

2014 AAPA Environmental Awards Competition

Environmental Enhancement:
Georgia Ports Authority --
*Voluntary Diesel Reduction
Through Investment in Equipment*

Submitted by:
Natalie Dawn
Georgia Ports Authority
Environmental Sustainability Manager
June 27, 2014

PROJECT DESCRIPTION

GPA is concerned about the impacts of its diesel fuel usage on the environment. This is the case even though we are fortunate to be in an area that is in compliance (or attainment) with governing federal and state clean air standards. GPA has pursued a three-pronged approach to address its diesel fuel usage: reducing diesel consumption, electrifying equipment, and improving equipment and process efficiency. Through equipment modifications including retrofits and repowerings, by working with crane manufacturers and energy industry representatives, and by evaluating process and equipment efficiency as we undertook changes, GPA achieved sustainable outcomes. GPA reduced fuel usage, associated energy costs, and air and climate emissions.

MEETING AWARD CRITERIA

- a) **Benefits to environmental quality:** GPA is proud of its efforts to date which have yielded a more than 70% reduction in diesel usage intensity (Gallons per Twenty-Foot Equivalent Unit [TEU]) while demonstrating to the ports industry that with thought and targeted collaboration, a sustainable diesel-less future is possible.
- b) **Independent involvement and effort:** GPA has led the efforts to identify means and methods to reduce its diesel usage. Moreover, as GPA is located in an air attainment zone, there is no regulatory requirement to its initiative. GPA has engaged with others in the shipping, logistics, ports and energy industry to identify and implement these measures.
- c) **Creativity:** GPA has pursued studies and engaged with partners and other stakeholders to find and implement creative solutions to the challenge of reducing diesel usage. Notably, after much study, in 2012, GPA introduced the first North American electric-powered rubber-tired gantry cranes (eRTG) for a cleaner and more efficient method of operation.
- d) **Program results:** GPA's efforts have reduced diesel usage intensity from 1.77 in 2001 to 0.503 in 2013. GPA anticipates a 50% or greater reduction in diesel usage intensity from 2013 levels by 2024 (0.207).
- e) **Program cost effectiveness:** Each year, the GPA conserves more than 7.2 million gallons of diesel through efficient equipment upgrades and energy savings programs. For instances, for eRTG conversions alone, GPA anticipates saving over \$58,000 per RTG annually (net energy and maintenance cost differential).
- f) **Transferability to the Port Industry:** GPA has engaged with others in the shipping, logistics, ports and energy industry to identify and implement these measures. One of the reasons we do so is to communicate our efforts and also pursue them in a manner that enables for easy transfer across the industry. It is one of the reasons we worked with EPRI and Georgia Power on evaluating the impacts of the eRTG program.

For more information about our program, contact Natalie Dawn.

TABLE OF CONTENTS

Introduction	1
Goals and Objectives	2
Discussion.....	3
Background	3
Reducing Fuel Consumption	4
Electrifying Equipment.....	6
Improving Equipment and Process Efficiency.....	7
Objectives and Methodology.....	8
Fulfillment of Award Criteria	9
Benefits to Environmental Quality	9
Independent Involvement and Effort.....	10
Program Creativity.....	10
Program Results.....	11
Program Cost Effectiveness	11
Transferability of Program to the Port Industry	12
Conclusion	12

INTRODUCTION

The Georgia Ports Authority (GPA) owns and operates two deepwater terminals - Ocean Terminal and Garden City Terminal – at the Port of Savannah. This port provides access to 44% of U.S. consumers in 2-3 days.

A dedicated breakbulk and RoRo facility, Ocean Terminal processes a wide variety of cargo. The 200.4-acre (81 ha) facility handles forest and solid wood products, steel, automobiles, farm equipment and heavy-lift cargoes. It features 82 acres of open storage and 82 acres of paved storage.

Garden City Terminal is the fourth busiest container port in the nation, moving more than 3 million TEUs of containerized cargo in calendar year 2013. At 1,200 acres, it is also North America's largest single-terminal container facility. This allows for maximum efficiency and flexibility, concentrating all manpower, technology and equipment in one massive container operation.

