

Los Angeles County
Metropolitan Transportation Authority

Metro's 2015 Energy and Resource Report



Metro®



ACKNOWLEDGEMENTS

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← Elevator



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List of Acronyms and Abbreviations

AGM	absorbed glass mat	LEED-ND	Leadership in Energy and Environmental Design For Neighborhood Development
APTA	American Public Transit Association	LRV	light rail vehicle
ARB	Air Resources Board	Metro	Los Angeles County Metropolitan Transportation Authority
BRT	Bus Rapid Transit	MOW	Maintenance of Way
CH₄	methane	MSIP	Metro Sustainability Implementation Plan
CMF	Central Maintenance Facility	MT	metric tons
CNG	compressed natural gas	MWh	Megawatt hour
CO	carbon monoxide	N₂O	nitrous oxide
CO₂	carbon dioxide	NMHC	nonmethane hydrocarbons
CO_{2e}	carbon dioxide equivalent	NO_x	oxides of nitrogen
DPM	diesel particulate matter	NTD	National Transit Database
EMS	Environmental Management System	OMF	Operation and Maintenance Facility
EPA	Environmental Protection Agency	PFC	perfluorocarbon
ETI	Environmental Training Institute	PM	particulate matter
FTA	Federal Transit Administration	PMT	passenger miles traveled
GGE	gasoline gallon equivalent	PPA	Power Purchase Agreement
GHG	greenhouse gas	PSM	produced seat miles
GWP	Global Warming Potential	PV	photovoltaic
HC	hydrocarbon	PWP	Pasadena Water and Power
HFC	hydrofluorocarbon	QA	Quality Assurance
HPMS	Highway Performance Monitoring System	RVL	revenue vehicle length
HVAC	heating, ventilation, and air conditioning	SCAQMD	South Coast Air Quality Management District
ISO	International Standards Organization	SCE	Southern California Edison
kW	kilowatt	SF₆	sulfur hexafluoride
kWh	kilowatt hour	SOP	Standard Operating Procedure
LADWP	Los Angeles Department of Water and Power	STI	Southland Transit, Inc.
lbs	pounds	UPT	unlinked passenger trips
LCFS	Low Carbon Fuel Standard	U.S.	United States
LED	light-emitting diode	VMT	vehicle miles traveled
LEED	Leadership in Energy and Environmental Design	VRH	vehicle revenue hours
LEED-EBOM	Leadership in Energy and Environmental Design For Existing Buildings, Operations and Maintenance	VRM	vehicle revenue miles
		WESS	Wayside Energy Storage Substation





EXECUTIVE SUMMARY

This Energy and Resource Report analyzes Metro's 2014 sustainability and environmental performance and the economic cost of its operational activities. The purpose of the report is to present Metro's sustainability data for calendar year 2014 in comparison to the previous year's environmental performance. The report compares trends by monitoring and analyzing the increases or decreases in environmental impacts and assessing Metro's ongoing progress toward sustainability. This trend analysis can then be used to improve sustainable performance in a cost-effective manner for future years.

The Metro Board adopted the Metro Sustainability Implementation Plan (MSIP) in June 2008. An ongoing task under the MSIP is the reporting of Metro's environmental sustainability performance. This report addresses environmental performance in five key areas: ridership, energy, emissions, water, and waste management. Trends of these key areas are broken down into indicators and sub-indicators as shown in **Figure 1**. The indicators were derived using the Global Reporting Initiative sustainability reporting framework. In addition, this report reflects the Recommended Practice for Quantifying and Reporting Transit Sustainability Metrics, prepared by the American Public Transit Association (APTA) Standards Sustainability Metrics Working Group.

This report has two goals: 1) to provide information that can be used to improve Metro's sustainability performance; and 2) to inform the public on Metro's sustainability performance. This report demonstrates Metro's commitment to meeting social, financial, and environmental goals by

highlighting the Environmental Management System (EMS), key accomplishments, and case studies. A brief summary of each indicator's performance, as compared to 2013, follows, and is represented graphically in **Figure 1**. In addition, **Table 1** provides an overview of each indicator's progress over the last few years.

- > **Vehicle Miles Traveled (VMT) Per Capita:** Los Angeles County has seen a 2.3% increase in population over the past 10 years but has experienced a decrease in VMT by 1.3%.
- > **Unlinked Passenger Trips:** Although overall boarding decreased 1.7%, vehicle revenue hours (VRH) experienced a 3.3% increase.
- > **Operating Expenses:** The number of boardings per \$1,000 of operating expenses has decreased since 2012, resulting in a reduction in operating expense efficiency per boarding.
- > **Water Use:** There was a significant decrease of water use by 28.1%.

Table 1: Historic Indicator Performance

INDICATOR	2011	2012	2013	2014	UNIT
Vehicle Miles Travelled per Capita	7,937	7,870	7,867	-	miles
Unlinked Passenger Trips per Capita	456,001,753	472,706,561	476,299,313	468,124,396	trips
Operating Expenses per Boarding	\$2.86	\$2.77	\$2.83	\$2.93	2014 Dollars
Water Use	256,370,268	359,895,712	414,570,076	297,906,502	Gallons
Fuel Use	44,179,465	42,490,623	43,930,100	44,710,242	GGE
Rail Propulsion Power	178,556,320	199,093,552	229,866,746	210,937,940	kWh
Facility Electricity Use	77,974,107	97,500,044	90,099,301	94,144,097	kWh
Solid Waste and Recycling	10,439	9,145	9,741	9,500	tons
Used Oil Waste	145,785	141,735	147,260	142,220	gallons
Hazardous Liquid Waste	680,470	667,794	658,986	620,320	gallons
Nonhazardous Liquid Waste	513,023	503,862	476,918	461,130	gallons
Anti-Freeze Waste	86,050	79,440	81,405	75,300	gallons
Criteria Air Pollutant Emissions	664	341	312	295	tons
Greenhouse Gas Emission	456,598	474,537	471,932	465,543	MT CO ₂ e
Greenhouse Gas Displacement	419,344	491,118	475,269	482,182	MT CO ₂ e

Figure 1: Indicator Area Summary for 2014, Compared to 2013

INDICATOR	← REGRESSED	IMPROVED →
	Compared to 2013	Compared to 2013
Vehicle Miles Traveled per Capita		0% 3 Miles Less Traveled
Unlinked Passenger Trips per Capita	1.7% 8.2 Million Less Boardings	
Operating Expenses per Boarding	3.5% 10 Cents More per Boarding	
Water Use		 28.1% 117 Million Less Gallons Consumed
Energy Use > Fuel Use > Rail Propulsion Power > Facility Electricity Use	1.8% FUEL USE: 1 Million More Gallons Used 4.5% FACILITY ELECTRICITY USE: 4-Million-kWh-More-Used	 8.2% RAIL PROPULSION POWER: 19 Million kWh Less Used
Waste and Recycling > Solid Waste and Recycling > Used Oil Waste > Hazardous Liquid Waste > Nonhazardous Liquid Waste > Anti-Freeze Waste		 2.5% SOLID WASTE & RECYCLING: 242 Tons Less Produced  3.4% USED OIL: 5,040 Gallons Less Produced  5.9% HAZARDOUS LIQUID: 38,666 Gallons Less Produced  3.3% NONHAZARDOUS LIQUID: 15,788 Gallons Less Produced  7.5% ANTI-FREEZE: 6,105 Gallons Less Produced
Criteria Air Pollutant Emissions		 5.4% 17 Tons Less Emitted
Greenhouse Gas Emissions		 1.4% 6,389 Tons Less Emitted
Greenhouse Gas Displacement		 1.5% Increase in Metric Tons of CO ₂ e Displaced from Metro Operations

 Co-benefit achieved (other environmental benefits achieved due to change in resource consumption)



- > **Energy Use - Fuel Use:** Compressed natural gas (CNG) consumption for Metro-operated bus services has been decreasing over the past five years, with a nearly 19% drop from its peak use in 2008. Overall fuel use efficiency increased slightly by 0.3%.
 - > **Energy Use - Rail Propulsion Power:** There was an overall reduction in rail propulsion power demand by 8%, despite a relatively constant ridership.
 - > **Energy Use - Facility Electricity Use:** Facility electricity use increased by 4%.
 - > **Waste and Recycling - Solid Waste and Recycling:** Total solid waste output decreased 2.5%.
 - > **Waste and Recycling - Used Oil Waste:** Metro experienced a 26% decrease in gallons of used oil from 2002 to 2014.
 - > **Waste and Recycling - Hazardous Liquid Waste:** Metro produced approximately 620,000 gallons of hazardous liquid waste in 2014, representing a 5.9% decrease from 2013 and a 12.6% decrease from 2003.
 - > **Waste and Recycling - Nonhazardous Liquid Waste:** Metro produced approximately 461,000 gallons of nonhazardous liquid waste, representing a 3.3% decrease from 2013 but an overall 10.8% increase from 2002.
 - > **Waste and Recycling - Anti-Freeze Waste:** Metro produced approximately 75,300 gallons of anti-freeze waste, a decrease of 7.5% from 2013.
 - > **Criteria Air Pollutant Emissions:** Total fleet emissions in 2014 were 55.6% lower as compared to 2011 and 70% lower as compared to 2008.
 - > **Greenhouse Gas Emissions:** Total greenhouse gas (GHG) emissions decreased by 1.4% from 2013, with emissions from rail propulsion power consumption decreasing by 6% and revenue-generating diesel consumption in buses increasing by 15%.
 - > **Greenhouse Gas Displacement:** Metro achieved GHG displacement of approximately 482,182 metric tons (MT) of carbon dioxide equivalent (CO₂e) by shifting passengers from individual vehicular travel to transit. This alone results in more GHG emissions displaced by passengers not driving than by all of Metro's operational emissions (465,529 MT CO₂e).
- The following report provides details of each indicator's performance and associated costs.



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MESSAGE FROM THE CEO

When I look to our system here in Los Angeles, I recognize the commitment to building a world-class transportation system; one that is clean, efficient, reliable, accessible, and cost-effective for riders. I also recognize that the greenhouse gas benefits realized from transit use are amplified when our operations are also made sustainable. As we progress in our construction program, I look to the Metro family to continue championing our efforts to reduce Metro's impact on the environment by managing resources in all of our planning, construction, operations, and procurement activities.



As I embark upon my journey here at Metro and look towards opportunities to work together on key issues, I'd like to take the time to highlight the agency's recent successes, which include:

- Expansion of Metro's Environmental Management System (EMS) to include all major rail and bus facilities. By July 2015, eighteen facilities in total will have achieved International Standards Organization (ISO) 14001:2004 Certification, having fully committed to ensuring world class environmental compliance at all levels of our organization.
- A continuing commitment to achieve Leadership in Energy and Environmental Design (LEED) certification standards on new construction projects and existing buildings. Three new facilities will open as LEED-Gold or higher and two existing facilities are undergoing LEED certification this year.
- Expansion of Metro's Electric Vehicle charging Stations. More stations will be installed at rail stations and park and rides this year to add to the existing 20 chargers located at Union Station, Sierra Madre Villa Station, Willow Station, Universal City Station, and El Segundo Station.
- Installation of flywheel energy storage system at the Westlake/MacArthur Park station on the Red Line, which utilizes regenerative technology to store energy generated from braking trains. The system is expected to save over 500 megawatt hours per year.
- A reduction of over 2.5 million gallons of water between 2013 and 2014 at one of Metro's bus maintenance yards. A pilot program to wash buses on an alternative schedule was implemented, which is now being expanded to all Metro bus divisions.

The sustainable and environmental programs that have been initiated here form the foundation for the vast possibilities ahead. Sustainability guidelines are created not only to encourage sustainability considerations within the various projects and programs, but also to instill a culture of sustainability throughout the organization. Here at Metro, we continue to intergrate environmental considerations into all of our planning, design, construction, operations, and maintenance activities. We have worked to support many environmental programs, focusing on recycling, water quality, clean fuel, green products' procurement and greenhouse gas emissions reduction strategies. Environmental issues such as these transcend geographical limitations, and must be given attention, whether here in Los Angeles or elsewhere.

I look forward to building on this momentum, combining my experience elsewhere and Metro's forward-thinking approach to sustainability to continue fostering the growth of Los Angeles' transit system. I congratulate our staff and partners in their work of influencing the changing nature of Los Angeles and working towards a more sustainable region. Let's press ahead and make this system cleaner, greener, and more efficient.

Sincerely,

A handwritten signature in black ink, which appears to read "Phillip A. Washington". The signature is fluid and stylized, with a large loop at the end.

Phillip A. Washington
Chief Executive Officer



Metro

Metro San Gabriel Valley



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ABOUT METRO

The Los Angeles County Metropolitan Transportation Authority (Metro) strives to be responsible for the “continuous improvement of an efficient and effective transportation system in Los Angeles County.” Metro’s role is unique among the nation’s transportation agencies by serving as transportation planner and coordinator, designer, builder, and operator for one of the country’s largest, most populous counties. Metro is dedicated to providing Los Angeles County with safe, clean, reliable, and courteous transportation service.

In the last 25 years, Metro has developed an extensive mass rapid transit system consisting of more than 80 miles of urban rail, three very successful Bus Rapid Transit (BRT) routes, and the nation's largest fleet of more than 2,200 very low emissions buses. Metro operates 170 bus routes within 1,433 square miles of service area to accommodate more than 286.8 million annual boardings.

Metro's rail system includes the Red and Purple subway lines and the Blue, Green, Gold, and Expo light rail lines. The Red and Purple Lines equal a combined 17 miles in length, include 16 stations, and averaged a total of 49.9 million annual boardings in fiscal year (FY) 2014. Combined, the four light rail lines are 70.3 miles long with 67 stations. Metro continues to maintain and improve on these rail lines with projects such as the Blue Line Upgrade, a \$1.2 billion project that will upgrade the stations and tracks of Metro's oldest and most used rail line, and major expansions of the Expo, Gold, and Purple lines.

Metro's Long Range Transportation Plan (LRTP) calls for investments to expand the region's rail system to 185 miles—with over 150 stations—and to add 170 more miles of carpool lanes to our freeways. Planning and construction work continues on several corridors to develop additional light and heavy rail transit. These investments, in combination with a statewide mandate to better coordinate land-use planning with the transportation system, Senate Bill 375: The Sustainable Communities and Climate Protection Act of 2008, will transform Los Angeles' urban landscape over the next 30 years, reduce demand for single-occupancy travel, reduce per capita GHG emissions, and further improve air quality.

Metro also encourages transit oriented development (TOD) on Metro-controlled property near transit facilities to facilitate walking and bicycle

improvements as well as enhance the utilization of, and connectivity to, the region's transit system. Recently, Metro completed construction on an expansive TOD project at One Santa Fe, a mixed-use development with 20% affordable housing units in the Downtown Los Angeles Arts District adjacent to Metro's Red Line Rail Yard. Also under development is Taylor Yard, a mixed-use development that includes 301 affordable family and senior units and a mixed-use development at 1st and Boyle that will have 79 affordable family units and access to Metro Gold Line.

Planning, developing, and operating the region's transportation system is an energy-intensive endeavor. To reduce the consumption of natural resources and the associated emission of pollutants and GHG, Metro has implemented several initiatives and policies to operate more efficiently and to be better stewards of the environment. Specifically, Metro has committed to:

1. Making its facilities more sustainable: three new maintenance and operation facilities are under construction and will be certified LEED Gold. Metro is also in the process of certifying its existing buildings, with one bus division receiving LEED-EBOM silver in 2014 and two additional facilities are currently being certified.
2. Expanding Metro's clean bus fleet by acquiring 5 new zero emission electric buses that will further reduce greenhouse gas emissions from Metro's bus operations in the county.
3. Adopting and implementing an agency-wide Environmental Management System (EMS). In January 2011, Metro's pilot EMS facility, the Red Line Yard, received ISO 14001 Certification. Since then, an additional 10 facilities have been enrolled into the program. The agency continues an aggressive enrollment schedule and is the process of certifying seven facilities at once, making Metro a worldwide leader in monitoring and mitigating its impact on the environment.



4. Continuing efforts in fulfilling commitments in our Renewable Energy Policy to incorporate renewable energy into Metro facilities. Solar panels have been installed at five Metro facilities to produce over two megawatts of energy, with two more systems under construction. An additional four sites are currently in planning in 2015. An additional 500 megawatt-hours per year are expected to be saved by the newly installed flywheel energy storage system on the Metro Red Line.
5. Adopting Metro's Green Construction Equipment Policy to reduce emissions from construction activities by requiring the use of clean, green construction equipment on all Metro construction projects.
6. Adopting Metro's Energy Management and Conservation Plan, which provides a blueprint to direct Metro's overall energy management and use in a sustainable, cost-effective, and efficient manner.
7. Continuing to implement the Climate Action and Adaptation Plan and completing agency-wide vulnerability and criticality assessments to reduce the impacts of evolving climatic effects, increase our current and future investments' resiliency to maintain a consistent state of good repair
8. Continuing to implement the Water Conservation and Management Plan through measures such as bus washing procedure modification, recycled water use, drought-tolerant and native landscaping, and water efficient fixture installations. When fully implemented, reductions in Metro's potable water consumption will reach more than 200 million gallons per year

These policies and programs are inherently linked to Metro's mission—the responsibility to provide an efficient and effective transportation system—and its effort to do so in a sustainable manner. Ultimately, these efforts ensure that the agency equitably continues to balance a growing presence in the region while seeking to reduce its overall impacts on the environment.



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INTRODUCTION

Since 2009, Metro has produced an annual sustainability report to summarize the agency's continual efforts in achieving higher sustainability performance through the implementation of planning, construction, operations, and maintenance activities. This Metro's 2015 Energy and Resource Report is a continuation of this effort and reflects the agency's sustainability performance for calendar year 2014. The report will continue to bring visibility to Metro's sustainability efforts and help explore new ways to manage environmental impacts, while maintaining Metro's commitment to providing quality transit services for the region. This report strives to align the strategies and recommendations provided by Metro with the City of Los Angeles' Sustainable City pLAn.



The purpose of this report is to compare data with previous years to track Metro's progress toward attaining goals for sustainability, and provide an update on Metro's resource use and contribution to the reduction of pollutant emissions and GHG emissions. Additionally, this report provides Metro's decision-makers with information they can use to improve Metro's sustainability performance.

This report describes the methodology used to collect and analyze the data, including how the different indicators were chosen, how efficiency is measured within the specific indicators, and identifying potential weaknesses in the data. Data accuracy is essential; therefore, the best available data as of April 2015 were used along with the most reliable sustainability guidelines to develop this report. Additional data constraints are discussed in the Reporting Methodology.

Data are organized according to indicator area, with each area focusing on a resource or economic cost by which Metro can analyze the effectiveness of its sustainability strategies over time. This report reflects the Recommended Practice for Quantifying and Reporting Transit Sustainability Metrics, as developed by APTA. The indicator areas selected for historic and ongoing analysis are as follows:

- > Vehicle Miles Traveled per Capita
- > Unlinked Passenger Trips per Capita
- > Operating Expenses
- > Water Use
- > Energy Use
 - Fuel Use
 - Rail Propulsion Power
 - Facility Electricity Use



> Waste and Recycling

- Solid Waste and Recycling
- Used Oil Waste
- Hazardous Liquid Waste
- Nonhazardous Liquid Waste
- Anti-Freeze Waste

> Criteria Air Pollutant Emissions

> Greenhouse Gas Emissions

> Greenhouse Gas Displacement

This report includes a detailed discussion of each indicator area according to the following structure:

- > **Accomplishments:** Significant actions or programs that affected the indicator during the 2014 calendar year.

- > **Data and Analysis:** Analytical summaries and data graphs.

- > **Next Steps:** Specific actions and general next steps that Metro is considering for future implementation.

In addition to the specific issues described in the indicator area sections, Metro has developed and implemented broad policies, goals, and standards to demonstrate a commitment to apply sustainable strategies throughout the planning, construction, and operation of various projects. Specifically, Metro projects will comply with all local, state, and federal codes, ordinances, and regulations, and applicable Federal Transit Administration (FTA), Federal Highway Administration, and APTA guidelines.

Case studies are also provided throughout this report to highlight specific sustainability achievements of Metro.



A decorative graphic in the top right corner of the green header. It features several overlapping gears of different sizes and colors (light green and white) and several stylized leaves of varying shades of green. The overall aesthetic is clean and modern, suggesting a focus on technology and nature.

ENVIRONMENTAL MANAGEMENT SYSTEM

As Los Angeles County's largest transportation provider, Metro is responsible for a comprehensive list of services, including transportation planning and coordination, as well as designing, building, and operating these systems. As part of its day-to-day activities, Metro is also taking ownership of its impact on the environment, and working to integrate sustainability practices into the values of the agency. One avenue for approaching this issue is through the compilation of Best Practices to streamline maintenance and operations in a more environmentally friendly manner. For Metro, this approach encouraged the design and implementation of an Environmental Management System (EMS). As described in Metro's Environmental Policy (2009), Metro's EMS "is a set of operational procedures, based on an adopted Environmental Policy, to ensure compliance with federal, state, and local environmental regulations, as well as to facilitate environmental stewardship."



A BRIEF HISTORY OF EMS ▼

In August 2007, Metro was one of eight transit agencies across the country that was selected by the FTA to participate in a pilot project to implement an EMS in their organization. In December that same year, Metro was one of seven agencies participating in the second round of FTA-assisted EMS training, with the intention of utilizing and certifying the agency's applicable facilities to the International Standards Organization (ISO) 14001:2004 Standard.

Metro has adopted an agency-wide EMS, meaning that all of its major facilities will eventually be included in the program. Metro's current EMS includes operational activities and involves employees from Operations and Maintenance. An EMS Administrative Team was established to manage the documentation and implementation of the overarching EMS program, and contains representatives from Environmental Compliance and Services, Quality Assurance, Corporate Safety, Facilities Maintenance, and Bus and Rail Maintenance and Transportation Departments. The EMS Facility Core Teams were developed to address site-specific environmental impacts, with support from the EMS Administrative Team.

