

Office of Research and Development Inventory of Innovative Technologies For the US Seaports

**Prepared by:
International Institute for Sustainable Seaports
Global Environment & Technology Foundation**



**2900 S. Quincy Street, Suite 375
Arlington, VA 22206
703-379-2713
www.getf.org**

The impact of climate change and the global economic downturn are daily reminders to the port and maritime industry of the need to change “business as usual”. The pressures to integrate the global supply chain, the need for greater port expansion, and the immediate requirement to preserve natural resources require strong leadership and innovative approaches and technologies. Operating sustainably offers seaports the opportunity to implement state-of-the-art best practices and approaches that heighten operational efficiencies and increase cost savings. Access to better tools and information that provide credible metrics and results will allow members of the maritime industry the ability to assure lawmakers, communities, and other stakeholders that the best available technologies and approaches are being applied and integrated within their strategic planning process.

As such, the US Environmental Protection Agency partnered with the International Institute of Sustainable Seaports (I2S2) to develop an inventory of innovative technologies to provide ports with access to timely information to support their sustainability efforts. I2S2 is a non-profit **Center of Excellence** specifically designed to support port authorities, their tenants and members of the maritime community implement sustainable practices - ensuring economic vitality, while protecting environmental quality and community integrity. The I2S2 supplies port-specific, sustainability-related tools, information, data exchange, networks, best practices and innovative technology information that members of the maritime industry can integrate into their strategic planning and business operations. The I2S2 helps ports determine what works and what do not work to leverage successes and avoid problems.¹

This inventory of innovative technologies and best practices applicable to the maritime sector will support this sector in becoming more sustainable. In addition, this inventory will:

- Allow members of the maritime industry access to a central accounting of data – not currently in existence – to support technology deployment and best practices implementation for sustainable port operations;
- Provide a resource for members of the maritime community to measure and monitor their progress toward sustainability; and
- Provide information to members of the maritime industry on new technologies and approaches to support sustainable operations.

Information for this inventory has been gathered from literature reviews on a number of technology professional journals, publications, and websites including, but not limited to:

- U.S. Environmental Protection Agency;
- The Northeast Diesel Collaborative;
- National and International Seaports; and
- Department of Defense.

¹ I2S2 is a partnership between the Global Environment & Technology Foundation, a 501 c (3) not-for profit and the American Association of Port Authorities.

Through the use of innovative technologies and best practices detailed within this inventory, the port sector will potentially be able to:

- Reduce environmental impacts;
 - Minimize operational inefficiencies;
 - Reduce costs;
 - Recognize resource scarcity;
 - Address increased community concerns;
 - Identify and communicate their positive contributions;
 - Develop and implement time-tested solutions as opposed to quick fixes; and
 - Ensure prosperity and livability for the port community as a whole.
-

EPA Clean Ports USA Technologies

<http://www.epa.gov/otaq/diesel/ports/technologies.htm>

The Clean Ports USA Technologies website provides several examples of options for reducing diesel emissions from cargo handling equipment, tugboats, ferries, ships, trucks and rail yards. The site includes information outlining technologies and strategies for reducing ports emissions, organized into six broad categories: Refuel, Retrofit, Repair/Rebuild, Repower, Replace, and Operational Strategies. Specific examples of these technologies at ports around the U.S. are provided below.

EPA New England Diesel Sustainable Ports

<http://www.epa.gov/ne/eco/diesel/ports.html>

Tiered Approach to Greening New England's Ports

EPA New England developed an overview of the many and diverse strategies that ports can choose to begin to “green” their operations. These strategies are organized into three tiers – Environmental Stewardship, Technology Strategies, and Infrastructure and Replacement Strategies – based on cost and complexity. Full descriptions of each of these strategies are available from the Options for the Marine Ports Sector: Green Strategies for Sustainable Ports brochure: <http://www.northeastdiesel.org/pdf/Green-Strategies-4-Sustainable-Ports.pdf>

In the brochure, EPA New England aims to encourage ports to undertake voluntary emission-reduction measures by providing education, assistance and other incentives. This non-regulatory approach can address emissions from existing diesel engines and non-road equipment that are not affected by EPA’s standards for diesel fuel and newly manufactured diesel engines.

Leading ports around the country are reducing diesel emissions to respond to customer needs, community pressures, and/or their own environmental priorities. Ports such as LA/Long Beach, Boston, and many others are stepping forward to work with their tenants and customers to reduce diesel pollution. (Read about their efforts at www.epa.gov/diesel/ports/casestudies.htm). Examples from the ports of LA/Long Beach and Boston MassPort can be found below.

EPA Office of Transportation and Air Quality

Series Hydraulic Hybrid Yard Hostler

The special cargo mover, called a series hydraulic hybrid yard hostler, will be field tested in New Jersey. EPA and its industry partners have applied EPA's patented series hydraulic hybrid vehicle technology to the heavy-duty truck as part of the EPA National Clean Diesel Campaign's Clean Ports USA program.

Hostlers are large, off-road vehicles used to transfer cargo containers at marine ports, rail yards, warehouses and distribution centers. The trucks spend about half of their time idling and contribute to air pollution generated in ports throughout the world.

EPA's unique series HHV power train efficiently recovers, stores, and reuses braking power while significantly reducing idling and optimizing engine operation to use less fuel and reduce air pollution. HHV technology has been demonstrated and field tested in a number of vehicles, including package delivery vehicles and refuse trucks. EPA believes this vehicle design can improve the efficiency of the yard hostler operation by 50-60 percent.

Several EPA programs, including National Clean Diesel Campaign and its Clean Ports USA, Clean Automotive Technology, Office of International Affairs, and EPA Region 2 (New York and New Jersey) collaborated on this project. Industry technical partners include APM Terminals, Parker-Hannifin, Kalmar Industries, FEV Inc., R.H. Sheppard Co. Inc. and Webasto. Additional support was provided by the Port Authority of New York and New Jersey and the New Jersey Department of Environmental Protection.

Contact Information:

William Omohundro
Telephone: (312) 353-8254
Email: omohundro.william@epa.gov
(NCDC)

Jeffra Rockwell
Telephone: (734) 214-4401
Email: rockwell.jeffra@epa.gov

Sport Utility Vehicle Hydraulic Hybrid

In March 2004, EPA unveiled the world's first full-sized hydraulic hybrid sport utility vehicle (SUV) at the 2004 Society of Automotive Engineers (SAE) World Congress in Detroit, Michigan. EPA retrofitted a Ford Expedition SUV with a hydraulic full hybrid power train that has been patented by EPA. EPA is estimating that these will nearly double the fuel economy and that a consumer would recoup the higher vehicle cost in less than three years through fuel savings and less brake wear.

This vehicle demonstrates that hydraulic hybrid technology has the potential to dramatically and cost-effectively improve the fuel economy of sport utility vehicles (SUVs), while at the same time improving performance. This technology responded to President Bush's energy and climate goals by reducing fuel consumption and greenhouse gas emissions.

The demonstration vehicle uses EPA's full hydraulic hybrid technology integrated in a stock

SUV. Over the last decade, EPA has collaborated with many organizations to develop hydraulic hybrid technology including the U.S. Army, Ford, Eaton Corp., Parker-Hannafin Corp., FEV Engine Technology, Inc., Michigan State University, Ricardo Inc., Southwest Research Institute and the University of Wisconsin.

The vehicle on display is a hydraulic hybrid, reported to achieve a 55 percent improvement in fuel economy. This hydraulic hybrid technology is projected to increase the cost of a large SUV by about \$600, which would be quickly recouped by the consumer's lower fuel and maintenance costs.

Hydraulic hybrid technology uses a hydraulic energy storage and propulsion system in the vehicle. This hydraulic system captures and stores a large fraction of the energy normally wasted in vehicle braking and uses this energy to help propel the vehicle during the next vehicle acceleration. The hydraulic system also enables the engine to operate more efficiently when it is needed.

Hydraulic hybrids draw from two sources of power to operate the vehicle - the diesel or gasoline engine and the hydraulic components. In other words, a typical diesel-powered or gasoline powered vehicle can be fitted with hydraulic components as a secondary energy storage system. The primary hydraulic components are two hydraulic accumulator vessels (a high-pressure accumulator capable of storing hydraulic fluid compressing inert nitrogen gas and a low-pressure accumulator) and one or more hydraulic pump/motor units.

Benefits of Hydraulic Technology

Hydraulic drive trains are particularly attractive for vehicle applications that entail a significant amount of stop-and-go driving, such as urban delivery trucks. A major benefit of a hydraulic hybrid vehicle is the ability to capture and use a large percentage of the energy normally lost in vehicle braking. Hydraulic hybrids can quickly and efficiently store and release great amounts of energy due to a higher power density. This is a critical factor in maximizing braking energy recovered and increasing the fuel economy benefit. While the primary benefit of hydraulics is higher fuel economy, hydraulics also increases vehicle acceleration performance. Hydraulic hybrid technology cost-effectively allows the engine speed or torque to be independent of vehicle speed, resulting in cleaner and more efficient engine operation.

