Executive Summary
CONTAINER PORTS AND AIR POLLUTION

by James S. Cannon, Energy Futures, Inc.

The 4,600 container ships plying the oceans today are the backbone of globalization, the commercial strategy that has dominated the world's economy for the last 30 years. Twin environmental and energy crises are now challenging globalization. Bunkerfuel, the dregs of oil refining now powering most ships at sea, is subject to new international laws adopted in October 2008 that could greatly restrict its use and raise fuel costs. The second crisis stems from the increasing awareness of the environmental consequences of energy use, both from bunkerfuel emissions from container ships and diesel air pollution from the thousands of land-based vehicles used daily to transport goods to and from ports.

Just one step above asphalt, bunkerfuel is a viscous, jet black semi-solid that must be heated to make it liquid enough to be piped from storage tanks and injected into an engine. Due to its poor quality and limited applications, bunkerfuel generally sells for half to two-thirds the price of the crude oil from which it was refined. Current fuel quality standards set by the International Maritime Organization (IMO) allow the use of bunkerfuel that contains 45,000 parts per million (ppm) of sulfur, a key fuel contaminant and air pollutant. This is thousands of times more polluting than 15 ppm sulfur diesel allowed in onroad trucks in the United States (U.S.).

An October 2007 study calculated that air pollution emitted by ships burning bunkerfuel takes a horrific health toll on coastal populations, causing about 64,000 annual premature deaths, mostly from cardiopulmonary diseases or lung cancer. Other pollution problems exist as well. For example, if the international shipping industry were a country, it would rank just below Japan as the fifth largest emitter of carbon dioxide, the leading greenhouse gas causing global warming.

A premise of the work of Energy Futures, Inc. in its studies of air pollution in the container shipping industry is that alternative fuels offer viable options for use in goods movement operations to replace polluting fuels derived from oil. *Container Ports and Air Pollution* is a new study from Energy Futures that updates an earlier Energy Futures report, *U.S. Container Ports and Air Pollution: A Perfect Storm*, published in February 2008. The new report also includes new analyses of air pollution control efforts underway at ports outside the U.S. and international maritime issues, such as emissions from transoceanic ships.

U.S. Container Ports: An Emerging Market for Alternative Fuels

U.S. container ports completed their 20th consecutive year of growth in 2007. The top ten container ports handled 78.9 percent of all containers unloaded in the U.S. from abroad in 2007. In total, they handled about 45 million twenty foot equivalent units (TEUs) of containers during the year. (A standard container includes two TEUs.) During the past ten years, the 10 largest ports grew by 92.6 percent, exceeding the overall growth of 72.0 percent across the entire industry.

This growth in business has been accompanied by increasing port pollution. Air pollution at ports has been a major problem that has been largely unrecognized by the U.S. government and by state and local governments outside of California, but this is beginning to change. In July 2008, Congress passed the Maritime Pollution Prevention Act, which officially adopted the provisions of the IMO regulating emissions from ships. In 2008, two bills were introduced in Congress to establish a $25 container fee that would be collected by U.S. port authorities and applied to reduce port air pollution, but neither passed. In California, the first installments from a new $1.0 billion state bond fund dedicated to addressing environmental issues at ports were made in 2008. The California legislature passed a state container fee bill to finance more port cleanup by a wide margin, but it was vetoed by the governor.

Meanwhile, many ports themselves are taking action to reduce the pollution they generate through innovative alternative fuel and technology programs. The table below lists the alternative fuel projects currently underway at U.S. container ports.

Natural gas is currently the leading alternative to diesel and bunkerfuel used at U.S. container ports. In 2008, regional truck programs were launched at the three California ports that are likely to deploy thousands of natural gas powered onroad trucks during the next few years. They represent a major expansion of early natural gas programs, which, prior to 2008, included less than 30 prototype vehicles.

