skirts, which run between the axles of the trailer, cut fuel consumption an additional 4-6 percent. A combination of the two products yields 9-11 percent fuel savings.” Both of these technologies are verified for use under the EPA SmartWay program and 2010 ARB regulations for trailer aerodynamics.

ATDynamics is reducing costs for trucking fleets at a time when many carriers are facing challenges in the marketplace. “During difficult economic periods, fleets have a hard time passing on shipping costs to consumers,” says Rodger. “We offer them products that lower those costs and provide a rapid return on investment.”

The company is presently working with state and federal agencies to research, develop and demonstrate next-generation technologies and to accelerate adoption of existing commercial technologies. “We believe that by 2015, next-generation trailer aerodynamics will play a major role in improving the freight efficiency of tractor-trailers by more than 50 percent,” says Rodger.

Regarding prospects for future growth, Rodger says, “For better or worse, regulations affect market access. They are a factor as we work our way into the Canadian market and eventually, Mexico.” Growth factors include technology improvements, AB 32’s heavy-duty vehicle GHG emission-reduction measure, and the trucking industry’s gradual recognition of the competitive advantage of fuel-savings. Adds Rodger: “Simply put, our products make economic and environmental sense.”

## Port Drayage Trucks

**REGULATION:** Drayage trucks transport containers from ports to railyards and distribution warehouses. Effective in December 2009,<sup>44</sup> AB 32’s drayage truck regulation provides GHG benefits and is designed to support local emission-reduction goals, such as those of the SPB Ports’ CAAP and the Port of Oakland’s Comprehensive Truck Management Plan.<sup>45</sup>

Phase one of the regulation requires fleet owners to replace pre-1994 trucks, which contain mechanical fuel injection, with 1994 or newer vehicles, which contain an electronic fuel injection. The latter get six miles per gallon (mpg), versus 4.5 mpg with mechanical fuel-injection engines. The annual diesel fuel savings is an

estimated 11 million gallons, which is expected to reduce CO<sub>2</sub> emissions by about 7 percent.<sup>46</sup> Capital investment necessary for compliance is estimated at approximately \$1.1 - 1.5 billion (2006 dollars).<sup>47</sup> In the past four years, close to \$300 million in port and public funds have gone to port trucking companies to assist in the turnover of fleets serving the SPB Ports.<sup>48</sup>

**INNOVATION:** Trucking company Total Transportation Services, Inc. (TTSI) provides drayage truck service to all the deepwater ports. In business for 22 years, it operates offices in Long Beach and Rancho Dominguez and deploys 160 trucks in Southern California.

TTSI saw the benefits of a cleaner fleet and, with the aid of \$9 million in public funding,<sup>49</sup> leaped ahead of its peers in 2008 by converting 100 percent of its Southern California fleet either to natural gas or to AB 32-compliant diesel standards. This was well in advance of the mandatory deadline. “We felt it was the right thing to do,” says President Vic LaRosa, “and the Clean Air Action Plan made the need for the change imminent.” Currently, around 30 percent of the fleet’s trucks run on liquefied natural gas (LNG).

The change also serves TTSI’s ultimate zero-emission goal. Adds LaRosa:

*Diesel is definitely not the future. The bridge is going to be natural gas, and then eventually we would love to get to hydrogen-based, zero-emission fuel trucks because of the fact that these trucks run in the inner cities, which are heavily impacted population areas. You can move goods in a ship quite a distance in the world, and you can move goods in a train quite a distance in the United States; but ultimately you have to get the goods from a port or railhead to the store*



TTSI’s LNG truck fleet  
Photo courtesy of TTSI

*and the consumer. The only way you are going to be able to do that is with a truck. In order to serve both masters, the environment and the consumer, we feel that we have to get to the zero-emissions base.*

In addition to a zero-emission vision, fixing the port trucking system demands a comprehensive approach, as exemplified by POLA’s CTP. As originally intended, the CTP not only addresses tailpipe and engine standards to reduce air pollution, but also provides community protections such as parking restrictions, while providing for the program’s own sustainability by requiring drivers to be hired as employees. To improve long-term compliance and simplify enforcement of clean air standards, trucking companies, rather than low-income drivers, need to be accountable for truck ownership and maintenance.<sup>50</sup> Unfortunately, the American Trucking Association (ATA) is fighting the CTP in court to preserve a broken system, one that misclassifies truck drivers as independent contractors and makes them responsible for the costs of maintaining trucks—even publicly subsidized ones.

## Medium- and Heavy-Duty Vehicle Hybridization

**REGULATION:** A medium- and heavy-duty vehicle hybridization measure is to be implemented prior to 2015.<sup>51</sup> In 2008, ARB approved the Hybrid Truck and Bus Voucher Incentive Project (HVIP). This will provide up to \$20.4 million to fund vouchers of \$10,000–\$45,000 for the purchase of new eligible hybrid vehicles. ARB estimates that approximately 800 new hybrid trucks or buses will be funded and that statewide GHG reductions will reach 0.5 million metric tons of CO<sub>2</sub> by 2020.<sup>52</sup> The capital investment necessary for compliance is approximately \$6.4 million.<sup>53</sup>

**INNOVATION:** US Hybrid Corporation is a clean tech company based in Torrance, California. Since 1999, it has specialized in the design and manufacture of power conversion systems for medium- and heavy-duty electric, hybrid and fuel-cell commercial buses and trucks, making them more reliable and fuel-efficient, with lower emissions and better responsiveness.

In July 2010, U.S. Senator Barbara Boxer (D-CA) visited US Hybrid to illustrate how clean technology companies are contributing to the economy, cleaning the air, and reducing the country's reliance on foreign oil.<sup>54</sup> US Hybrid President Dr. Abas Goodarzi told the *Los Angeles Times* that the company “tripled its revenue and doubled its workforce last year, despite the economic downturn.”<sup>55</sup> He also highlighted how US Hybrid's products benefit companies' bottom lines and the environment. “When our hybrid components have been added to heavy- and medium-size trucks, we have shown more than double fuel economy and reduced GHG emissions by 50 percent,” said Goodarzi. “The additional incremental cost to install the hybrid

components is very reasonable because in two or three years, most companies recover the money spent on this investment.”

He adds:

*There is no manufactured filter that can capture greenhouse gases. The only way to reduce greenhouse gas emissions when using conventional fuels is to improve your fuel economy. You can do this by making the vehicle lighter or by making the engine work more efficiently. There is no way around it: CO<sub>2</sub> is directly connected to the fuel economy of a vehicle.*

*Energy management in vehicles really doesn't exist. Your cell phone and your laptop have far more sophisticated energy management than your car because when they are not in use, they shut off. Vehicles, on the other hand, continue consuming energy while they are parked at a stoplight or idling in traffic. If we can resolve that alone, we can improve our fuel economy substantially. The incorporation of hybrid technology is the only way to make this happen.*



Plug-in hybrid truck made possible by US Hybrid mechanical components  
Photo courtesy of US Hybrid

In addition to US Hybrid's great success in manufacturing power conversion systems for medium- and heavy-duty electric vehicles, it is paving the way in making marine terminal tractors work more efficiently and thus reduce GHG emissions. US Hybrid was selected through a competitive bid process to develop a hybrid drive system integrated into a marine terminal yard tractor. Compared to a conventional diesel yard tractor, the hybrid version is expected to reduce emissions of NO<sub>x</sub> by 67 percent and PM by at least 50 percent. Additionally, CO<sub>2</sub> emissions could be reduced up to 72 percent, while fuel consumption could be reduced up to 60 percent. Three hybrid yard hostlers are currently in demonstration at POLB. A final report summarizing the results of the testing is expected in the summer of 2011.<sup>56</sup> •

U.S. Senator Boxer standing with US Hybrid team  
Photo courtesy of US Hybrid

# OCEAN-GOING VESSELS

Producing 32 percent of GHG emissions, ocean-going vessels are the SPB Ports' second-highest emitters. The Ports have a voluntary vessel speed reduction (VSR) program to cut GHG emissions; they have also begun building the infrastructure needed for shore power, whereby ships are plugged into an electrical system, allowing them to shut off engines while docked. Furthermore, enforcement of the North American Emission Control Area (ECA) starting in 2012 will reduce sulfur content in ship fuel by 98 percent, reducing PM emissions by 85 percent and NO<sub>x</sub> emissions by 80 percent. But despite these great strides by the ports and global community, GHG emissions from ocean-going vessels remain high, exemplifying the need for mandatory AB 32-like measures to reduce marine emissions nationwide.

AB 32 contains three main measures to reduce GHG emissions from ocean-going vessels:

1. Ship electrification at the ports: PM and GHG emissions are cut by shutting down ship engines while docked.
2. Clean ships program: Technologies and strategies are used to improve fuel efficiency.
3. VSR: Ships must slow down within a certain proximity to the ports, significantly lowering fuel consumption.

Some of these measures are included in the T-6 category—a group of measures within the AB 32 Scoping Plan that deal exclusively with freight transport. The CO<sub>2</sub> emission reductions by the T-6 measures together add up to 3.5 million metric tons of CO<sub>2</sub>,<sup>57</sup> equal to the amount of carbon offset by 81.4 million tree seedlings over 10 years. ARB has assigned

an overall emission-reduction goal for the entire port and freight transport sector, rather than for each individual measure.<sup>58</sup> Capital investment required for these measures is difficult to estimate, and ARB anticipates that “overall savings due to efficiency improvements and lower energy demand will offset the costs associated with implementing the strategies,” due to the “relatively short payback periods.”<sup>59</sup>

## Ship Electrification at Ports

**REGULATION:** In December 2007, ARB approved a regulation to reduce emissions from diesel auxiliary engines on container, passenger and refrigerated-cargo ships while berthing at California ports. It requires operators of docked fleets to either turn off the auxiliary engines and connect the vessel to some other source of power, or use alternative control techniques that achieve equivalent emission reductions.<sup>60</sup>

This regulation became effective in January 2009. Starting in January 2014, at least 50 percent of fleet visits to California ports must comply with time limits for onboard auxiliary diesel-engine operation while docked; and each docked fleet must reduce onboard auxiliary diesel-engine power generation by at least 50 percent from the fleet's baseline power generation.<sup>61</sup> These requirements increase to 70 percent by 2017 and 80 percent by 2020.