During the fall of 2008, Metro began its EMS program with the Red Line Yard as the pilot site, which houses rail maintenance and operations for Division 20 and Maintenance of Way (MOW). In January 2011, the Red Line Yard received ISO 14001:2004 Certification. Following the well-earned success at the Red Line Yard, Division 10, one of Metro's bus facilities, was selected for enrollment in the EMS program. The program is expanding to include 17 facilities in total: four rail divisions, 12 bus divisions, and one non-revenue vehicle division. The agency continues an aggressive enrollment schedule and, as of January 2015, is currently in the process of certifying seven divisions simultaneously. Since the inception of the agency's multi-site EMS, the process has demonstrated its continual improvement in several ways. By decreasing the time it takes to enroll a facility from two years to six months and by increasing the number of facilities enrolled in one cycle, Metro's EMS proves to be innovative and robust when compared to other transit agencies throughout the nation. In 2014, Columbia University conducted a study that rated LA Metro's EMS as the most successful implementation in relation to 13 other regional transit agencies with a similar program.

INTRODUCTION TO EMS

EMS relies on a continual improvement process to identify best practices and ways that Metro can reduce its impact on the environment. This is aided by the engagement and empowerment of Metro employees, who are encouraged to voice their opinions on environmental challenges. EMS relies on a “Plan-Do-Check-Act” model, which represents the four critical stages in the process:

1 Plan

At the agency-wide level, Metro's EMS requires the development of “Objectives and Targets” to set goals for the program. At the division level, each division evaluates its facilities to determine major environmental impacts (referred to as “Environmental Aspects”) and creates Action Plans to address those impacts that they identify as significant.

2 Do

Action Plans are developed to assign tasks and responsibilities for meeting the goals of reducing an activity's impact on the environment. Regular meetings, at the agency-wide level and the division level, are scheduled to track progress and keep records of these efforts.

3 Check

The “Check” phase focuses on monitoring and measuring Metro's EMS activities. Internal and external auditors are tasked to ensure that procedures are followed and the agency's environmental goals are being met. Metro has chosen to conform to, and has successfully achieved, the ISO 14001:2004 Certification for its EMS. This



ISO Certification provides an internationally recognized framework for EMS that formalizes the continual improvement process.

Metro has elected to certify all of its facilities that are enrolled thus far in its EMS program, which currently includes six facilities, with two more under review. Metro has become and continues to be a leader in the transit industry; it is one of the few ISO 14001:2004 Certified transit agencies in the country, and is the first to receive this recognition for a multi-site system.

4 Act

On an annual basis, Metro's EMS executives are briefed in a management review of the program. This offers opportunities for senior management to ask critical questions to determine the progress and success of the program. In addition to the management review, the EMS Administrative Team and Facility Core Teams also evaluate the program's accomplishments from the past year, and identify new environmental challenges to address. Therein lies the continual improvement process of EMS, and the cycle begins again.

PROGRAM BENEFITS ▼

Reduction of Environmental Impacts

Through a continual improvement process, EMS helps each facility to identify key areas of improvement relating to its environmental performance. For example, Metro's Quality Assurance (QA) group performs audits of the facilities each month. The monthly environmental compliance reports have been aggregated over the last several years to target those areas with environmental concerns that can be addressed through the EMS program. As a result, those targeted environmental issues have been significantly reduced. As new issues arise, the program utilizes the continual improvement process to address additional areas on an annual basis.

Employee Awareness

The program is invested in increasing employee awareness of environmental issues, both in the workplace and at home. Extensive training is offered through the Environmental Training Institute (ETI), which includes topics such as general EMS awareness, regulatory-required trainings, and general sustainability training on energy, waste, and recycling. These trainings increase employee awareness and provide the tools for staff to make improvements in their daily responsibilities. EMS ultimately empowers employees to voice their concerns, bring attention to new issues, and promote the continual improvement process.

Sharing of Best Practices

As an agency-wide program, EMS seeks to capitalize on the existing best practices taking place at various bus and rail maintenance facilities, and to share those with other EMS facilities. For example, maintenance staff at Division 10 developed an end-of-shift checklist to focus on general housekeeping and environmental due diligence on a daily basis. This checklist proved successful for the division when going through the EMS audit process. As a result, the checklist was shared with other bus facilities, and a checklist for Metro rail facilities was also developed.

Other best practices include both formal and informal procedures at the divisions to effectively mitigate and manage their environmental impacts. The development and dissemination of Standard Operating Procedures (SOPs) have been enhanced and are formally referenced in EMS documents. These SOPs serve as a guide on proper procedures for various activities impacting the environment. With various divisions developing specific SOPs for their facilities, those relevant to the EMS program have been shared and adapted to fit the needs of the agency-wide program. This effort has resulted in streamlining and greater efficiency in responding to and mitigating recurring issues.

Capital Project Assistance

In conjunction with Metro's energy, water, waste and recycling, and climate initiatives, EMS offers additional resources to facilities to implement innovative pilot and full-scale projects and essential resource saving measures. These measures are designed to assist the agency in reducing its overall environmental impact and operational cost. Through both fiscal and project management assistance, EMS staff coordinate with various Metro departments to identify critical issues and opportunities for improvement, seek funding for these projects, and implement these projects in a timely manner. Projects developed through the EMS program include:

1. Sealed coolant recovery system to capture and reuse anti-freeze from buses. The pilot facilities were successful, and this system is expected to be fully distributed to all bus maintenance divisions in 2015.
2. Agency-wide policy guidance on the proper handling and disposal of broken fluorescent tubes. A storage shed at Division 3 was purchased for waste fluorescent light tubes. The division now keeps their new and waste light tubes separated and more efficiently manages their universal waste until properly disposed.
3. Pilot project initiated at Division 3 to reduce water consumption and re-assess the efficiency of the current bus wash system.



4. Canopies have been installed at multiple EMS sites as a structural best management practice for potential stormwater issues. In the past, metal scrap bins and hazardous waste accumulation areas have been exposed to the elements.
5. Purchase of a flammable storage cabinet at Division 11 to store hazardous materials when not being used. This served as a strategy to improve housekeeping in the shop, but also reduced the amount of aerosol cans wasted because employees check this cabinet before obtaining new cans from stores.
6. Categorized bus wash activities as an Environmental Aspect at Divisions 2, 5 and 15, which is prompting Metro Operations to assess overall water consumption patterns throughout the agency and strategies to reduce impacts associated with bus wash activities.
7. “Reduced bus wash schedule” initiative called for divisions to wash the entire bus fleet on an alternating schedule based on odd and even bus numbers, rather than the daily washing of each bus, to reduce agency-wide water consumption.

FUTURE INITIATIVES

Metro’s EMS program continues to evolve and expand. As it is an agency-wide system, all of Metro’s major facilities will be enrolled in the program by 2016. As Metro’s primary tool for environmental compliance and operational sustainability, the EMS program is incorporating the agency’s work on energy (including Leadership in Energy and Environmental Design [LEED] Certification), water resource management, waste and recycling, and climate change to create an integrated approach to environmental and sustainability management.

Through Metro’s EMS program, numerous system-wide initiatives have been developed as a response to the Environmental Aspects selected at each division. Innovative solutions continually emerge from this program and affect decisions made throughout the entire agency, such as the frequency with which buses are washed, and programmatic guidance on how to reduce, recycle, or reuse materials before they become waste. The EMS framework is a dynamic process that analyzes every component of the division’s daily activities, systematically determining the root cause of any environmental stressor. Trainings offered through ETI help assess issues arising from improper handling (user-error), while coordination with other departments helps the Facility Core Teams assess whether the technology used is performing according to its designed specifications (structural). Through this comprehensive approach to managing environmental assets and procedures, Metro continues to demonstrate that saving money and remaining in environmental compliance are complementary byproducts of a robust and resilient EMS program.

DIVISION 13 SUSTAINABILITY FEATURES



In February 2013, Metro started construction on Division 13, a new Bus Maintenance and Operations Facility on the corner of Cesar E Chavez Avenue and Vignes Street. With Metro's sustainability goals in mind, several sustainability features were installed to increase water and energy efficiency at the division. The project includes a 275,000 gallon underground cistern, designed to capture and recycle rainwater for use at the bus wash facility. The green roof garden, accessible to Metro employees, will improve

surrounding stormwater conditions, promote improved air quality, and provide the building with insulation. Additionally, 271 kilowatts (kW) of solar panels will be installed to generate renewable energy and reduce energy costs at the facility. These, along with many other features, including reflective roofing, water efficient irrigation system, and skylights, have put the project on track to become a LEED Certified Gold Building. Construction on Division 13 is anticipated to be completed in June 2015.



PHOTOVOLTAIC TECHNICAL AND PREVENTATIVE MAINTENANCE TRAINING PROGRAM



CHALLENGE

Metro's existing and future sustainability assets, such as photovoltaic (PV) systems, should be maintained for optimal performance. Innovative, technology-based sustainability solutions may create a need for education and training.

ACTION

In 2014, a training course on PV preventative maintenance was developed specifically for Metro's facilities maintenance crews and electricians who maintain the PV systems throughout the region. The course covered the history and theory of PV, safety, and the newly developed Preventative Maintenance Plan. Two instruction sessions and on-site rooftop visits were offered. This training was rolled into the ETI program, which houses the EMS course modules.

▼ OUTCOME

Metro will continue to provide training sessions for PV preventative maintenance in order to continually educate and train Metro's personnel. Training sessions that focus on maintaining the current facilities and preventing system failures will provide for uninterrupted service and peak

performance, while allowing Metro's personnel to gain hands-on experience.



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WAITING

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REPORTING METHODOLOGY

As a founding member of the APTA Sustainability Commitment, Metro follows the guidance provided by APTA to report and track key indicators of sustainability. APTA's Recommended Practice of Quantifying and Reporting Transit Sustainability Metrics provides the framework and methodology for the 2015 Energy and Resource Report and offers guidance for reporting and tracking key indicators of sustainability. This Recommended Practice identifies nine sustainability performance metrics to be reported on an annual basis, as follows: 1) Vehicle Miles Traveled per Capita; 2) Unlinked Passenger Trips per Capita; 3) Operating Expenses; 4) Water Use; 5) Energy Use; 6) Waste and Recycling; 7) Criteria Air Pollutant Emissions; 8) GHG Emissions; and 9) GHG Displacement.



NORMALIZATION FACTORS

APTA also recommends that a transit agency select normalization factors that “tell its story” by providing context for its operations. The eight possible normalization factors are: 1) passenger miles traveled (PMT); 2) vehicle revenue hours (VRH); 3) vehicle miles; 4) vehicle revenue miles (VRM); 5) unlinked passenger trips (UPT); 6) produced seat miles (PSM); 7) revenue vehicle length (RVL); and 8) per capita in service area of operation. As one of the nation’s largest transit agencies, Metro’s service area encompasses more than 1,400 square miles of Los Angeles County, with an estimated average weekday ridership of over 1.35 million (bus and rail). Metro’s core mission is to provide efficient and effective transit service to the Los Angeles region. This report focuses on PMT, VRH, and UPT as the primary normalization factors to measure Metro’s sustainability performance and examine the balance between Metro’s service expansion and sustainability impact.

Passenger Miles Traveled (PMT)

PMT is the sum of the distances traveled by all Metro passengers. This metric directly shows the potential VMT and associated GHG emission reductions. It highlights Metro’s operational efficiency and effectiveness as they relate to GHG reductions.

Vehicle Revenue Hours (VRH)

VRH refers to the total number of hours that Metro’s vehicles are in revenue service (including vehicles that operate in fare-free service). This metric captures the effectiveness of the transit service. Measuring Metro’s sustainability performance through VRH helps to reveal how its overall sustainability performance is impacted by the transit service expansion. This metric enables the comparison of sustainability efficiency year-to-year, regardless of the service size and scale.

Unlinked Passenger Trips (UPT)

UPT, also called boardings, is defined as the total number of times passengers board public transportation vehicles, regardless of whether the boarding results in one trip or multiple trips. This metric captures the scale and effectiveness of Metro’s transit service. It helps to reveal the relationship between Metro’s efforts to attract passengers and increase service productivity and the resulting impact on the sustainability performance brought on by such efforts.

DIVISION-LEVEL ANALYSIS ▼

Major facilities at Metro help support Metro's delivery of transit services to Los Angeles County. At the same time, they also account for a large portion of Metro's overall environmental and resource footprint. Measuring Metro's sustainability performance at the major facility level in terms of water and electricity has been included in Metro's annual sustainability report for the last few years. Sustainability performance and an efficiency comparison analysis have been expanded in this report by major facilities (divisions) for all metrics with available data. This division-level performance measurement and analysis tie the performance of a division's operation to its fulfillment of sustainability goals and objectives.

GHG METHODOLOGY ▼

Emissions of all applicable GHGs have been accounted for in this report. Given that each GHG has a different Global Warming Potential (GWP), total emissions were reported in units of MT CO_{2e}, which are derived by multiplying the tonnage of individual GHGs by their respective GWP. GHG emissions are specific to certain types of activities. For example, burning fossil fuels produces emissions of carbon dioxide (CO₂), nitrous oxide (N₂O), and methane (CH₄). On the other hand, GHGs such as sulfur hexafluoride (SF₆), perfluorocarbons (PFCs), or hydrofluorocarbons (HFCs) are used as end-products in equipment for their insulating, fire-suppressing, or refrigerating properties, and it is only when these substances leak into the atmosphere that they are accounted for in GHG inventories. If Metro's future operations result in emissions of additional GHGs, they will be included in future inventory reports as applicable.

In general, the GHG emissions calculations for the years 2012, 2013, and 2014 use the same methodology as recommended by APTA. The GHG emission calculations for years prior to 2012 may have used a different methodology. For the years prior to 2012, the following discrepancies may exist:

- > Omissions of CH₄ and N₂O emissions from Metro-owned revenue-generating vehicle fleet.
- > Omissions of CH₄ and N₂O emissions from contracted revenue-generating vehicle fleet.
- > The use of slightly different emission factors for CH₄ and N₂O emissions from electricity, diesel, and gasoline consumption.
- > The use of slightly different conversion factors for units of fuel quantities.
- > Omissions of GHG emissions associated with water services-related electricity consumption.
- > The use of slightly different average vehicle fuel economy factors for calculating GHG displacement.
- > The use of slightly different emission factors for CH₄ and N₂O emissions for GHG displacement calculations.
- > Potential over-counting of emissions from gasoline and diesel consumption of Metro's non-revenue vehicles.
- > Over-counting of emissions from refrigerants; specifically, the refrigerant R-22, also known as HCFC-22. R-22 is an ozone-depleting substance and is not required to be reported as a GHG because it is regulated by a different environmental standard.

In some specific areas, GHG methodology used in this 2015 report differs slightly from previous years. The GHG calculations included some new data sources that may not have been included in previous years. Specifically, GHG emissions from refrigerant consumption in vehicles were quantified in the 2014 data; whereas in past years, this source of emissions was not included. Furthermore, the 2014 calculations used the updated GWP values for refrigerants as per new guidance from the Climate Registry and updated GWP values for methane and nitrous oxide as per 2014 U.S. Environmental Protection Agency (EPA) guidance. For comparison purposes, the emissions from refrigerants in last year's 2014 Metro Energy and Resource Report were updated with the new GWP values to identify the main drivers of change in refrigerant emissions from 2013 to 2014. However, it should be noted that the GWP values in the inventories prior to 2013 have not been updated.



The GHG methodology also included some new assumptions to comprehensively account for emissions from all relevant sources. For example, in the category of contracted bus services, the data received from one of Metro's contractors, Southland Transit, Inc. (STI), only included information on vehicle miles traveled and not fuel consumption. To account for emissions from fuel consumption, average fuel economies for the bus types in STI's fleet were calculated and used to estimate fuel consumption by dividing the vehicle miles traveled by the average fuel economies. For comparison purposes, the emissions from STI's fuel consumption in last year's 2014 report were updated to allow for a more accurate understanding of the trend in emissions from contracted bus services between 2013 and 2014.

A NOTE ON THE DATA ▼

Analyzing the environmental performance of an agency as large and complex as Metro involves the collection of large amounts of data from many

sources. The best data available as of April 2015 that provided an accurate analysis of the agency's performance were used for this report. However, the following data inconsistencies were encountered that should be addressed in future reports:

- > **Limited Sub-meter Program:** Because a few of Metro's current utility meters monitor several buildings within a division (for example), it is difficult to accurately identify the source of increasing or decreasing energy usage within a specific division. Sub-meters are currently being installed at a number of divisions so more accurate data will be available for subsequent reports.
- > **Meter Discrepancies:** Water billing and electricity use were provided by meter address, which does not always match to a specific division/major facility. Metro's sub-meter program is actively characterizing and inventorying all utility meters for more accurate reporting and verification. This report distinguishes four types of major facilities based on functionality and operations: rail yards, bus divisions, other maintenance, and



administrative buildings. A total of 21 locations are considered as major facilities including Divisions 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 15, 18, 20, 21, 22, 30, 34, 60, 66, and 99.

- > **Reconciled Missing Data:** In the 2014 report, water and facility electricity consumption and cost data for some of 2013 were based on a projection due to missing Los Angeles Department of Water and Power (LADWP) data. For the 2015 report, the missing LADWP data were made available and the data reconciled to reflect actual 2013 consumption. Therefore, the 2015 report includes reconciled 2013 consumption data, rather than the projections used last year. It should be noted that while the projections for the missing water and facility electricity consumption data varied from the actual data, the margin of error was minor. The 2013 projected water use was 1.9% less than the actual water use. Additionally, the projected water cost was 2.1% less than the actual water cost. For facility electricity, the 2013 projected electricity use was 3% less than the actual electricity use, and the projected electricity cost was 4.1% less than actual electricity cost.
- > **Other Providers:** Prior to 2012, only water data from Metro's main water supplier, LADWP, were analyzed. Beginning in 2012, water consumption data included LADWP and other providers, which include Pasadena Water and Power (PWP), California Water Services, Park Water Company, Golden State Water Company, and other municipal providers.
- > **New Transit Category - Rapid Bus:** A new transit category of Rapid Bus was included in the National Transit Database (NTD) data beginning in 2012. This reflects the recently added Orange Line Extension with dedicated busway offering improvements to north-south mobility in the western San Fernando Valley and connecting the Orange Line with Amtrak and Metrolink. In addition, NTD data are reported on a fiscal year basis instead of a calendar year.
- > All dollars presented in this report are 2014 U.S. dollars, unless otherwise noted.



Metro Local

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ACCOMPLISHMENTS

Throughout 2014, Metro actively pursued sustainable programs, strategies, and action items consistent with the City of Los Angeles' Sustainability City pLAN in an effort to maximize transportation service efficiency, access, safety, and performance while minimizing energy use, consumption, pollution, and the generation of GHG and other waste. Those efforts are discussed by indicator area, along with the sustainable strategies that were recommended in the previous sustainability report and the accomplishments achieved in 2014. Many sustainable strategies are considered relevant and ongoing; therefore, they are carried forward on an annual basis. Each accomplishment is a validation of Metro's commitment to increasing their sustainability, efficiency, and environmental performance. Nine key accomplishment areas for 2014 are summarized below. More details on the programs and specific strategies implemented and accomplished in 2014 are itemized in the chapters corresponding to the indicator topics.

KEY ACCOMPLISHMENT AREA 1: CONTINUED CAPITAL IMPROVEMENT PROJECTS

The development of new facilities allows for the opportunity to implement sustainable systems within the project design. Three new facilities are expected to be completed in 2015 and 2016 that incorporate sustainable elements, such as a green roof and a rainwater capture cistern. Metro continues to support sustainable planning, design, and construction of the following capital projects:

- > Division 13 – New Bus Maintenance Division
- > Expo Yard – Rail Maintenance Facility in conjunction with Expo Line Phase 2
- > Monrovia Yard – Rail Maintenance Facility for Foothill Extension

KEY ACCOMPLISHMENT AREA 2: ENVIRONMENTAL MANAGEMENT SYSTEM AND ISO 14001 CERTIFICATION

Subsequent to receiving Platinum recognition from APTA for leadership in sustainability as a signatory of the APTA Sustainability Commitment in 2012, Metro continues to strive for higher standards in all aspects of its operations. In 2014, Metro continued to implement their agency-wide EMS, with the goal that all Metro facilities be enrolled in the program by 2016. This program offers a continual improvement process that engages operational activities at all levels to identify best practices and strategies in reducing environmental impact. Key benefits of this initiative include improved environmental compliance at the operational facilities level; improved employee awareness of sustainability issues and resource conservation needs; shared best practices; and access to additional resources to support innovative capital projects as pilot efforts.

With the continued implementation of EMS, key Metro facilities are being selected to comply with ISO 14001 Certification requirements. As a pilot site, Division 20 and Location 61 (Red Line Yard) received ISO 14001:2004 Certification in 2011. The program has since expanded to several more facilities including Divisions 3, 5, 7, 9, and 10 (bus facilities); Location 30

Central Maintenance Facility (CMF); Division 11 (Blue Line Yard); Division 21 (Gold Line Yard); and Division 22 (Green Line Yard). Metro continues to implement an aggressive schedule of enrolling the remaining bus and rail divisions by 2016.