MAJOR ACTIVE ALTERNATIVE FUEL PROJECTS AT U.S. CONTAINER PORTS

Port	*Year*	*Project Description*
Natural Gas		
Los Angeles (LA)	2005	2 LNG Yard Tractors at YTI Terminal
Long Beach (LB)	2007	3 LNG Yard Tractors at ITS Container Terminal
LA and LB	2007	10 LNG Yard Tractors at Commerce Rail Yard
Oakland	2007	10 LNG Drayage Trucks
Oakland	2007	Mobile LNG Cold Ironing Power Generator
LA and LB	2008	Clean Truck Program to Upgrade 16,000 Drayage Trucks
Oakland	2008	Clean Truck Program to Upgrade 3,000 Drayage Trucks
LA	2008	Mobile LNG Cold Ironing Power Generator
Grid or Hybrid Electric		
Los Angeles	2006	Grid Alternative Marine Power at 1 Terminal
Long Beach	2006	1 Hybrid Yard Tractor at Long Beach Container Terminal
Los Angeles	2007	Foss Maritime Hybrid Tugboat
New York/New Jersey	2007	1 Hydraulic Hybrid Yard Tractor at Terminal in Elizabeth
New York/New Jersey	2008	2 Hybrid Electric Yard Tractors at Terminal in Staten Island
Hampton Roads	2008	1 "Green Goat" Hybrid Electric Locomotive
Los Angeles	2008	1 Battery Electric Drayage Truck
Long Beach	2008	Grid Cold Ironing at 1 Terminal
Biodiesel		
Tacoma	2006	50% Biodiesel Blend at Husky Container Terminal
Seattle	2006	99% Biodiesel in Port of Seattle Vehicles

Electric vehicle use is rapidly growing at U.S. container ports, representing an important new alternative fuel option. In 2008, hybrid electric yard tractor and rubber tire gantry projects were launched by the Port Authority of New York and New Jersey and at the Port of Long Beach in California, and a hybrid electric locomotive was purchased by the Port of Hampton Roads in Virginia. Development of a hybrid electric tugboat continued to make progress in 2008. The first pure electric vehicle made its debut in 2008 at the Port of Los Angeles. Major shore power programs to replace electricity generated from fuel burning ships with grid power delivered by wire to container ship berths are underway at the ports of Los Angeles and Long Beach. In October 2008, a dockside power unit fueled by natural gas was demonstrated at the Port of Los Angeles, duplicating an earlier demonstration at the Port of Oakland.

Interest in biodiesel remains strong at northwestern container ports. The ports of Seattle and Tacoma on Puget Sound in the state of Washington continue to spearhead the use of biodiesel blends in their vehicle fleets, although no new biodiesel programs were launched in 2008.

International Container Shipping

The U.S. is the largest importer of containerized goods. Even so, it accounts for only about 10 percent of the global container trade. In 2008, environmental programs affecting the international goods movement made significant progress. Most importantly, the IMO adopted amendments to regulations governing air pollution from ships in October. The revisions will require a gradual reduction in the global sulfur cap on bunkerfuel from the current limit of 45,000 ppm to 5,000 ppm.

There are no simple ways for the shipping industry to comply with the new IMO cleaner fuels provisions. To switch to a cleaner grade of petroleum fuel means switching from bunkerfuel to higher grade middle distillate fuels. These fuels historically have cost between twice and three times as much as bunkerfuel. Moreover, the distillate fuel market is already the most competitive market for oil derived fuels, including diesel truck fuel and aviation jet fuel. The entry of marine diesel fuel purchasers would further strain supplies and could cause prices to escalate.

Switching to alternative fuels is another option. Natural gas is the alternative fuel most widely used in ships. There are currently 52 oceangoing ships operating or on order worldwide powered by natural gas with a total power capacity of 2,000 MW. Emissions of particulate matter decline 70 percent, nitrogen oxides fall 72 percent and sulfur dioxide emissions are virtually eliminated when bunkerfuel is replaced by natural gas. Renewable fuels, particularly wind power, could replace at least a portion of bunkerfuel burned in ships. SkySails GmbH & Co. is currently marketing a large towing kite that can reduce ship fuel consumption by 50 percent under favorable conditions.

A second international effort is sponsored by the C40 Climate Leadership Group, an alliance of cities committed to tackling climate change. In July 2008, the city of Rotterdam in The Netherlands, home to Europe's largest container port, hosted a conference addressing world ports and climate change. Fifty-five ports endorsed the World Ports Climate Declaration at the conference, committing to reduce emissions of carbon dioxide and to improve air quality.

Europe: Unlike container port cleanup programs in the U.S., which have been created mostly by individual port authorities, progress in Europe has been directed by the European Commission. Its Energy and Transport Directorate and Environment Directorate have studied European port issues, funded a number of port cleanup projects and produced a series of marine policy reports. In June 2006, the commission released its *Maritime Policy Green Paper*, followed in October 2007 by an official action plan, called the *Integrated Maritime Policy for the European Union*. The policy creates a roadmap to facilitate continued growth in maritime activities while reducing the environmental footprint of these activities throughout Europe.