Georgia's deepwater ports are strong economic engines, fostering the development of virtually every industry. The ports are especially supportive of other forms of transportation, manufacturing, wholesale/distribution centers, and agriculture. The outstanding performance of Georgia's ports relative to other American ports reflects strong competitive advantages that allowed the GPA to expand its share of activities. These advantages are largely the result of strategic investments in port facilities by the state of Georgia over many years.

Businesses in the Southeast rely on Georgia's deepwater ports to provide efficient gateways to international markets. They generate benefits throughout the region and encourage development across a wide array of industries.

The GPA supports more than 352,000 full- and part-time jobs, which is 8.3 percent of Georgia's total employment. This means that one job out of every 12 is in some way dependent on the ports. Georgia's deepwater ports support approximately \$18.5 billion in personal income annually, about 5 percent of Georgia's total.

Our commitment to sustainability enables us to expand operations in the most environmentally and socially responsible manner possible. We engage with a diverse group of stakeholders who are active on the global,

national and local levels. One of the material issues for the Port and its stakeholders is fuel consumption and its environmental impacts. GPA has made significant reductions in the diesel fuel usage through multiple initiatives. By developing a response to challenges using a triple bottom line approach, which ensures that economic, environmental, and social outcomes are balanced, the Georgia Port Authority is setting the pace of trade, sustainably.

GOALS AND OBJECTIVES

The GPA is committed to conducting port operations in an efficient and environmentally respectful manner. The Authority is working hard to identify what must be done today to sustain growth, performance and security for tomorrow.

Since at least 2001, the GPA has pursued actions within its own operations (as well as actions with our business partners) to reduce its usage of diesel fuel. The objectives of our voluntary effort to minimize our diesel fuel usage include:

- improved efficiency,
- increased cost savings, and
- reduced environmental impacts including
 - air emissions, including particulate matter and nitrogen oxides
 - greenhouse gas emissions
 - noise

GPA's efforts to date have delivered the anticipated benefits and our projections indicate that our future plans will continue to do so also.

DISCUSSION

BACKGROUND

The primary operations and activities of GPA and its employees consist of moving cargo. This activity requires use of equipment (and buildings) which use energy. The primary energy-using equipment associated with cargo handling includes:

- Rubber-tire gantry cranes (RTGs),
- Jockey trucks,
- Generator sets (Gen-Sets) [fixed emergency generators and portable units formerly used to provide power to refrigerator containers],
- Toplifts,
- Forklifts,
- Chassis Flippers/Rotators, and
- Fleet vehicles (i.e., heavy duty trucks, light duty trucks and light duty cars).

Historically, diesel fuel has been the energy source of choice for much of this equipment. The reasons for this are numerous including

- Necessary horsepower to accomplish task (lifting, moving)
- Status and efficiency of battery technology to charge, maintain and discharge energy
- Availability of infrastructure

GPA's programmatic approach to reducing diesel fuel usage was pursued along three broad pathways: reducing fuel consumption, electrifying equipment, and improving equipment and process efficiency.

Reducing Fuel Consumption

In an effort to reduce GPA's reliance upon diesel fuel, GPA has initiated pilot studies and implemented projects with the primary goal of reducing diesel fuel consumption and its associated emissions. GPA converted its fleet of yard cranes, trucks, and other equipment to cleaner-burning ultra-low-sulfur diesel (ULSD) in 2008, which cut emissions by ten percent and reduced the total sulfur content by 99 percent, two years before a federal mandate.