Each port is required to submit terminal plans that indicate the installation of grid-based shore



Ocean-going vessels are the second-highest emitter of GHGs at the SPB Ports.

power systems or alternative control technologies. It is calculated that ship electrification will reduce 136,000 - 269,000 metric tons of CO<sub>2</sub> a year by 2020.<sup>62</sup> This roughly equals the amount of carbon offset by more than 6 million tree seedlings over 10 years. The total capital investment to add shore-power equipment for each port is expected to range between \$4 million and \$86 million.<sup>63</sup>



An AMP system in use at the POLA China Shipping terminal

**INNOVATION:** Docked vessels need electricity to run their onboard systems, mainly for refrigerated containers and cargo handling. Alternative Maritime Power (AMP) allows ships to switch off their engines and plug into an electrical supply, thus reducing GHGs and helping to improve air quality at the dock and in surrounding communities. To provide that electricity reliably, considerable shoreside infrastructure is required, demanding a skilled workforce.

AMP is among the list of what electrical workers provide to a “greener” economy, a list which rolls off the tongue of Kevin Norton, assistant business manager at the International Brotherhood of Electrical Workers (IBEW) Local 11: “energy storage, energy management, co-generation plants, renewable energy projects, solar, biomass, wind turbine, installing [and] operating the equipment when ships plug into shore power, and various upgrades to refineries and power plants when required. Our members work on any kind of electrical system that is brought into the industry. They generally work for cutting-edge contractors used by early adopters in the electrical market.”

To magnify the benefits of plugging in, renewable energy development can provide clean sources of electricity. In December 2010, POLA unveiled a one-megawatt solar photovoltaic installation at the World Cruise Center (home of the original *Love Boat* TV series). The energy produced will reduce GHGs equivalent to taking more than 4,300 cars off the road. The \$10.8 million project, which is expected to result in an annual \$200,000 energy cost savings, is the first phase of a multi-location solar power program that will eventually produce 10 megawatts of solar system generation capacity. Three additional project phases are slated for completion over the next five years.

Electrical workers, who have suffered from the slowdown of construction during the recession,

have a lot riding on the next wave. “IBEW Local 11 has invested millions of dollars in training on solar photovoltaics, promotion of clean energy projects, and advanced lighting controls,” says Norton. “We have 3,000 state-certified electricians that are also certified to install solar power, and we’ve made efforts to bring several Chinese manufacturers to the Los Angeles Basin.”

How does Norton view the prospects for growth in the green technology sector? “Very good, if the availability of capital improves.”



New electrical infrastructure demands continued investment in a skilled workforce.

Photo courtesy of IBEW Local 11

## Clean Ships

**REGULATION:** Among AB 32’s T-6 category of “Freight Transport Efficiency Measures”<sup>64</sup> is a clean ships measure drafted to encourage a reduction in fuel consumption, which will then lower CO<sub>2</sub> equivalent emissions. This will be achieved through a variety of technologies and strategies that improve the efficiency of

ocean-going vessels. Concepts to be investigated include hull and propeller design in new ships and air cavity systems to reduce hull resistance.<sup>65</sup> ARB has yet to adopt associated regulatory measures.<sup>66</sup>

## Vessel Speed Reduction

**REGULATION:** Ocean-going VSR can significantly improve air quality and reduce GHGs,<sup>67</sup> since slower speeds reduce drag and friction as ships plow through the water.<sup>68</sup> VSR has the potential to reduce CO<sub>2</sub> levels by 1,500 tons per day (if a 40nm full-coast radius approach is used).<sup>69</sup> *Going Slow to Reduce Emissions*, a study by environmental research group CE Delft, showed that “slow steaming” container ships cut emissions by approximately 30 percent.<sup>70</sup>

Although these regulations were scheduled to be adopted by January 1, 2011, and to take effect at the beginning of 2012,<sup>71</sup> the process was delayed under Governor Schwarzenegger. However, there appears to be hope with Governor Jerry Brown: He has publicly supported GHG reductions from the ports and freight transport sector and has specifically called out VSR as a strategy of choice. As California Attorney General in 2007,<sup>72</sup> he filed a petition with the U.S. EPA to set pollution rules for large ocean-going marine vessels; and in 2010, during his campaign for governor, he promised to “reduce dangerous emissions that contaminate the air we breathe [by requiring] vessels entering California waters to reduce speeds.”<sup>73</sup>

A voluntary VSR program is currently in place at the SPB Ports. Based on costs associated with the POLA and POLB programs, port

costs could range from \$50,000 - \$100,000 per year.<sup>74</sup> A ship operator's daily costs due to slower speeds are estimated at \$250 - \$600. However, significant cost savings are realized in the reduction of fuel consumption.

**INNOVATION:** International shipping companies are also practicing slow steaming to save money, with the positive environmental byproduct of reducing their GHG emissions. The *Los Angeles Times* reported that Maersk, which has a larger vessel fleet than the U.S. Navy, saw a profit of \$639 million during the first three months

of 2009, from a \$373 million loss in the same period the year before. Part of this economic improvement is a 9 percent savings in fuel consumption due to slow steaming.<sup>75</sup>

“A typical 8,000-container ship traveling at 21 knots will burn 125 metric tons of fuel to go 500 nautical miles,” said Lee Kindberg, environmental director for Maersk North America. “The same ship will need just 80 metric tons of fuel to travel the same distance if the speed drops to 15 knots.”<sup>76</sup> According to Maersk's calculations, a trip from Hong Kong to Long Beach at current bunker fuel prices would equal an estimated

\$250,000 savings on fuel. And as Maersk's Director of Environmental Sustainability Soren Stig Nielsen told the *New York Times*, slow steaming is a great way to lower emissions “without a quantum leap in innovation.”<sup>77</sup> •

## CARGO HANDLING EQUIPMENT

Shipyards and railyards use cranes and other machines to move cargo containers between the ships, trucks and trains that carry them. Such equipment accounts for 13 percent of all GHG emissions at the SPB Ports. ARB recognizes that GHG emissions can be significantly reduced through equipment electrification, hybridization and reduction of idling time. Operational efficiency is already being improved by such measures as employing electric forklifts and cranes, hybridizing diesel-powered cranes, and using alternative fuels such as biodiesel.

**REGULATION:** Having adopted a rule to modernize cargo handling equipment in 2005,<sup>78</sup> ARB committed to developing a measure to restrict unnecessary idling. Reduced idling can cut fuel consumption and associated GHGs, as well as criteria pollutants and toxic air contaminants.<sup>79</sup> The regulation was expected to be adopted

by January 1, 2011, and to take effect at the beginning of 2012.<sup>80</sup> Unfortunately, development and implementation of the regulation has been delayed, and ARB staff may propose little more than a voluntary program to reduce unnecessary idling.<sup>81</sup> Moreover, staff is considering further rollbacks to its 2005 regulation.<sup>82</sup>

**INNOVATION:** VYCON, located in Yorba Linda, California, offers an innovative product to reduce GHG emissions from crane equipment at the ports. Since 2002, the company has produced flywheel technology that significantly reduces fuel usage and diesel and GHG emissions.

Non-electric mobile cranes get their power from an on-board diesel generator. During lift cycles, peak power is drawn from the generator; during lowering and braking, all regenerated power is sent to a resistor bank where it is dissipated.



VYCON flywheel in use at the Port of Los Angeles  
Photo courtesy of VYCON

However, the flywheel recaptures that energy to be used again, thus conserving energy, lowering operating costs, and reducing diesel pollution.

“The flywheel is providing more capability for that crane to work for less cost,” explains VYCON President Frank DeLattre. “The fuel savings by using this technology has proven to be from 30-40 percent when operating the crane. The added benefit is the emissions reduction. The flywheel is one of the technologies out there that reduces emissions but also has [a return on investment] because we are saving fuel at the same time.”

Additional benefits of the flywheel include a 20-year lifespan, increased life of the generator, minimal maintenance requirements, reduced noise, and better machine responsiveness, which improves operator efficiency.

Despite these clear benefits, the SPB Ports use flywheel technology with only about 20 percent of their cranes. The Port of Oakland does not use it at all. Says DeLattre: “There is potential for more use and more emission reductions at California ports and railyards.”

•

Another innovator in this sector is Toyota, the country’s top supplier of electric and internal-combustion lift trucks, with a plant in Columbus, Indiana, and its sales and marketing headquarters in Irvine, California. The majority of Toyota lift trucks sold in North America are manufactured at the Columbus-based Toyota Industrial Equipment Mfg., a certified zero-landfill plant and two-time recipient of the Indiana Governor’s Award for Environmental Excellence.

All Toyota 8-Series gasoline, liquefied petroleum gas (LPG) and compressed natural gas (CNG) configured models produce 70 percent less smog-forming emissions than the current federal EPA standards.

Toyota also offers zero-emission electric lift trucks. Electric Drive System Technology has improved greatly over the years and is closing the performance gap with its internal-combustion counterparts. The AC-powered drive system offers operators increased productivity by enabling them to handle more pallets per hour, per shift and react faster to operator commands. Additionally, they have no springs, brushes or wearable parts, thus reducing planned maintenance.