The Port of Rotterdam manages an extensive array of programs designed to reduce air pollution from container handling, guided by its *Port Vision 2020* plan adopted in 2004. The plan endorses a number of strategies to reduce air pollution from port operations, despite a projected 250 percent growth in container traffic. The port is studying the use of natural gas as a fuel for hundreds of barges carrying containers from the port to inland destinations. It is also developing a sustainability shipping index to create financial incentives, such as lower fees for clean ships and access to preferred "green lanes" for ship operators that comply with the index. Pollution control efforts are being applied in the development of the massive new Maasvlakte 2 port complex through the application of sustainability components among four evaluation criteria in applications for terminal operators.

Asia: In Asia, it is the container terminal operators that have taken the lead in port cleanup efforts. A review of port cleanup efforts in Asia by Energy Futures—including field research in Singapore, Hong Kong and Shanghai—found a number of container port programs involving the use of alternative fuels and advanced propulsion technologies. Unlike the U.S., where natural gas is currently leading other alternatives to diesel, in Asia, various uses of electrical energy are the alternative of choice.

Energy Futures identified only one natural gas vehicle project at Asian container ports, two yard tractors at the port of Bangkok, but it found hybrid electric rubber tire gantry projects underway at a number of ports, including Hong Kong and Shenzhen in China. Moreover, the Shanghai East

Container Terminal Co., Ltd. has converted 48 diesel gantries to electricity delivered from the grid. The electricity is provided from fixed overhead power lines though flexible cables.

Recommendations

The current global economic crisis is hitting the international container industry particularly hard. There was a significant drop in shipments late in 2008, and 2009 is likely to see the first substantial decline in container trade in more than two decades. Global ship orders, a key indicator of longer term trends in shipping, dropped 90 percent in October 2008 compared to orders placed a year earlier. Hard economic times create an added burden on the shipping industry as it addresses its environmental challenges, but it also creates an opportunity to implement more fundamental changes to the industry than are possible during periods of rampant growth.

Container Ports and Air Pollution identifies a growing array of advanced projects to deploy vehicles powered by alternative fuels, especially natural gas and electricity, in container port operations. These fuels work well in port applications and there is great promise that they can be more widely used in the container shipping supply chain. More funds are needed to optimize alternative fuel use in many specialty vehicles used in the goods movement industry. Direct government funding of research and development programs and indirect funding through tax credits and other incentives for alternative fuel vehicle deployment are needed.

In the U.S., one critical air pollution control element that is currently lacking is a coordinated national port cleanup strategy. Several ports are already acting individually and cooperatively to reduce air pollution. The next logical step is to broaden these efforts through federal government leadership. A national strategy should establish minimum cleanup targets for all ports and ships operating in U.S. waters and include a national funding mechanism to finance uniform and comprehensive cleanup. To help achieve this goal, the U.S. government should look to the model created by the ambitious port programs being implemented by the European Commission.

Asia, with its reliance on private sector leadership, also provides a good model for new port cleanup strategies. One of the first steps international shipping companies and their global terminal operators should take in response to the new IMO rules is to participate in expanded port pollution control programs to gain vital experience in the use of alternative fuels. This would leave them better informed several years from now when tough choices will have to be made about how to power transoceanic ships. In the meantime, port communities will benefit from improved air quality.

In recent years, most international shipping lines have established green programs to improve the environmental performance of their ships and container terminals. The economic downturn gives these companies the chance to proceed carefully to incorporate changes in their operating procedures that both reduce pollution and save money. Natural gas and electricity are both cheaper fuels than many of the grades of diesel and bunkerfuel now used for goods movement.

A particularly innovative addition to these green programs would be partnerships between alternative fuel providers and shipping companies to deploy cleaner cargo handling vehicles at port terminals around the world. The partnerships could take advantage of local government incentives to help finance use of alternative fuels, but leadership of these green programs would remain in the private sector. This leadership is overdue.

James S. Cannon, President of Energy Futures, Inc., has studied alternative transportation fuels since 1986 and is the author or editor of six books on the topic and more than a dozen reports and over 50 professional papers. He also authored the 2008 report, ***U.S. Container Ports and Air Pollution: A Perfect Storm***. Both reports are available at no cost at www.energy-futures.com.