The GPA has been awarded two United States Environmental Protection Agency (USEPA) Diesel Emissions Reduction Act (DERA) grants that have assisted in reducing fuel consumption and emissions. DERA, under the Energy Policy Act of 2005, assists states and organizations with grants and loans to curtail diesel emissions without hampering their economic development. A \$250,000 award was used to upgrade three diesel RTGs to higher tier engines with variable alternators. The variable alternators deliver power as needed, only turning as required for the current load, as compared to legacy engines which ran constantly at a higher rate. The variable alternators reduce diesel consumption and emissions. A \$2.72 million award, which was matched by more than \$900,000 from GPA, was used to upgrade 17 diesel RTGs, respectively, to higher tier engines with variable alternators. The second repower project, as calculated by the USEPA's Diesel Emissions Quantifier, reduced diesel emissions more than 33 percent or 24,829 tons over the lifetime of the 17 cranes while also reducing fuel consumption by 129,200 gallons annually.

GPA's movement of containers between vessels and the container yard stacks and other destinations throughout the terminal requires various container handling equipment. One of the specialized vehicles used is called a yard hustler, or jockey truck, which pulls the trailer that handles loaded and emptied containers. The GPA leases over 60 jockey trucks. In May 2010, GPA completed a study to assess the viability of utilizing alternative fuel vehicles, such as a natural gas, electric, or a hybrid, compared to the existing diesel powered jockey trucks.

Three different jockey trucks were tested at the Garden City Terminal in Savannah: a standard diesel powered truck; an alternative fuel truck that is powered by compressed natural gas (CNG); and a hybrid truck that is battery powered and utilizes a small internal combustion engine to power a generator. Each of the vehicles was

placed into operation for three weeks supporting the same type of operations. GPA operates vehicles upwards of 20 hours per day with the bulk of the jockey trucks committed to supporting container field operations and only a small number dedicated to warehousing support.

This study revealed that the conventional diesel and CNG jockey trucks generally performed well and were more energy efficient potentially leading to a reduction in the overall costs for fueling. The inability of the CNG trucks to make sharp turns due to the overall length and its larger turning radius were noted. Although the battery capacity of the hybrid diesel-electric vehicles was insufficient to meet the required demand loads, this vehicle could also potentially lead to a reduction in the overall fuel costs. In FY2013, GPA revised its leasing arrangement such that five percent of all vehicles it leases will be powered by liquefied natural gas (LNG). As a result, GPA now has its first LNG jockey truck. GPA continues to assess the state of alternative fuel vehicles for expanded use within its operations.

GPA's engineering staff commissioned a study also in 2010 to determine whether the Power Kleen fuel additive would be effective in reducing pollutant emissions and increasing engine fuel efficiency for its diesel equipment fleet. Fuel consumption and operating hours were measured to develop a consumption rate in gallons per hour. The result of the study indicated a decrease of approximately five percent in fuel consumption. Reductions in EPA criteria pollutants were more significant. Particulate matter reductions averaged as high as 71 percent, while nitrogen dioxide decreased as much as 20 percent and carbon monoxide decreased an average of 19 percent. The Power Kleen additive is incorporated into the fuel supply.

In July 2013, GPA was recognized for its diesel usage reduction efforts by the Southeast Diesel Collaborative (SEDC). The goal of the SEDC is to improve air quality and public health by reducing emissions from diesel engines throughout USEPA Region 4. GPA was awarded SEDC's 2012 Community Leadership Award which recognizes a non-profit organization which demonstrates exemplary leadership by proactive actions to reduce their diesel emissions.

Electrifying Equipment

GPA utilizes a large number of specialized container-handling equipment, such as cranes, toplifts, forklifts and yard hustlers. These modern, state-of-the-practice pieces of equipment are effective at quickly moving containers within the terminal. Reducing fuel consumption and related emissions by electrifying this equipment is a powerful combination in our ongoing mission to be good stewards of the environment. Electrical infrastructure improvements to GPA's terminal, including a new substation and transformers to provide additional capacity and redundancy, have been implemented to insure that the equipment needs would be properly served.