In the late 1970s, approximately 60 percent of lift trucks sold used internal combustion. Today, electric lift trucks have overtaken internal-combustion ones, with electrics representing approximately 64 percent of sales. Marketing Manager Melinda Beckett-Maines states:

*There are several factors contributing to the rise of electric forklift sales: Electric lift trucks designed for indoor usage are becoming more popular in the U.S. market, due to rising fuel prices that reached an all-time high in recent years; battery charging technologies that have greatly improved in the past 10 years; and the proven fact that electric lift trucks typically enjoy a longer lifespan and require less maintenance than other lift trucks. Another important factor is that legislative initiatives are influencing customers to look at cleaner technologies such as electric.*

In 2009, ARB passed stringent regulations regarding the smog-forming hydrocarbon (HC) and NO<sub>x</sub> emissions of lift trucks operating in California; they require the vehicles to meet certain fleet averages by 2011 and even higher standards by 2013. “Toyota’s emission system is welcome news to California end-users seeking ways to meet ARB’s fleet-averaging measures,” adds Beckett-Maines. •



Worker operating an electric Toyota forklift  
Photo courtesy of Toyota

# RAIL LOCOMOTIVES

**REGULATION:** In September 2009, ARB directed its staff to investigate reducing toxic emissions and health risks at railyards in California, focusing on site-specific measures at the highest-risk railyards in order to expedite relief for nearby communities. In 2010, an accord was adopted between ARB, BNSF Railway and Union Pacific Railroad (UP). Known as the *ARB and Railroad Commitments to Further Reduce Diesel PM Emissions at High Priority Railyards*, the accord covers the four highest-priority railyards in the South Coast Air Basin: BNSF San Bernardino, BNSF Hobart, UP Commerce and UP ICTF/Dolores.<sup>83</sup>

Although the railroad companies and ARB have defended the agreement as progressive and protective, local community groups and environmental organizations have criticized the agreement as too limited. Environmental health and justice advocates feel these agreements exclude California's 14 remaining railyards, which could also benefit from statewide regulation of locomotives, cargo handling, operational measures, and risk-reduction audit plans.

Furthermore, measures to reduce NO<sub>x</sub> and PM at California's railyards should also aim to maximize GHG reductions while achieving the greatest public health benefits as quickly as possible. For example, electrification or alternate fuel use for yard hostlers, rather than repowering them with diesel engines, can eliminate diesel emissions and provide GHG emission reductions as well. These measures would help contribute to the GHG-reduction goals of AB 32.

**INNOVATION:** Since 1997, Pacific Harbor Line, Inc. (PHL) has handled all of the freight leaving the SPB Ports via rail; in 2009, that equaled 1.2 million rail cars of freight. Rail locomotives are responsible for 40 percent of the Ports' outbound container movement and 7 percent of their GHG emissions. PHL works to improve efficiency and reduce those emissions, and it is seeing the environmental and economic benefits of doing so.

In 2003, PHL started working with the Ports and the South Coast Air Quality Management District (SCAQMD) to pursue advanced technologies to reduce emissions. While they were conducting research on the technology, the company began an initiative to clean up operating procedures, which included a switch to ultra-low-sulfur diesel fuel, the installation of advanced technology diesel-fuel injectors that reduced fuel consumption, and an anti-idling policy to save fuel and reduce emissions.

In 2005, PHL worked with locomotive manufacturer Motor Power Incorporated to develop reduced-emission motors. Motor Power partnered with Detroit Diesel, and together they developed then cutting-edge technology for a Tier 2\* locomotive engine. ARB and the Ports granted PHL funding to purchase 16 Tier 2 engines, which the company started using in their locomotives in 2007.

The remaining six locomotives in the fleet were retrofitted with gen-set engines, which also have economic and environmental benefits. Gen-set locomotives contain three separate engines that



A complete overhaul of PHL's fleet is underway.

turn on or off, depending on the power needed. In comparison to other technologies, gen-set engines achieve dramatic reductions in particulates, NO<sub>x</sub> and GHG emissions, primarily through the savings of fuel consumption.

In the past seven years, PHL has continued to explore new technologies to increase fuel efficiency and lower emissions. It has continued working with other engine manufacturers and is completing funding contracts and purchase agreements with Caterpillar, which has designed a conventional Tier 3 plus locomotive capable of greater emission reductions and fuel savings. Through contracts with POLA and POLB, PHL is in the process of replacing all current Tier 2 locomotives with Tier 3 plus. None of the existing PHL Tier 2 locomotive engines will be operating in the Port complex after 2012.<sup>84</sup> •

\* See emission comparisons for locomotives at [www.epa.gov/oms/standards/nonroad/locomotives.htm](http://www.epa.gov/oms/standards/nonroad/locomotives.htm).

# HARBOR CRAFT

**REGULATION:** Harbor craft such as pilot vessels and tug boats account for 5 percent of emissions at the SPB Ports. Among several options, ARB is looking to address this emission source through maintenance and design efficiency. ARB adopted a rule to help modernize the harbor craft fleet in November 2007, which became effective in January 2009. ARB staff is currently developing proposed revisions to the rule that would add in-use engine requirements for dredges and other barges.<sup>85</sup>

POLB has a voluntary program that relies on basic maintenance and operational best practices such as propeller design and routine engine monitoring.<sup>86</sup> In January 2011, the Port adopted regulations that will take effect at the beginning of 2012.<sup>87</sup>



The ALTAIR in action at the Port of Long Beach  
Photo courtesy of Jacobsen Pilot Boat, Inc

**INNOVATION:** One company at POLB in particular has taken the initiative to improve design efficiency in order to increase reliability of its operations and be a good neighbor. Since 1924, Jacobsen Pilot Service, Inc. has transported pilots for all the cargo ships that dock at POLB. Captain Thomas A. Jacobsen, the company president, is the third generation to manage this family business. The company owes its longevity in part to continued adaptation to changing market tides and the pioneering of new technology frontiers in order to stay competitive.

Jacobsen Pilot Service designed and funded development of the ALTAIR, the first and only outboard-powered pilot boat operating on the entire West Coast. In addition to reducing air emissions, the vessel's improved efficiency makes it more reliable. "We have diesel engines in our other boats that are six-year-old, Tier 2 engines that haven't been that reliable," says Captain Jacobsen. "In our business, we need reliable engines because when a ship is coming to the port, we have to be there every time. We simply can't afford having our boats breaking down."

About 40 percent of the ALTAIR's overall workload is handled by two four-stroke Yamaha F350 engines. The F350 emits 84 percent less emissions than a conventional carbureted two-stroke outboard motor—earning it a three-star rating from ARB, which uses much stricter standards than the U.S. EPA does for that type of motor. Compared to the other pilot boats in the fleet, the ALTAIR's F350s emit nearly 80 percent less CO<sub>2</sub> and 41 percent less NO<sub>x</sub> and HC. Since they are gas-powered, they emit no PM. Due to these great emission reductions, Jacobsen Pilot Service won the 2010 Clean Air Action Plan Air Quality award from the SPB Ports.

"The ALTAIR saves substantially on fuel, helps us reduce greenhouse gases, and improves air quality," highlights Captain Jacobsen. "Switching over to cleaner engines is the right thing for the port and the community. An added benefit with the new technology is that it saves our company money." Due to the economic and environmental benefits of the new technology, Jacobsen Pilot Service is looking to retrofit its two other pilot boats and has submitted a grant for EPA funding. •

# RECOMMENDATIONS

This report highlights the environmental and economic benefits realized by manufacturers and operators of clean technology. In order to ensure that economic growth continues in the port and freight transport sector and that GHG emissions are further reduced, CCA recommends that:

- ➔ The implementation of AB 32 measures should be expedited.
- ➔ All California and U.S. ports need to develop GHG reduction plans.
- ➔ Ports should switch from diesel-operated equipment to that which uses electric power or alternative fuels.
- ➔ The SPB Ports should develop a Zero-Emission Container Movement System infrastructure immediately.
- ➔ A fair marketplace must be ensured for companies that comply with regulations, and the economic justice needs of impacted communities and workers must be addressed.



SynchroNet team members working at their Pleasanton, California office

Photo courtesy of SynchroNet

## AB 32 Measures

AB 32 measures to reduce GHG emissions from the port and freight transport system must be expedited. Strong measures and regulations are greatly needed at state and federal levels. In the CAAP, the Ports state that “federal, state and local air quality agencies will play an essential role by identifying and pursuing future regulatory measures targeting specific source categories to further reduce emissions [in] order to achieve the San Pedro Bay Standards.”<sup>88</sup> This type of agency leadership also serves to level the playing field on which the Ports compete for business, and it opens up new markets and drives innovation.

### Clearing the Air, Not Shipping It

Efficiency systems such as the one SynchroNet Intermodal Services, Inc. (SIS) provides, can help businesses save money, fuel and time while reducing GHG emissions.<sup>89</sup>

Located in Pleasanton, California, SIS provides a technology that tracks more than 350,000 containers at 40,000 locations in 88 countries around the globe. SynchroNet Marine and SynchroNet Intermodal Services help customers find an empty container, or someone in need of a container, and arrange its transfer to the desired location. In North America, businesses provide their box number and location, which is entered into the SIS database, and the company helps coordinate logistics so that a truck, train or ship is not unnecessarily transporting an empty box.

## Port GHG Plans

California and U.S. ports need to develop specific GHG reduction plans that can address their unique challenges and identify additional measures that can be tailored to each port’s specific needs. As the 2009 emission inventory for the SPB Ports reflects, existing measures aimed at cutting PM, NO<sub>x</sub> and SO<sub>x</sub> are not enough to adequately reduce GHG emissions from port operations.

Besides technology being implemented to reduce GHG emissions, there are opportunities for operational efficiencies that the ports should include in their GHG plans.

By matching otherwise empty containers with cargo, GHG reductions and air quality benefits can be achieved. “It is ludicrous to ship air,” says Chief Marketing Officer Barbara Marsh-Wetherell. “SynchroNet makes transporting boxes an efficient use of a company’s assets.”