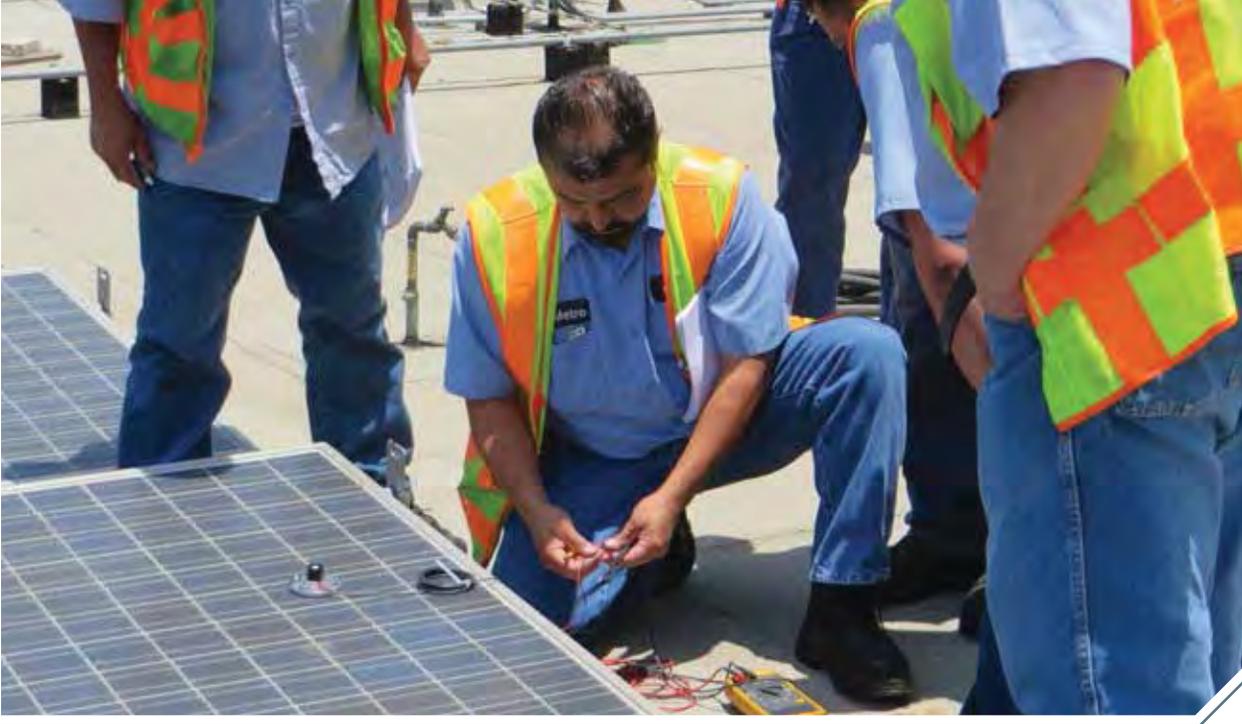
KEY ACCOMPLISHMENT AREA 3: INSTALLATION OF SUB-METERING SYSTEM, TIMERS, AND OTHER AUTO-CONTROL SYSTEMS

In 2014, additional practices and measures were implemented at the facility level to better understand the specific energy needs of the facility while addressing environmental awareness and resource conservation. Sub-metering systems for water and electricity were installed at Division 20 and Division 21. This accomplishment allows more detailed tracking and analysis at these major facilities for improved performance in the future. Sub-meter design plans have been completed for Divisions 3, 11, 18, 22, and Location 60.

KEY ACCOMPLISHMENT AREA 4: DEVELOPMENT OF DIVISION-SPECIFIC PROGRAMS

More customized planning and programming was developed for major facilities at Metro in 2014. The specific functions, operations, and needs at the division level were evaluated to ensure that the programs are appropriate and effective for reducing resource consumption and improving efficiency. These include:

- > A Linear Kinetic Cell technology pilot project was completed to analyze water reduction opportunities. Divisions 5 and 18 were selected as a result of the study to demonstrate the application of the technology.
- > Energy opportunity assessments were completed at CMF and Divisions 3, 7, 9, 11, 15, and 22.
- > A series of lighting retrofits and upgrades occurred at selected locations, including Divisions 11 and 22.
- > Division 3 purchased a storage shed for waste fluorescent light tubes to store new and waste light tubes separately, and more efficiently manage their waste.



KEY ACCOMPLISHMENT AREA 5: IDENTIFICATION AND CAPTURE OF RENEWABLE ENERGY OPPORTUNITIES

To further offset emissions associated with energy use, Metro continues to implement comprehensive energy efficiency upgrades including lighting and heating, ventilation, and air conditioning (HVAC) upgrades, and renewable energy installations at multiple bus and rail divisions. A scope of work was developed for the solicitation of a PV Power Purchase Agreement (PPA) Provider for a bundled solar power project at Divisions 9, 11, and 22 and the Expo Yard. Metro is also currently exploring the feasibility of constructing a structure over selected bus division yards for the installation of PV panels, lighting, and to provide shade for the buses. In addition, lighting retrofits were completed at Divisions 11 and 22, which involved installing light-emitting diodes (LED) lights in rail tunnels.

Metro completed the installation of the Wayside Energy Storage Substation (WESS) along the Red Line at the Westlake/McArthur Park Station. WESS uses flywheel technology to hold energy and convert it to electric power through the use of a high speed electric motor or generator. This regenerative technology allows the Red Line to store the energy it

generates when the train decelerates and redistribute it for use when the train accelerates. With the success of the Red Line WESS, Metro plans to install another substation along the Gold Line for additional renewable energy opportunities.

Metro staff continued to pursue the procurement of biomethane after Board direction in May 2014. Procurement is underway and expected to be completed in fall 2015. The Biomethane Implementation Plan, originally approved by the Metro Board in June 2013, outlines strategies to transition to renewable natural gas that is made with the same fuel specifications as CNG which is currently used to fuel the Metro bus fleet. Because biomethane comes from landfills, dairy digesters, and wastewater treatment plants, Metro can significantly reduce the carbon footprint of its transit operations with no operational changes.

KEY ACCOMPLISHMENT AREA 6: INCREASED LEED-CERTIFIED FACILITIES

Metro continues to pursue LEED recognition for additional buildings within the current portfolio. In 2014, Metro successfully obtained LEED Silver Certification at Division 10.



Additionally, the process has been initiated to pursue LEED For Existing Buildings, Operations and Maintenance (LEED-EBOM) Certification at Divisions 7 and 30. The soon-to-be completed Gold Line Operations Campus also includes sustainability features that will qualify the building for future LEED Gold Certification.

maintenance was developed specifically for Metro's facilities maintenance crews and electricians. The course covered the history and theory of PV, safety, and the newly developed preventative maintenance plan. Two instruction sessions and on-site rooftop visits were given. This training was rolled into the ETI program, which houses all EMS course modules.

KEY ACCOMPLISHMENT AREA 7: ENHANCED OUTREACH PROGRAMS AND AWARENESS EDUCATION

Metro recognizes the importance of education and awareness building amongst all employees to develop a more sustainable practice in the long term. As part of this effort, Metro conducted 29 Energy and Water Conservation Awareness and Recycling trainings throughout the year. As a result, over 725 staff members were trained. Staff also participated in programs such as the Air Resources Board's (ARB) Low Carbon Fuel Standard (LCFS) program. This resulted in the first-ever LCFS credit transaction, which deposited funds into the newly created "Green Fund." The Green Fund promotes long-term maintenance of sustainability-related assets. It is Metro's goal to continue to optimize the revenue from LCFS credits through sales.

Innovative, technology-based sustainability solutions may create a need for education and training. In 2014, a training course on PV preventative

KEY ACCOMPLISHMENT AREA 8: ENHANCED WASTE MANAGEMENT PROGRAM

Metro continues to focus on reducing its chemical, non-hazardous liquid, oil usage, and associated waste. In 2014, Metro completed the procurement of coolant recovery systems at all bus divisions. This system now allows bus facilities to reuse the anti-freeze from buses. The coolant recovery system consists of removing contaminants through filtration and restoring the coolant's properties with additives. The implemented coolant recovery system not only reduces the cost of purchasing new coolant, but ultimately conserves resources.

In addition, Metro completed solid waste and recycling audits at eight major facilities to better understand Metro's waste production and diversion rates. As a result, multiple divisions have acquired a cardboard compactor, while others, such as Division 7, recycle ferrous and nonferrous metals. The monthly diversion reports and rate sheets provided



by the contractor allow Metro to effectively manage data. Metro can now measure how much waste is produced agency-wide, analyze what programs work and which need improvement, and set targets for the agency to reduce its consumption of products and natural resources. As an ongoing effort, Metro plans to complete waste and recycling audits at all bus and rail divisions to explore additional opportunities to improve landfill diversion rates.

KEY ACCOMPLISHMENT AREA 9: PILOT SUSTAINABILITY DEMONSTRATION PROJECTS

Innovation and new technology breakthroughs continue to push for increased sustainability achievements. As a leader in sustainability amongst transportation agencies nationwide, Metro is proactively working with professionals and specialists to find opportunities for new pilot projects. In 2014, Metro established an alternate bus washing schedule pilot program at Divisions 8 and 15. The program involves washing buses every other day rather than daily. Water reductions have already been recognized and, as a result, the program has been rolled out to all bus divisions. Metro will implement the program at all rail yards in the future.

Beginning in 2013, a lighting pilot project was introduced to the 15th floor of Metro Headquarters. The pilot program involved monitoring electrical

consumption with sub-meters as various types of LED products were installed throughout the floor. Data from the sub-meters revealed a reduction in energy consumption by up to 51% from the baseline. In addition, qualitative surveys were completed by Metro employees and 90% of respondents preferred the new fixtures. However, this energy reduction varied, which reinforces the need for integrated lighting controls in addition to energy-efficient light fixtures. These lessons have been incorporated into the current project to replace the entire building's lighting system.

As global discussions of climate change impacts evolve, improving the resilience of critical infrastructure has moved to the forefront of Metro's priorities. In 2014, Metro began developing a resiliency indicator framework to calculate asset resilience. In coordination with internal stakeholders such as Corporate Safety and Risk Management, Planning and Operations, the metrics were refined to reflect Metro-relevant needs and vulnerabilities. Then, the framework was tested with a variety of case studies, reflecting some of Metro's most critical or obvious vulnerabilities, in order to verify the framework's consistency and dependability across Metro's assets. The final resiliency indicator framework tool contains two dimensions, technical and organization, which include roughly 60 indicators. The resiliency indicator framework can be utilized to evaluate the physical ability of the system to perform, or the overall ability of the organization to take actions in preparation for or in response to a hazard event.

METRO RAIL'S GOLD LINE OPERATIONS CAMPUS



The Gold Line Operations Campus is being built as part of the 11.5-mile Metro Gold Line Foothill Extension project. The campus is located on 24 acres of land in the City of Monrovia and is expected to house 84 light rail vehicles. The Operations Campus will provide full maintenance and operational support for the Gold Line and other Metro Rail light rail lines. The \$265 million project includes sustainability features that will qualify it for future LEED Gold Certification, including a 178.5 kW solar panel array that will generate an average of 22,000 kilowatt hours (kWh) of electricity a month. In

addition, drought-tolerant landscape and smart technologies will reduce water used for irrigation by 50%, while a new stormwater collection and filtration system will capture and treat up to 112,000 gallons of rainfall. Once completed and operational, these sustainability features are expected to reduce energy consumption by 32.5% and reduce water usage by 35% when compared to a traditional facility of its size. The Operations Campus is expected to be completed by the Gold Line Foothill Construction Authority and turned over to Metro in summer 2015.







M Metro Vanpool
metro.net/vanpool



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HOW DID WE DO?

Metro's environmental performance throughout 2014 is assessed by our performance in each indicator area. This analysis provides Metro the data to track progress from year to year, as well as to set new targets, establish strategies, and recommend goals for future years. Each indicator section presents accomplishments achieved in 2014 followed by general indicator information. Annual performance data are also described and presented graphically. Finally, next steps are provided for future implementation.

INDICATOR AREA

VEHICLE MILES TRAVELED PER CAPITA

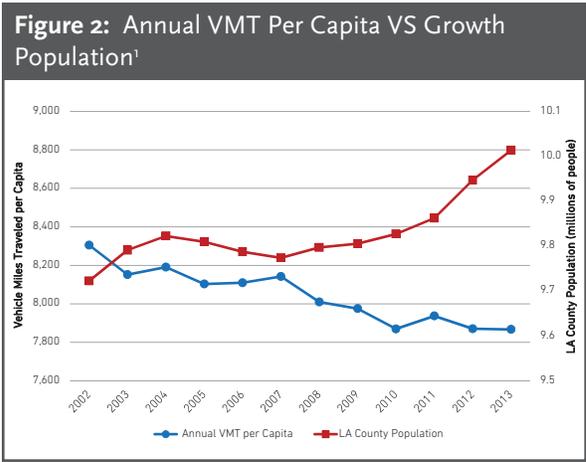




OVERALL PERFORMANCE ▼

According to the State Department of Finance's adjusted annual population estimate, the total population of Los Angeles County increased 2.3% between 2003 and 2013, from 9.79 million to 10.0 million. According to the Highway Performance Monitoring System (HPMS) California Public Road Data, 218.7 million vehicle miles were traveled daily in 2003 within Los Angeles County, which decreased to 215.8 million in 2013.¹ This constitutes a 1.3% decrease in VMT compared to a 2.3% total population growth over the past 10 years. The VMT per 1,000 capita decreased from 8,152 in 2003 to 7,867 in 2013 (**Figure 2**).

VMT has been on a downward trend since 2007, despite the increasing population. This reduction in VMT per capita is attributable to a number of factors, including Metro's increased focus on improving transit service efficiency and convenience. The provision of transit services allows for increased opportunities for mobility and accessibility for the general public, while also offering alternative transit options for single-occupant vehicle drivers.



1. 2014 data are currently unavailable.

INDICATOR AREA

UNLINKED PASSENGER TRIPS



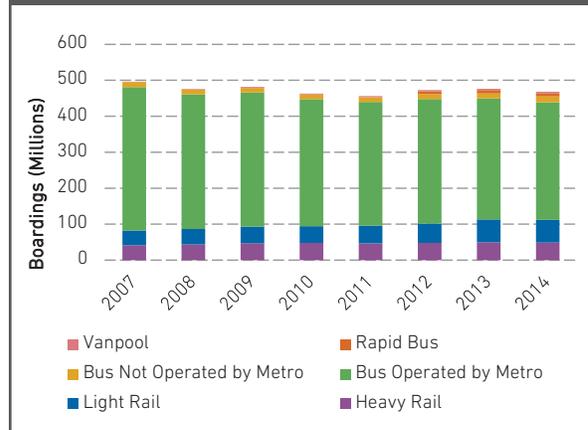


OVERALL PERFORMANCE ▼

In 2014 Metro experienced a 1.7% decrease in overall ridership, from approximately 476 million boardings in 2013 to approximately 468 million boardings (Figure 3). This constitutes the first decline in ridership since 2011. The largest declines in ridership occurred in Bus Rapid Transit (BRT) and Metro-operated bus service, which experienced ridership decreases of 4.1% and 2.8%, respectively. Heavy and light rail experienced slight decreases of 1.6% and 0.9%, respectively.

Non-Metro-operated bus service and vanpool were the only transit modes that experienced increases in ridership, growing by 17.4% and 11.9%, respectively (Table 2). These increases may be correlated to the decrease in ridership of BRT and rail services, as well as the expansion of non-Metro-operated bus and

Figure 3: Historic Boardings by Transit Mode



vanpool services. Although the ridership decreases for BRT and rail services can be attributed to a variety of factors, the recent recovery from the economic downturn that began in 2008, coupled with lower

Table 2: Historic Boarding by Transit Mode

	2007	2008	2009	2010	2011	2012	2013	2014
Heavy Rail	41 M	44 M	47 M	48 M	46 M	48 M	50 M	49 M
Light Rail	41 M	43 M	46 M	46 M	49 M	54 M	64 M	63 M
Bus Operated by Metro	399 M	374 M	373 M	353 M	344 M	346 M	336 M	327 M
Bus Not Operated by Metro	14 M	13 M	13 M	13 M	13 M	14 M	14 M	16 M
Rapid Bus	-	-	-	-	-	7.8 M	9.1 M	8.7 M
Vanpool	0.1 M	1.8 M	2.5 M	2.7 M	3 M	3.4 M	3.6 M	4.1 M

M = Million Boardings

gasoline prices, may have played a role in a greater number of Los Angeles residents driving rather than using Metro transit services.

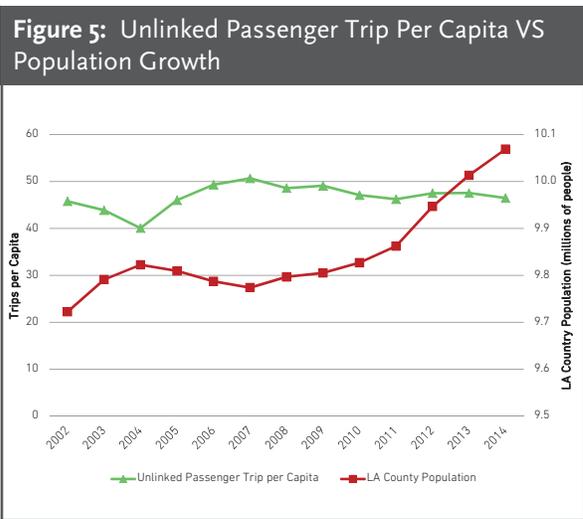
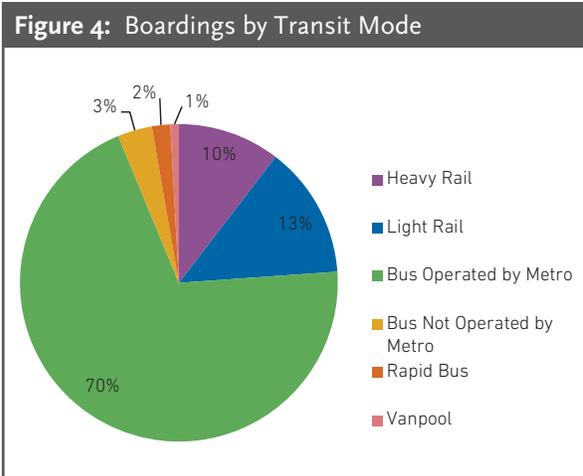
The trend for VRH shows an increase of 3.3% from 2013. This constitutes the second consecutive year of increases in VRH. The most significant increase in revenue hours occurred in vanpool and BRT services, with increases of 12% in 2014 as compared to 2013. Historically, the trend for VRH has generally followed the ridership trend. However, the increase in VRH is not consistent with ridership since ridership decreased 1.7% in 2014.

TRANSIT MODE ▼

Bus service remains the dominant transit mode among Los Angeles County's transit rider population, with 73% of transit trips occurring by bus in 2014 (Figure 4). Similar to last year, heavy rail and light rail combined account for 24% of total transit trips.

Vanpool service experienced a 11.9% increase in ridership, which equates to an average annual growth of approximately 10% over the last five years. With a 17.4% increase in ridership, non-Metro-operated bus service became the transit service with the fastest-growing ridership in 2014. This trend aligns with Metro's commitment to provide a variety of transit options, such as the vanpool service and other purchased transportation options.

BRT service was reported as a separate transit mode starting in 2012, and showed a 4.1% decrease in ridership from 2013. Similar to last year, Metro-operated bus service experienced a 2.8% decrease in ridership in 2014. This trend of shrinking traditional bus ridership as a portion of Metro's overall transit services has been consistent for the last 10 years. Despite the overall increase in total transit ridership since 2003, the proportion of the Metro bus services has dropped 8% during that time period, which can be attributed to expanded services in rail and vanpool transit modes.



UNLINKED PASSENGER TRIPS PER CAPITA ▼

Historically, data for unlinked passenger trips per capita show that ridership increased rapidly despite the decrease in regional population between 2005 and 2007. More recently, unlinked passenger trips per capita show that ridership decreased despite the increase in regional population between 2009 and 2011, and again between 2013 and 2014. Overall, ridership per capita has remained steady at 46 to 48 trips per capita over the last five years, despite the 2% population growth pace since 2010 (Figure 5).

CASE STUDY

“GO METRO TO FARMERS’ MARKET” CAMPAIGN: FARMERS’ MARKET UPDATE



CHALLENGE

After last year’s kick-off of Metro’s Blue Line Farmers’ Market, located in the MLK Transit Center adjacent to the Compton Station, Metro seeks to further expand its involvement in providing access to fresh, healthy food along its transit systems.

ACTION

In preparation for the Blue Line Farmers’ Market, Metro conducted a survey of active, existing farmers’ markets. It became apparent that an abundance of farmers’ market options existed throughout Los Angeles. Thus, Metro identified markets within walking distance (0.5 mi) from Metro rail stations in order to bridge the gap between fresh food resources and transit mobility.

OUTCOME

In 2014, Metro launched the “Go Metro to Farmers’ Markets” website. The interactive map on the website allows users to pick the market closest to their station of choice. The website also provides a list of farmers’ markets, and includes information such as time, seasonal schedule, location, and directions. The market

list is organized by region and transit line so that Metro patrons can easily navigate their way to these markets. Through this initiative, Metro connects its riders to fresh, healthy food options while also promoting sustainable transportation. The website can be visited at metro.net/riding/farmers-markets/.

INDICATOR AREA

OPERATING EXPENSES



As one of the largest transportation agencies in the country, Metro is dedicated to the continuous development of an efficient and effective transportation system for Los Angeles County. There are approximately 10 million residents in Los Angeles County today, and it is expected to grow to 13.1 million by 2040.¹ To meet the demand of a growing community, Metro aims to add and improve transportation amenities throughout the County to increase boarding and passenger miles, while committing to reduce associated GHG emissions and recycle internal waste streams.