Future of Hydraulics

Hydraulic hybrid systems create a unique opportunity to optimize engine operations. EPA has produced research concept vehicles that demonstrate the hydraulic technology. One concept vehicle is an urban delivery truck that uses hydraulic "launch assist." This delivery truck retains its conventional engine and transmission, but adds on a hydraulics package optimized for fuel economy. The next generation of hydraulic vehicles involves fully integrating hydraulic technology. In this configuration, the "full" hydraulic hybrid replaces the conventional drive train with a hydraulic drive train and eliminates the need for a transmission and transfer case. Using the full hydraulic drive in conjunction with EPA's clean diesel combustion technology is projected to improve fuel economy even more.

EPA also has achieved major breakthroughs in designing hydraulic accumulators and pump/motors to be more efficient, smaller, and lighter for motor vehicle applications, which will help improve fuel efficiency. EPA currently has cooperative research and development agreements with several private sector partners to further the development of hydraulics.

Hydraulic hybrids are just one of several new clean diesel automotive technologies being developed by automakers, other companies and the Federal Government. Other technologies include electric hybrids, clean diesel engines, fuel cells and ongoing improvements to conventional gasoline engines. For more information, visit:

<http://www.epa.gov/otaq/technology/>.



EPA's Ford Expedition Hybrid

Engine Research – Low Emission Diesel Technology

EPA's engine research focuses on developing engines that are simultaneously clean, efficient, and cost effective, and which have high potential to produce real-world benefits.

Clean Diesel Combustion technology is one example of these innovative engine concepts. EPA's testing suggests the potential for a diesel engine design, using innovative air, fuel, and combustion management and conventional particulate matter aftertreatment, to achieve lower NOx levels without the need for NOx

aftertreatment. EPA is developing this technology as a potential alternative with other diesel emissions control approaches (e.g., NOx absorbers, urea selective catalytic reduction (SCR), etc.). Clean Diesel Combustion technology shows the potential to meet NOx levels "engine-out" over the entire engine operating range, to a level required for future diesel emissions standards. EPA has partnered with several automotive and engine manufacturers to evaluate the production feasibility of this technology. Using clean diesel combustion technology in conjunction with the full hydraulic drive is projected to improve fuel economy more than using either technology alone.



- Fact Sheet: [Clean Diesel Combustion -- Clean, Efficient, and Cost Effective Technology \(PDF\)](#)
 - Presentation and speaker's notes: [A Path to More Sustainable Transportation \(PDF\)](#) (presented August 29, 2004 at the 10th Annual Diesel Engine Emissions Reduction Conference (DEER) in Coronado, CA.) This presentation includes an update on an EPA diesel combustion technology that meets the 2007 heavy duty standards with engine-out NOx emissions of less than 0.2 gm/BHP/hr without the need for any NOx aftertreatment.
 - Presentation on SAE Paper 2004-01-0933: [An HCCI Engine Power Plant for a Hybrid Vehicle \(PDF\)](#) (delivered March 10, 2004, at the SAE World Congress in Detroit, Michigan). This presentation describes work conducted at the National Vehicle and Fuel Emissions Laboratory to explore the potential use of a homogenous charge compression ignition (HCCI) as a power plant for a hybrid vehicle.
-

Partnerships

- EPA and BorgWarner, Inc. announced on April 18, 2006 that they have formed a partnership to advance clean fuel efficient automotive components. The partnership will evaluate and determine the commercial viability of newly advanced turbochargers, engine air management, and sensors for use with diesel and high efficiency gasoline engines.
 - Fact Sheet: [EPA and BorgWarner to Develop Fuel Efficient Technology | PDF Version](#)
- EPA and the University of Toledo announced on March 24, 2006 that they have formed a cooperative agreement to work collaboratively on advanced vehicle technology. The cooperative agreement will focus on improving and optimizing the components of hydraulic hybrid systems for vehicles.
 - Fact Sheet: [Cooperative Agreement between EPA's Office of Transportation and Air Quality and the University of Toledo | PDF Version](#)
- EPA announced on February 10, 2005, a new partnership to demonstrate the world's first Full Hydraulic Hybrid Urban Delivery Vehicle. EPA will be working with United Parcel Service (UPS), Eaton, International Truck and Engine, and the U.S. Army to retrofit a UPS truck with a full-series hydraulic hybrid drivetrain that has been patented by EPA. EPA is estimating that this advanced hybrid system will improve the fuel efficiency of the UPS truck by 60-70 percent and that the fleet owner, in this case UPS, would recoup the higher vehicle cost in less than three years through fuel savings and less brake wear. As a second phase to this project, EPA and its partners will be demonstrating the effectiveness of a Clean Diesel Combustion (CDC) engine in this vehicle. A CDC engine can meet 2010 diesel emission standards with no NOx aftertreatment.
 - Press Release: [EPA and Industry Partners Unveil UPS Truck With 60 to 70% Higher Fuel Economy](#) (May 24, 2006)
 - Fact Sheet: [World's First Full Hydraulic Hybrid in a Delivery Truck | PDF Version](#)

- Press Release: [EPA to Build World's First Full Hydraulic Hybrid Urban Delivery Vehicle](#) (February 10, 2005)
 - Fact Sheet: [EPA Announces Partnership to Demonstrate World's First Full Hydraulic Hybrid Urban Delivery Vehicle | PDF Version](#)
 - EPA joined senior executives from Ford on January 28, 2005, to announce their partnership to further develop a new diesel emission technology called Clean Diesel Combustion (CDC). Clean Diesel Combustion technology is another approach to meeting EPA's future diesel emissions standards for cars, SUVs, and trucks. Ford has partnered with EPA researchers through a [Cooperative Research and Development Agreement \(CRADA\)](#) to further refine the technology and examine its commercial viability. EPA and Ford highlighted their cooperative effort at EPA's [National Vehicle and Fuel Emissions Laboratory \(NVFEL\)](#) in Ann Arbor, Michigan.
 - Press Release: [EPA, Ford Test Promising Clean Diesel Technology on Passenger Vehicles](#) (January 28, 2005)
 - Fact Sheet: [EPA and Ford to Develop Clean Diesel Combustion Technology | PDF Version](#)
 - EPA joined senior executives from International Truck and Engine Corporation on May 13, 2004, to announce a partnership to further develop and bring to the market a new diesel emissions control technology. According to EPA, Clean Diesel Combustion technology is another approach to meeting EPA's future diesel emissions standards for cars, SUVs, and trucks. International Truck has partnered with EPA researchers to evaluate and demonstrate Clean Diesel Combustion effectiveness in International's new SUV sized V-6 diesel engine. Leavitt highlighted this cooperative effort at International Truck's manufacturing and technical center in Melrose Park, IL.
 - Fact Sheet: [EPA and International Truck to Develop Clean Diesel Combustion Technology \(PDF\)](#)
-

Alternative Fuels Research

Research in this area evaluates the feasibility of running vehicles on non-petroleum fuels, such as alcohol fuels. The use of alternative fuels can potentially lower health-related emissions, reduce greenhouse gas emissions, and create less dependence on imported oil.

EPA's advanced research in alternative transportation fuels, such as ethanol and methanol, explores their potential for providing a cost-effective means of using sustainable fuels to achieve both low emissions and high fuel economy. Alternative fuel research consists of engine and vehicle development to achieve an economical alternative to conventional gasoline and diesel engines.

- SAE Paper 2007-01-3993: [High Efficiency with Future Alcohol Fuels in a Stoichiometric Medium-Duty Spark Ignition Engine](#) at 2007 SAE Powertrain and Fluid Systems Conference and Exhibition (14 pp, 202K)
- SAE Paper 2007-01-4093: [Low Engine-Out NOx Emissions with DME Using High Pressure Injection](#) at 2007 SAE Powertrain and Fluid Systems Conference and Exhibition (17 pp, 431K)

- Presentation and Commentary: Sustainable Technology Choices for Alternative Fuels (delivered September 28, 2005, at the ISAF XV International Symposium on Alcohol Fuels). This presentation and commentary describe work at EPA to modify a 1.9 liter 4 cylinder diesel engine to port fuel injection and spark ignition for use with various blends of gasoline and alcohol fuels.
 - [Sustainable Technology Choices for Alternative Fuels Presentation \(PDF\)](#)
 - [Sustainable Technology Choices for Alternative Fuels Commentary \(PDF\)](#)
 - Presentation: [Ethanol-Gasoline Blends: Fuel Economy and Emissions Benefits \(PDF\)](#) (delivered May 13, 2003, at the SAE Government and Industry Meeting). This presentation describes recent work at EPA with ethanol-gasoline blends, highlighting the potential cost and emissions benefits of E30.
 - Presentation: [Research in Alcohol-Fueled Engines at EPA NVFEL \(PDF\)](#) (delivered February 25, 2003, at the NEVC Annual Meeting). This presentation describes recent work at EPA with pure ethanol and methanol fuels, including the context of EPA NVFEL's work - the results and the challenges. The results show the ability to achieve diesel-like efficiency with low steady-state emissions on the level of Tier 2.
 - SAE Paper 2002-01-2743: [High Efficiency and Low Emissions from a Port-Injected Engine with Neat Alcohol Fuels \(PDF\)](#) © 2002 SAE International (7 pp, 68K)
-

Technical and Analytical Support

The automotive technology research carried out under Clean Automotive Technology provides EPA staff with insights that are useful in providing technical support on a wide range of automotive technology-related issues. EPA annually publishes a [Light-Duty Automotive Technology and Fuel Economy Trends Report](#) that is considered the most authoritative compilation of fuel economy data from new personal vehicles sold in the U.S. since 1975.