She adds: “Our concern for the environmental impact of container transport was a founding principal of the company. Through the use of SynchroNet’s innovative technology since 1996—long before it was in vogue to be green—we have provided services that reduce carbon emissions through maximizing container movement efficiency. Furthermore, we provide cost-saving solutions for container repositioning.”

## Alternative Fuels

Diesel is the primary fuel used in the port and freight transport sector. A move away from diesel to natural gas and biodiesel will significantly reduce GHGs, lessen toxic emissions, and hedge against the rising costs of imported petroleum diesel. Furthermore, the use of electric-powered technologies can avoid many localized health impacts of fuel combustion<sup>90</sup> while reducing overall GHG emissions.

A switch from dirty diesel equipment to alternative fuels needs to occur in order to maximize GHG emissions. Further development, innovation and investment is required to achieve full market penetration, but proven, off-the-shelf technology is available to accommodate a smooth transition. Natural gas and electric technologies, in particular, are gaining prominence in the marketplace to readily compete with diesel.

### Natural Gas

Clean Energy, based in Seal Beach, California, is North America's leading provider of CNG and LNG as transportation fuels. It owns and operates more than 200 stations in North America and also has operations in India, China and South America. The company builds, operates and maintains public and private fueling stations for light, medium and heavy-duty vehicle fleets and is in the position to provide natural gas fuel on a long-term contract basis. "Clean energy is dedicated to providing our customers with a clean, low-carbon transportation fuel," says Todd Campbell, director of public policy for Clean Energy and a CCA board member.<sup>91</sup>

Approximately 20 percent of Clean Energy's employees are located in California. The company has grown substantially in the past five years,

increasing its employees from 50 to more than 800. In California, 25 percent of that growth occurred just in 2009. "One of the reasons why we grew so quickly is because we provide a clean fuel that is affordably priced," Campbell asserts.

The price of both diesel fuel and LNG change with market conditions. As diesel prices are returning to near-peak levels, fuel cost savings are more than \$2.10 per gallon on an energy-equivalent basis.<sup>92</sup>

"Fleets that are seeking to be green, they think our fuel makes a lot of sense because we have a competitive advantage over gasoline and diesel," says Campbell. "Companies like to tell their customers about their sustainability programs. Switching to natural gas powered trucks is a great way for companies to be able to do something about the environment in a cost-effective way."

Economic and public-relations benefits are not the only drivers of growth in this industry. "California has a number of initiatives and policies that are encouraging companies to think about sustainability—such as AB 32," Campbell adds. "This makes the switch to natural gas attractive for business. Also, businesses may be able to claim carbon credits in the future, as we move forward with the Low-Carbon Fuel Standard."

Natural gas trucks are cleaner than 2007 EPA Standards, and GHG reductions are more than 20 percent compared to diesel.<sup>93</sup> Clean Energy is investing to meet not only today's compliance standards, but also ones in 2050. For example, it is the largest provider of biomethane, a renewable natural gas. Landfill gas and biomethane can reduce carbon emissions by 71-89 percent when compared to diesel.<sup>94</sup>

There is plenty of room for growth in the use of natural gas-fueled trucks at ports. An estimated 8,000-10,000 trucks are now operating at the SPB Ports, fewer than 1,000 of which run on natural gas. "The important lesson here is that just a couple of years ago, these trucks were not operating in the ports," says Campbell. "The fact that they are operating and handling the loads no longer makes them a beta case. It makes them a proven alternative that is capable of operating in the freight transport industry. I think that is very important and symbolic for potential growth in other sectors and markets."

### Biodiesel

Biodiesel is an emerging alternative fuel, which can help reduce GHGs from the port and freight transport sector. Although industry blends are not standardized yet, domestic, renewable biodiesel can be blended at any level with petroleum diesel. It can be used in most diesel engines without modification; however, acceptance by



Community Fuels employee loading customer tank truck with biodiesel  
Photo courtesy of Community Fuels

engine manufacturers is still in the early stages. When not mixed with petroleum, biodiesel is biodegradable, nontoxic, and practically free of sulfur and aromatics.<sup>95</sup>

Depending on the source of biodiesel, the GHG emission reductions can be as high as 87.5 percent.<sup>96</sup> A report published in the Proceedings of the National Academy of Sciences in 2006 cited a 41 percent reduction in GHG emissions.<sup>97</sup> According to Manning Feraci, vice president of federal affairs for the National Biodiesel Board (NBB), “Since 2005, biodiesel’s contribution to reducing greenhouse gas emissions is equal to removing 3.12 million passenger vehicles from America’s roadways.”<sup>98</sup>

However, such benefits are not achieved when biodiesel contains a high petroleum content or energy-intensive agricultural products. Furthermore, studies have shown the overall lifecycle emissions of smog-forming NO<sub>x</sub> may be greater from biodiesel than from petroleum diesel.<sup>99</sup> That is a concern in California, home to eight of the country’s 10 smoggiest cities.<sup>100</sup> While the trade-off may be more acceptable in regions without NO<sub>x</sub> problems, these emissions must be addressed before biodiesel can reach its potential in California.

Biodiesel definitely has potential for boosting the economy. “In 2011, the NBB estimates that the U.S. biodiesel industry will support over 30,000 jobs in all sectors of the economy,” adds Feraci. “This will add more than \$3 billion to the nation’s Gross Domestic Product (GDP).”<sup>101</sup>

Biodiesel producer Community Fuels has been creating jobs in California since early 2005. The company is headquartered in Encinitas and manufactures fuel at its biorefinery in Stockton.

CEO Lisa Mortenson foresees tremendous growth for the company and the biodiesel

industry, due primarily to two new fuel standards: “the U.S. EPA’s Renewable Fuel Standard, which would require 1 billion gallons of biomass-based diesel to be blended into diesel fuel by 2012; and California’s Low-Carbon Fuel Standard (LCFS), which would require the carbon content of diesel fuel to be reduced by 10 percent by 2020. Although there are several scenarios for compliance with the LCFS, biodiesel represents a commercially available fuel to help meet the targets.”

These two measures are prime examples of how government leadership can stimulate growth in the green economy, and Community Fuels shows the potential of biodiesel as part of that growth. “Biodiesel can immediately be blended with the fuel supply,” adds Mortenson. “It is creating good manufacturing jobs and is helping clean the air today.”

People’s Fuel Cooperative is a biodiesel distribution and consulting company based in Northern California. The company started in 2005 to meet “the need for fuel distribution in the Bay Area as an alternative to diesel,” says Co-Owner Wesley Caddell. People’s Fuel distributes to a variety of customers, from home fueling systems and business fleets to organic farms and fishing vessels.

“Biodiesel is a ready alternative that offers environmental benefits without sacrificing operating performance,” says Caddell. “Switching to biodiesel offers a clean start for both you and your engine by reducing the amount of greenhouse gas emissions.” Regarding the future of the biodiesel industry, he adds: “I hope to see more biodiesel at the pump; however, it is going to take capital investment, community support, and government leadership to make this possible.”



People’s Fuel biodiesel distribution truck  
Photo courtesy of People’s Fuel

## Electric Power

Electric-powered technologies are another emerging alternative poised to compete with traditional, dirty diesel-powered engines. Rising fuel costs, air quality regulations, and fuel efficiency standards all contribute to the potential for electricity in the port and freight transport sector. Balqon Corporation, located in Harbor City, California, is recognized as a pioneer in the electric vehicle industry and is a global leader in developing zero-emission electric drive systems for commercial electric vehicles. Founded in 2005, Balqon is the only electric drive system manufacturer that offers a complete, integrated solution for heavy-duty commercial vehicles, including power management, propulsion, power conversion systems and chargers.

“Our ability to develop and commercialize fully customizable electric vehicle technologies—through product configurations that are competing with diesel products in price and performance—has caused a paradigm shift in the way our customers think about vehicle pollution-control technology,” explains President and CEO Balwinder Samra.

After sharing an electric truck concept with POLA and the SCAQMD, Balqon was awarded a more than half-million-dollar grant to develop a tractor that can pull up to 30 tons. Balqon exceeded that expectation in 2008 by demonstrating capabilities of more than 50 tons. Hence the Nautilus XE 20 was born, along with an assembly line to build all electric trucks for POLA, creating 15 high-paying jobs. In addition, Balqon acquired a leading manufacturer of drive systems and moved the facility to Harbor City.

“Bringing Balqon to L.A. represents a giant leap in our effort to develop a clean industry of tomorrow,” said Los Angeles Mayor Antonio Villaraigosa. “Smart, environmentally-friendly growth at the port is a priority. The days of big belching, black smoke are numbered.”

Although electric trucks still need to be studied for all uses,<sup>102</sup> Balqon’s testing indicates that use of zero-emission yard tractors and short-haul drayage vehicles to near-dock railyards and warehouses can achieve significant emission benefits in SPB Port areas. It is estimated that replacing a diesel-powered yard tractor with an electric one can reduce emissions by more than 25 tons during the lifetime of the vehicle. In the



Balqon electric truck  
Photo courtesy of Balqon

South Coast Air Basin, replacement of all diesel-powered yard tractors with electric could reduce 4,000 tons of emissions every year.

High-idling and low-speed applications make feasible the use of electric tractors in container transportation applications. Improvements in battery technology, where limitations of range and rechargability remain challenges, would expand the potential for market penetration. Additional benefits include reduction in noise and energy costs, which can ease early adoption of this technology.

As worldwide demand for cleaner technology increases, Balqon is becoming not only a California and U.S. leader, but a global one as well. Today the company has an international dealer network representing its products in Latin America, Europe and Asia. In January 2011, Balqon cracked open the market in China by signing a \$16 million contract to supply 300 electric drive systems for inner-city buses.

Government investment helps to spur clean-tech growth, and companies investing in clean technologies early have a competitive advantage, says Samra. “With the Energy Commission recently approving a \$108 million investment plan intended partially to speed up the development of electric vehicle technologies, it is not a bad time to be in the green business. Early adopters...will be ahead of the technology curve, over companies who are resistant and will have to catch up.”