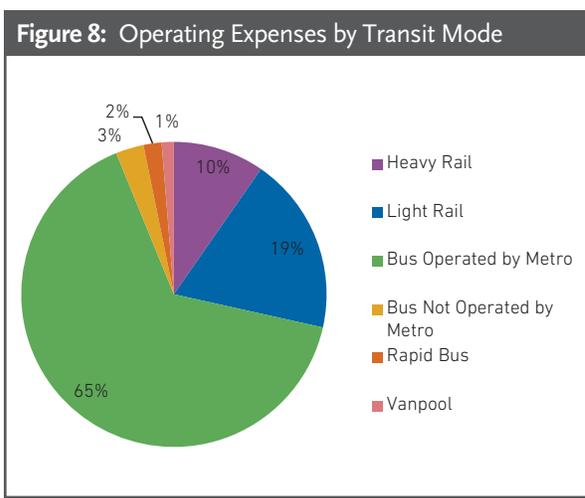
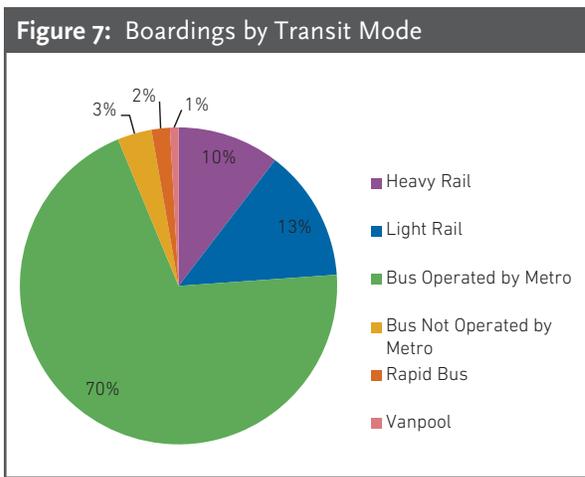
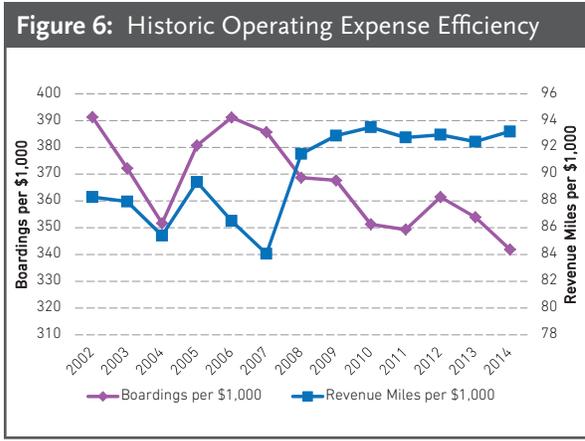
As a key component of the sustainability triple bottom line (economic, environmental, and social), operating expenses and efficiency are important indicators that reflect the agency's economic sustainability goals. This section analyzes the trend of Metro's overall operating costs and efficiency for each transit mode in 2014 compared to previous years.

OVERALL PERFORMANCE ▼

In 2014, overall boarding for all transit modes decreased 1.7% and overall PMT increased 1.5% from 2013. In 2014, Metro's operating expenses were approximately \$2.93 per boarding, which represents a 3.5% increase (10 cents) from 2013 after adjusting for inflation. Metro's operating expenses were approximately \$10.73 per revenue mile, which represents a 1% decrease (9 cents) from 2013.

Overall, the number of boardings per \$1,000 of operating expenses has decreased since 2012, resulting in a reduction in operating expense efficiency per boarding (**Figure 6**). However, the operating expense efficiency per revenue mile has remained steady since 2008 at approximately 93 revenue miles per \$1,000.

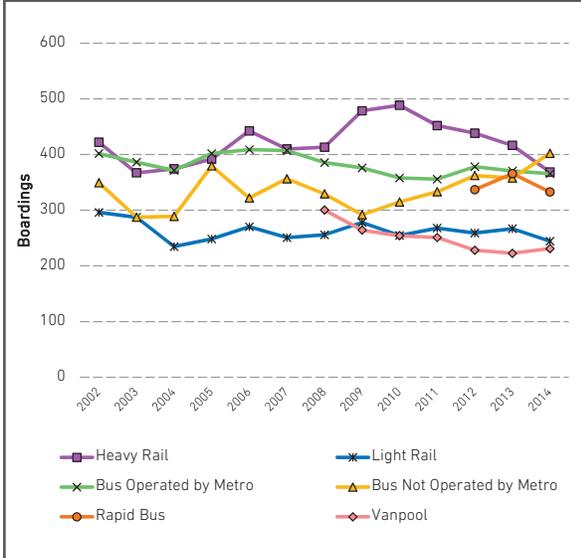
Over 68% of Metro's operating expenses were spent on bus service, which accounted for 73% of Metro's total ridership in 2014 (**Figure 7** and **Figure 8**). In 2012, a new category was added for Metro-operated BRT, which constitutes approximately 2% of the



overall boarding and operating expenses. Light rail continues to be the only transit mode whose portion of ridership contribution is less than its portion of operating expenses.

1. Metro 2009 Long Range Transportation Plan.

Figure 9: Boardings Per \$1,000 Operating Cost

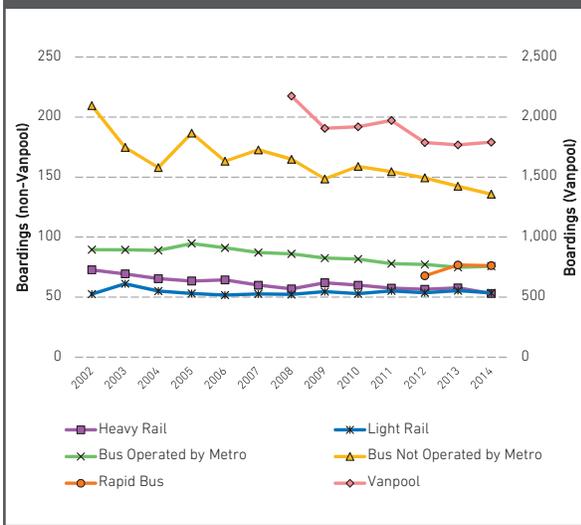


Bus Service

In 2014, Metro-operated bus service had approximately 366 boardings per \$1,000 operating cost, which is approximately 5 less boardings than in 2013, but 8 more boardings than in 2010 (Figure 9). In 2014, non-Metro-operated bus had approximately 402 boardings per \$1,000 operating cost, which is 44 more boardings than in 2013, a 12% increase in efficiency. Additionally, in 2014, non-Metro-operated bus experienced its highest number of boardings per \$1,000 operating cost since 2002. This coincides with the 17% increase in non-Metro operated bus ridership from 2013 to 2014.

In terms of revenue miles per operating cost, there were 76 revenue miles traveled per \$1,000 operating cost, which is a slight increase from 2013 at 75 revenue miles (Figure 10). Non-Metro-operated bus experienced a decrease in revenue miles traveled per operating cost at 136 revenue miles per \$1,000 operating cost in 2014 compared to 142 revenue miles in 2013.

Figure 10: Revenue Miles Per \$1,000 Operating Cost



Light Rail

Boardings per operating expense for light rail decreased to 244 boardings in 2014 compared to 267 boardings in 2013 (Figure 9). This 8% decrease in efficiency from 2013 to 2014 contrasts with the 3% improvement in efficiency that occurred from 2012 to 2013. This may be attributed to the increasing costs of operation coupled with a decrease in light rail ridership (approximately 600,000 less boardings than 2013). In terms of revenue miles, there were approximately 54 revenue miles per \$1,000 operating expense in 2014 compared to 55 boardings in 2013. The slight decrease in revenue miles represent a 3% decrease in efficiency compared to 2013 (Figure 10).

Heavy Rail

Historically, boardings per operating expense for heavy rail have fluctuated around approximately 400 boardings per \$1,000 operating cost, while experiencing decreases each year since 2010. However, in 2014, boarding per operating expense experienced a more significant decrease of 12% from 2013. There were approximately 369 boardings per \$1,000 operating expense in 2014, which is a decrease from 416 boardings in 2013 (Figure 9). In terms of revenue miles, there were approximately 53 revenue miles traveled for every \$1,000 operating cost (Figure 10). This is an 8% decrease from 2013,

HEAVY RAIL EXPERIENCED A SIGNIFICANT INCREASE OF 12.9% IN OPERATING EFFICIENCY IN 2014.

which experienced 58 revenue miles traveled. This may be attributed to the steady costs of operation coupled with a 2% decrease in heavy rail ridership in 2014.

Rapid Bus

As a new transit category item beginning in 2012, Metro-operated Rapid Bus constitutes approximately 2% of overall boarding and expenses. In general, the number of boardings per \$1,000 operating cost is comparable to the overall bus service provided by Metro. In 2014, boardings per operating expense decreased 9% compared to 2013, leading to a decrease in efficiency (Figure 9). Similarly, revenue miles traveled per \$1,000 operating expense slightly decrease by 1% compared to 2013, leading to a decrease in efficiency (Figure 10). These decreases in efficiency may be attributed to expected fluctuations in ridership in the beginning years of a new transit mode. Therefore, additional time is needed to establish a trend.

Vanpool

The vanpool operating cost data continue to validate that vanpool services are an effective transit mode for serving a longer distance radius, especially for areas that are underserved by more conventional transit modes. Metro started its vanpool services in 2007 and, after the initial startup period, the overall operating expenses have steadily increased along with the number of boardings (Figure 11). Boardings per \$1,000 operating expense had steadily decreased up until 2014 when vanpool boardings experienced a 4% increase from 223 boardings in 2013 to 231 boardings in 2014 (Figure 9). Overall, compared to other modes, vanpool operating cost per boarding is 58% more expensive than Metro-operated bus service and 6% more expensive than light rail service. However, when capturing PMT, vanpool becomes a much more effective means of travel. In 2014, PMT for vanpool was approximately 44 miles compared to other transit modes that ranged from 4.2 miles to 6.5 miles per trip (Figure 12). This results in a very low operation cost per revenue mile at \$0.56.

Therefore, operating expenses for PMT show that the vanpool program is a significantly cheaper option (10 cents per PMT) than other transit modes (Figure 13). As a sustainable travel option compared to single occupant vehicles, the vanpool program plays a key role in reducing traffic and associated GHG emissions.

Figure 11: Vanpool Ridership and Operating Expenses

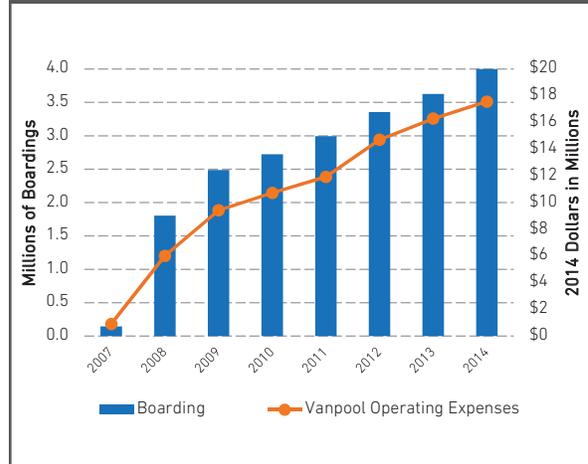


Figure 12: Passenger Miles Traveled per Trip

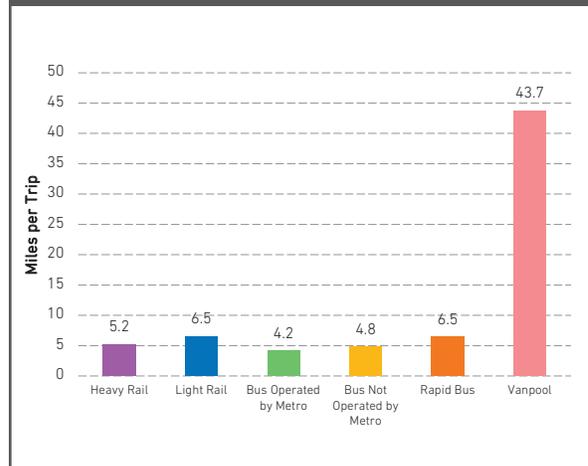
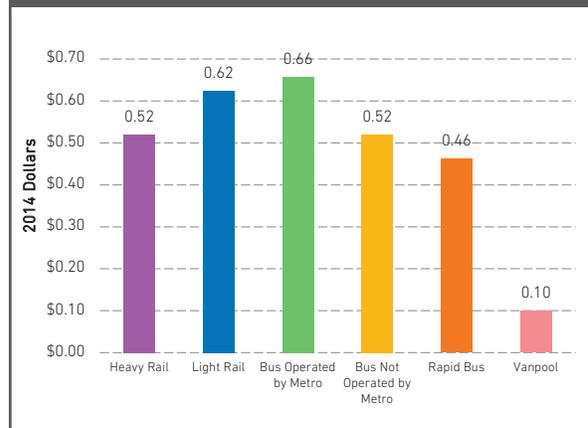


Figure 13: Operating Expenses per Passenger Miles Traveled by Mode



INDICATOR AREA

WATER USE



DATA AND ANALYSIS

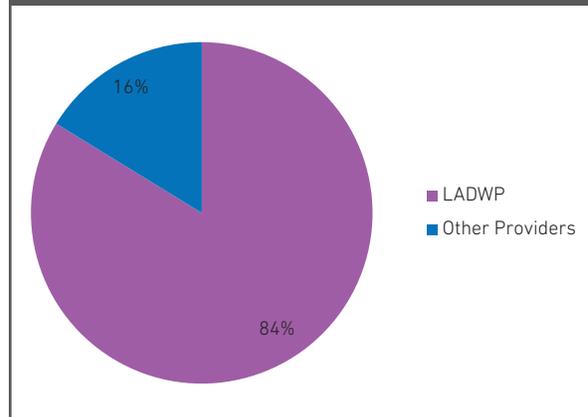
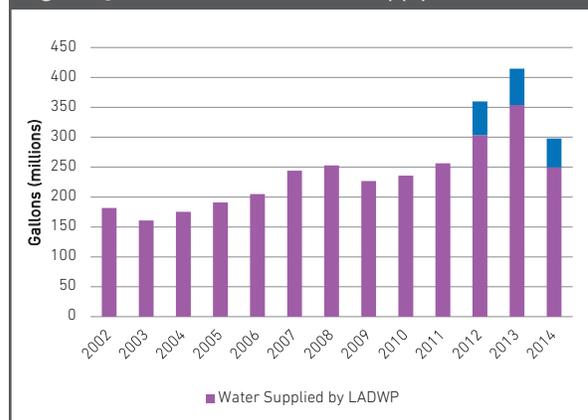
One of the key elements of Metro's MSIP is to reduce water consumption and improve efficiency while continuing to provide transit services to local residents. Metro's overall water consumption in 2014 decreased, which may be attributed to the implementation of effective water saving programs, such as the alternate bus washing schedule pilot project.

In 2014, Metro operations consumed approximately 298 million gallons of water, a significant decrease of 28.1% from 2013. Daily water use includes bus and rail car washing, maintenance operations, daily water use by employees, and facility landscape irrigation. Similar to previous years, 84% of the water consumed by Metro was provided by LADWP, with the remaining 16% supplied by PWP, California Water Services, Park Water Company, Golden State Water Company, and other municipal providers (Figure 14).

It is worth noting that 2014 is the third year that other providers (in addition to LADWP) were included and analyzed in this report. Compared to 2013, total LADWP supply decreased by 30%, which is a significant reduction in comparison to the 17% increase in LADWP supply that occurred from 2012 to 2013. Other providers combined showed a 20% decrease in water supply in 2014, a significant reduction in comparison to the 8% increase from 2012 to 2013 (Figure 15). These decreases in water demand may be attributed to the decrease in Metro's fleet size as well as water conservation efforts.

IN 2014, METRO'S OVERALL WATER CONSUMPTION EXPERIENCED A SIGNIFICANT DECREASE OF 28%.

Figure 14: Metro Water Supply Source

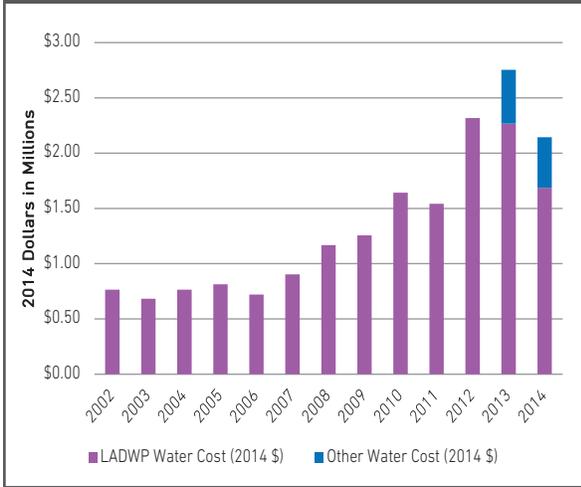
Figure 15: Historic Total Water Supply¹

ACCOMPLISHMENTS

- > Implemented an alternate bus washing schedule at all divisions to reduce water consumption. The program requires bus washing to occur every other day rather than daily.
- > Analyzed water reduction opportunities using Linear Kinetic Cell technology to reduce water consumption and cost savings.
- > The new Division 13 facility, to be completed in late 2015, incorporates water conservation elements, such as a water-efficient irrigation system and a 275,000 gallon underground cistern to capture and recycle rainwater.

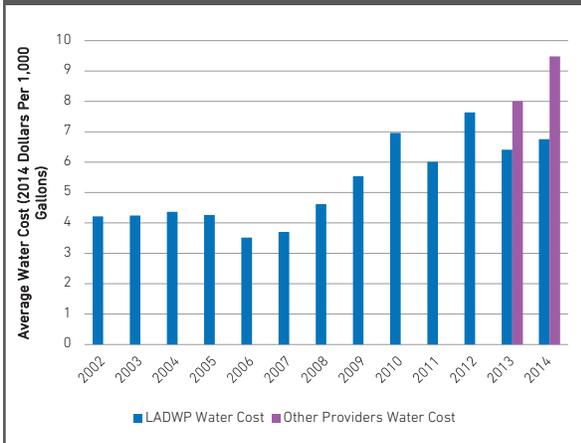
1. Beginning in 2012, water consumption data included LADWP and the category Other Providers. The other providers included PWP, California Water Services, Park Water Company, Golden State Water Company, and other municipal providers.

Figure 16: Historic Water Cost



Due to the reduction in water use, the associated water costs also decreased by approximately 22%, from \$2.76 million in 2013 to \$2.15 million in 2014, after adjustment for inflation (**Figure 16**). In terms of average water unit cost, there was a 44 cent per 1,000 gallon increase for total water consumed in 2014 compared to the previous year, which represents a rate increase of 6.5% (**Figure 17**). It is worth noting that beginning in 2013, sewer costs were separated out from the overall water bills to increase the accuracy of reporting. This may account for the increase in average water unit cost.

Figure 17: Historic Average Water Cost

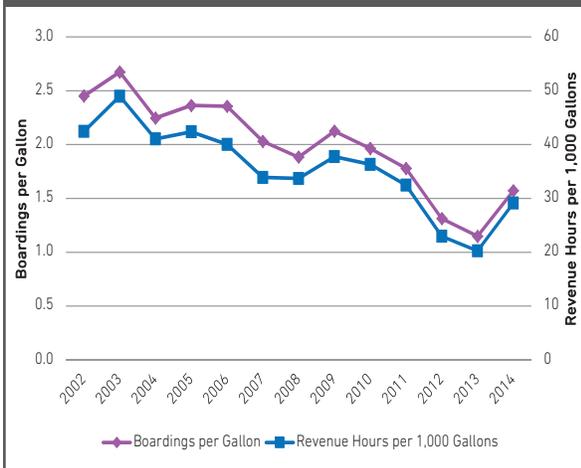


Overall, water use efficiency increased in 2014 due to the decrease in water consumption. In 2014, there were approximately 1.6 boardings per gallon of water consumed, which is a 37% increase in efficiency from approximately 1.1 boardings per gallon in 2013. Additionally, there were approximately 29 revenue hours per 1,000 gallons of water consumed in 2014, which is a 44% increase in efficiency from 2013 when there were approximately 20 revenue hours per 1,000 gallons (**Figure 18**).

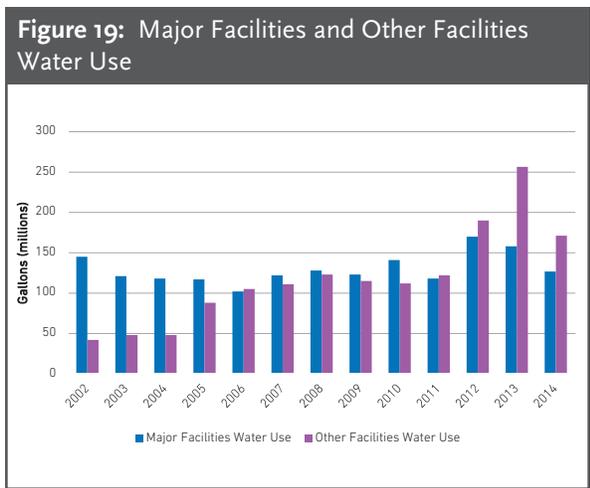
MAJOR FACILITIES

Metro's major facilities accounted for approximately 43% of Metro's overall water footprint in 2014. Annual water consumption for major facilities in 2014 was approximately 127 million gallons of water, of which 96 million gallons were supplied by LADWP (76%) and 31 million were supplied by other providers (24%).