- Report: A Study of Potential Effectiveness of Carbon Dioxide Reducing Vehicle Technologies. This report, prepared for EPA by the engineering firm Ricardo under subcontract to Perrin Quarles Associates, Inc., provides a detailed assessment of the carbon dioxide emissions reduction potential of a large number of conventional vehicle technology packages. Also included is a peer review of the report, as well as a presentation given by EPA to the National Research Council's Committee on Fuel Economy of Light-duty Vehicles, which provides contextual background for this report.
 - [Revised Full Report \(PDF\)](#) (126 pp, June 2008)
 - [Peer Review \(PDF\)](#) (34 pp, January 2008)
 - [Presentation to NRC Committee regarding the Report \(PDF\)](#)
-

Northeast Diesel Collaborative

<http://www.northeastdiesel.org/index.htm>

Ports/Authorities - <http://www.northeastdiesel.org/ports.htm>

Diesel engines power almost all port activities, from the vessels themselves to cargo-handling equipment to the trains and trucks that move goods in and out of marine terminals. Ports therefore become concentrated sources of diesel emissions, and they are often located near large urban centers affected by pollution from other diesel-powered vehicles. With rapid growth in cruise ship calls, container freight volumes and land-side businesses such as fish processing, the need to work with port authorities and terminal operators on emission reduction strategies has never been stronger.

Early collaborative efforts in the Northeast between industry and government agencies demonstrating emission reduction options for marine vessels and port operations include:

- In New York Harbor, retrofitting and repowering public and private ferries and tugboats to significantly reduce NOx emissions.
- At the Port Authority of New York/New Jersey and its private terminals, repowering, upgrading and refueling cargo-handling equipment and instituting gate management efficiencies.
- At the New York Container Terminal, installing regenerating diesel particulate filters on cargo handling equipment and piloting idle reduction technology on locomotives.
- At South Jersey Port Corporation, the purchase of an electric crane.
- At Boston's MassPort Conley Container Terminal, retrofitting yard and cargo-handling equipment, using ultra-low sulfur diesel (ULSD), and systematically acquiring new equipment with maximum-efficiency engines.

National Seaports Technologies and Best Practices

Port of Los Angeles

Electric Tow Tractor Demonstration Project

The Port of Los Angeles and South Coast Air Quality Management District (AQMD) have partnered on a demonstration project to use electrically-powered tractors to tow cargo containers from the Port to local warehouses and rail yards. The \$527,000 initiative, funded by the Port and AQMD, will explore the feasibility of replacing diesel-powered tractors with ultra-clean, electrically-powered units. Under the Clean Air Action Plan (CAAP) approved by the ports of Los Angeles and Long Beach in November 2006, \$15 million has been set aside for a Technology Advancement Program. The electric tow tractor demonstration project is the first project to be approved under this CAAP program component.

AQMD has committed \$48 million to help replace older diesel trucks in addition to technology advancement projects such as the electric tractor. As part of the CAAP commitment, the Port has committed at least \$85 million over the next five years for truck replacement and retrofits.

The project is slated for three main components, and expected to be completed in about 7 months. The three components of the project are:

- Develop a barebones chassis to test;
- Complete chassis for initial road tests; and
- Demonstration phase.

The basic parameters of the project will be to develop an all-electric tow tractor that will have:

- Fast-charging capabilities;
 - A top speed of 25 miles per hour;
 - A range of 40 miles per charge; and
 - Sufficient torque and power to tow up-to a 60,000 pound container.
-

Use of Shore-Side Power for Ocean-Going Vessels

<http://westcoastcollaborative.org/files/sector-marine/AAPA-ShorePower-050107.pdf>

A number of technologies are emerging as tools in the reduction of emissions from ocean-going vessels.

Some of these include application of new engine technologies (e.g., electronic controls, slide valves), post combustion treatments (e.g., sea water scrubbing, selective catalytic reduction) and fuel improvements (e.g., low sulfur fuels, fuel emulsion). Use of shore supplied power is a technology being utilized or considered by a number of ports/operators to reduce the emissions from auxiliary engines of ocean-going vessels while at-berth.

The Port of Los Angeles, in collaboration with the American Association of Port Authorities, has developed a white paper to describe the background on the use of shore-power as a control measure for ocean-going vessels to reduce air emissions while at-berth. The paper also discusses technical requirements, challenges, the need to develop international standards, case studies and cost-effectiveness.

Both shore-power and alternative control technologies can reduce air emissions related to ocean-going vessel hotelling in port. Although many alternative control technologies are available, their effectiveness of emission control for marine vessel application is yet to be proven. The following discussion uses cleaner fuels (i.e., lower sulfur content) versus shore-power as an example to demonstrate effective air emission reduction by using shore-power.

Using the Port of Los Angeles 2005 port-wide auxiliary engine hotelling emissions for all ocean-going vessels and a 2005 low sulfur marine fuel survey study, air emission reductions by using cleaner fuels and shore-power are:

- An approximately 10% reduction for NO_x; 18%-65% for PM₁₀ and 45-96% for SO₂, depending on types of low sulfur fuel used.

- Almost no hotelling air emissions when a ship uses shore-power (assuming only 95% of hotelling time uses shore-power, therefore, 95% reduction efficiency for all air pollutants is used for the comparison).

Significant air emission reductions of SO₂ and PM can be accomplished by using lower sulfur fuel emissions but with only marginal NO_x reduction. While significant emission reduction of all three air pollutants (NO_x, SO₂ and PM) can only be achieved by using shore-power.

Among the three types of ocean-going vessels (i.e., container ship, cruise ship and tanker) in the Port of Los Angeles, cruise ships have the highest estimated annual air emission reduction potential *per ship* using shore-power due to its high power demand at berth and frequent annual port calls, even though the average berthing time is relatively short, approximately 10 hours per visit.

A complete copy of the white paper is available at: <http://westcoastcollaborative.org/files/sector-marine/AAPA-ShorePower-050107.pdf>.

Port of Long Beach

Main Engine Low-Sulfur Fuel Incentive Program

The Port has committed up to \$10 million for a one-year incentive program to encourage vessel operators to use low sulfur (0.2 percent sulfur or less) Marine Gas Oil (MGO) in their main engines during their approach or departure, out to 20 or 40 nautical miles from Point Fermin. The port will provide funding to cover the cost differential between the cleaner burning low-sulfur fuel and the heavy bunker fuel typically used. To receive the incentive, vessel operators must also participate in the Vessel Speed Reduction Program and use low sulfur fuel in their auxiliary engines while at berth. The program will be in place from July 1, 2008 through June 30, 2009, after which time the California Air Resources Board regulation is expected to come into effect. All program materials are available on the Port of Long Beach and Port of Los Angeles' joint **Clean Air Action Plan website**.

Cargo Handling Equipment Diesel Oxidation Catalyst (DOC) Retrofits

Due to the Port of Long Beach's Air Quality Improvement Plan, the Port was awarded one of EPA's 2005 Environmental Achievement Award for significant, long-term reductions in emissions from its port operations, particularly from diesel particulate matter (PM). An element of this plan is the Diesel Emissions Reduction Program (DERP), which provides funding for the installation of emissions control equipment. Any terminal or fleet operator at the Port of Long Beach who desires funding for the procurement and installation of cleaner technologies or fuels under DERP is required to submit an application detailing the type of technology requested and the emissions benefits expected.

EPA and the California Air Resources Board have spent more than \$2 million to retrofit more than 600 pieces of cargo handling equipment (including forklifts, heavy lifts, rubber tire gantry (RTG) cranes, side picks, top picks and yard hostlers) with diesel oxidation catalysts (DOCs) at

seven container terminals. Projects funded through DERP have proven successful in voluntarily reducing air pollution from port operations. The Port has reduced emissions of nitrogen oxide (NOx) by an estimated 79 tons per year — a reduction of 20 percent — and eliminated 16 tons of diesel particulates per year — a 50 percent reduction.

Contact Information:

Thomas Jelenic
Environmental Specialist Assistant
Port of Long Beach
Phone: (562) 590-4160
Fax: (562) 901-1728
Email: Jelenic@polb.com

Green Flag Program

The Port of Long Beach has committed as much as \$2.2 million a year to encourage participation in the Voluntary Vessel Ship Speed Reduction Program. Ships traveling at slower speeds reduce emissions. With the Green Flag incentives, vessel operators are rewarded with environmental recognition and lower dockage fees. The Port's voluntary speed reduction program asks that vessels entering or leaving the Port observe a 12 knot speed limit in a zone that extends 20 nautical miles seaward from Point Fermin. The speed of every vessel in the speed reduction zone is measured and recorded by the Marine Exchange of Southern California.