The cranes that move the cargo from ship-to-shore (STS) are workhorses for container ports, sometimes used around the clock. Since 1997, GPA – motivated by environmental and reliability considerations – has begun adding or converting its STS cranes from diesel to electric. The conversion and purchase of the port's first 17 electric STS cranes was estimated to reduce diesel usage by nearly 1.2 million gallons per year. One of the largest fleets of STS cranes in the country now includes 16 super post-Panamax electric cranes – bringing the total to 27. The super post-Panamax cranes arrived on a specialized vessel on June 5, 2013. After the cranes were offloaded, crews began raising the booms, and the electrical and machinery housings roughly 100 feet to their proper position. Additional on-site work included elevator installation and final wiring connections. On October 23, 2013, all four of the super post-Panamax STS cranes were fully operational at the GPA's Garden City Terminal.

GPA began construction of electrified refrigerated container racks in 2009, each of which will eliminate the use of 54,000 gallons of diesel fuel annually. These container racks provide increased capacity and efficiencies for our refrigerated cargo customers while reducing the release of particulate matter and dependence on foreign fuel. The GPA now has 84 electrified refrigerated container racks; accommodating 24 containers each. As the leading U.S. East Coast port for refrigerated containerized export cargo, the GPA has more than doubled its refrigerated cargo volume in last six years with an increase of 120 percent. Over the 2011-2012 period, volume has increased 19.8 percent. GPA constructed another 20 racks in FY2013.

GPA introduced the first North American electric-powered rubber-tired gantry cranes (eRTG) in December 2012 for a cleaner and more efficient method of operation. The project took about one and a half years to complete after years of studying and reviewing concepts from around the world. The eRTG innovative technology is estimated to provide 95 percent decrease in diesel fuel usage and related emissions by utilizing RTG-mounted electrical equipment and retractable arms connecting with the bus bars providing electrical power. Like our other cranes, these machines do generate their own power for 18 minutes out of every hour of operation by capturing energy while lowering containers. The auto-engage system switches between electrical power and the diesel engine only when the crane moves between container stacks.

The eRTGs provide for regenerative braking that produces power for more efficient equipment operation. GPA partners on the project included Konecranes, Conductix-Wampfler, EPRI (Electric Power Research Institute) and Georgia Power. Two eRTGs were operational in December 2012; the other two in 2013.

GPA allowed EPRI to equip these cranes with sensors and equipment to collect data on engine performance, generator outputs, and location. The research is designed to help assess the costs and benefits of electric cranes versus diesel. In addition, EPRI researchers and Georgia Power, GPA's local electric utility, will also use this data to evaluate the additional electricity needs and demand profiles of an expanded electric gantry crane fleet. Data collection began in 2012 and continued through September 2013.

In 2014, the GPA board approved spending \$8 million for Phase II of the eRTG project, which will convert 10 additional diesel RTGs to electric power. GPA's transition to an all eRTG fleet – expected to be comprised of 169 eRTGs - should be complete by 2024.

Improving Equipment and Process Efficiency

In 2009, GPA completed the assembly of 11 new rubber-tired gantry cranes (RTG). Besides typical generational changes, the newer models are more energy efficient. The cranes are designed with a power management system that operates at variable speeds. These RTGs are always ready to work, but only as dictated by demand. Operating within a spectrum from 800 to 2100 rotations per minute (rpm), these machines burn an average of four gallons of

diesel per-hour – a 33-percent fuel/cost savings compared with the then-existing fleet’s average consumption. The GPA estimated that these new cranes conserve more than 83,000 gallons of diesel per year.

With the conversion to electrical STS cranes as described above, the port is realizing operating and maintenance expense savings as well. GPA also estimates that equipment down time on the electric cranes has been cut between 25 and 50 percent, which translates to a decrease in lost revenue for the port. And each new crane can lift up to 65 tons, improving speed and efficiency of cargo movement. Finally, the port also expects significant increases in equipment life span, from approximately 25 to 40 years, as compared to diesel.

As mentioned above, the new eRTGs, developed with input from GPA engineers, do still rely on diesel fuel when moving between container stacks. The eRTGs use a retractable arm that latches to a conductor rail while the crane is in use over a container stack. When moving between rows, a diesel generator automatically starts at the end of one conductor rail, and then stops when the computer-guided arm re-engages with the conductor rail at the next row. This process means the diesel engines only run while being used.