Figure 18: Water Use Efficiency

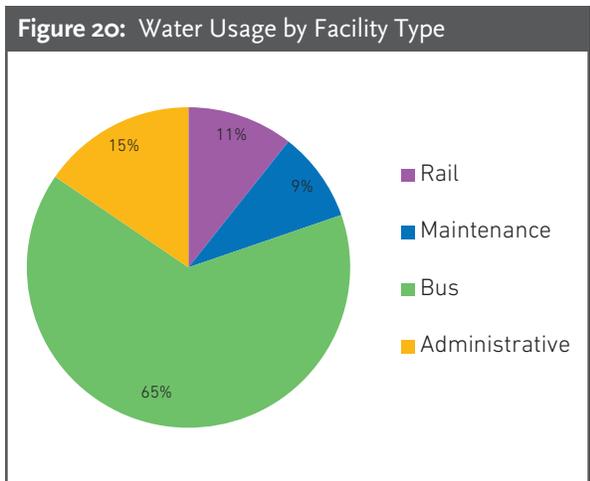


In 2014, the major facilities consumed 41.8 million gallons less than 2013, which represents a 20% improvement in water conservation (**Figure 19**). The improvement in water conservation may also be attributed to the proactive conservation programs and strategies implemented at several key major divisions. These include the alternate bus washing schedule; analyzing water reduction opportunities using new technology to reduce water consumption and cost savings; and recycling water at the bus washers. It should be noted that several water

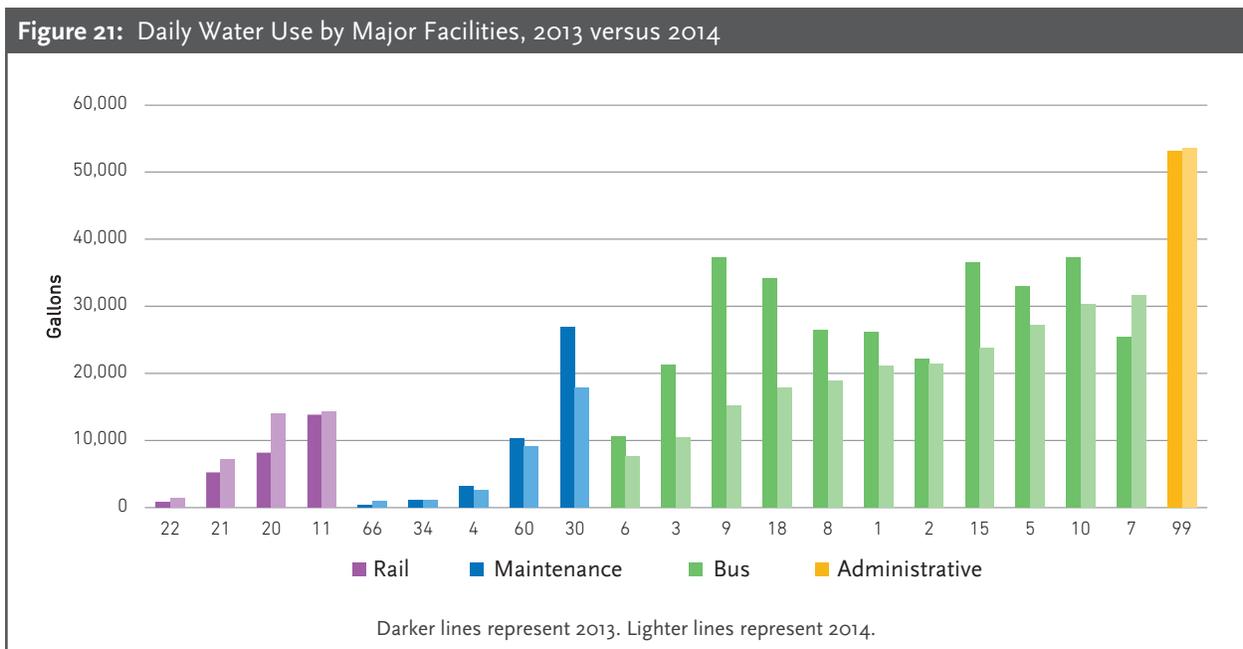


meters associated with major facilities were closed in 2014, which may account for some of the decrease in water consumption.¹

In general, Metro has four types of major facilities based on functionality and operations: rail yards, bus divisions, other maintenance, and administrative buildings. On average, the bus division facilities (11 locations) consume 64.9% of the overall water usage, which is more than rail (10.6%), maintenance (9.1%), and administrative buildings (15.4%) (Figure 20). This primarily reflects the bus washing needs for Metro, which has one of the largest bus fleets in the nation. However, due to the alternate bus washing schedule pilot program, the bus division consumed 27% less water in 2014 than in 2013.



Several major facilities have effectively reduced their water consumption, with the top three decreases occurring at Division 9 (59%), Division 3 (51%), and Division 18 (48%), mainly due to the implementation of effective water conservation measures and programs at bus divisions and changes in bus fleet (Figure 21). Other notable decreases include Division 15 (35%) and CMF (34%). The reduction at CMF may be associated with the removal of landscaping, which is a large consumer of water. Conversely, Divisions 20 and 22, and Location 66 showed substantial



1. Water meters at 900 Lyon Street, 470 Bauchet Street, 800 N Alameda Street, 304 S Santa Fe Avenue, 421 1/2 W 37th Place, and 671 Crenshaw Boulevard were closed due to various operational needs such as construction and meter replacement.



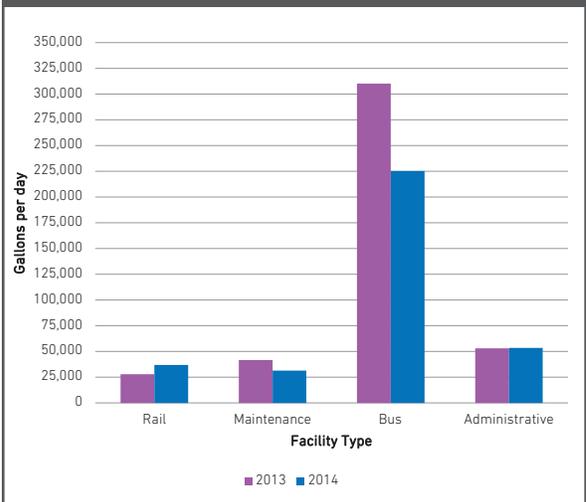
increases from 2013 to 2014 at 71%, 90%, and 167%, respectively. These increases may be due to the nature of the facilities as Divisions 20 and 22 are rail yards and Location 66 is a maintenance facility. Water conservation initiatives implemented thus far by Metro have focused mainly on bus division facilities due to the bus divisions being the largest consumers of water (**Figure 22**). Although the overall average daily water consumption of the major facilities decreased from 2013 to 2014, bus division facilities experienced a 27% decrease, while rail yards experienced a 32% increase.

CHANGE ANALYSIS ▼

In terms of expenditures, the 2014 total water cost decreased 4%, from \$994.7 million in 2013 to \$951.2 million in 2014. This can be attributed to the 20% decrease in overall major facilities water use.

An operational change that contributed to a significant decrease in Metro's overall water usage was the decrease in both boarding and revenue miles in 2014. In addition, the alternate bus washing schedule pilot program further decreased water consumption.

Figure 22: Average Daily Water Use by Facility Type



NEXT STEPS

- > Begin installation of recycled water lines along a portion of the Metro Orange Line.
- > Enroll all recycled water projects in the Recycled Water On-Site Retrofit Rebate Program.
- > Explore water saving strategies at Metro's facilities. For instance, a new water conditioning system using Linear Kinetic Cell technology is being rolled out at Divisions 5 and 18 in 2015.

CASE STUDY

WATER SAVINGS PILOT PROGRAM: BUS OPERATIONS



CHALLENGE

As Metro continues to expand and enhance its services throughout Los Angeles County, the agency has experienced a steady increase in water use over the last several years. In 2013, Metro consumed over 400 million gallons of water across the agency at a cost of nearly \$3 million. In light of the current drought and outdoor urban water reduction mandates from the State and various municipalities, Metro's Maintenance Department implemented a pilot program to accrue savings from the agency's largest water consumers: bus operating divisions. Nearly three-quarters of the agency's water use is consumed at bus divisions, with a large majority of this consumption from bus washing activities.

ACTION

A water savings pilot program was initiated at Division 8. Division 8 was chosen as the pilot due to the facility's supportive management and staff, along with a readily available sub-meter already installed at the bus wash, which would facilitate accurate monitoring and measurement. The pilot program sought to reduce bus wash water use through a two-pronged approach. First, the division converted from a full fleet daily wash to an odd/even day bus washing schedule. The second component involved adjusting the bus wash cycle timer to more accurately reflect the amount of time each bus spends in the bus wash and reduce any additional water expended while washing was not taking place. After performing several tests and observing staff running buses through the wash, it was determined that no bus remained in the wash for more than one minute. Thus, this effort reduced the cycle timer by nearly one minute, down to a 90-second timer.

OUTCOME



Division 8 witnessed a dramatic reduction in its water use in the last several months of 2014. Between 2013 and 2014, Division 8 experienced a decrease of over 2.5 million gallons, and cost savings upwards of \$7,000. Based on the promising results of the initial pilot efforts at Division 8, Metro implemented this pilot agency-wide at all bus operating facilities, beginning in fall 2014. Based on the last few months in 2014, it

is estimated that Metro accrued approximately 10% in cost savings by decreasing its water use across all bus operating facilities by approximately 42%. As the program is introduced agency-wide, Metro will take into consideration the unique operating environment, the caliber of the bus wash equipment, and specific water reduction mandates for each of the divisions to ensure that this program effectively conserves water.

INDICATOR AREA

ENERGY USE



FUEL USE

ACCOMPLISHMENTS

> Metro staff continued to pursue the procurement of biomethane after Board direction in May 2014, pursuant to Metro's 2013 Biomethane Implementation Plan. Procurement is underway and expected to be completed in fall 2015. Because biomethane comes from landfills, dairy digesters, and wastewater treatment plants, Metro can significantly reduce the carbon footprint of its transit operations with no operational changes.

DATA AND ANALYSIS

In 2014, Metro's vehicle fleet (which includes revenue and non-revenue vehicles, but does not include contracted operations) used 40.3 million gasoline gallon equivalent (GGE) of fuel, which is a slight decrease of 1% from 2013 (**Figure 23**). This decrease may be attributed to the reduced Metro-operated CNG bus services, since the total revenue miles in 2014 from Metro's bus operations decreased by 0.3% as compared to 2013, and the total boardings decreased by 3%. CNG continues to be the primary fuel type used by Metro-operated vehicles, accounting for more than 97% of total fuel used. This is due to Metro's efforts to transition to a 100% CNG-powered bus fleet for its directly operated bus services. However, the CNG consumption for Metro-operated bus services has been decreasing over the past five years, with a nearly 19% drop from its peak use in 2008. This may be attributed to Metro replacing and repowering CNG buses with the newest technology engines.

In 2014, fuel expenditures for Metro-operated bus services were approximately \$33 million, which is a 19% increase from 2013 (**Figure 24**). This increase is due to the increase in CNG prices, which accounts for over 87% of total fuel expenditures for Metro-operated

Figure 23: Historic Fuel Use, Metro Operated Vehicles

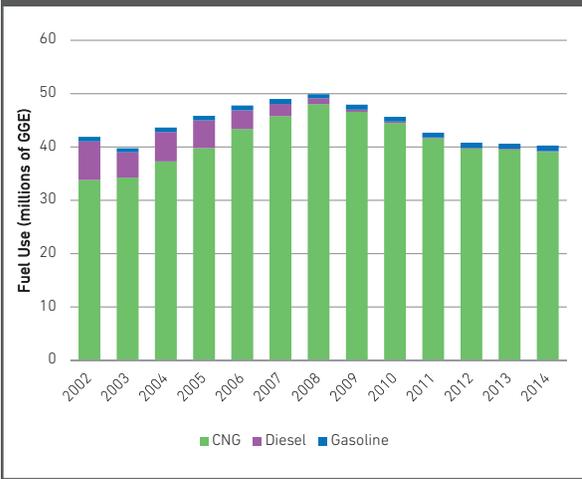


Figure 24: Total Fuel Cost, Metro Operated, 2014 Dollars

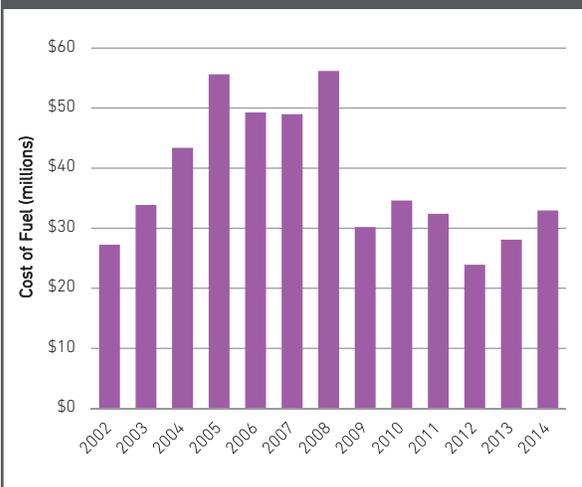
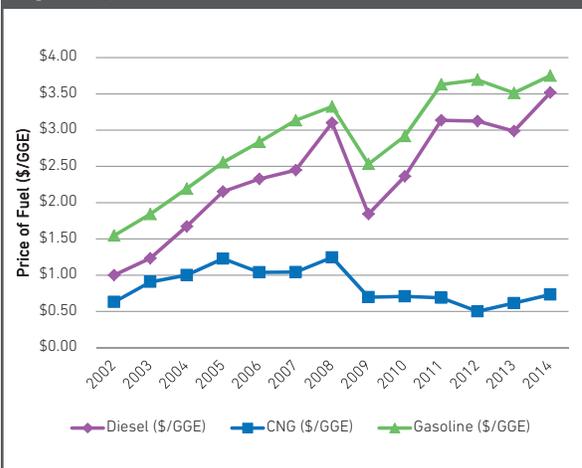


Figure 25: Historic Price of Fuel



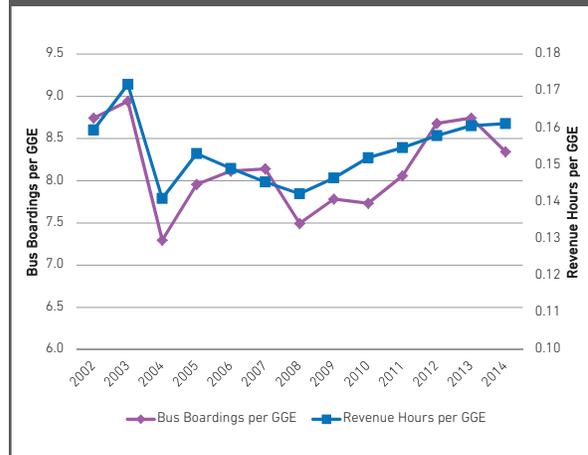


buses. The average price that Metro paid for CNG was 73 cents per therm in 2014, which is a 20% increase from 2013 at 61 cents per therm. The prices for diesel and gasoline experienced a 18% and 7% increase in 2014, respectively, from the previous year, which is the first increase since 2011 (**Figure 25**).

The overall fuel use efficiency for Metro-operated buses in 2014 increased slightly by 0.3% compared to 2013. The increasing efficiency of revenue hours per GGE has occurred since 2008 (**Figure 26**). This may be attributed to Metro's various efforts to improve bus efficiency and higher mileage per gallon performance, such as replacing bus fleet batteries with absorbed glass mat (AGM) batteries to reduce fuel use. The number of boardings per GGE in 2014 decreased from the previous year by 4.6% compared to 2013, with boardings per GGE decreasing from 8.7 to 8.3. This decrease in efficiency was observed despite a decrease in fuel consumption, partly attributed to the decrease in overall bus boardings between 2013 and 2014.

In addition to Metro-operated vehicles, buses operated by Metro contractors used an additional 2.5 million GGE of fuel in support of Metro's transit services in 2014. Unlike Metro's direct fleet, which is almost 100% CNG-powered, 37% of the fuel consumption for Metro-contracted bus services is from diesel-powered buses, with the remaining 63% being CNG-powered buses. Approximately

Figure 26: Fuel Use Efficiency



\$4.4 million was spent by the contractors on fuel costs in 2014, with diesel accounting for 74% of the costs. In terms of efficiency, Metro-contracted bus services used less fuel per boarding in 2014, a 20% improvement compared to Metro-operated bus services.

NEXT STEPS

- > Continue to transition Metro's transit bus fleet to cleaner fuels and more modern technology.

ELECTRIC BUSES



CHALLENGE

Los Angeles County ranks among the highest in the nation for poor air quality, which is largely attributed to GHG emissions from heavy passenger vehicle use in the region. This has led to public health and environmental issues throughout the region. To combat these issues, the region's principal public transportation provider, Metro, has pursued a number of technologically driven environmental initiatives aimed at reducing GHG emissions and passenger vehicle use. Currently, Metro runs and operates the country's largest fleet of clean air CNG buses. By switching from diesel to CNG, Metro avoids emitting nearly 300,000 pounds of GHG emissions per day, contributing to better regional air quality. Metro seeks to further reduce its environmental impact by implementing other advanced technologies that can eliminate the emissions associated with its massive bus operations.

ACTION

In a new initiative led by Metro's Advanced Transit Vehicle Consortium, a partnership with the City and County of Los Angeles and the South Coast Air Quality Management District (SCAQMD), five low-floor battery-powered electric buses have been purchased from BYD Motors and are being manufactured and tested in Los Angeles County. The buses are zero emissions vehicles, holding up to 120 people, with a range of 170 miles per charge. These new electric buses will further decrease Metro's GHG emissions and make alternative fuel vehicles even more visible throughout the region.

▼ NEXT STEPS

As the five electric buses reach the final stages of the manufacturing process, Metro is preparing to test them for a short period of time (15-30 days) before finally putting them into revenue service.

If the pilot project is successful, Metro plans on purchasing 20 more electric buses for use within the region.

FLYWHEEL ENERGY STORAGE – METRO RED LINE



CHALLENGE

With an expanding rail system comes an increase in energy consumption for propulsion power. As a result, Metro is seeking to reduce energy consumption of its transit operations through innovative strategies that conserve energy and lessen Metro's electrical demand and impact.

ACTION

In March 2014, Metro completed the installation of a flywheel energy storage system at the Westlake/McArthur Park Station on the Red Line. The Wayside Energy Storage System (WESS) utilizes regenerative technology to store energy generated by the activation of a train's braking system during deceleration and redistributes that energy to accelerate trains leaving the station. This system also provides peak power and voltage support, which are critical during rush hour when utility power is at a premium. The system consists of four 500 kW flywheel modules and a series of control, monitoring, and interference devices.

OUTCOME

The performance monitoring period for this project began in August 2014 and will conclude in July 2015. The most recent results indicate that in a 24-hour period, the WESS saved an average of 12% or 1.5 Megawatt hours (MWh) (energy returned to the line), with a maximum of 17% or 2.13 MWh.

The WESS is projected to save an average of 44 MWh each month or 541 MWh each year. The system will continue to be monitored over the next few months for safety and efficiency. This is the first system of its kind in the nation.

RAIL PROPULSION POWER

OVERALL PERFORMANCE

Rail propulsion power consumed 211 million kWh of electricity in 2014, an 8% decrease from 2013 (**Figure 27**). LADWP continues to be the major provider of rail propulsion power, supplying 65% of the total demand. The Red/Purple Line remains the largest consumer of rail propulsion power compared to other transit lines, at 37% of total consumed rail propulsion power. The overall reduction in rail propulsion power demand, despite a relatively constant ridership, may be attributed to a number of contributing factors including lighting retrofits and the installation of the WESS, an energy recovery system, on the Red Line.

From 2013 to 2014, the combined ridership of light rail and heavy rail decreased slightly (1.2%) to 112 million boardings. The rail share of total transit ridership has remained constant at 24%. In terms of revenue hours, the rail service revenue hours increased 5% from 2013, which indicates an increased efficiency in Metro's rail transit services.

DATA AND ANALYSIS

After successive increases since 2011, the Red/Purple Line power demand dropped sharply by 16% in 2014, from 94 million kWh to 79 million kWh. The Green Line power demand also experienced a reduction, decreasing 10% to 26 million kWh in 2014 (**Figure 28**). Contributing factors include the retrofitting of track-side lighting to LED and the implementation of the WESS on the Red Line.

In 2014, rail propulsion power continued to be supplied by LADWP (65%), Southern California Edison (SCE) (31%), and PWP (4%).

Figure 27: Historic Rail Propulsion Power Use by Provider

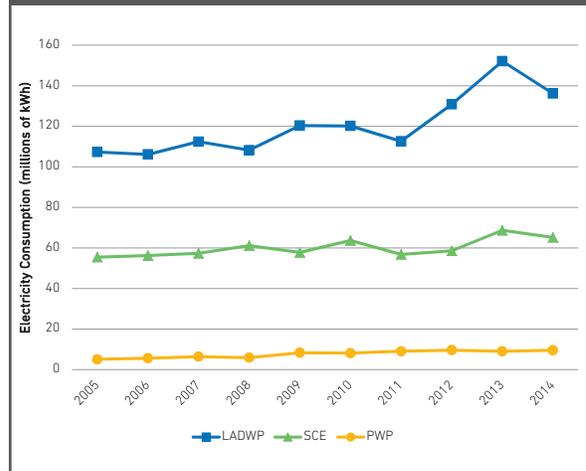
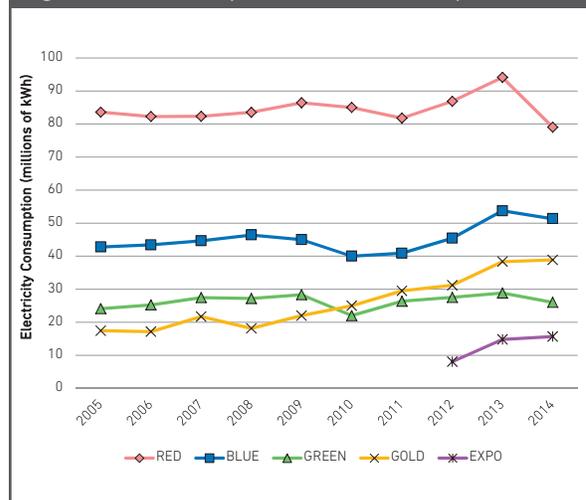


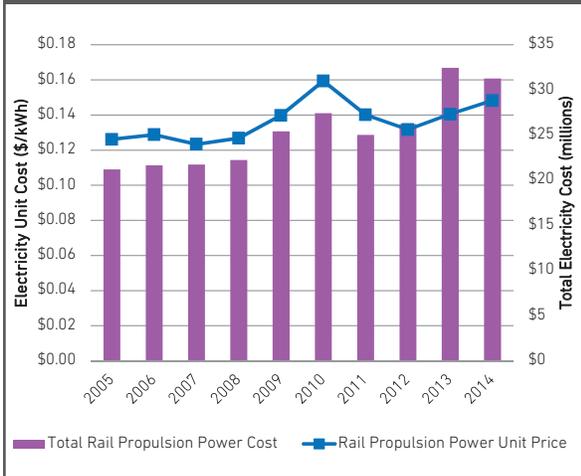
Figure 28: Rail Propulsion Power Use by Rail Line



**RAIL PROPULSION
CONSUMED 8%
LESS ELECTRICITY
IN 2014 THAN 2013.**



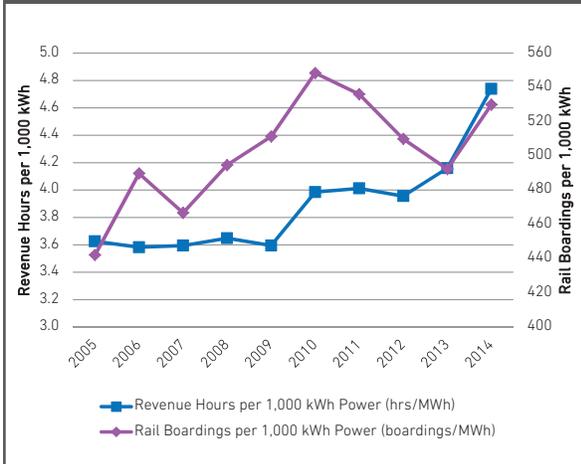
Figure 29: Rail Propulsion Power Costs



In terms of expenditures, rail propulsion power costs decreased by approximately 2%, from \$31.9 million in 2013 to \$31.3 million in 2014 (**Figure 29**). This decrease in expenditure occurred even with the increasing costs of rail propulsion power, which increased by 5% for a kWh of electricity in 2014 compared to 2013.