Beginning in January 2005, individual vessels that dock at the Port of Long Beach earn a Green Flag Environmental Achievement Award when they attain 100 percent compliance with the voluntary vessel speed reduction program for a 12 month period. In 2006, 507 individual ships out of 910 qualified for Green Flag Awards, up from 333 ships in 2005.

Beginning January 2006, carrier lines that achieved a 90 percent or better compliance rate in a 12 month period were eligible for a 15 percent reduced dockage rate (Green Rate) the following year. Nearly half of all vessel operators or 120 carriers received reduced dockage rates in 2007. Almost all of the Port's most frequent visitors were among the carriers with the highest compliance.

It has been estimated that if all vessels in the Port joined the program, the amount of nitrogen oxide (NOx) produced by cargo vessels would be reduced by 550 tons per year. For more information, visit [Port of Long Beach Green Flag Program](#).

Yard Hostler Hybrid and Liquefied Natural Gas (LNG) Repower

In 2006, the Port of Long Beach received a \$300,000 grant from EPA, plus \$900,000 in matching funds, for the development of ultra low emissions hybrid yard hostlers and evaluation of their performance in day-to-day operations. The Port will operate three hybrid yard hostlers, which could be either electric or hydraulic, at the Long Beach Container Terminal for six months.

Project activities include performance evaluation on fuel economy, emissions, and operator acceptance relative to baseline diesel yard hostlers, and the creation of a business case assessment for broader use of hybrid yard hostlers both inside and outside of the marine sector. The hybrid-drive system, coupled with the cleanest available diesel engine, is expected to reduce nitrogen oxide (NOx) and particulate matter (PM) by 93 percent. In addition, the hybrid technology is expected to eliminate emissions during idling, which can represent more than half of a yard hostler's duty cycle.

In 2005, the Port of Long Beach repowered three yard hostlers at the Long Beach Container Terminal's Pier F facility with on-road certified liquefied natural gas (LNG) engines. This demonstration and evaluation program was aimed at reducing emissions from diesel equipment that operates at the Port. EPA provided a \$75,000 grant to the Port of Long Beach and Weststart/CALSTART, with \$525,000 in matching funds. During the six month evaluation period, the LNG and diesel powered yard hostlers were compared in categories such as vehicle emissions, performance, fuel economy, and operator acceptance. This project was estimated to reduce yard hostler emissions by 63 percent for nitrogen oxide (NOx) and 80 percent for particulate matter (PM).

For more information, visit the [LNG Port Equipment Demonstration Project](#).

British Petroleum (BP) – Cold Ironing

The Port of Long Beach and British Petroleum (BP) have initiated a voluntary project, not required by its lease, to install shore-side electrical power at Berth T-121 and wiring and plugs on two BP tankers. The tankers will use cold ironing whenever they call on Long Beach. Work at the berth was scheduled for completion in late 2007. This is the first step in a master plan to upgrade the Port's electrical infrastructure to accommodate cold ironing at 10 berths throughout the Port. When the plan is completed in 2011, it will allow for 381 shore-powered ship calls per year.

According to the California Air Resources Board, if ships making three or more annual visits to the Port used cold ironing, emissions would be reduced by 70 percent or about 17 tons of nitrogen oxide (NOx) and .4 tons of particulate matter (PM) per day. For more information, visit [Port of Long Beach Air Quality](#).

MassPort Port Sustainability Progress Report

MassPort is in the process of developing a formal sustainable design and construction program for use on all MassPort and major tenant projects. The program will establish specific requirements and criteria for a variety of sustainability components including criteria for designer selection and design review, as well use of "green technologies" which foster the efficient use of renewable resources such as energy, water, and air.

MassPort has voluntarily agreed to comply with the "LEED Plus" green building requirements incorporated into Executive Order 484, Leading by Example – Clean Energy and Efficient Buildings. The LEED Plus standard was developed by the Commonwealth of Massachusetts Sustainable Design Roundtable and incorporates principles of the Leadership in Energy and

Environmental Design (LEED®) standard, as well as additional requirements associated Smart Growth, Water Conservation, Energy Efficiency and Indoor Air Quality. The LEED Plus standard established by the Commonwealth requires that, in addition to achieving basic LEED certification, a building incorporates a number of other specific features, including:

- Energy conservation that reduces consumption to at least 20 percent below the Massachusetts Energy Code requirements;
- At least one of four Smart Growth criteria, including development on a previously used site in a densely populated neighborhood, use of a brownfields site, reuse of at least 75 percent of an existing structure, or development within one-half mile of public transportation; and
- Water conservation measures, including reduction of potable water use for irrigation by 50 percent and reduction of total building water use by 20 percent.

At Conley Terminal, there are a number of operational controls that have been established to foster the principles of sustainability through improved environmental performance. These include:

- Recycling of waste oil;
- Recycling of fluorescent bulbs;
- Recycling of specialized waste, such as batteries, tires and anti-freeze;
- Integration of environmental considerations into purchasing decisions regarding new equipment; and
- Installation of diesel oxidation catalysts on mobile equipment to reduce air emission impacts.

Ultra Low-Sulfur Diesel Usage

MassPort is using ultra low-sulfur diesel (ULSD) fuel in all diesel equipment at Conley Terminal. ULSD significantly reduces one of the key pollutants of concern from diesel engines – sulfur dioxide. As with the engine requirements, the requirements for use of ULSD are being phased-in. Off-road vehicles and equipment (such as that used at Conley) are not required by regulation to use ULSD until 2010. In an effort to reduce its environmental impacts in advance of the regulations, MassPort started using ULSD at the Conley Terminal in early 2004.

Truck Idling Reduction

Conley Terminal has embraced the challenge of increasing capacity and improving operational efficiency within the facility's constrained footprint. Since November 1, 2006, MassPort has decreased the dwell time for containers from five days to two days to encourage turnover and free up space. To reduce the possibility of trucks idling on city streets before container pick up or drop off, MassPort has instituted an efficient gate processing system and extended the gate operating hours. Pre-gates are available to process several trucks at any one time, again with the goal of reducing idling time. With computers and remote cameras, the Conley Terminal dispatchers can process a trucker's request for pick-up or drop-off within a couple of minutes and then direct the truckers to the appropriate location for the container. The system works efficiently, resulting in few occasions of queuing at the gate. In general, efficiency will continue

to improve and air impacts will be reduced with the implementation of more sophisticated computer systems to manage container operations among dispatchers, brokers, shippers, U.S. Customs, carriers, and MassPort. MassPort is currently evaluating next generation computer terminal operating systems (MTOS) for use at Conley which, when implemented, will further increase terminal efficiency.

The Conley EMS identified truck idling as an issue for further study, and MassPort has evaluated options for reducing impacts from truck idling. Since the container trucks visiting Conley are not directly operated by MassPort and the majority of the truck idling occurs outside MassPort property, the options for MassPort to directly reduce truck idling are limited. MassPort has identified two specific activities as the best options for reducing truck idling. First, MassPort initiated a discussion with the MA State Police to remind them of the importance of enforcing the state law which limits idling to five minutes (unless there are specific conditions, such as preservation of refrigerated cargo, that require idling). Second, MassPort developed a handout describing the requirements of the idling law which was provided to truckers entering the Conley Terminal. It should also be noted that Conley Terminal provides 360 electrical power outlets to maintain cold temperatures within refrigerated units (reefers) to reduce the need for idling.

Voluntary Diesel Retrofit Program

As part of MassPort's commitment to decreasing emissions from portside equipment, it has implemented a program of engine retrofitting and upgrades that are now an integral part of Conley Terminal's equipment maintenance and management system. MassPort already has made many retrofits at the terminal. All cargo cranes have been electrified, reducing air emissions; however, much of the remaining mobile equipment at Conley is diesel-powered. With help from an EPA grant, MassPort retrofitted four rubber tire gantry cranes, 14 tractors, and two reach stackers at its Conley container terminal with emission controls. Tractors have been equipped with diesel oxidation catalysts and some have Tier III engines. Many of the forklifts are powered with propane and two additional forklifts are electrified. Snowmelters at all MassPort facilities are equipped with diesel particulate filters (DPFs). MassPort has experienced no loss of fuel efficiency with these retrofits, or any additional maintenance requirements.

Fish Processing Waste

As part of the waste stream management from seafood processing operations, a local company collects the seafood gurry (the portion of the seafood product left over after cleaning, cutting, portioning and other processing) and recycles this byproduct into cat food and fertilizer.

Fish Pier Electrification

MassPort currently maintains two power stations extending shore-to-ship power for up to four vessels at the Boston Fish Pier ("the Fish Pier") in South Boston, the home of Boston's commercial fishing fleet. Currently, 13 fishing vessels regularly dock at the Fish Pier and additional berthing space is available to accommodate visiting vessels and future growth of the fishing vessel fleet. The fishing vessels operate on-board diesel generators approximately 10 to 14 hours per day when docked to supply electricity for all on-board service needs. The available

electrical power stations at the Fish Pier enable vessels to connect to shore power when docked, reducing unnecessary idling by 95% and yielding significant reductions in the emissions of EPA criteria pollutants and greenhouse gases. Benefits include idle reduction, regional air quality improvement, public health improvements, and immediate economic benefits for fishing and visiting vessels. The project directly reduces NOx and VOCs, two main contributors of ozone formation, as well as PMs. MassPort is pursuing grant opportunities to install shore power stations at the remaining nine berths at the Fish Pier.