In addition to trucks, cargo handling equipment, and ships at dock—discussed earlier in this report—locomotives are another candidate for electrification. Electric freight locomotives have been available in Europe for more than 20 years,<sup>103</sup> and it is time for the United States to catch up and modernize this heavily polluting industry.

As ports incorporate electrification into their operations, that power must come increasingly from renewable sources, such as solar, wind or geothermal, in order to comprehensively reduce GHG emissions. Governor Brown recently bolstered this cause by signing into law a requirement that 33 percent of California’s electricity come from renewable sources by 2020.

## Zero-Emission Container Movement Systems

With activity increasing steadily this year, the SPB Port complex “will remain a hub for the nation’s supply chain,” according to *The Business Press*,<sup>104</sup> and increased cargo volumes may challenge the air pollution and health risk reduction goals of the Ports’ CAAPs. To prepare, a Zero-Emission Container Movement System (ZECMS) infrastructure needs to be immediately developed and fully functional by 2020; and further proactive measures should be developed by each port, as well as by local, state and federal governments.

The Ports need to stand strong in their commitment to develop and implement a ZECMS. In the 2006 CAAP, they planned to “build and test a demonstration prototype and perfect a detailed plan for widespread construction” by the summer of 2011. But the 2010 CAAP update detailed only a vague plan to study the issue, without making commitments or establishing deadlines for advancing a ZECMS. The Ports should remain accountable for the progress of a ZECMS by establishing interim benchmarks.

*The Review of Concepts and Solutions to Provide Zero-Emission Container Movement Systems (ZECMS) to the Ports of Long Beach and Los Angeles*, a USC report released in July 2010, evaluated seven project proposals for a ZECMS at the SPB Ports. It concluded that although a ZECMS is technically feasible, the proposed systems were not ready.<sup>105</sup> In response, POLB staff recommended an off-site demonstration project to strengthen the technology.<sup>106</sup> However, a demonstration project needs to be conducted soon on port property to immediately reap the emission-reduction benefits and ensure that full implementation is completed by 2020.

## Fair Marketplace and Economic Justice

### Fair Marketplace

A fair marketplace should be maintained for green technologies by enforcing originally enacted regulatory deadlines. When regulations are delayed or weakened to assist businesses that fail to comply, it unfairly penalizes clean technology businesses and those who have invested in the green economy and compliant practices.<sup>107</sup>

Approved in December 2008, the ARB Statewide On-Road Truck and Bus Regulation was adopted to clean up emissions from the nearly 1 million heavy-duty diesel trucks operating in California.<sup>108</sup> In December 2010, the ARB board weakened the regulation and made changes to ease impacts on the beleaguered construction industry. ARB revised its emissions inventory and accounted for fewer emissions due to reduced economic activity that kept some equipment non-operational—at least temporarily. Among the

amendments to the On-Road rule, some 150,000 diesel trucks were exempted from having to retrofit with PM filters.<sup>109</sup>

ARB's rollback of this regulation risks causing cuts in the diesel filter industry, which employs 1,000 workers in California, according to a 2008 survey.<sup>110</sup> The rollback also disadvantages any truck owners who had taken the initiative to purchase filters in order to comply with the original rule. When pollution controls are eased to provide economic “relief,” a cost is often shifted to others, including investors in cleaner technology, other business sectors whose pollution reductions increase in significance, or simply Californians whose lungs have subsidized dirty air for too long.

### Economic Justice

The economic benefits of investing in pollution-reduction technologies must also benefit the communities most impacted by the pollution from port and freight transport.

According to Margaret Gordon, Port of Oakland commissioner and longtime environmental justice advocate, “The African-American community makes up about 28-32 percent of the population of Oakland but receives less than 4 percent of the construction jobs or contracts from Port of Oakland. If there’s an economic benefit or job creation, it’s not to West Oakland or East Oakland.”<sup>111</sup> Given decades of impacts on communities near ports and transportation corridors, the health and quality-of-life benefits from cleaner technologies should also be coupled with the economic benefits of the economic surge, through jobs, job training, and infrastructure investments.

Like residents in nearby communities, workers at ports and in the freight industry feel the brunt



of pollution. As public investments are made to support the cleanup of this industry, it is important that benefits are shared with workers. In the case of the broken drayage truck system, trucking companies must drop their lawsuit and allow full implementation of the POLA CTP. Currently, trucking companies place the responsibility for owning and maintaining trucks on drivers who typically lease the trucks and are required to pay lease costs, as well as maintenance, fuel, insurance, and other operational costs.<sup>112</sup> Most drayage drivers earn approximately \$30,000 annually,<sup>113</sup> but lease payments and other costs that many trucking companies pass on to their drivers can subtract significantly from the earnings they take home.

The Coalition for Clean and Safe Ports, comprised of CCA and other environmental, labor and community organizations, is a leading voice on drayage issues. Chairwoman Patricia Castellanos notes:

*We've gotten new, clean trucks on the road at the Ports, and that's a huge first step; but the structural failures of the port trucking industry persist, and we must solve them in order for these initial emissions gains to be sustained over time. Companies should step up and show true leadership by taking responsibility for the*

*ownership and maintenance of the new trucks; by ending the pernicious practice of misclassifying drivers; and by being responsible stewards of public funds. Without addressing the deeper problems and creating a path to sustainability, the new trucks will be a mere band-aid.*

Addressing the economic conditions of port drivers is an environmental and economic justice issue similar to that of unemployed workers in the communities most impacted by the freight industry. Truly sustainable, environmental programs should address these issues through fair distribution of green jobs in environmental justice communities and by not placing the responsibility of cleaning up our air solely on the shoulders of low-income workers. •

### AB 32: Influencing Market Demand Beyond California's Borders



Lotus Engineering, a global company headquartered in Michigan, is conducting research on how its products can be incorporated in the port and freight transport sector to reduce GHGs. Part of that interest stems from California's leadership with AB 32.

“Lotus Engineering has a long history of engineering green, high-performance engines and vehicles but has also diversified into heavy-duty vehicles and engines,” says Engineer Stephen Bruekner. “One primary driver is the economy. Other reasons for the revised focus are governmental factors, such as the greenhouse gas emissions standards that ARB pioneered. These new drivers provide Lotus the opportunity to offer its innovative technology solutions in new markets such as heavy-duty vehicles and off-road cargo handling machines.”

## RESOURCES

Federal, state and local governments offer millions of dollars in grants each year to help large and small companies implement cleaner technologies and programs. The following is just a sample of the many resources available to incentivize the move to a less-polluting freight transport industry.

### Proposition B Funds

With funding from the Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act (Proposition B) of 2006, California created the Goods Movement Emission Reduction Program. This partnership between ARB and local agencies, such as the ports and air districts, offers financial incentives to owners of

equipment used in the freight and transportation industries, allowing them to upgrade to cleaner technologies. Through this program, California taxpayers are doing their part to quickly reduce air pollution emissions and health risks from freight movement-related activities along California's main transportation corridors. Projects funded with grants from this program must achieve early or extra emission reductions not otherwise required by law or regulation.

Some examples of available funding include:<sup>114</sup> up to \$30,000 for a Class-7 replacement truck with an engine that meets model-year 2010 emissions;<sup>115</sup> \$60,000 for replacement of a Class-8 truck;<sup>116</sup> up to \$3.5 million, or 50 percent of eligible costs, to install grid-based power for

ships at berth;<sup>117</sup> and \$3 million to BNSF to repower four switcher locomotives.<sup>118</sup>

### AB 118 Funds

The Alternative and Renewable Fuel and Vehicle Technology Program of 2007, or AB 118, authorizes the California Energy Commission (CEC) to fund alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies.<sup>119</sup> The CEC has an annual program budget of approximately \$100 million in grants, loans, loan guarantees, and other funding mechanisms. Eligible recipients include: public agencies, private businesses, public-private partnerships, vehicle and technology consortia, workforce

training partnerships and collaboratives, fleet owners, consumers, recreational boaters, and academic institutions.<sup>120</sup>

### National Clean Fleets Partnership

On April 1, 2011, President Obama launched the National Clean Fleets Partnership (NCFP) as part of the Clean Cities initiative run by the U.S. Department of Energy's Vehicle Technology Program. This public-private partnership is intended to help large companies reduce diesel and gasoline use by incorporating alternative fuels, electric vehicles, and fuel-saving measures into fleet operations. The Department of Energy (DOE) will offer specialized resources, technical expertise and support through the NCFP.<sup>121</sup>

## CONCLUSION

AB 32 measures and regulations will have long-term environmental and economic benefits for California. Though some of the measures have yet to be fully enforced, many companies are anticipating these changes—and some are already reaping the financial benefits. As the stories of those who manufacture and operate these clean technologies have shown, a government policy such as AB 32 creates jobs and allows new markets to emerge and thrive. GHG-reduction measures can save money while protecting the environment and reducing air pollution.