OBJECTIVES AND METHODOLOGY

GPA pursued its diesel reduction program with the following objectives in mind. For each objective, GPA leveraged existing process as the methodology by which to monitor the stated objectives.

1. **Reduce environmental impacts:** For each program investment GPA has assessed the pre- and post-implementation environmental impacts.
2. **Address a stakeholder concern:** GPA engages with interested stakeholder groups “external” to the core operation of our business, such as affected communities, local government authorities, non-governmental and other civil society organizations, local institutions and other interested or affected parties. We take these engagement efforts seriously and recognize that the dialogue presents us with opportunities to both give and receive information, but also to work to mutual progress. We also have established corporate policies and procedures regarding interaction with parties that are core to our business function (e.g., suppliers, contractors, and customers).

3. **Reduce costs:** For each program investment GPA has made, a cost-benefit analysis has been undertaken to demonstrate the value of the investment.
4. **Increase equipment reliability:** For each program investment, GPA assessed the pre- and post-implementation reliability of affected equipment.
5. **Improve processes:** For each affected process, GPA assessed the pros and cons of implementation as well as the opportunities for process improvement.

FULFILLMENT OF AWARD CRITERIA

Benefits to Environmental Quality

Table 1 presents the historic total diesel fuel usage intensity at Garden City Terminal (GCT). The diesel fuel usage intensity was calculated by dividing the total annual diesel fuel usage at GCT by the total annual twenty-foot equivalent unit (TEU) cargo volume for each fiscal year 2001-2013. The diesel fuel usage intensity is observed to be declining during this period.

Table 1: Historic GCT Total Diesel Usage KPI (gal/TEU)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total	1.77	1.46	1.34	1.01	0.859	0.815	0.901	1.06	0.894	0.757	0.782	0.837	0.503

Table 2 presents the projected total diesel fuel usage intensity at Garden City Terminal (GCT) following expected full implementation of the eRTG conversion program.

Table 2: Projected GCT Total Diesel Usage KPI (gal/TEU)

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Total	0.511	0.466	0.427	0.394	0.356	0.319	0.297	0.277	0.252	0.240	0.207