Mass Transit Support

MassPort recognizes the importance of transportation demand management (TDM) to encourage alternative modes of district access and reduce single occupancy trips to the South Boston Waterfront. Tenants on MassPort development parcels are expected to actively embrace TDM measures for their employees such as ridesharing, van pools, public transit subsidiaries, flex-time work schedules etc. MassPort included specific TDM requirements in its development permitting commitments for the overall build out of Commonwealth Flats. These commitments require MassPort and private developers of MassPort parcels to implement an extensive set of TDM measures intended to discourage single-occupancy vehicle trips and encourage the use of transportation alternatives.

International Ports Technologies and Best Practices

Port of Brisbane

Brisbane, Australia

<http://www.portbris.com.au/AboutUs/Sustainability>

Harvest Aquatic Weeds to use as Mulch

The Port of Brisbane continued a program to harvest the aquatic weeds which grow in their Visitors Center Lake. The lake plays a critical role in stormwater management by settling and filtering stormwater from the surrounding roads and motor vehicle storage areas. Regular harvesting of these aquatic weeds keeps the lake system healthy. This year, they removed in excess of 150 tons of weed using a commercial weed harvester. The weed was dried and used as mulch at the Whyte Island revegetation project.

Shanghai International Port Group – Terminal Operator

Shanghai, China

<http://www.portshanghai.com.cn/en/index.html>

Intelligent Management System of Container Operation

The Project has used the fuzzy control theory, multistage optimum decision-making theory, computer remote-control monitoring, computer emulation, network communication, database and modern information management and control technologies in the container production and management systems of the port. The technical innovations have lifted the level of container handling capacity and sharpened the core competitive edge of the container production in the Port of Shanghai. The retrieval made by Shanghai Science and Technology Information

Research Institute for the purpose of examining the international level in this connection confirmed that technologies innovated by the team of this project came up to the world advanced level in general, and some of them had a world leading position in particular.

The research subject of the Project covers the whole process of container handling operation in the port. For the “intelligent container production system” intended for operation-level staff members, the team, by the utilization of fuzzy control theory and real-time dynamic digitalization technology, introduced the fully-automated marshalling of the container carriers of the entire container yard of the terminal, intelligent piling and stacking of containers in the yard, and loading and unloading of containers of the same multiples from ships, thus boosting the handling efficiency of the terminal. For the “multistage optimum management system of container production” intended for the management-level personnel, the team achieved the digitalized process by the use of database and NET technologies, meanwhile the team innovated the management mode for container production, which may fulfill the personnel’s aspiration for the real-time dynamic scientific management of the port without the limitation of space and time, by examining the bottleneck in the container production. For the “remote-control monitoring and fault alarm system” intended for the technology-level personnel, the team cut down the equipment maintenance response time and secured the continuous high-efficiency running of the container production system by developing data interception technology and equipment software, the PLC grouped data transfer and other technical innovations for the port equipment and facilities. For the “E Port” intended for customers, the team created the technology for humane information service given to customers by developing and employing WEB SERVICE technology. For the “emulation decision-making system of container handling techniques” intended for the investment decision-makers, the team brought in new ideas in the decision-making management that can find out the technology with maximum efficiency and minimum investment used in container terminal by exploiting a multistage queuing network model in the optimization emulation of containers of the terminal.

Benefits

After more than two years’ production practices, this project has tremendously enhanced the container handling capacity of the Port of Shanghai, the throughput capability per meter of waterfront has increased by 47.3%, the average berthing time at the port decreased by 17.38%; the utilization rate of major equipment went up by 11% and the failure rate went down from 6% to 2%. The profit growth of the demonstration points and the whole port was RMB83.93 million and RMB173.403 million respectively, and their respective increase in taxes was RMB2.515 million and RMB15.895 million.

The implementation of the Project provides the Port of Shanghai with technical support and as a result the position of the Port of Shanghai on the ranking list of the world container throughput rose from the sixth in 2000 to the third in 2003. In two years, the Port of Shanghai witnessed a net increase of container throughput by 53.5% while the waterfront for accommodating containerships only increased by 14.3%. This gives full expression to the effect of the technical innovations contributed by the team of the Project. The fulfillment of the Project has laid a solid technological foundation for the realization of the target to construct the Port of Shanghai into an international shipping center. Moreover, the Project has played an exemplary role in the promotion of the technical progress of container handling jobs for all China’s ports. Also, it is

beneficial to the advancement of the Chinese ports towards the international port business market.

Hong Kong Container Terminal Operators Association Limited

Hong Kong, China

<http://www.hkctoa.com/intro.html>

Gate Automation

With the introduction of Information Exchange Services and tractor booking systems, the gatehouse operations are now automated at Kwai Chung Port. The gate operations are further enhanced by the launch of common smart-card based tractor identity cards (TID) for external tractors. Now, transactions for external tractors are paperless. This greatly reduces the turnaround time for tractors.

Electronic Data Interchange Technology (EDI)

The Hong Kong Port has been promoting the use of Electronic Data Interchange (EDI) since 1988. EDI enables accurate information links between shipping lines and terminal operators. It is being progressively extended to provide even higher level functions and greater convenience in services rendered.

One-stop E-business Portal Site

A portal site was established by one of the terminal operators in December 2000 as the first portal to offer a one-stop e-business platform for a wide range of port-related services to the Hong Kong shipping community.

Terminal Management System

Millions of containers are handled by container terminal operators at Kwai Chung. To handle this volume, the container terminal operators have their own terminal management systems, specially designed for the unique operating environment in Hong Kong. Each one of them is a full integration of technology, process, and people; ensuring excellent services are delivered to customers. Fully automated terminal management system integrates all terminal activities including gate, yard and vessel operations. The system provides optimization of operation parameters, a common data base for the terminal operations and a real-time updating of the data. Container terminal operators in Kwai Chung are equipped with real-time monitoring systems to ensure accurate and efficient services. The discharging and loading of vessels are planned and optimized by ship planning system, to ensure both efficiency in container handling and ship storage at all times. Similarly, yard planning in Hong Kong container terminals is performed via sophisticated computer systems to ensure smooth operating procedures in container yard.

Barge Operations

More and more container cargo originates from the extensive production base in Southern China. Recognizing the importance of barge traffic, Barge Centre was developed in 1998 to meet the

growing demand. To further streamline barge operations, a Barge Identity Card system was introduced to automate the identity authentication process.

Ashdod Port Company Ltd.

Israel

<http://www.ashdodport.co.il/english/Pages/default.aspx>

Preventing air contamination when loading bulk ships – dust suppressor ecological loader

The Port of Ashdod Company takes many measures to limit the dust discharge during the loading of bulk cargos. Each year, millions of tons of fertilizers of the type of potash and phosphate are exported through the Port of Ashdod to many markets throughout the world. In the past, the bulk ships were loaded by means of a pipe loader that caused increased emissions of phosphate and potash dust because of its method of operation, resulting in the contamination of the sea and air.

A solution to the problem was achieved through the combined efforts of the Port's Company and the Israel Chemicals and Fertilizers Company. In an investment plan stretched over a period of four years, all the old loaders were replaced by dust suppressor ecological loaders of the type Cleveland Cascade. Those systems make possible the loading of all types of fertilizers while minimizing the air contamination. In research conducted after the installation of the ecological loaders, it was found that the reduction in the contamination of the air and sea was at a rate in excess of 95%.

Prevention of sea contamination during cargo unloading – drainage system

Millions of tons of bulk cargos are being unloaded annually in the Port of Ashdod. Among the cargo is sulfur, grains, petroleum coke, fertilizers and other materials. The unloading of those cargos was done by means of a shovel crane into trucks located at the bottom of the unloading funnel, as customary in many ports in the world. During the unloading, remnants of cargo fall onto the piers and in the winter time, before cleaning of the piers can be done, may be swept into the sea by rain water and cause the contamination of the sea.

In order to solve this problem, all the bulk and general cargo piers in the Jubilee Port of Ashdod were planned with a rear drainage system combined with settling pits, assuring that all cargo leftovers on the piers will be absorbed by the settling pits and not overflow into the sea.

Ports and Harbors Bureau, Ministry of Land, Infrastructure and Transport

Japan

http://www.mlit.go.jp/english/2006/k_port_and_harbors_bureau/index.html

Wind Power Generation

http://www.mlit.go.jp/english/2006/k_port_and_harbors_bureau/13_windpower/index.html

As one approach to addressing global environmental concerns, the introduction of wind power generation – particularly using land stations – has expanded rapidly in Japan over the past several years. The development of wind power generation facilities in the future at sea and in seaside areas endowed with stable wind conditions and enormous wind power energy is

considered necessary and indispensable for further promoting natural energy use, and for requests for locating facilities in port and harbor spaces have increased. The primary advantages of ports and harbors as wind power generation sites include the following:

- Strong, comparatively stable wind;
- Located near areas of industrial concentration, with advantages from the perspective of systems and communications;
- Easy delivery and transport of materials; and
- Comparatively few problems such as noise and vibrations.