Clean technologies are becoming more competitive in a sector dominated by dirty diesel equipment, but they often remain heavily reliant on public subsidies. For the cleanest technologies to become the norm, industry must pay its

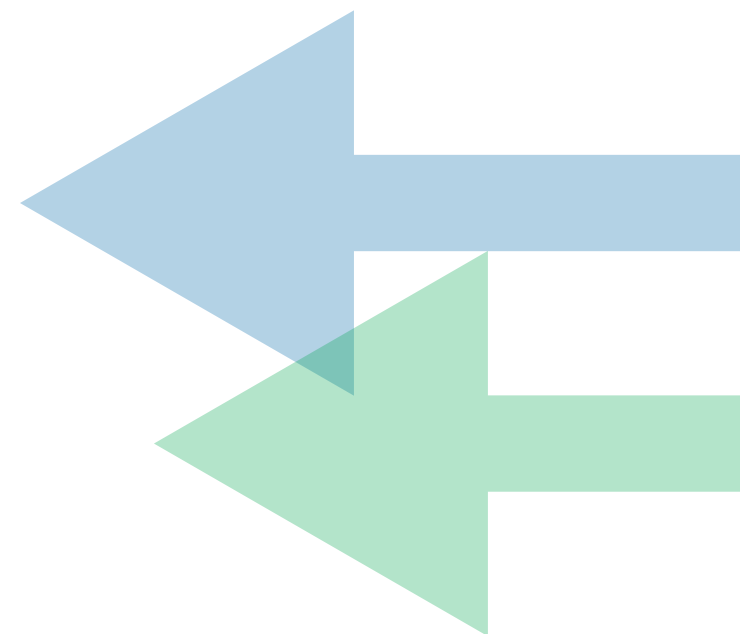
Members will have opportunities to exchange information with peers, collaborate with DOE and national laboratories on research and development initiatives, and get assistance in pursuing group purchasing opportunities to help small companies gain the benefits of buying advanced vehicles in bulk.<sup>122</sup>

### Regulatory Agency Guide

Numerous regulatory agencies oversee and provide resources to the port and freight transport sector, often with overlapping jurisdictions. For a comprehensive list of such regulatory agencies, visit [www.coalitionforcleanair.org/links.html](http://www.coalitionforcleanair.org/links.html).<sup>123</sup> •

fair share through regular modernization of equipment, responsibility for the costs of upkeep, and contributions to pooled resources such as those collected via container fees. The appropriate regulatory tools must be employed to achieve this vision of a sustainable port and freight transport sector and to lessen the risks of climate change.

Together, the private sector and government agencies have begun to lay the foundation for reaching the GHG-reduction goals set by AB 32. This partnership is important not only for reducing the impacts of climate change, but for boosting the economy as well. An investment in reducing GHGs is an investment in the people of California and beyond. •



# REFERENCES

1. Katzanek, Jack. "Inland Empire Business," The Business Press: Business News for Inland Southern California. Accessed July 12, 2010. [http://www.inlandsocal.com/business/content/topnews/stories/PE\\_News\\_Local\\_D\\_bp\\_summit14.2ec1bc.html](http://www.inlandsocal.com/business/content/topnews/stories/PE_News_Local_D_bp_summit14.2ec1bc.html).
2. "Quantifying the Health Benefits and Economic Value of Diesel Particulate Matter Control Measures." California Air Resources Board, December 11, 2003. Accessed December 8, 2010. <http://www.arb.ca.gov/research/health/healthup/dec03.pdf>.
3. "Nitrogen Dioxide." U.S. Environmental Protection Agency. Last updated October 28, 2010. Accessed March 12, 2011. <http://www.epa.gov/oaqps001/nitrogenoxides/>.
4. "Air Trends: Basic Information." U.S. Environmental Protection Agency. Last updated on Thursday, April 01, 2010. Accessed April 22, 2011. <http://www.epa.gov/airtrends/sixpoll.html>.
5. Romley JA, Hackbarth A, and Goldman, DP. The Impact of Air Quality on Hospital Spending. Santa Monica, Calif.: RAND Corporation, 2010. Accessed December 13, 2010. [http://www.rand.org/content/dam/rand/pubs/technical\\_reports/2010/RAND\\_TR777.pdf](http://www.rand.org/content/dam/rand/pubs/technical_reports/2010/RAND_TR777.pdf).
6. Port of Long Beach and Los Angeles. Draft 2010 Update- San Pedro Bay Ports Clean Air Action Plan-technical Report. Last updated April 2010. Accessed July 1, 2010. <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=>
7. "Draft 2011 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities." The White House. Office of Management and Budget, April 1, 2011. Accessed May 9, 2011. [http://www.whitehouse.gov/sites/default/files/omb/legislative/reports/Draft\\_2011\\_CBA\\_Report\\_AllSections.pdf](http://www.whitehouse.gov/sites/default/files/omb/legislative/reports/Draft_2011_CBA_Report_AllSections.pdf).
8. Kristopher Hanson. Port of Long Beach set to boom in 2011: Executive director uses 'state of' speech to share a cheery outlook for future. Long Beach Press Telegram. Accessed January 28, 2011. [http://www.presstelegram.com/news/ci\\_17229353](http://www.presstelegram.com/news/ci_17229353).
9. "Port of Oakland State of the Port Event." Posted February 11, 2011. [http://www.youtube.com/user/PortOfOaklandInfo#p/a/u/1/f1Kv37jwX\\_k](http://www.youtube.com/user/PortOfOaklandInfo#p/a/u/1/f1Kv37jwX_k).
10. Vivien Lou Chen and Timothy R. Homan. "Busier Seaports in U.S. Benefit Union Pacific: Freight Markets" Bloomberg. Accessed January 25, 2011. <http://www.bloomberg.com/news/2011-01-25/busier-seaports-in-u-s-benefit-union-pacific-freight-markets.html>
11. US Environmental Protection Agency, "Greenhouse Gas Equivalencies Calculator. Clean Energy, US EPA. Accessed August 25, 2010. <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results>.
12. "California's Greenhouse Gas Emissions Inventory - Graphs." California Environmental Protection Agency. California Air Resources Board. Accessed August 13, 2010. <http://www.arb.ca.gov/cc/inventory/data/graph/graph.htm>.
13. "California Greenhouse Gas Inventory for 2000-2008—by Category as Defined in the Scoping Plan." California Environmental Protection Agency. California Air Resources Board. Accessed July 17, 2010. [http://www.arb.ca.gov/cc/inventory/data/tables/ghg\\_inventory\\_scopingplan\\_00-08\\_2010-05-12.pdf](http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_00-08_2010-05-12.pdf).
14. "Draft 2010 Update- San Pedro Bay Ports Clean Air Action Plan- Technical Report." Port of Long Beach and Los Angeles. Last updated April 2010. <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2441>.
15. Find more information about the San Pedro Bay Ports Clean Air Action Plan at <http://www.cleanairactionplan.org/>.
16. "2009 Air Emissions Inventory." Port of Long Beach, Accessed June 2010. <http://www.polb.com/environment/air/emissions.asp>.
17. "Port Pollution Down in Long Beach In 2009, But So Was Cargo." The Cunningham Report. Accessed August, 5 2010. [http://www.cunninghamreport.com/news\\_item.php?id=1312](http://www.cunninghamreport.com/news_item.php?id=1312).
18. Port of Long Beach Inventory of Air Emissions- 2009. Tech. Starcrest Consulting Group, LLC., June 2010. Accessed July 12, 2010. <http://www.polb.com/civica/filebank/blobdload.asp?BlobID=7390>.
19. Lisa Wunder, Environmental Specialist at the Port of Los Angeles, mail message to author, August 2, 2010.
20. "Greenhouse Gas Equivalencies Calculator" U.S. Environmental Protection Agency. Clean Energy, US EPA. Accessed August 25, 2010. <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results>.
21. "Draft 2010 Update - San Pedro Bay Ports Clean Air Action Plan- Technical Report." Port of Long Beach and Los Angeles. April 2010. Accessed July 1, 2010. <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2441>.
22. "Port of Long Beach Inventory of Air Emissions- 2009." Tech. Starcrest Consulting Group, LLC., June 2010. Accessed July 12, 2010. <http://www.polb.com/civica/filebank/blobdload.asp?BlobID=7390>.
23. Port of Los Angeles Inventory of Air Emissions- 2009." Tech. Starcrest Consulting Group, LLC., June 2010. Accessed July 09, 2010. no. 050520-525. [http://www.portoflosangeles.org/DOC/REPORT\\_Air\\_Emissions\\_Inventory\\_2009.pdf](http://www.portoflosangeles.org/DOC/REPORT_Air_Emissions_Inventory_2009.pdf).
24. "Potential Impacts of Climate Change on US Transportation." National Research Council of the National Academy, 2008. Accessed July 17, 2010. <http://onlinepubs.trb.org/onlinepubs/sr/sr290.pdf>.
25. Ibid.
26. Ibid.
27. "California's Greenhouse Gas Emissions Inventory - 1990 Level." California Air Resources Board, May 28, 2010. Accessed August 10, 2010. <http://www.arb.ca.gov/cc/inventory/1990level/1990level.htm>.
28. "Climate Change Scoping Plan- E California Global Warming Solutions Act of 2006." California Air Resources Board. December 2008. Accessed July 12, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/adopted\\_scoping\\_plan.pdf](http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf).
29. "Greenhouse Gas Equivalencies Calculator" US Environmental Protection Agency. Clean Energy, US EPA. Accessed August 25, 2010. <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results>.
30. "Climate Change Scoping Plan- E California Global Warming Solutions Act of 2006." California Air Resources Board. Accessed July 12, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/adopted\\_scoping\\_plan.pdf](http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf).
31. "Greenhouse Gas Equivalencies Calculator" US Environmental Protection Agency. Clean Energy US EPA. Accessed August 25, 2010. <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results>.
32. "Climate Change Scoping Plan- Appendices." California Air Resources Board. December 2008. Accessed 15 July 2010. [http://www.arb.ca.gov/cc/scopingplan/document/appendices\\_volume1.pdf](http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf).
33. "Maritime Air Quality Improvement Plan." Board of