Independent Involvement and Effort

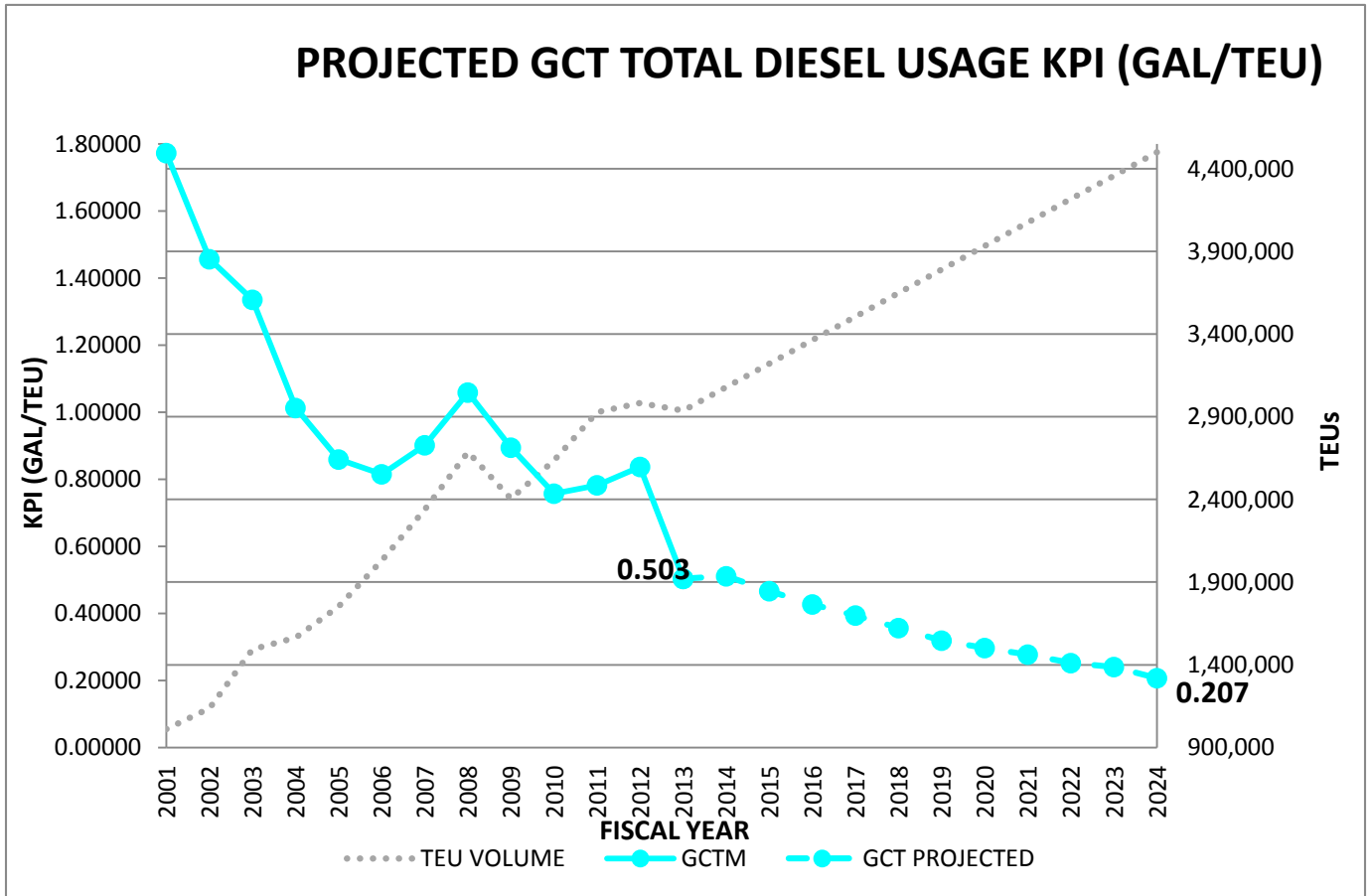
GPA has led the efforts to identify means and methods to reduce its diesel usage. Moreover, as GPA is located in an air attainment zone, there is no regulatory requirement to its initiative. GPA has engaged with others in the shipping, logistics, ports and energy industry to identify and implement these measures.

Program Creativity

GPA has pursued studies and engaged with partners and other stakeholders to find and implement creative solutions to the challenge of reducing diesel usage. In 2010, GPA completed a study to assess the viability of utilizing alternative fuel vehicles, such as a natural gas, electric, or a hybrid, compared to the existing diesel powered jockey trucks. This led to the decision to move some of the fleet to LNG. After much study, in 2012, GPA introduced the first North American electric-powered rubber-tired gantry cranes (eRTG) for a cleaner and more efficient method of operation.

Program Results

The historic and projected results of GPA’s efforts to reduce diesel usage are presented in the following graph:



Program Cost Effectiveness

Cutting diesel consumption means not only cleaner air, but also lower energy costs. Each year, the GPA conserves more than 7.2 million gallons of diesel through efficient equipment upgrades and energy savings programs. For instances, for eRTG conversions alone, GPA anticipates saving over \$58,000 per RTG annually (net energy and maintenance cost differential).

Transferability of Program to the Port Industry

GPA has engaged with others in the shipping, logistics, ports and energy industry to identify and implement these measures. One of the reasons we do so is to communicate our efforts and also pursue them in a manner that enables for easy transfer across the industry. It is one of the reasons we worked with EPRI and Georgia Power on evaluating the impacts of the eRTG program.

CONCLUSION

GPA believes that its Voluntary Diesel Reduction Program through Equipment Investment demonstrates that environmental enhancement opportunities are compatible with good business. In fact, GPA contends they are inextricably linked. GPA is committed to setting the pace of trade, sustainably.

GPA appreciates the opportunity to submit its efforts to the 2014 AAPA for its consideration.