A study group conducted research activities to promote wind power generation at harbors and in coastal areas through cooperation among industries, academia and government. The Study Group for Promotion of Wind Power Generation at Harbors and Coastal Areas, which is comprised of two committees (the Location Planning Committee and the Construction Technology Committee) and five working groups (WG) (Planning WG, Environmental Evaluation WG, Load WG, Structures WG and Construction WG), conducted studies from the perspectives of both the environment and technology over a two-year period from 2003. The details of each WG's activities are described below.

The **Planning WG** studied issues such as the necessary project schemes and related laws and regulations, and support systems when locating ocean wind power generation facilities in port and harbors districts.

The **Environmental Evaluation WG** studied issues such as ocean wind power generation facility environmental impact assessment items and techniques. Also summarized the results of an underwater sound measurement study and an aquatic life survey implemented at a site at Setana Port (Japan's first ocean wind power generation site), in order to confirm the environmental impact of ocean windmills on aquatic life.

The **Load WG** studied issues such as the orientation of thinking and topics concerning design loads in Japan, based on design trends for foundations of ocean wind power generation facilities in Europe. Also summarized the results of a wind direction and wind velocity study implemented at the Setana Port site.

The **Structures WG** conducted comparisons of ocean wind power generation facility foundations and tower structural forms, and studied issues such as the characteristics of each form, approaches to design and issues to note. In particular, investigated analytical methods and assessments for the influential factors and dynamic problems unique to ocean wind power and the performance requirements for facility foundations.

The **Construction WG** studied issues such as ocean-based construction methods for each foundation form, main body structures, submarine cables and other components of ocean wind power generation facilities, and their unique characteristics and examples. Similarly studied approaches to the maintenance management, repair and dismantlement and scrapping processes unique to ocean wind power, and related topics.

Department of Defense – Navy

Navy Environmental Sustainability Development Integration Program

See [FY 2008 Year in Review Report](#) to learn more about the program's accomplishments, objectives, and direction.

Improved BMPs for Storm Water Run-off

Background

The Navy spent over \$18 million on storm water management from 2000-2004. This amount is expected to rapidly increase in future years as new regulations come into effect. At present, the Navy is required to self-monitor their storm water discharges, and identify and install storm water Best Management Practices (BMPs) appropriate to their facilities. Currently, the Environmental Protection Agency (EPA) is establishing guidelines for Total Maximum Daily Loadings (TMDLs) for each impaired water body. This will result in discharge limits being placed on Navy storm water discharges. There is a need to determine the Navy unique storm water problems (such as limited space availability, low hydraulic head, unusual contaminants or contaminant levels), and determine which storm water BMPs are most cost effective for Navy use.

Objective

The overall objective of this project is to enhance the management of storm water run-off to reduce cost and to address Navy unique requirements. New and advanced BMPs were evaluated for climate and weather conditions, cost and performance, and from lessons learned. The most promising BMP was selected to demonstrate/validate and transition for Navy-wide applications.

Description

The NAVFAC Engineering Service Center developed a web-based expert system, (Storm Water BMP Decision Support Tool) which is designed to help users identify the most cost effective storm water BMPs to address storm water run-off issues at Department of Defense (DoD) installations and activities. The BMP website is based on a review of proven BMPs and lessons learned from past and ongoing BMP projects performed by the DoD, government, and the private sector. The website ties BMPs to Navy specific industrial operations, site conditions and discharge limits. The BMP website is hosted on the Joint Service P2 Technical Library at <http://p2library.nfesc.navy.mil/stormwaterbmp/index.htm>.

The NAVFAC Engineering Service Center identified Navy unique site requirements such as limited available space, maintenance limitations and weather conditions and developed a storm water run-off BMP to meet these requirements. An innovative filter-adsorption media bed system was designed to reduce the concentration of metals, hydrocarbons, suspended solids, and other pollutants. This system was demonstrated at the Naval Regional Recycling Center in San Diego, CA.

Relevant performance data compiled from BMP testing will be included in the web-based expert system. A final report will document the results of the BMP(s) evaluation and located on the ESTCP website under Project ID SI-0405.

Contact Information: Contact the NESDI Program manager at 805-982-4454 for additional information on this project.

Department of Defense – Environmental Security Technology Certification Program

Low Impact Technologies to Reduce Pollution from Storm Water Runoff (SI-0405)

Objective

The objective of this project is to demonstrate the low-cost structural control of storm water runoff from industrial or military operations. Military installations must comply with National Pollutant Discharge Elimination System (NPDES) storm water permit requirements. Implementation of pollution prevention Best Management Practices (BMP) alone may not be adequate to comply with discharge requirements. Many installations also will be affected by the proposed U.S. Environmental Protection Agency Total Maximum Daily Load (TMDL) rule. TMDL is the amount of a pollutant that a stream, lake, estuary or other water body can accept without violating state water quality standards. Thus, military installations' point and non-point sources may be subject to discharge allocations set by TMDLs. Conventional treatment processes, such as those used for treating sanitary wastewater, can remove pollutants from storm water. However, such processes are usually too capital and maintenance intensive to be cost effective.

Technology Description

Innovative filtration trench systems will be demonstrated for the removal of metals and suspended solids in storm water runoff from the Navy Regional Recycling Center (NRRC) in San Diego and from a rifle range at Fort Stewart, Georgia. The filtration trench system is an example of Low Impact Development (LID) storm water treatment technologies. LID is a storm water management method that attempts to alter hydrologic functions of the site to mimic natural filtering processes, thereby meeting environmental regulatory requirements. Filtration trenches mimic natural sediment traps to capture contaminated particles. Filtration trenches have been used in the past to treat runoff from shopping center parking lots, residential areas, and other non-industrial applications. The application primarily has been to reduce runoff volume and to remove suspended solids. In these demonstrations, the design has been modified to allow the use of special adsorbent materials to increase the removal efficiency of metals. It is the combination of simple, low cost, storm water treatment technology (filtration trenches) with engineered materials (adsorbents) specifically selected to remove targeted industrial pollutants that make this technology innovative.

Expected Benefits

The expected benefit to the Department of Defense (DoD) is compliance with more stringent storm water discharge regulations. LID technologies will help DoD meet current and future NPDES and TMDL requirements in a cost-effective manner, resulting in a reduction of metals, sediment, and other pollutants entering the nation's rivers, lakes, and harbors. In addition, many LID technologies improve the aesthetics of a site, and these practices can be integrated into the building systems, landscape, and infrastructure - allowing for cost savings by combining construction and design projects. LID projects also can be constructed incrementally, thus reducing the need for large capital outlays.

Principal Investigator:

Mr. Gary Anguiano

Naval Facilities Engineering Service Center
1100 23rd Avenue
Port Hueneme, CA 93043
Telephone: (805) 982-1302
Fax: (805) 982-4832
E-mail: gary.anguiano@navy.mil

Validating the Kinematic Wave Approach for Rapid Soil Erosion Assessment and Improved Best Management Practice Site Selection to Enhance Training Land Sustainability (SI-0820)

Objective

Based on the concept of accumulating overland flow energy, an erosion potential model was developed for Fort Riley, Kansas, under the Strategic Environmental Research and Development Program (SERDP) project *Assessing the Impact of Maneuver Training on NPS Pollution and Water Quality (SI-1339)*. By integrating data from digital elevation models (DEM) and land use/land cover (LULC) classifications in a geographic information system (GIS) environment, the model determines where surface water runoff transitions from overland sheet flow to concentrated flow and, as a result, where the potential for soil erosion and gully formation increases. This model was calibrated and validated with field data from two watersheds in Kansas and proved successful (88% accuracy) in identifying the location of gullies. The objective of this follow-on project is to run the erosion potential model for additional military installations selected from regions with different precipitation regimes, land cover conditions, topographic characteristics, and soil types, as well as to operate the model in a predictive mode to better assess the impact of military training activities on future gully formation.

Technology Description

The erosion potential model, referred to as the nLS model and developed for Fort Riley, is capable of determining areas of high erosion potential and, therefore, the optimal locations for siting erosion-preventing best management practices (BMP). The nLS model is operationalized as a three-layer raster calculation in a GIS using classified LULC data and DEMs. The computed nLS output grid represents a unitless estimate of the energy of surface runoff water as it flows downslope. The relationship between actual gully locations and accumulated energy then are compared to develop a predictive model. Because it requires few inputs, for which easily accessed data sets are available nationwide, data acquisition and preparation times are minimal compared to existing erosion models such as AGNPS and RUSLE. While the nLS model has been shown effective in identifying the location of existing gullies, it also can be operated in a predictive mode to forecast the impact of military training exercises on the formation of new gullies. By incorporating vehicle tracking data from field training or simulator-based exercises, anticipated environmental damage such as vegetation loss and vehicle rutting can be simulated and used as the basis to modify representations of current installation terrain. The validated nLS model then can be run using modified vegetation and topographic input to identify likely sites of gully initiation.