- Port Commissions, Port of Oakland, April 2009. Accessed July 19, 2010. <http://www.portofoakland.com/pdf/maqip090515.pdf>.
34. "Sustainable City Action Plan." City of Long Beach, 2009. Accessed August 08, 2010. <http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=26498>.
35. "Climate: Greening L.A." The Mayor of the City of Los Angeles. Accessed August 25, 2010. <http://mayor.lacity.org/Issues/Environment/Climate/index.htm>.
36. "Clean Air Action Plan Update." Port of Long Beach, p 56. Accessed October 21, 2010. <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2479>.
37. Ibid., p 61-62.
38. "Heavy-Duty Vehicle Greenhouse Gas Emission Reduction Measure." California Air Resources Board. Accessed August 11, 2010. <http://www.arb.ca.gov/cc/hdghg/hdghg.htm>.
39. Ibid.
40. Ibid.
41. Ibid.
42. "Greenhouse Gas Equivalencies Calculator." US Environmental Protection Agency. Clean Energy, US EPA.. Accessed August 25, 2010. <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results>.
43. "Climate Change Scoping Plan-Appendices." California Air Resources Board, December 2008. Accessed July 15, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/appendices\\_volume1.pdf](http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf).
44. "ARB's Drayage Truck Regulatory Activities." California Air Resources Board. Accessed August 25, 2010. <http://www.arb.ca.gov/msprog/onroad/porttruck/porttruck.htm>.
45. Ibid.
46. "Staff Report: Initial Statement of Reasons for Proposed Rulemaking- Proposed Regulation for Drayage Trucks." California Environmental Protection Agency, Air Resource Board, Stationary Source Division Project Assessment Branch. October 2007. Accessed July 10, 2010. <http://www.arb.ca.gov/regact/2007/drayage07/drayisor.pdf>.
47. Ibid.
48. "Clean Air Action Plan Update" pages 61-62. Port of Long Beach. Accessed April 21, 2010. <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2479>.
49. "TTSI received \$1.94 million for 97 trucks under the POLA Incentive Program; \$6.75 million for 72 trucks under the SCAQMD-administered Proposition 1B truck replacement program; and \$182,000 for 1 truck under the San Pedro Bay Ports' 2007 LNG truck program." LAANE Analysis of data from POLA, POLB and SCAQMD. Email to author. May 17, 2011.
50. Bensman, David. PORT TRUCKING DOWN THE LOW ROAD: A Sad Story of Deregulation. (New York City: Demos, 2009). Accessed May 18, 2011. [http://www.demos.org/pubs/trucking\\_072009.pdf](http://www.demos.org/pubs/trucking_072009.pdf).
51. "Development of New Hybrid Requirements for Medium and Heavy-Duty Vehicles." California Air Resources Board. Last updated February 3, 2010. [http://www.arb.ca.gov/cc/hybridtruck/meetings/wrkshp\\_presentation\\_2-3-10.pdf](http://www.arb.ca.gov/cc/hybridtruck/meetings/wrkshp_presentation_2-3-10.pdf).
52. "Climate Change Scoping Plan-Appendices." California Air Resources Board. Last updated December 2008. [http://www.arb.ca.gov/cc/scopingplan/document/appendices\\_volume1.pdf](http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf).
53. Ibid.
54. "Safe, Strong and Secure: Reducing America's Oil Dependence: America's rising consumption of oil threatens the economy and national security." NRDC, October 27, 2004. Accessed April 30, 2011. <http://www.nrdc.org/air/transportation/aoilpolicy2.asp>.
55. Reston, Maeve. "Boxer, Fiorina Present Contrasting Views of California - Latimes.com." Los Angeles Times, Last updated July 17, 2010. Accessed August 26, 2010. <http://www.latimes.com/news/local/la-me-senate-20100717,0,5541593.story>.
56. "Clean Air Action Report 1st quarter 2011 Status Report." Port of Long Beach. Accessed February 12, 2011. <http://www.cleanairactionplan.org/reports/default.asp>.
57. "Scoping Plan Measures Implementation Timeline." California Air Resources Board. Last updated July 01, 2010. [http://www.arb.ca.gov/cc/scopingplan/sp\\_measures\\_implementation\\_timeline.pdf](http://www.arb.ca.gov/cc/scopingplan/sp_measures_implementation_timeline.pdf).
58. "Climate Change Scoping Plan- E California Global Warming Solutions Act of 2006." California Environmental Protection Agency, California Air Resources Board. Accessed July 12, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/adopted\\_scoping\\_plan.pdf](http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf).
59. Ibid.
60. "Shore Power for Ocean-Going Vessels." California Environmental Protection Agency, California Air Resources Board, accessed August 25, 2010. <http://www.arb.ca.gov/ports/shorepower/shorepower.htm>.
61. "Shore Power for Ocean-Going Vessels." California Air Resources Board. Accessed August 25, 2010. <http://www.arb.ca.gov/ports/shorepower/shorepower.htm>; Final Regulation Order: Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels at-berth in a California report. California Air Resources Board, 2007. <http://www.arb.ca.gov/regact/2007/shorepwr07/93118-t17.pdf>.
62. "Adoption of the Regulation to Reduce Emissions from Diesel Auxiliary Engines on Ocean- Going Vessels while at Berth." California Air Resources Board. Accessed July 17, 2010. <http://www.arb.ca.gov/regact/2007/shorepwr07/uid2007.pdf>.
63. Ibid.
64. California Environmental Protection Agency - Air Resources Board. Freight Transport Efficiency. Last updated May 6, 2009. <http://www.arb.ca.gov/cc/freight/freight.htm>.
65. "Climate Change Scoping Plan-Appendices." California Air Resources Board, December 2008. Accessed July 15, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/appendices\\_volume1.pdf](http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf).
66. "Public Workshop to Discuss Freight Transport Efficiency Measures: Summary of T-6 Early Action Measures & More." California Air Resources Board, May 21, 2009. Accessed May 13, 2011. <http://www.arb.ca.gov/cc/freight/meetings/overviewpresentation.pdf>.
67. "Vessel Speed Reduction." California Air Resources Board, February 1, 2001. Accessed August 12, 2010. <http://www.arb.ca.gov/ports/marinevess/vsr/vsr.html>
68. Rosenthal, Elizabeth. "Slow Trip Across Sea Aids Profit and Environment. The New York Times, 16 Feb. 2010. Accessed August 4, 2010. <http://www.nytimes.com/2010/02/17/business/energy-environment/17speed.html>.
69. "Public Workshop Vessel Speed Reduction for Ocean-Going Vessels, Sacramento." California Air Resources Board, July 29, 2009. Accessed July 07, 2010. <http://www.arb.ca.gov/ports/marinevess/vsr/docs/072909speakingnotes.pdf>.
70. Jasper Faber (CE Delft), Malte Freund (GL Environmental Research), Martin K pke (GL Environmental Research), Dagmar Nelissen (CE Delft), "Going Slow to Reduce Emissions." CE Delft, January 2010. Accessed August 15, 2010. [http://www.ce.nl/publicatie/going\\_slow\\_to\\_reduce\\_emissions/1029](http://www.ce.nl/publicatie/going_slow_to_reduce_emissions/1029).
71. "Climate Change Scoping Plan- E California Global Warming Solutions Act of 2006." California Air Resources Board. Accessed July 12, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/adopted\\_scoping\\_plan.pdf](http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf).
72. "EPA Urged to Reduce Global Warming Pollution from Ships." Friends of the Earth." October 3, 2007. Accessed