Overall, the slight decrease in rail propulsion power is attributed to a similar reduction in ridership, rail line LED lighting retrofits, and the installation of the WESS energy recovery system on the Red Line. Efficiency in terms of revenue hours per MWh of rail propulsion power use has continued on an upward trend over the past decade, with an increase of 14% from 4.2 hours/MWh in 2013 to 4.7 hours per MWh in 2014 (**Figure 30**). In terms of ridership, there was also a significant increase in efficiency, with boardings per MWh increasing from 492 boardings to 530 boardings.

Figure 30: Rail Propulsion Power Efficiency



FACILITY ELECTRICITY USE

ACCOMPLISHMENTS

- > Conducted Energy and Water Conservation Awareness and Recycling training sessions, for a total of 29 sessions for 725 staff.
- > Received LEED-EBOM Silver Certification at Division 10.
- > Completed energy opportunity assessments at Divisions 3, 7, 9, 15, 11, and 22, and CMF.
- > Completed lighting retrofits at Divisions 11 and 22.
- > Completed installation of sub-meters at Divisions 20 and 21.
- > Completed sub-meter designs for Divisions 3, 11, 18, 21, and 22, and Location 60.
- > Developed a Scope of Work for the solicitation of a PV Power Purchase Agreement (PPA) Provider for a bundled solar power project at Divisions 9, 11, and 22, and Expo Yard.
- > Developed PV Technical and Preventative Maintenance Training Program.
- > Completed installation of WESS along Metro Red Line using flywheel technology.

OVERALL PERFORMANCE

Electricity plays a major role in Metro's everyday operations. Metro used 305 million kWh of electricity in 2014, which is a 5% reduction from 2013. In 2014, 31% of electricity consumption was attributed to meeting facility energy demand and the remainder for rail propulsion (**Figure 31**). Compared to 2013, facility electricity use increased by 4% and rail propulsion power use dropped 8% in 2014 (**Figure 32**). The slight increase in facility electricity demand is despite a variety of electricity conservation programs and measures that were implemented across Metro and at specific facilities. For example in 2014, lighting retrofits were completed in Divisions 11 and 22, and LEED-EBOM Certification was achieved at Division 10 and the process engaged for Divisions 7 and 30. Some of the facility electricity use increase may be attributed to additional meters coming online in 2014.

Figure 31: Electricity Consumption by Use in 2014

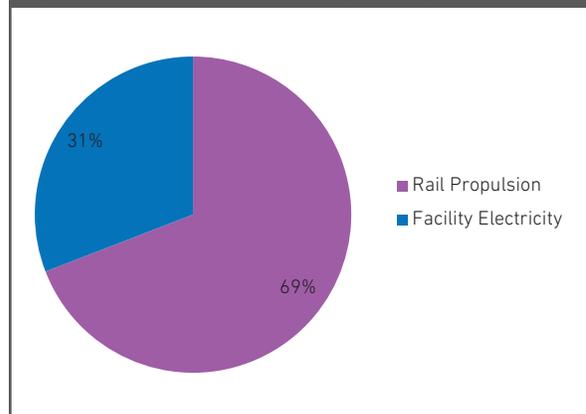
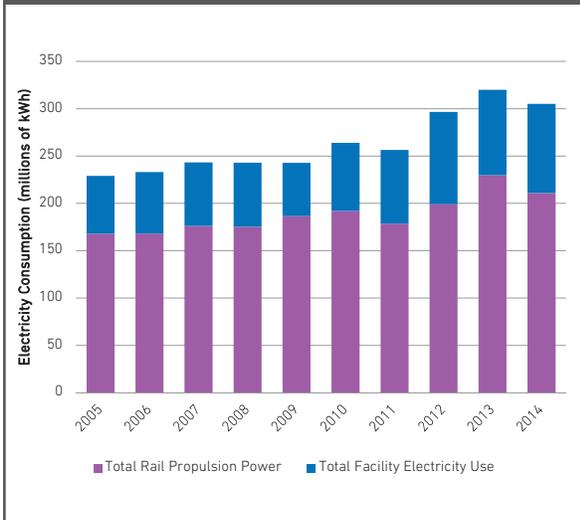


Figure 32: Historic Electricity Consumption by Use**Figure 33: Facility Electricity Use by Provider**

METRO IS IMPLEMENTING A NUMBER OF COMPREHENSIVE ENERGY EFFICIENCY UPGRADES.

DATA AND ANALYSIS

Despite the overall reduction in total electricity consumption, electricity use by Metro facilities in 2014 increased by 4% from 90 million kWh in 2013 to 94 million kWh. Metro is continuing to conduct energy opportunity assessments at a number of divisions to better understand the facility energy consumption and implement appropriate energy conservation measures. Metro is in the process of implementing a number of comprehensive energy-efficiency upgrades including lighting and HVAC upgrades, and renewable energy installations at multiple bus and rail divisions.

Historically, facility electricity consumption trended upwards from 2005 to 2012. There was a drop in 2009 followed by an artificial rise in 2010 due to changes in how facility versus rail propulsion electricity was calculated. In 2011, Metro experienced a rise in electricity consumption due to the switch to electricity-driven CNG compressors at bus facilities. Consumption significantly decreased in 2013 and then increased slightly in 2014. This increase may be partly attributed to the increase in average temperature (over 2°F higher), and therefore cooling demand, in 2014 compared to 2013.

There are three main electricity provider groups for Metro: LADWP, SCE, and other local electricity providers. LADWP continues to be the largest electricity provider for Metro's facilities by delivering approximately 66.4 million kWh of electricity (71%), with SCE providing approximately 27.4 million kWh (29%), and other providers with less than 0.5% (**Figure 33**). In 2014, Metro spent \$13.2 million on electricity for all facilities, which is 14% greater than in 2013 (**Figure 34**) and more than any previous year. Electricity expenditures for facilities increased more sharply than the increase of electricity use, indicating that the overall average electricity cost per kWh increased in 2014. It is worth noting that the two providers, LADWP and SCE, have different rates for rail propulsion versus facility electricity usage.

Overall, electricity efficiency decreased in 2014 due to an increase in facility electricity use. This increase, coupled with Metro experiencing a 1.7% drop in UPT in 2014, reduced boardings per MWh facility electricity use from 5.3 in 2013 to 5.0 in 2014. Total revenue hours increased in 2014; however, revenue hours per MWh facility electricity use were slightly reduced to 92 compared with 93 in 2013 (**Figure 35**).

Among the major facilities, Division 20, a major rail maintenance division, continues to be the highest consumer of electricity at 19.7 million kWh in 2013, a 2% increase from 2013 (Figure 36). This is largely due to construction activity related to new projects. Metro Headquarters (Location 99) has the second highest annual electricity consumption at 17.2 million kWh, which is a 4% increase from 2013 despite the installation of LED lighting and automated dimming controls. Metro Headquarters consists mainly of office space for approximately 1,800 personnel.

Despite an overall increase in facility electricity use, major facilities combined saw a very slight decrease of <1% in electricity consumption compared with 2013. Over half of the major facilities experienced a decrease in electricity use compared to 2013.

Figure 34: Facility Electricity Costs

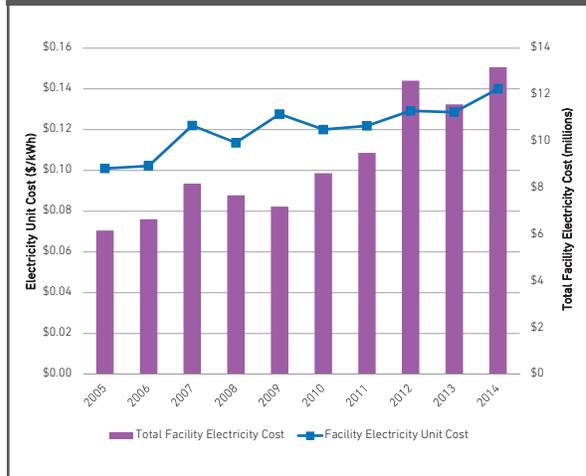


Figure 35: Facility Electricity Use Efficiency

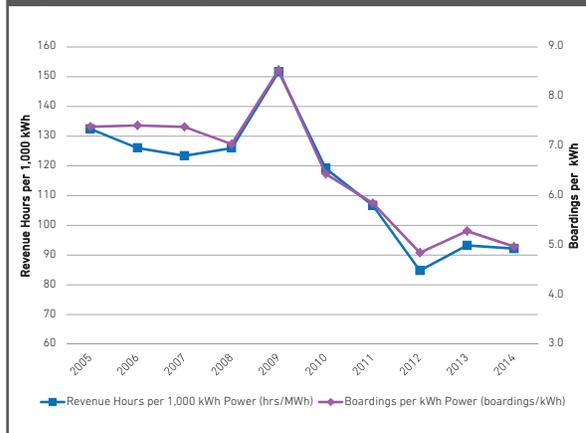
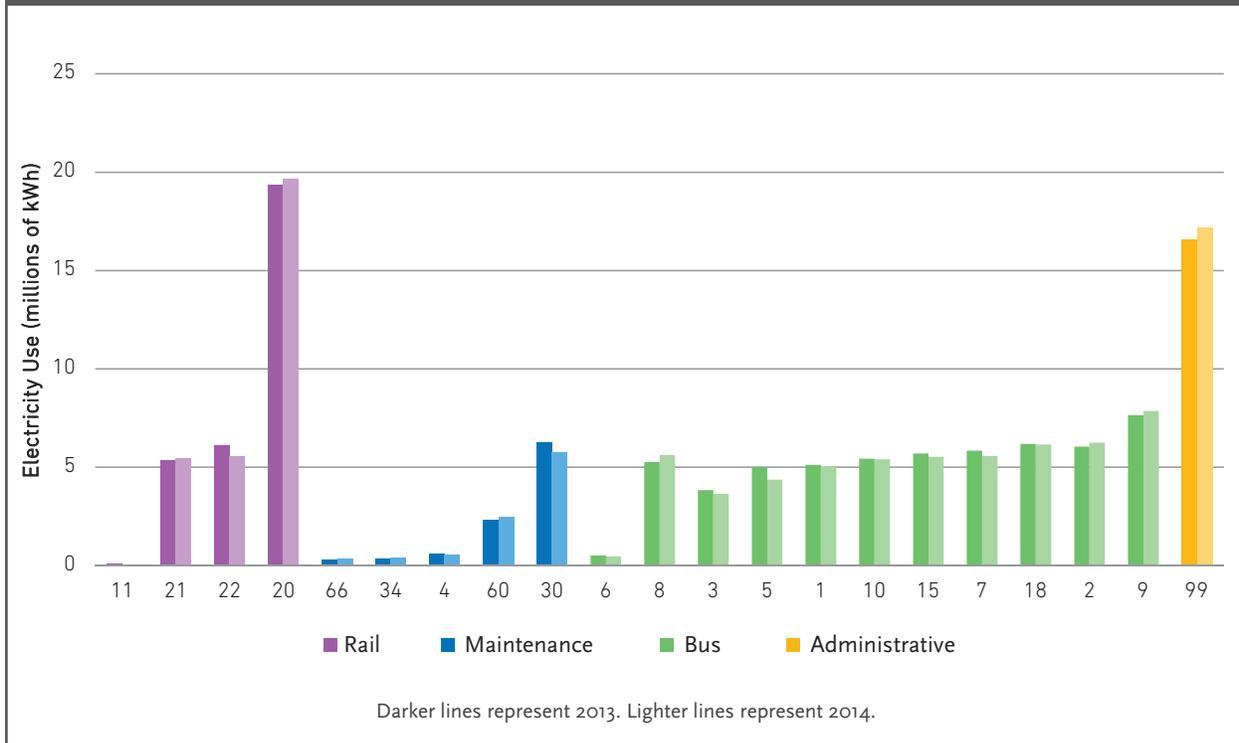


Figure 36: Facility Electricity Use by Major Facilities, 2013 versus 2014

NEXT STEPS

- > Complete Energy, Water Conservation Awareness, and Recycling Trainings at all 17 participating EMS divisions throughout the agency.
- > Complete LEED-EBOM Certification activities at Division 7 and CMF.
- > Implement comprehensive energy-efficiency upgrades, including lighting and HVAC upgrades, and renewable energy installations at multiple bus and rail divisions.
- > Complete installation of sub-meters at Divisions 1, 4, 5, 6, 11, 18, and 22, and Location 60.
- > Initiate LEED-EBOM Certification at Divisions 9, 20, and 21, and Union Station.
- > Initiate LEED-EBOM and LEED For Neighborhood Development (LEED-ND) for Union Station and the Union Station Master Plan.
- > Enroll seven additional facilities in 2015 into Metro's agency-wide EMS program, including Divisions 1, 2, 4, 6, 8, 15, and 18.

CASE STUDY

GATEWAY BUILDING LED LIGHTING PILOT STUDY



CHALLENGE

Metro Headquarters (Gateway Building) consumes the highest amount of energy in the agency. With over 27 floors and multiple tenants, energy management at this building is a top priority. The lighting system at the Gateway Building, which includes over 5,000 inefficient fluorescent lamp fixtures, presents a great opportunity to reduce consumption and utility costs, and improve occupant comfort.

ACTION

Beginning in 2013, a lighting pilot study was designed to identify a cost-effective lighting strategy that could be scaled up to a full building retrofit. The 15th Floor of the Gateway Building, which houses the General Services Department, was chosen as the pilot area due to its varying space types. The floor was then divided into five zones. Electrical consumption in each zone was monitored with sub-meters as various types of LED products were installed. Occupant surveys were conducted before and after the installations to generate qualitative data.

OUTCOMES



Results from the lighting pilot study were positive, with 90% of survey respondents indicating that they preferred the new fixtures over the older fixtures. Data from sub-meters revealed a 51% reduction in energy consumption from baseline for the pilot area. However, this reduction varied, which reinforces the need for integrated lighting controls in addition to energy-

efficient light fixtures. These lessons have been incorporated into the current project to replace the entire building's lighting system. A similar integrated lighting system is currently being installed at one of Metro's rail maintenance facilities, which will further inform this project.

INDICATOR AREA

WASTE AND RECYCLING



SOLID WASTE AND RECYCLING

ACCOMPLISHMENTS

- > Completed solid waste and recycling audits at eight major facilities to find the most efficient ways to divert waste from landfills.
- > Established an agency-wide policy to ensure the proper handling and disposal of broken fluorescent tubes.

DATA AND ANALYSIS

Overall, solid waste output has decreased since 2013, from approximately 9,741 tons in 2013 to 9,500 tons in 2014 (**Figure 37**). As a result, there was a 2.5% decrease in total solid waste from 2013 to 2014, with a 1% decrease in solid waste output and a 6.8% decrease in recycled waste collected from Metro facilities. Last year, there was a drastic change in reported solid waste and recycled waste, with solid waste increasing 51% and recycled solid waste decreasing 42%, but total solid waste (solid waste and recycled soil waste combined) remained similar to previous years. This shift was attributed to new waste collection methods and diversion rates employed by Republic Services, Inc. For 2014, the amount of solid waste and recycled solid waste generated was similar to the data reported in 2013. Therefore, the 2014 waste collection data are consistent with the new reporting methods and diversion rates that began in 2013.

Beginning in 2013, Metro contracted a new waste hauler to enhance the waste management program through more detailed documentation strategies. Waste audits were conducted to provide a better understanding of each division's waste contribution and recommend opportunities for improvement. Such opportunities include increasing the rate of service for pick-ups; adding additional recycling bins;

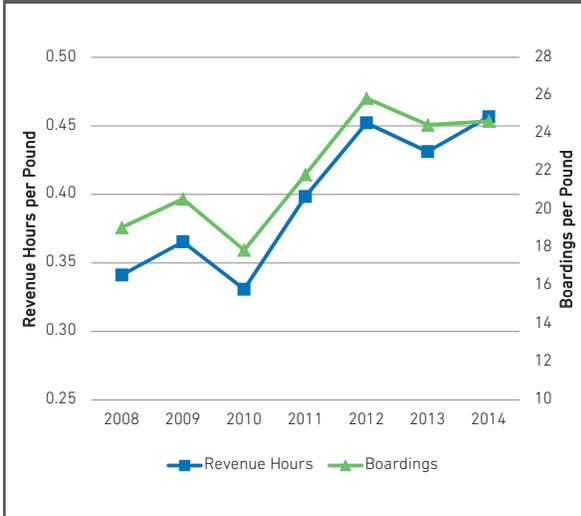
TOTAL SOLID WASTE OUTPUT DECREASED 2.5% IN 2014, ATTRIBUTED TO NEW WASTE COLLECTION METHODS.

Figure 37: Historic Waste Production¹



1. Due to changes in data collection techniques, recycling data are only available as recent as 2008.

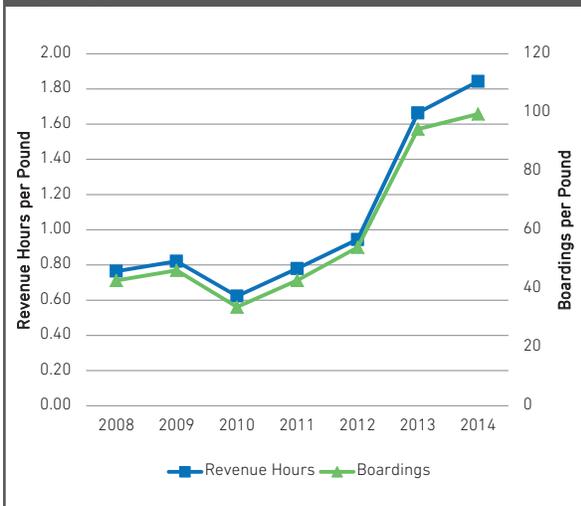
Figure 38: Total Solid Waste Efficiency



or increasing the amount of signage and training to better inform Metro staff of the current waste processes. In addition, Metro has implemented several internal programs to divert waste from landfills, focusing on products such as bus batteries, printer cartridges, scrap metal, e-waste, and other office products.

In 2014, eight divisions underwent waste audits, and the remaining facilities are scheduled for waste audits in the next several months. As a result of the audits, divisions are able to better understand their waste streams and can, therefore, establish specific ways to minimize or recycle waste in their division. For example, multiple divisions have acquired cardboard compactors, while others, such as Division 7, now recycle ferrous and nonferrous metals.

Figure 39: Recycled Waste Efficiency



Overall solid waste efficiency (which includes solid waste and recycled solid waste) has remained steady since 2008. Total solid waste efficiency increased slightly from 2013 to 2014, from 0.43 revenue hours per pound of total solid waste to 0.46 revenue hours (Figure 38). Additionally, boardings per pound of total solid waste slightly increased from 24.4 boardings per pound of total solid waste in 2013 to 24.6 boardings in 2014.

Recycled waste efficiency also increased from 2013, from 1.66 revenue hours per pound of recycled waste produced in 2013 to 1.84 revenue hours in 2014 (Figure 39). Additionally, there were approximately 94.3 boardings per pound in 2013 compared to 99.4 boardings in 2014 (Figure 39).

NEXT STEPS

- > Complete waste and recycling audits at remaining bus and rail divisions to expand opportunities for improvement of Metro's landfill diversion rates.
- > Conduct Recycling Trainings at all 17 participating EMS divisions throughout Metro.



WASTE AUDITS



CHALLENGE

Metro faces unique challenges in its waste program in finding the most efficient ways of reducing the amount of waste going into landfills. Waste stream management is a component of multiple sustainability initiatives Metro is currently pursuing, such as LEED Certification and EMS. Identifying the amount of waste generated and the methods for proper disposal are critical for reducing the associated environmental impact.

ACTION

Beginning in 2013, Metro contracted a new waste hauler to enhance the waste management program through more detailed documentation strategies. Waste audits have provided a clearer picture of each division's structural and procedural capacity, and recommendations on opportunities for improvement. These include increasing the rate of service for pick-ups, adding additional recycling bins, or increasing the amount of signage and training so staff is aware of the current process for each waste stream's disposal. Metro has implemented several internal programs to divert waste from landfills, focusing on products such as bus batteries, printer cartridges, scrap metal, e-waste, and other office products.