Expected Benefits

The nLS modeling approach promises to be an effective tool for identifying current and predicting the location of future gully locations on military training lands. Using this approach, military installations will gain the capability to quickly evaluate gully formation potential across their training lands, saving significant time normally spent on ground and air surveys, while making training safer for soldiers and less damaging to equipment. The nLS modeling approach also will assist installation Integrated Training Area Management (ITAM) staff in siting BMPs designed to reduce soil erosion and meet state-enforced total maximum daily loads (TMDL) for streams leaving federal lands. The ability of the nLS model to predict future erosion potential offers several advantages to military installations. Key advantages include providing a sound scientific basis for estimating land rehabilitation and maintenance (LRAM) costs and the ability to estimate and compare environmental impacts associated with realignment and mission change. (Anticipated Project Completion - 2011)

Principal Investigator:

Dr. Stacy Hutchinson
Kansas State University
Biological and Agricultural Engineering
147 Seaton Hall
Manhattan, KS 66506
Telephone: (785) 532-2943
Fax: (785) 532-5825
E-mail: sllhutch@ksu.edu

DoD Liaison:

Mr. Alan Anderson
U.S. Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research
Laboratory
2902 Newmark Drive
Champaign, IL 61822-1076
Telephone: (217) 373-7233
Fax: (217) 373-7266
E-mail: alan.b.anderson@usace.army.mil

Demonstration/Validation of Low-VOC Barrier Coating for Industrial Maintenance (SI-0301)

Objective

To protect against corrosion, all exterior Aboveground Storage Tank (AST) surfaces initially receive two coats of epoxy (MIL-DTL-24441) and a polyurethane topcoat (MIL-PRF-85285), containing no more than 350 grams per liter (g/L) of Volatile Organic Compounds (VOCs) per coat. Exterior maintenance painting of ASTs is generally required at less than eight years of service, and when the three-coat system is used for complete reapplication over aged and weathered coatings, it has contributed to costly, premature coating failures. In addition to performance requirements, California's air quality standards are the immediate environmental drivers whereby the current three-coat system for ASTs is not compliant. In effect since August of 2002, California's South Coast Air Quality Management District has required that all Industrial Maintenance Coatings contain no more than 250 g/L of VOCs and, effective in August of 2006, no more than 100 g/L of VOCs. The objective of this project is to demonstrate/validate a Low-VOC Barrier Coating (LVBC) system for use in the exterior maintenance painting of marginally sound, coated surfaces on ASTs.

Technology Description

The technology to be demonstrated and validated was developed in response to the Small Business Innovative Research Program's (SBIR) Solicitation 01.1, "N0-027: Sprayable Polysulfide Elastomeric Development." The SBIR contractor, PolySpec, developed a 99 percent solid, high-build, low-VOC (i.e., less than 5 g/L), two component proprietary blend of Bis F epoxy and liquid polysulfide, which displayed maximum adhesion to industrial topcoats, good tensile strength, outstanding flexibility, and excellent barrier protection. This demonstration will apply the LVBC and the topcoat recently validated by ESTCP for aircraft and equipment (Zero-VOC Waterborne, Polyurethane Topcoat [<http://www.estcp.org/projects/pollution/199802v.cfm>]: MIL-PRF-85285D, Type III, Class W) to the exterior surface of an AST with approximately 20,000 square feet of weathered/semi-sound coatings. Prior to installation, the existing AST coating system will be quantitatively assessed and, following installation, monitored for field performance over no less than four years.

Expected Benefits

Maintenance painting of ASTs using the LVBC/Zero VOC Topcoat system should reduce annual Department of Defense VOC emissions by 22,750 pounds as well as produce annual savings in excess of \$1.5M when compared to complete coating removal and reapplication. (Anticipated Project Completion - 2007)

Contact Information:

Mr. David Gaughen
Naval Facilities Engineering Service Center
1100 23rd Avenue
Port Hueneme, CA 93043-4370
Telephone: (805) 982-1065
Fax: (805) 982-1074
E-mail: gaughencd@nfesc.navy.mil

Design, Monitoring, and Validation of a High-Performance Sustainable Building (SI-0724)

Objective

The Department of Defense (DoD) uses more than 620,000 buildings and structures. Facility energy costs exceeded \$2.5 billion in fiscal year 2006 and are expected to rise rapidly and unpredictably over the next decade. The objectives of this project are three-fold. First, the project will demonstrate that off-the-shelf building materials and components used in an integrated design will achieve higher facility performance. Second, the project will provide documented benefits of high-performance construction, including life-cycle cost savings, resource conservation, and waste reduction. Finally, lessons learned will be institutionalized in Service standard designs.

Technology Description

Whole system design principles and Federal goals will be applied to the design, construction, and operation of the Fort Bragg emergency services building. Initial performance goals will include those stated in the Energy Policy Act of 2005 and the Federal Leadership in High Performance

and Sustainable Buildings Memorandum of Understanding. Design elements and technologies that can meet these objectives will be evaluated during the design charrette and specified in the final building design if life-cycle cost effective. The building and a similar building built in 2003 will be monitored for a period of one year and the differences in life-cycle cost, energy and water use, occupant comfort and productivity, and solid waste, wastewater, and stormwater generation will be measured and documented. Cost and technical research data developed during project execution will be published for application to a wide range of federal projects.

Expected Benefits

DoD policy calls for the sustainable design of facilities; however, sustainable facilities are not yet standard on military installations. Standard building design practices need to be developed as well as stormwater and wastewater management techniques, design elements for energy conservation equipment, and new building materials. Also, the lack of readily available generalized cost and performance data has hindered initiation of building sustainable facilities on military installations. Expected benefits of the demonstrated high-performance building versus conventional construction are reduced energy and water consumption, increased occupant comfort and productivity, operational costs at least 25% lower, and reduced wastewater, stormwater, and solid waste. (Anticipated Project Completion - 2011)

Principal Investigator:

Mr. Michael Frnka

U.S. Army Installation Management Command - Southeast

1593 Hardee Ave SW

Fort McPherson, GA 30330

Telephone: (404) 464-0776

Fax: (404) 464-1623

E-mail: frnkam@forscom.army.mil

Summary of Port Sustainable Technologies

| Environmental Area | Technology | Benefit (Projected and/or Realized) | Notes | Organization | Point of Contact |
|--------------------|---|--|--|--|--|
| Air Emission | Series Hydraulic Yard Holster | reduces air pollution by reducing idling and optimizing engine operation | Can also improve vehicle efficiency by 50 - 60 % | EPA Office of Transportation and Air Quality | William Omohundro Ph: 312-353-8254 omohundro.william@epa.gov Jeffra Rockwell Ph: 734-214-4401 rockwell.jeffra@epa.gov |
| Air Emission | Sport Utility Vehicle Hydraulic Hybrid | reduces greenhouse gas emissions and fuel consumption | Doubles fuel economy (55% improvement in fuel economy) | EPA Office of Transportation and Air Quality | http://www.epa.gov/otaq/ |
| Air Emission | Yard Holster Hybrid and Liquefied Natural Gas Repower | reduces nitrogen oxide and particulate matter by 93% | hybrid technology will eliminate emissions during idling | Port of Long Beach | http://www.westcoastcollaborative.org/grants/ca-liquified-gas.htm |
| Air Emission | Low Emission Diesel Technology | reduces NOx levels | | EPA Office of Transportation and Air Quality | http://www.epa.gov/otaq/ |
| Air Emission | Ultra-Low Sulfur Diesel | reduces air emissions | MassPort Conley Container Terminal | Northeast Diesel Collaborative | http://www.northeastdiesel.org/index.htm |
| Air Emission | Main Engine Low-Sulfur Fuel Incentive Program | reduces air pollution | use of low sulfur (0.2 % or less) Marine Gas Oil on approach or departure | Port of Long Beach | Clean Air Action Plan http://www.cleanairactionplan.org/strategies/vessels/fuel.asp |
| Air Emission | Voluntary Diesel Retrofit Program | reduces air emissions | tractors, forklifts, and other equipment retrofitted with electric engines | MassPort | http://www.massport.com/ports/about.html |

| Environmental Area | Technology | Benefit (Projected and/or Realized) | Notes | Organization | Point of Contact |
|--------------------|---|--|---|--------------------------------|---|
| Air Emission | Cargo Handling Equip. Diesel Oxidation Catalyst (DOC) Retrofits | reduces NOx emissions by an estimated 79 tons per year (20% reduction), eliminates 16 tons of diesel particulates per year (50% reduction) | retrofit more than 600 pieces of cargo handling equipment (forklifts, heavy lifts, rubber tire gantry cranes, side picks, top picks, and yard holsters) with DOCs | Port of Long Beach | Thomas Jelenic (Jelenic@polb.com), Environmental Specialist Assistant, Port of Long Beach; Phone: 562-590-4160, Fax: 562-901-1728 |
| Air Emission | Retrofitting and Repowering Ferries and Tugboats | significantly reduces NOx emissions | New York Harbor | Northeast Diesel Collaborative | http://www.northeastdiesel.org/index.htm |
| Air Emission | Idle Reduction Technology | on locomotives | New York Container Terminal | Northeast Diesel Collaborative | http://www.northeastdiesel.org/index.htm |
| Air Emission | Truck Idling Reduction | Efficient gate processing system and enforcement of idling laws | computer system to improve efficiency, provides 360 electrical power outlets to maintain cold temperatures within refrigerated units to reduce need for idling | MassPort | http://www.massport.com/ports/conle_gatyrd.html |
| Air Emission | Electric Tow Tractor | reduces air pollution | replacing diesel-powered tractors with ultra-clean, electrically powered units Fast charging capabilities Top speed 25 mph Range of 40 miles per charge Sufficient torque and power to tow up to a 60,000 pound container | Port of Los Angeles | Theresa Adams Lopez (310) 732-3507 Sam Atwood, AQMD (909) 396-3456 |