- April 22, 2011. <http://www.foc.org/epa-urged-reduce-global-warming-pollution-ships>.
73. “Jerry Brown: Governor 2010.” Jerry Brown, 2010, Accessed April 22, 2011. <http://www.jerrybrown.org/sites/default/files/Environmental%20Plan.pdf>.
74. “Public Workshop Vessel Speed Reduction for Ocean-Going Vessels, Sacramento.” California Air Resources Board, July 29, 2009. Accessed July 07, 2010. <http://www.arb.ca.gov/ports/marinevess/vsr/docs/072909speakingnotes.pdf>.
75. “Slowing Steaming: Ocean Shipping Lines Cut Speed to save Fuel Costs - Latimes.com.” Los Angeles Times, July 31, 2010. Accessed August 5, 2010. <http://www.latimes.com/business/la-fi-slow-sailing-20100731,0,3362974.story>.
76. Ibid.
77. Rosenthal, Elizabeth, “Slow Trip Across Sea Aids Profit and Environment.” The New York Times, 16 Feb. 2010. Accessed August 4, 2010. <http://www.nytimes.com/2010/02/17/business/energy-environment/17speed.html>.
78. Cargo Handling Equipment Regulatory Activities, California Air Resources Board, Accessed May 23, 2011. <http://www.arb.ca.gov/ports/cargo/cargo.htm>
79. “Climate Change Scoping Plan-Appendices.” California Air Resources Board, December, 2008. Accessed July 15, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/appendices\\_volume1.pdf](http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf).
80. Climate Change Scoping Plan- E California Global Warming Solutions Act of 2006. California Air Resources Board. Accessed July 12, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/adopted\\_scoping\\_plan.pdf](http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf).
81. Dan Donohoue, Chief, Emissions Assessment Branch, ARB. Email to author. May 20, 2011.
82. “Proposed Regulatory Amendment Concepts,” presented by ARB staff at Mobile Cargo Handling Equipment Workshop, February 23, 2011, <http://www.arb.ca.gov/ports/cargo/presentations/022311present.pdf>
83. “ARB and Railroad Commitments to Further Reduce Diesel PM Emissions at High Priority Railyards.” California Environmental Protection Agency, Air Resources Board, 2010. Accessed January 7, 2011. <http://www.arb.ca.gov/railyard/commitments/commitments.htm>.
84. Richard D. Cameron, Director of Environmental Planning, Port of Long Beach, email message to author, May 18, 2011.
85. Commercial Harbor Craft Regulatory Activities, California Air Resources Board, Accessed May 24, 2011. <http://www.arb.ca.gov/ports/marinevess/harborcraft.htm>
86. “AB 32 Scoping Plan Overview and Freight Transport Measures.” California Air Resources Board, May 21, 2009. <http://www.arb.ca.gov/cc/freight/meetings/overviewpresentation.pdf>.
87. “Climate Change Scoping Plan- E California Global Warming Solutions Act of 2006.” California Air Resources Board. Accessed July 12, 2010. [http://www.arb.ca.gov/cc/scopingplan/document/adopted\\_scoping\\_plan.pdf](http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf).
88. “Draft 2010 Update - San Pedro Bay Ports Clean Air Action Plan- Technical Report.” Port of Long Beach and Long Angeles, April 2010. <http://www.cleanairactionplan.org/civica/filebank/blobdownload.asp?BlobID=2441>.
89. The Ports of Long Beach and Los Angeles. San Pedro Bay Ports Clean Air Action Plan (CAAP) 2010 Update. <http://www.cleanairactionplan.org/default.asp>.
90. Fujita, Eric M. et al., “Concentrations of Air Toxics in Motor Vehicle-Dominated Environments.” Health Effects Institute, February 2011, Number 156. Accessed July 1, 2010. <http://pubs.healtheffects.org/view.php?id=354>.
91. Clean Energy is a donor to the Coalition for Clean Air. As an independent 501(c)3 nonprofit organization, CCA solicits and accepts support only for activities that are consistent with our mission of clean air for California.
92. Data provided by Clean Energy via email, May, 24, 2011. Price of Clean Energy LNG \$2.089/diesel gallon equivalent; diesel price \$4.219/gallon at POLB. In 2008 CCA found LNG savings ranged from \$0.35 to \$1.73 per gallon compared to diesel fuel.
93. ARB Low Carbon Fuel Standard, Table 7. Carbon Intensity Lookup Table for Diesel and Fuels that Substitute for Diesel. [http://www.arb.ca.gov/fuels/lcfs/121409lcfs\\_lutables.pdf](http://www.arb.ca.gov/fuels/lcfs/121409lcfs_lutables.pdf), scheduled to be updated: <http://www.arb.ca.gov/regact/2011/lcfs11/lcfs11.htm>.
94. Ibid.
95. “Biodiesel Basics” National Biodiesel Board, 2011. Accessed July 1, 2010. [http://www.biodiesel.org/resources/biodiesel\\_basics/](http://www.biodiesel.org/resources/biodiesel_basics/)
96. ARB Low Carbon Fuel Standard, Table 7. Carbon Intensity Lookup Table for Diesel and Fuels that Substitute for Diesel. [http://www.arb.ca.gov/fuels/lcfs/121409lcfs\\_lutables.pdf](http://www.arb.ca.gov/fuels/lcfs/121409lcfs_lutables.pdf), scheduled to be updated: <http://www.arb.ca.gov/regact/2011/lcfs11/lcfs11.htm>.
97. “Biodiesel - Community Fuels - Makes Sense.” American Biodiesel, Community Fuels. Accessed July 28, 2010. <http://communityfuels.com/ghg.html>.
98. Manning Feraci, “The American Energy Initiative.” Written testimony submitted to the House Energy and Commerce Committee, Subcommittee on Energy and Power Hearing. National Biodiesel Board (NBB) Vice President of Federal Affairs. May 5, 2011.
99. “Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus.” U.S. Department of Agriculture and U.S. Department of Energy Final Report, May of 1998. Accessed July 7, 2010. <http://www.nrel.gov/docs/legosti/fy98/24089.pdf>.
100. “State of the Air 2011,” American Lung Association, April 2011. <http://www.stateoftheair.org/>
101. Manning Feraci, “The American Energy Initiative.” Written testimony submitted to the House Energy and Commerce Committee, Subcommittee on Energy and Power Hearing. National Biodiesel Board (NBB) Vice President of Federal Affairs. May 5, 2011.
102. St. John, Jeff. Balqon’s Electric Truck: 90-Mile Range, Fully Loaded. Greentechmedia. August 18, 2009. <http://www.greentechmedia.com/articles/read/balqons-electric-truck-90-mile-range-fully-loaded/>
103. Siemens Transportation Systems. Railcolor.net. EuroSprinter 1st generation, A short introduction. 2011. <http://www.railcolor.net/index.php?nav=1404916&lang=1>
104. Katzanek, Jack, “Business News for Inland Southern California.” Inland Empire Business, The Business Press, June 14, 2010. Accessed July 12, 2010. [http://www.inlandsocal.com/business/content/topnews/stories/PE\\_News\\_Local\\_D\\_bp\\_summit14.2ec1bc.html](http://www.inlandsocal.com/business/content/topnews/stories/PE_News_Local_D_bp_summit14.2ec1bc.html).
105. Review of Concepts and Solutions to Provide Zero-Emission Container Movement Systems (ZECMS) to the Ports of Long Beach and Los Angeles.” Keston Institute for Public Finance and Infrastructure Policy, University of Southern California, July 2010. Accessed August 5, 2010. [http://longbeach.granicus.com/MetaViewer.php?view\\_id=38&clip\\_id=4140&meta\\_id=318594](http://longbeach.granicus.com/MetaViewer.php?view_id=38&clip_id=4140&meta_id=318594).
106. “Request for Concepts and Solutions for a Zero Emission Container Movement System- Findings and Recommendations.” Port of Long Beach, August 2, 2010. Accessed August 4, 2010. [http://longbeach.granicus.com/MetaViewer.php?view\\_id=38&clip\\_id=4140&meta\\_id=318593](http://longbeach.granicus.com/MetaViewer.php?view_id=38&clip_id=4140&meta_id=318593).
107. “CCA’s Earth Day letter to Jerry Brown.” Coalition for Clean Air, 2011. <http://www.coalitionforcleanair.org/pdf/4-22-11-CCA-Letter-to-Gov-Brown-appended.pdf>
108. “Changes to diesel rules protect public health, provide relief and flexibility to California businesses.” California Air Resources Board, December 17, 2010. <http://www.arb.ca.gov/newsrel/newsrelease.php?id=171>.
109. “Changes to diesel rules protect public health, provide

relief and flexibility to California businesses.” California Air Resources Board, December 17, 2010. <http://www.arb.ca.gov/newsrel/newsrelease.php?id=171>.

110. “Statement of the manufacturers of Emission Controls Association on the impacts of the economy on the Air Resources Board’s Regulations covering in-use on-road diesel trucks/buses and in-use off-road diesel-fueled fleets.” The Manufactures of Emission Controls Association, December 9, 2009. Accessed July 28, 2010. <http://www.meca.org/galleries/default-file/MECA%20Comments%20on%20Economic%20Impacts%20Truck%20and%20Off-road%20Fleets%20120909.pdf>

111. Margaret Gordon comments. Email to author. May 13, 2011.

112. Bensman, David. Port Trucking Down the Low Road: A Sad Story of Deregulation. (New York City: Dēmos, 2009). Accessed May 18, 2011. [http://www.demos.org/pubs/trucking\\_072009.pdf](http://www.demos.org/pubs/trucking_072009.pdf).

113. Bensman, David, Marvy, Paul Alexander and Smith, Rebecca. The BIG RIG: Poverty, Pollution, and the Misclassification of Truck Drivers at America’s Ports: A survey and research report. National Employment Law Project, 2010. Accessed May 18, 2011. <http://www.nelp.org/page/-/Justice/PovertyPollutionandMisclassification.pdf?nocdn=1>

114. “Goods Movement Emission Reduction Program; State funding opportunities” Air Resources Board, 2010. Accessed March 2, 2011. [www.arb.ca.gov/bonds/gmbond/gmbond.htm](http://www.arb.ca.gov/bonds/gmbond/gmbond.htm).

115. “Current funding available for the Prop1B Program: Program Announcement PA2011-11.” South Coast Air Quality Management District. Accessed March 10, 2011. <http://www.aqmd.gov/rfp/attachments/2011/PA2011-11.doc>.

116. “Current funding available for the Prop1B Program: Program Announcement PA2011-11.” South Coast Air Quality Management District. Accessed March 10, 2011. <http://www.aqmd.gov/rfp/attachments/2011/PA2011-11.doc>.

117. “Proposition 1B: Goods Movement Emission Reduction Program: Supplemental Procedures for Ships at Berth and Cargo Handling Equipment Projects.” California Environmental Protection Agency- Air Resources Board. Accessed March 11, 2011. [http://www.arb.ca.gov/bonds/gmbond/docs/prop\\_1b\\_goods\\_movement\\_march\\_2011\\_ships\\_at\\_berth\\_supplemental\\_procedures.pdf](http://www.arb.ca.gov/bonds/gmbond/docs/prop_1b_goods_movement_march_2011_ships_at_berth_supplemental_procedures.pdf)

118. “Goods Movement Emission Reduction Funding Program (Proposition 1): Approved Contract Documents for Locomotive Funding.” South Coast Air Quality Management District. Accessed October 18, 2010. <http://www.aqmd.gov/tao/Implementation/Locomotives.htm>.

119. “Solicitations for Transportation Area Programs” California Energy Commission. Accessed October 6, 2010. <http://www.energy.ca.gov/contracts/transportation.html>.

120. “Alternative and Renewable Fuel & Vehicle Technology Program.” California Energy Commission. Accessed April 4, 2011. <http://www.energy.ca.gov/altfuels/index.html>.

121. “FACT SHEET: National Clean Fleets Partnership. Public-Private Partnership to Engage Large Commercial Fleets to Significantly Reduce Petroleum Use.” US Department of Transportation, April 1, 2011. Accessed May 18, 2011. <http://www.energy.gov/news/10252.htm>.

122. “2011 President Obama Kicks Off National Clean Fleets Partnership.” California Natural Gas Vehicle Coalition, CalNGV NewsCalNGV. Accessed April 18, 2011. [http://www.cngvc.org/pdf/newsletters/CalNGVNews\\_041811.pdf](http://www.cngvc.org/pdf/newsletters/CalNGVNews_041811.pdf).

123. Courtesy of Coalition for a Safe Environment, Email to author, May 12, 2011. [www.coalition4safe.org](http://www.coalition4safe.org).