OUTCOME

Eight divisions have undergone this waste audit process, and the remaining facilities are tentatively scheduled for audits over the next several months. Multiple divisions have acquired a cardboard compactor, while others, such as Division 7, recycle ferrous and nonferrous metals. The monthly diversion reports and rate

sheets provided by the contractor allow Metro to effectively manage data. This record-keeping allows Metro to measure the amount of waste generated agency-wide, analyze what works and what needs improvement, and set targets for the agency to reduce its consumption of products and natural resources.



5153

CNG

304

5171

7052

USED OIL WASTE

ACCOMPLISHMENTS

- > Ensured that used oil filters were drained and removed from all locations and placed in correct hazardous materials containers.
- > Scheduled and tracked used oil waste disposal from all divisions.

DATA AND ANALYSIS

Overall, Metro has seen a 26% decrease in gallons of used oil from 2002 to 2014, which can generally be attributed to the increased use of synthetic oil (Figure 40). During 2014, Metro produced approximately 142,000 gallons of used oil, which represents a decrease of 3.4% from 2013. This slight decrease may be attributed to a smaller overall bus fleet of 2,218 buses in 2014, compared to 2,262 buses in 2013.

The bus divisions (Divisions 1, 2, 3, 5, 6, 7, 8, 9, 10, 15, and 18) continue to be Metro's main producers of used oil waste at approximately 90% of the total (Figure 41). Division 18, historically the largest producer of used oil waste, was the second-largest producer in 2014 using 16,400 gallons, a decrease of 1.2% from 2013. Division 9 has the largest bus fleet with 259 buses and was the top producer of used oil waste at 17,010 gallons in 2014, an increase of 5.2% from 2013. The range in used oil waste produced across the other bus divisions is attributed to varying fleet sizes and activities.

Additionally, effective September 2011, used oil disposal became a no-cost service, with Metro receiving 81 cents for each gallon of used oil it recycles. In 2014, Metro recycled 138,890 gallons of used oil for a total of approximately \$112,500, which offset the crude oil costs and resulted in a no-cost service for recycling used oil.

Figure 40: Historic Used Oil Waste

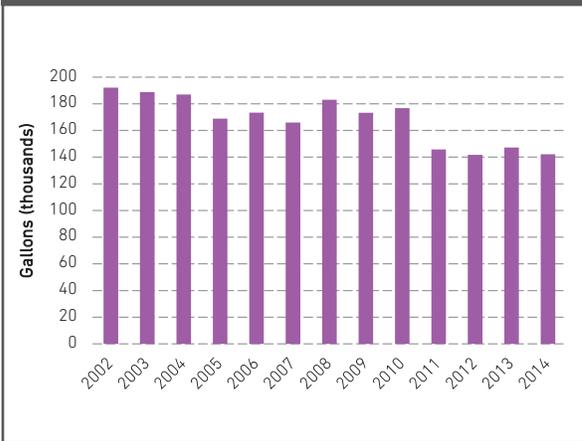
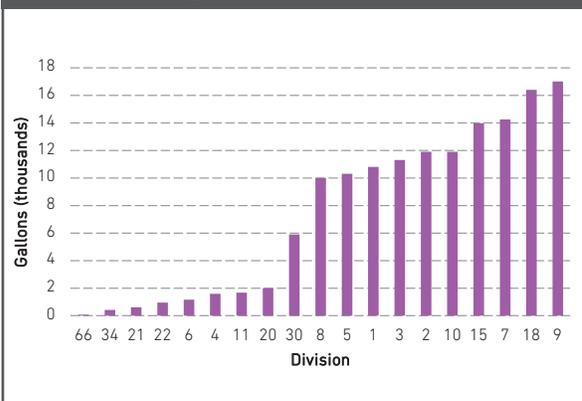


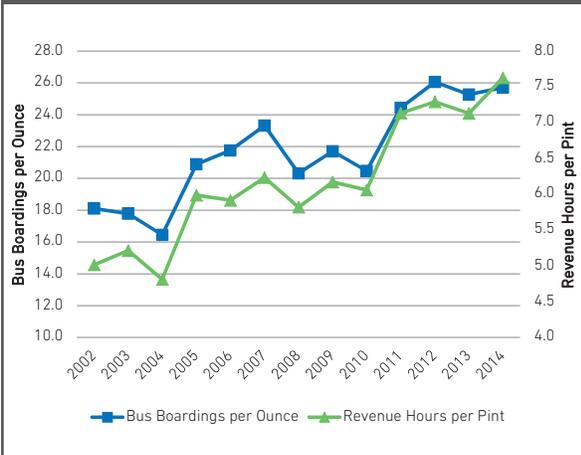
Figure 41: Used Oil Waste Generated by Major Facilities in 2014



METRO DECREASED GALLONS OF USED OIL BY 26% FROM 2002 TO 2014.



Figure 42: Used Oil Waste Efficiency



Overall, used oil waste efficiency has increased since 2002 with the decrease in the amount of used oil produced per revenue hour and boarding over the years (**Figure 42**). In 2014, there were 7.6 revenue hours per pint of used oil produced, which represents a 6.9% increase from 2013 with 7.1 revenue hours per pint of used oil produced. In addition, bus boardings per ounce of used oil produced slightly increased from 25.3 boardings per ounce in 2013 to 25.7 boardings per ounce in 2014.

NEXT STEPS

- > Ensure that all oil filter drainage locations, including shop pits, are free from oil spills, trash, or debris.
- > Continue to use synthetic oils and other alternative oil products.



HAZARDOUS LIQUID WASTE

ACCOMPLISHMENTS

- > Canopies were installed at multiple EMS locations as a structural best management practice for potential stormwater issues related to outdoor exposure of metal scrap bins and hazardous waste accumulation areas.
- > Division 11 purchased a flammable storage cabinet to store hazardous materials when not in use.

DATA AND ANALYSIS

Hazardous liquid waste is mainly generated by Metro's bus maintenance divisions and repair centers, from chassis jets, steam bays, and fuel station trenches and clarifiers. Metro produced approximately 620,000 gallons of hazardous liquid waste in 2014, representing a 5.9% decrease from 2013 and a 12.6% decrease from 2003 (Figure 43).

Similar to previous years, approximately 51.3% of total hazardous liquid waste was produced by Bus Divisions 8, 9, 15, and 18, and CMF, with Division 18 and CMF being the highest producers of hazardous liquid waste (Figure 44). This is mainly attributed to the servicing of bus fleets and repair work that occurs at these divisions. Division 1, previously one of the highest producers of hazardous liquid waste, produced 32.2% less in 2014 than 2013 due to a reduction in the servicing of stormceptors.

Waste disposal costs for hazardous liquids have steadily decreased from 2008 (Figure 45). Metro paid approximately \$440,000 in hazardous liquid waste disposal fees in 2014, which is a decrease of 14.6% from 2013 and a 22.6% decrease from 2003.

Figure 43: Historic Hazardous Liquid Waste

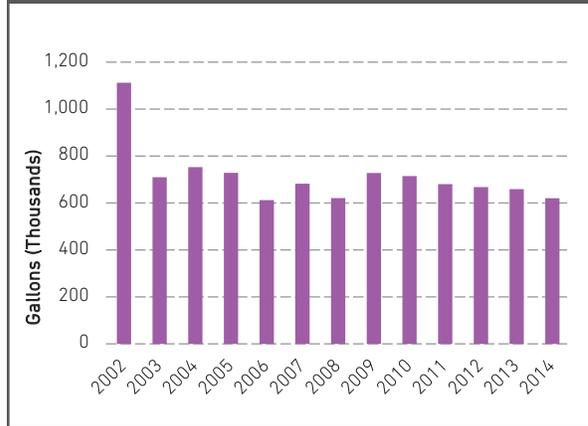


Figure 44: Hazardous Liquid Waste Produced by Major Facilities

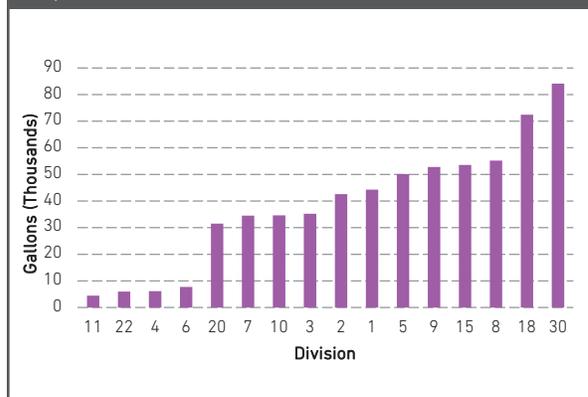
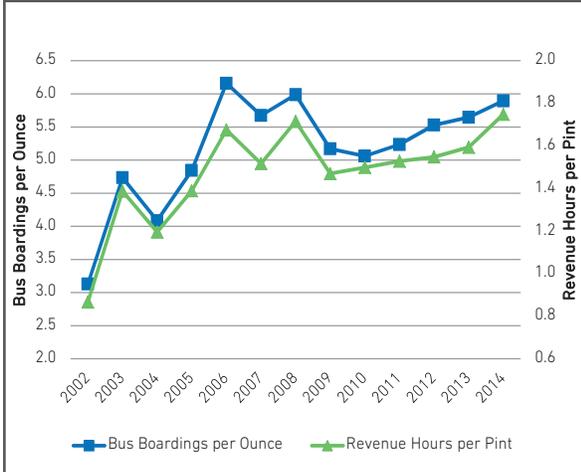


Figure 45: Hazardous Liquid Waste Costs





Figure 46: Hazardous Liquid Waste Efficiency



Hazardous liquid waste efficiency increased from 2013, with an increase in the number of bus boardings per ounce and revenue hours per pint of hazardous liquid waste produced (**Figure 46**). In 2014, there were 5.9 bus boardings per ounce of waste produced, which is an increase from the 5.6 boardings per ounce of waste produced in 2013. The number of revenue hours per pint of hazardous liquid waste also increased slightly from 1.6 revenue hours in 2013 to 1.7 revenue hours in 2014.

NEXT STEPS

- > Continue to schedule and track hazardous and universal waste removal from divisions.
- > Discuss waste minimization strategies for hazardous wastes across divisions.

NONHAZARDOUS LIQUID WASTE

DATA AND ANALYSIS

ACCOMPLISHMENTS

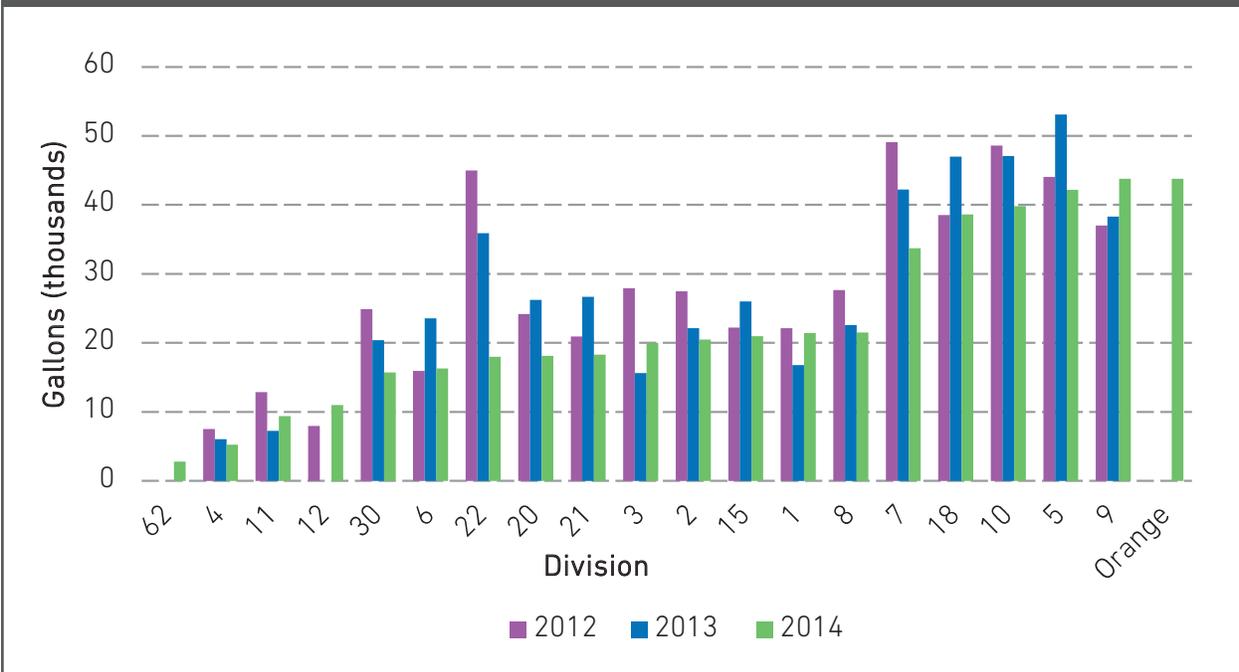
- > Established an alternate bus washing schedule to reduce water consumption, which in turn reduces nonhazardous liquid waste associated with bus washes.

Nonhazardous liquid waste includes storm sewer, catch basin, and sanitary sewer clean-out residue; grease trap clean-out residue; industrial wastewater; uncontaminated precipitation removed from secondary containment structures; wash water; and some off-specification commercial chemical products. In 2014, Metro produced approximately 461,000 gallons of nonhazardous liquid waste, representing a 3.3% decrease from 2013 but an overall 10.8% increase from 2002 (Figure 47). This gradual increase in nonhazardous liquid waste can be attributed to the increase in the number of Metro bus washers and the addition of two rail facilities. After the peak in 2010, nonhazardous liquid waste began a downward trend, due in part to efforts to reduce wastewater. For example, Metro has established an alternate bus washing schedule to reduce water consumption by washing buses every other day rather than daily. The pilot program was implemented at Divisions 8 and 15, and there are plans to expand the program to all bus divisions and rail yards in the future.

Figure 47: Historic Nonhazardous Liquid Waste



Figure 48: Nonhazardous Liquid Waste Produced by Division and Metro Orange Line



SINCE 2010, NONHAZARDOUS LIQUID WASTE BEGAN A DOWNWARD TREND, DUE IN PART TO EFFORTS TO REDUCE WASTEWATER.

Nonhazardous liquid waste varied across divisions from 2013 to 2014. The largest producer in 2014 was the Orange Line, which is a new data point included in this year's report. The servicing of stormceptors for the park-and-ride locations along the Orange Line has led to the generation of nonhazardous liquid waste. The next largest producers of nonhazardous liquid waste were Bus Divisions 5, 9, and 10. These divisions consist of maintenance buildings that include bus washers. Division 5, historically the largest producer of nonhazardous liquid waste, experienced a 20.5% decrease from 2013 (**Figure 48**). Division 9 experienced a 14.3% increase in nonhazardous liquid waste production from 2013, making it the second-largest producer in 2014. Notable decreases in nonhazardous liquid waste production can be seen at Division 22 (50%) and Division 6 (31%). A second new data point that is included in this year's report is Location 62, a rail communications facility that is currently being serviced for use by Metro.

In 2014, Metro paid approximately \$166,000 in nonhazardous liquid waste disposal fees, which is a decrease of 10% from 2013. This correlates with the decrease in nonhazardous liquid waste production (**Figure 49**).

Nonhazardous liquid waste efficiency has increased since 2010, with an increase in the number of bus boardings per ounce and revenue hours per pint of nonhazardous liquid waste produced (**Figure 50**). Bus boardings per ounce of nonhazardous liquid waste experienced a slight increase, with 7.9 boardings per ounce in 2014 compared to 7.8 boardings per ounce in 2013. Similarly, there were 2.4 revenue hours per pint of nonhazardous liquid waste produced in 2013, which is an increase from the 2.2 revenue hours per pint of nonhazardous liquid waste produced in 2013.

Figure 49: Nonhazardous Liquid Waste Cost

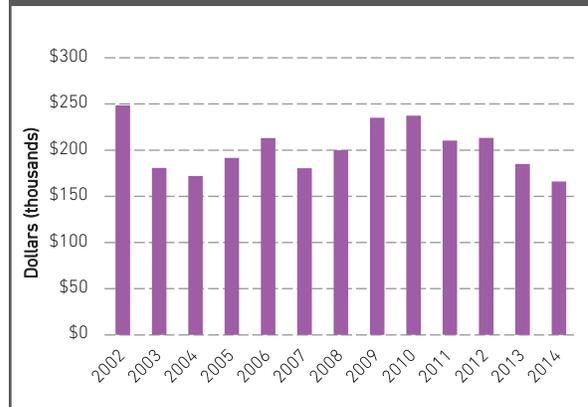


Figure 50: Nonhazardous Liquid Waste Efficiency



NEXT STEPS

- > Continue to schedule and track nonhazardous liquid waste disposal from divisions.
- > Explore water saving strategies at Metro's facilities. For instance, a new water conditioning system using Linear Kinetic Cell technology is being rolled out at Divisions 5 and 18 in 2015.
- > Expand the alternate bus washing schedule program to all bus divisions and rail yards.

ANTI-FREEZE WASTE

ACCOMPLISHMENTS

- > Completed procurement of a coolant recovery system at all bus divisions, allowing for the capture and reuse of anti-freeze from buses.

DATA AND ANALYSIS

Anti-freeze is mainly used in Metro's bus maintenance facilities. In 2014, Metro produced approximately 75,300 gallons of anti-freeze waste, a decrease of 7.5% from 2013 (**Figure 51**). Since 2008, anti-freeze waste production has been trending downward, which may be partly attributed to enhanced recycling efforts and programs. The decrease from last year may also be attributed to a slight decrease in bus fleet size, from 2,262 buses in 2013 to 2,218 buses in 2014.

Anti-freeze waste produced by division in 2014 was similar to 2013, with Divisions 15 and 18 being the highest producers of anti-freeze waste. However, Division 18 experienced a 9.8% decrease in anti-freeze waste production from 2013, possibly due to a reduction of its bus fleet from 250 to 243 buses.

Beginning in 2014, Divisions 3 and 10 were enrolled in a pilot program for the implementation of a coolant recovery system, which allows for the capture and reuse of anti-freeze from Metro buses. In previous years, Division 10 was one of the top producers of anti-freeze waste. However, after implementation of the coolant recovery system, Division 10 experienced a 32% reduction in anti-freeze waste from last year (**Figure 52**). Division 3 also experienced a large decrease in anti-freeze waste of 56.5% from 2013. At the end of 2014, the coolant recovery system was rolled out to all divisions and should lead to additional anti-freeze waste reductions this coming year.

Figure 51: Historic Anti-Freeze Waste

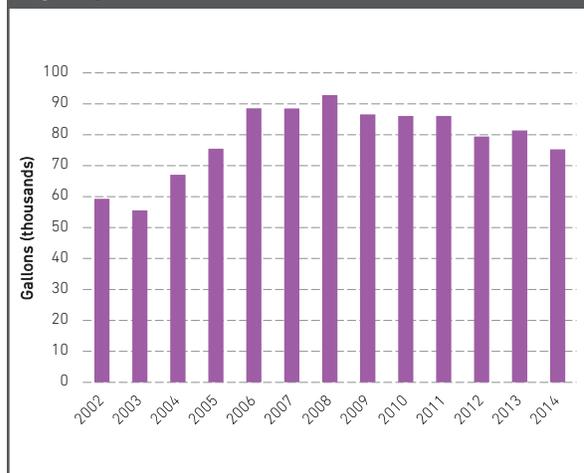
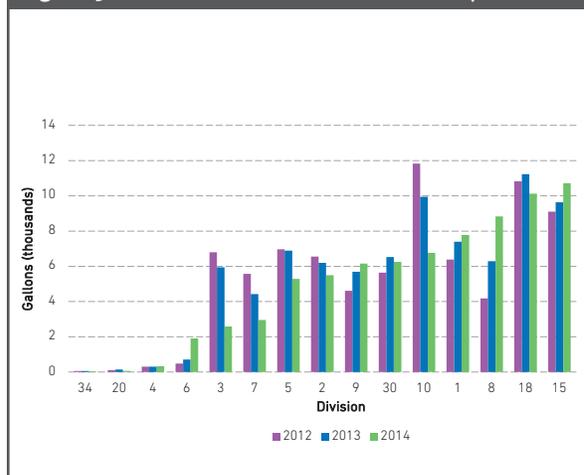


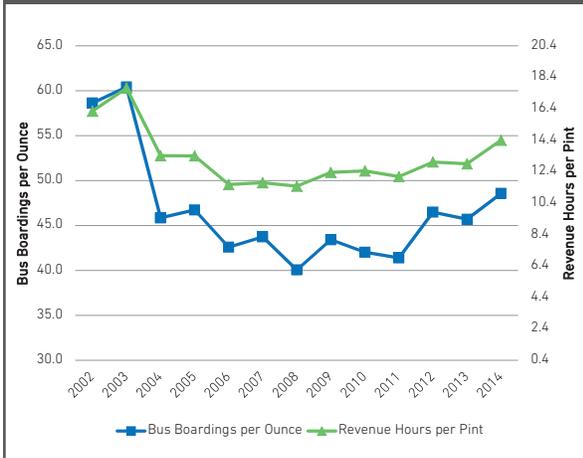
Figure 52: Anti-Freeze Waste Produced by Division



DIVISION 10 EXPERIENCED A 32% REDUCTION IN ANTI-FREEZE WASTE FROM LAST YEAR AFTER IMPLEMENTATION OF THE COOLANT RECOVERY SYSTEM.



Figure 53: Anti-Freeze Waste Efficiency



As discussed above, anti-freeze waste has generally decreased across divisions from 2013; however, notable increases occurred at the following vehicle maintenance divisions: Division 6 (169%), Division 8 (40.3%), and Division 15 (11.2%). Bus fleets at Divisions 6 and 8 remained the same, while Division 15 experienced a decrease in bus fleet from 253 to 236. It should be noted that anti-freeze waste generated at Divisions 20 and 34 was lower than the other divisions.