| Environmental Area | Technology | Benefit (Projected and/or Realized) | Notes | Organization | Point of Contact |
|--------------------|---|---|--|---|---|
| Air Emission | Use of Shore-Side Power for Ocean-Going Vessels | reduces air emissions: significant (45-96%)SO2 and (18-65%)PM air emission reductions as well as a 10% reduction for NOX | While the study incorporated both low-sulfur marine fuel and shore-power, significant emission reduction of all three air pollutants can only be achieved by using shore-power | Port of Los Angeles | http://westcoastcollaborative.org/files/sector-marine/AAPA-ShorePower-050107.pdf |
| Air Emission | British Petroleum Cold Ironing | reduces emissions by 70% or about 17 tons of NOx and .4 tons of particulate matter per day | cold ironing is using electric power for ships at berth instead of diesel-burning engines | Port of Long Beach | http://www.polb.com/environment/air/vessels/default.asp |
| Air Emission | Fish Pier Electrification | reduces emissions of EPA criteria pollutants and greenhouse gases including NOx, VOCs, and particulate matter | idle reduction, regional air quality improvement, public health improvements, and immediate economic benefits | MassPort | http://webcache.googleusercontent.com/search?q=cache:n7sD5U4P4Z4J:www.massport.com/about/press_news_Stimulus1.html+MassPort+Fish+Pier+Electrification&cd=1&hl=en&ct=clnk&gl=us |
| Air Emissions | Demo / Validation of Low-VOC Barrier Coating for Industrial Maintenance | reduce annual DOD VOC emissions by 22,750 pounds and produce annual savings in excess of \$1.5 M compared to complete coating removal and reapplication | using Low-VOC Barrier Coating /Zero VOC Topcoat system for maintenance painting of Aboveground Storage Tanks | Department of Defense - Environmental Security Technology Certification Program | Mr. David Gaughen Naval Facilities Engineering Service Center 1100 23rd Avenue Port Hueneme, CA 93043-4370 Telephone: (805) 982-1065 Fax: (805) 982-1074 E-mail: gaughencd@nfesc.navy.mil |

| Environmental Area | Technology | Benefit (Projected and/or Realized) | Notes | Organization | Point of Contact |
|-----------------------------------|---------------------------------------|--|---|---|---|
| Air Emission | Green Flag Program | Voluntary Vessel Ship Speed Reduction Program could reduce NOx by up to 550 tons per year if all Port vessels joined program | carrier lines participating in the program by observing a 12-knot speed limit in specified zone are eligible for 15% reduced dockage rate | Port of Long Beach | http://www.polb.com/environment/air/vessels/default.asp |
| Air Emissions | Wind Power Generation | necessary for further promoting natural energy use | ports and harbors have advantages for wind generation sites including strong stable wind, comparatively few problems, etc. | Ports and Harbors Bureau, Ministry of Land, Infrastructure and Transport, Japan | http://www.mlit.go.jp/english/2006/k_port_and_harbors_bureau/13_windpower/index.html |
| Air Emission | Mass Transit Support | reduce single occupancy trips to South Boston Waterfront | ridesharing, van pools, public transit subsidiaries, flex-time work schedules | MassPort | http://www.massport.com/business/water_water_south.html |
| | | | | | |
| Air Emissions and Water Pollution | Dust Suppressor Ecological Loader | loads fertilizers while minimizing air contamination by 95% | dust suppressor loaders were achieved through combined efforts of Port's Company and Israel Chemicals and Fertilizers Company | Ashdod Port Company Ltd., Israel | http://www.ashdodport.co.il/english/Pages/default.aspx |
| Storm water Management | Harvest Aquatic Weeds to use as Mulch | lake settles and filters storm water from surrounding roads and motor vehicle storage areas Regular weed harvesting keeps lake system healthy | 150 tons of weeds were removed in a year and dried to use as mulch for revegetation | Port of Brisbane, Australia | http://www.portbris.com.au/AboutUs/Sustainability |

| Environmental Area | Technology | Benefit (Projected and/or Realized) | Notes | Organization | Point of Contact |
|------------------------|--|--|--|---|---|
| Storm water Management | Drainage System | cargo leftovers on the piers is absorbed and does not overflow into the sea | bulk and general cargo piers planned with rear drainage system combined with settling pits | Ashdod Port Company Ltd., Israel | http://www.ashdodport.co.il/english/Pages/default.aspx |
| Storm water Management | Improved BMPs for Storm Water Run-off | reduce the concentration of metals, hydrocarbons, suspended solids, and other pollutants | project objectives: enhance management of storm water run-off to reduce cost and address Navy unique requirements Storm Water BMP Decision Support Tool | Department of Defense - Navy | http://p2library.nfesc.navy.mil/stormwaterbmp/index.htm NESDI Program manager (805) 98-4454 |
| Storm water Management | Low Impact Technologies to Reduce Pollution from Storm Water Runoff | reduction of metals, sediment, and other pollutants entering the nation's rivers, lakes, and harbors also improve aesthetics of site and allow for cost savings | Filtration Trench Systems treat runoff from shopping center parking lots, etc. to remove targeted industrial pollutants | Department of Defense - Environmental Security Technology Certification Program | Principal Investigator: Mr. Gary Anguiano Naval Facilities Engineering Service Center 1100 23rd Avenue Port Hueneme, CA 93043 Telephone: (805) 982-1302 Fax: (805) 982-4832 E-mail: gary.anguiano@navy.mil |
| | | | | | |
| Land Sustainability | Validating Kinematic Wave Approach for Rapid Soil Erosion Assessment | advantages include providing a scientific basis for estimating land rehabiliy and maintenance costs and compare environmental impacts associated with realignment and mission change | determines optimal locations for siting erosion-preventing BMPs | Department of Defense - Environmental Security Technology Certification Program | Principal Investigator: Dr. Stacy Hutchinson Kansas State University Biological and Agricultural Engineering 147 Seaton Hall Manhattan, KS 66506 Telephone: (785) 532-2943 Fax: (785) 532-5825 E-mail: sllhutch@ksu.edu |

| Environmental Area | Technology | Benefit (Projected and/or Realized) | Notes | Organization | Point of Contact |
|--------------------------------------|--|--|---|---|---|
| Improved System Efficiency | Intelligent Management System of Container Operation | increased per meter of waterfront throughput capability by 47.3% and average berthing time decreased by 17.38% | position of the Port of Shanghai on the ranking list of the world container throughput rose from the 6th in 2000 to the 3rd in 2003 | Shanghai International Port Group - Terminal Operator, China | http://www.portshanghai.com.cn/en/index.html |
| Improved System Efficiency | Gate Automation | reduces turnaround time for tractors and transactions are paperless | launch of common smart-card based tractor identity cards | Hong Kong Container Terminal Operators Association Limited, China | http://www.hkctoa.com/intro.html |
| Improved System Efficiency | Electronic Data Interchange Technology | accurate information links between shipping lines and terminal operators | progressively extended to provide higher level functions and greater convenience | Hong Kong Container Terminal Operators Association Limited, China | http://www.hkctoa.com/intro.html |
| Improved System Efficiency | Terminal Management System | ensures both efficiency in container handling and ship storages at all times | integrates all terminal activities including gate, yard, and vessel operation | Hong Kong Container Terminal Operators Association Limited, China | http://www.hkctoa.com/intro.html |
| Efficient Use of Renewable Resources | LEED Plus certification | efficient use of energy, water, and air | Energy Efficiency, Water Conservation, Smart Growth, and Indoor Air Quality | MassPort | http://www.massport.com/ports/conle.html |

| Environmental Area | Technology | Benefit (Projected and/or Realized) | Notes | Organization | Point of Contact |
|-----------------------------|---|---|---|---|---|
| Sustainable Building Design | Design, Monitoring, and Validation of a High-Performance Sustainable Building | Reduced energy and water consumption, increased occupant comfort and productivity, operational costs at least 25% lower, and reduced wastewater, storm water, and solid waste | Whole System Design principles and Federal Goals including initial performance goals stated in Energy Policy Act of 2005 and the Federal Leadership in High Performance and Sustainable Buildings MOU | Department of Defense - Environmental Security Technology Certification Program | Principal Investigator: Mr. Michael Frnka U.S. Army Installation Management Command - Southeast 1593 Hardee Ave SW Fort McPherson, GA 30330 Telephone: (404) 464-0776 Fax: (404) 464-1623 E-mail: frnkam@forscom.army.mil |