Overall, anti-freeze waste efficiency has increased (**Figure 53**). In 2014, there was an increase in efficiency due to a 11.7% increase in revenue hours per pint of anti-freeze waste produced from 2013 to 2014. Bus boardings per ounce of anti-freeze waste produced also increased from 45.7 boardings in 2013 to 48.6 boardings in 2014, resulting in a 6.3% increase in boardings per ounce from last year.

NEXT STEPS

- > Continue to schedule and track anti-freeze waste disposal from all divisions.

Culver City Station

↙ Eastbound
to Downtown LA

Platform
1



Culver City

104

M

Metro Rail

INDICATOR AREA

CRITERIA AIR POLLUTANT EMISSIONS





ACCOMPLISHMENTS

- > Repowered buses that were originally equipped with CNG engines with low-emitting state-of-the-art CNG engines, including the Cummins ISL G 8.9 liter and the Doosan GL11K 11.1 liter CNG engines.

OVERALL PERFORMANCE

Metro's bus and rail emissions in 2014 reflect Metro's continued expansion of rail service and continued modernization of the bus fleet. Total fleet emissions in 2014 were 55.6% lower as compared to 2011 and 70% lower as compared to 2008. These large reductions can be attributed to the retirement of Metro's diesel bus fleet and the continued replacement of older CNG engines with new state-of-the-art CNG engines. In 2014, bus VMT was approximately 1.2% higher than in 2013. Therefore, the increased criteria air pollutant emissions associated with a 1.2% increase in Metro bus miles traveled was offset by Metro's overall lower-emitting bus fleet for all criteria air pollutants. As Metro continues to replace and repower buses with the newest technology engines, emission reductions will continue and eventually taper once all of the older, higher-emitting buses are replaced or repowered with state-of-the-art engines.¹

DATA AND ANALYSIS

The 2014 analysis reflects Metro's efforts to repower older CNG buses with new, lower-emitting CNG engines. In many cases, buses that were originally equipped with CNG engines, such as the Detroit Diesel Corporation Series 50 natural gas engine, have been repowered with state-of-the-art CNG engines, including the Cummins ISL G 8.9 liter and the Doosan GL11K 11.1 liter CNG engines. The lower nitrogen oxide (NOx) emissions rating of the repowered engines results in a reduction in NOx, a primary ozone precursor emission. Reductions in ozone precursor emissions are of great importance to the South Coast region, which encompasses Los Angeles County, in order to meet federally imposed 2023 and 2035 ambient air quality attainment obligations.

A comparison of 2014 fleet criteria air pollutant emission levels to 2013 levels shows reductions in all criteria air pollutants. Metro's overall fleet emission levels for nonmethane hydrocarbons (NMHC), NOx, and particulate matter (PM) have been reduced by approximately 13.4%, 2.7%, and 10.3%, respectively, as compared to 2013 levels (**Figure 54**). Importantly, NOx emissions have greatly reduced by approximately 70.4% when comparing 2014 NOx emissions to 2008 levels. Of equal significance is the 56.7% reduction in PM emissions from 2008 to 2014. The retirement of Metro's diesel transit bus

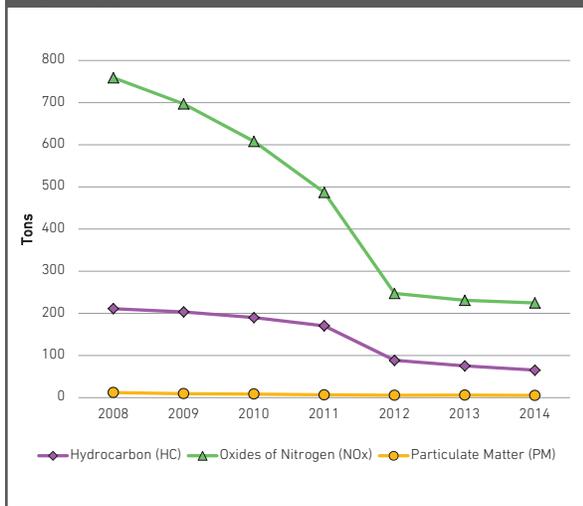
1. The current state-of-the-art urban bus engine is the Cummins ISL G, which reduces NOx emissions but results in higher carbon monoxide (CO) emissions. CO emissions are not included in the reporting of Criteria Air Pollutants since the SC AQMD region is designated as "Attainment" for CO by the U.S. EPA, meaning that the region meets the National Ambient Air Quality Standard for this pollutant. As such, CO is typically not considered by local and state air quality regulatory agencies, including the SC AQMD and California Air Resources Board, when assessing motor vehicle air quality improvement strategies.

Table 3: Comparison of 2014 Fleet Emissions Levels to 2013 Levels

FLEET EMISSIONS (TONS PER YEAR)	2013 BUS	2013 RAIL	TOTAL 2013 EMISSIONS	2014 BUS	2014 RAIL	TOTAL 2014 EMISSIONS	FLEET WIDE (TONS)	PERCENT CHANGE
Hydrocarbon (HC)	72.3	2.9	75.2	62.4	2.7	65.1	-10.1	-13.4%
Oxides of Nitrogen (NOx)	135.1	95.8	230.9	133.5	91.2	224.7	-6.2	-2.7%
Particulate Matter (PM)	2.9	2.9	5.8	2.5	2.7	5.2	-0.6	-10.3%
TOTALS (TONS PER YEAR)	210.3	101.6	311.9	198.4	96.6	295.0	-16.9	-5.4%

“-“ = Decrease in fleet emissions

Figure 54: Historic Criteria Air Pollutant Emissions



NOx EMISSIONS, AN OZONE PRECURSOR CRITERIA POLLUTANT, EXPERIENCED A 70.4% DECREASE IN 2014 AS COMPARED TO 2008 NOx EMISSION LEVELS.

fleet eliminated diesel particulate matter (DPM), which is classified as a toxic air contaminant by the California Air Resources Board and is a known carcinogen. Overall, total criteria pollutant emissions decreased approximately 16.9 tons, or 5.4%, from 2013 to 2014 (Table 3).

CHANGE ANALYSIS

The change in Metro fleet emissions between 2013 and 2014 is attributable to two primary factors:

- > **Continued modernization of the Metro CNG transit bus fleet.** Transit bus engine repowers contributed to the reductions in NMHC, NOx, and PM criteria air pollutant exhaust emissions. Even though overall bus miles increased by approximately 1.2% in 2014 as compared to 2013, the lower NMHC, NOx, and PM emission levels of the new engines offset the additional emissions resulting from the increased bus miles.
- > **Decrease in electricity usage for Metro.** 2014 electricity usage was approximately 5% lower than in 2013, which resulted in decreased criteria air pollutant emissions attributable to electrical power generation.

NEXT STEPS

- > **Continue to transition Metro's transit bus fleet to cleaner fuels and more modern technology.**





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INDICATOR AREA

GREENHOUSE GAS EMISSIONS



ACCOMPLISHMENTS

- > Conducted Energy and Water Conservation Awareness and Recycling training sessions, a total of 29 sessions for 725 staff.
- > Developed a resiliency indicator framework to prepare Metro to withstand and continue to provide reliable service in light of potential climate change impacts.

While Metro's primary role is to provide safe and effective transportation options for the Los Angeles region, the agency also seeks to do so in a cost-effective and environmentally sustainable manner. The GHG sections of this report address the impact of Metro's services on global climate change.

DATA AND ANALYSIS

GHGs occur naturally in the atmosphere but are also emitted through activities such as the burning of fossil fuels. Increased levels of GHG emissions being released into the atmosphere are causing global climate change, which has impacted the Los Angeles region and will continue to do so in the future. In 2014, Metro emitted approximately 465,529 MT CO₂e. Approximately 85% of Metro's total GHG emissions in 2014 were related to fuel consumption from moving passengers (Figure 55). In general, Metro's GHG emissions are directly calculated using activity data. Major emissions-generating activities include revenue-generating fuel consumption, rail propulsion electricity consumption, and facility electricity consumption. Minor activities include non-revenue transportation fuel consumption, facility natural gas fuel consumption, and the use of refrigerants.

Figure 55: Total Greenhouse Gas Emissions by Source

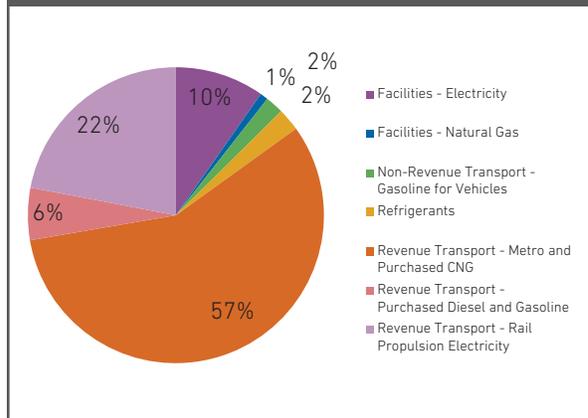
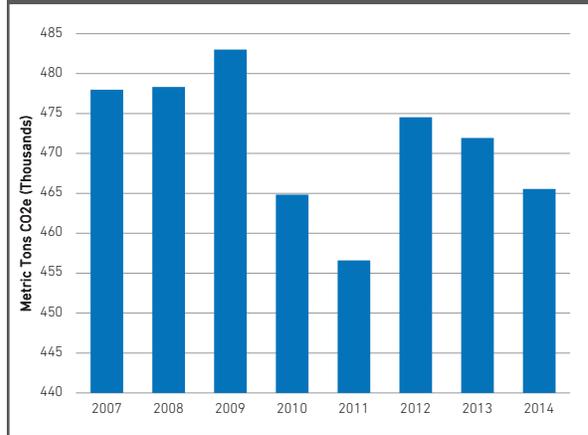


Figure 56: Historic Greenhouse Gas Emissions, 2007-2014



TRENDS IN METRO'S GHG EMISSIONS

Total GHG emissions in 2014 were approximately 1.4% lower than in 2013 (Figure 56). A detailed analysis of major emission-generating activities shows that emissions increased in some Metro sectors, but decreased in others. For example, emissions from rail propulsion electricity consumption decreased by 6%, while revenue-generating diesel consumption in buses increased by 15% between 2013 and 2014.

GHG emissions from Metro-operated CNG-powered buses decreased by 1%, compared to 2013. This decrease is directly attributed to a reduction in CNG

TOTAL GHG EMISSIONS IN 2014 WERE APPROXIMATELY 1.4% LOWER THAN IN 2013.

consumed by Metro's revenue-generating buses. Conversely, GHG emissions from Metro's contracted CNG-powered buses increased 3% compared to 2013. The overall GHG emissions from CNG-powered buses decreased by 0.8%.

GHG emissions from Metro's contracted diesel-powered bus services increased by 15% due to increased usage. As of 2009, Metro's direct operations do not use any diesel-powered revenue buses.

Metro's GHG emissions from its contracted vanpool services increased by 7%, and this increase is proportional to the quantity of gasoline consumed by the agency's vanpool service contractors due to an expansion in Metro's vanpool services. Lastly, Metro's GHG emissions for facility electricity consumption decreased by 3%, which may be attributed to Metro's increasing energy conservation efforts and EMS program.

Trends were also observed in secondary emissions-generating activities. For example, emissions from Metro's non-revenue transportation fuel consumption increased by 5% in 2013 while emissions from facility natural gas consumption decreased by 13%.

Overall, the reduction in Metro's total GHG emissions since 2013 has mainly been driven by efforts to reduce the consumption of CNG in Metro's revenue-generating vehicle fleet, as well as the reduced energy consumed by Metro's facilities.

PERFORMANCE METRICS

Performance metrics provide information about Metro's direct and indirect emissions relative to its core services and are expressed in terms of emissions per boarding, emissions per vehicle mile, emissions per revenue hour, and emissions per passenger mile.

In terms of emissions per boarding, Metro's buses were the most efficient transit mode in 2014, emitting 1.67 pounds (lbs) CO₂e per boarding (Table 4). While buses were the most efficient on a per boarding basis, bus passengers tend to travel fewer miles than rail passengers. GHG emissions

Table 4: Efficiency-Based Greenhouse Gas Emissions, 2014

MODE	LBS CO ₂ E/ BOARDING	LBS CO ₂ E/ VEH MIL	LBS CO ₂ E/ REV HOUR	LBS CO ₂ E/ PAS. MILE
Heavy Rail	2.00	12.75	305.04	0.38
Light Rail	2.02	8.75	187.30	0.31
Bus Not Operated by Metro	2.50	5.82	86.01	0.52
Bus Operated by Metro	1.67	6.89	86.60	0.40
Vanpool	9.86	1.29	56.09	0.23
Non-revenue Metro Vehicles	NA	1.99	NA	NA
TOTAL LBS CO₂E/METRIC (TOTAL)	1.85	6.12	99.99	0.37

per passenger mile traveled is another method of assessing Metro's efficiency. When calculated by passenger mile, light rail and vanpools were the most carbon-efficient mode of Metro's operations in 2014. Metro's efficiency per passenger mile is higher for all travel modes than a typical passenger vehicle, which emits approximately 1 lb/mile. Vanpool services also appear to be the most efficient transit mode in terms of GHG emissions per vehicle mile, emitting 0.23 lbs CO₂e per passenger mile, followed closely by light rail with 0.31 lbs CO₂e per passenger mile. In addition to being the most efficient transit mode, the vanpool services have been successful in increasing their ridership by 12% from 2013 to 2014. Lastly, when evaluated on a revenue hour basis, Metro's contracted bus services and vanpool services show the highest GHG efficiency per revenue hour.

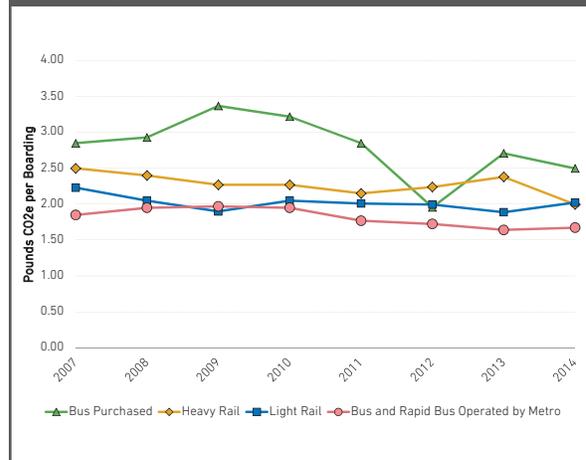
TRENDS IN PERFORMANCE METRICS ▼

Emissions Per Boarding

Between 2013 and 2014, Metro's total GHG emissions per boarding remained steady. Trends in emissions per boarding varied within each transit mode (**Figure 57**). GHG emissions per boarding for light rail increased by 7%, which may be partly attributed to the slight decrease in light rail ridership by approximately 1%. Conversely, GHG emissions per boarding for heavy rail decreased by 16%.

Metro-operated bus services experienced a 2% increase in GHG emissions per boarding, while contracted bus services demonstrated an 8% decrease. Bus ridership decreased by 2% between 2013 and 2014. The carbon efficiency of vanpool services on a per boarding basis increased by 4%, as the rate of increase in emissions from gasoline consumed by Metro's contracted van fleet (7%) was outpaced by the rate of increase in ridership (12%).

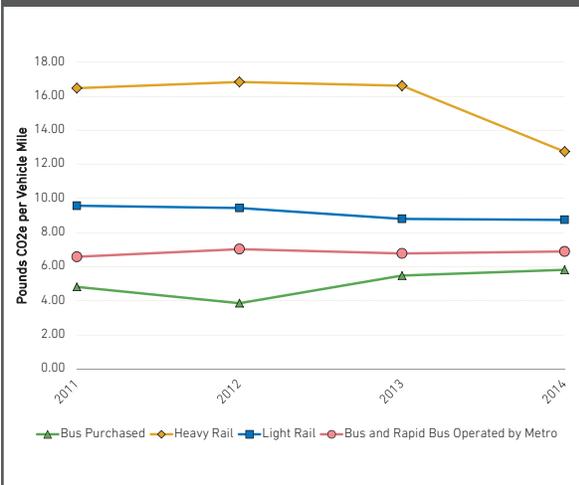
Figure 57: Greenhouse Gas Emissions per Boarding



LIGHT RAIL AND VANPOOLS WERE THE MOST CARBON-EFFICIENT MODE OF METRO'S OPERATIONS IN 2014 FOR GHG PER PASSENGER MILE.



Figure 58: Greenhouse Gas Emissions per Vehicle Mile



Between 2013 and 2014, Metro experienced a 3% decrease in GHG emissions per vehicle mile, based on mileage from revenue-generating vehicles. Improvements in GHG efficiency per vehicle mile were observed for heavy rail and light rail (**Figure 58**). The biggest improvement was seen in heavy rail at 23%. Vanpool services showed no change in GHG emissions per mile. GHG efficiency per vehicle mile decreased by 6% for contracted bus services, 2% for Metro-operated bus services, and 1% for light rail.

NEXT STEPS

- > Initiate LEED-EBOM Certification at Divisions 9, 20, and 21, and Union Station.
- > Initiate social vulnerability assessment for impacts of climate change on Metro ridership.
- > Prepare solicitation for a new Sustainability, Climate Change, and Greenhouse Gas Emissions Consultant.

CLIMATE RESILIENCY INDICATOR DEVELOPMENT



CHALLENGE

As global discussions of climate change evolve, improving the resilience of critical infrastructure has moved to the forefront of Metro's priorities. Many of Metro's assets are vulnerable to weather events such as flooding and extreme temperatures, which can lead to overheating and erosion and cause mechanical complications for these assets. Therefore, Metro has committed to improving the resiliency of its assets and networks in the face of climate change and the evolving frequency of extreme weather events.

ACTION

In 2014, Metro began developing a resiliency indicator framework, a metrics system that would calculate asset resiliency based on defined dimensions and principles. In coordination with internal stakeholders such as Corporate Safety & Risk Management and Planning and Operations, the metrics were refined to reflect Metro-relevant needs and vulnerabilities. The framework was then tested with a variety of case studies, reflecting some of Metro's most critical or obvious vulnerabilities, in order to verify the framework's consistency and dependability across all Metro assets.

OUTCOMES

The final resiliency indicator framework tool contains two dimensions, technical and organization, which house roughly 60 indicators. The score resulting from the framework provides a mechanism through which Metro can prioritize the necessary actions to ensure any vulnerable assets and/or networks are made resilient. The

resiliency indicator framework can be utilized to evaluate the physical ability of the system to perform or the overall ability of the organization to take actions in preparation for, or in response to, a hazard event.

INDICATOR AREA

GREENHOUSE GAS DISPLACEMENT



METRO PREVENTED MORE GHG EMISSIONS THAN IT PRODUCED IN 2014.

Metro continues to implement strategies to reduce GHG emissions, such as retrofitting facilities to be more energy efficient, and switching to cleaner fuels in its transit fleet. However, it is important to understand Metro's larger role in sustainability and reducing GHG emissions in the region. By providing transit options, Metro is reducing GHG emissions that would otherwise have occurred from passenger vehicles, increased congestion, and potentially more sprawl. When the combined effects of these factors are considered, Metro prevented more GHG emissions than it produced. As Metro expands its rail, bus, or vanpool services, it is contributing to regional GHG emission reductions even though the agency's absolute emissions will likely increase as a result of this expansion. In 2014, Metro achieved GHG displacement of approximately 482,182 MT CO₂e by shifting passengers from individual vehicular travel to transit (Table 5). This alone results in more GHG emissions displaced by passengers not driving than by all of Metro's operational emissions (465,529 MT CO₂e). These avoided or displaced emissions are not as directly quantifiable as Metro's operational emissions, but APTA has provided guidance for estimating three forms of displaced emissions:

- > **Mode Shift** refers to the GHG emissions displaced by shifting from a passenger vehicle to transit. This is calculated on a per passenger-mile basis, and APTA has estimated that 0.47 vehicle miles are avoided for every passenger mile of transit for a region the size of Los Angeles.
- > **Congestion Relief** refers to the GHG emissions displaced by improving roadway conditions for those who continue to drive passenger vehicles. Fewer cars on the road lead to increased road speeds, less traffic, and less idling, which increases the efficiency of the remaining on-road vehicles.
- > **Land Use** refers to emissions displaced when transit enables denser land use patterns, which encourage shorter trips and increased walking and cycling instead of vehicle use.

Congestion relief and land use GHG displacement estimates have not been applied to the GHG displacement calculation as they require more detailed modeling, but would demonstrate even greater emissions avoidance and Metro's central role in creating a more sustainable region.

NEXT STEPS

- > **Continue Electric Vehicle Charger Expansion project to install an additional 20 electric vehicle charge stations at five additional park-and-ride lots in the Los Angeles region.**

Table 5: Net Greenhouse Gas Emissions from Metro Operations, 2014

SOURCE	QUANTITY OF EMISSIONS DISPLACED (MT CO ₂ E)
Total Emissions Displaced from Mode Shift	(482,182)
Emissions from Metro Operations	465,529
NET EMISSIONS FROM METRO OPERATIONS	(16,653)



EXPO OPERATION AND MAINTENANCE FACILITY



The Expo Operation and Maintenance Facility (OMF) is being constructed as part of the Expo Phase 2 project. Located on the south side of the right-of-way between the future Expo/Bundy Station and the 26th Street/Bergamot Station, the Expo OMF will be an 8-acre brownfield redevelopment in Santa Monica. Once completed, the site will include six light rail vehicle (LRV) storage tracks for 15 three-car trains (45 total LRVs). The Expo OMF will also accommodate full maintenance and operational support for the Expo Line, which is expected to accommodate an estimated 64,000 daily riders by 2030.

Several sustainability features are included in the facility's design to increase water and energy efficiency. The project includes a large 400,000 gallon cistern to harvest rainwater for vehicle wash and facility irrigation. The facility's train wash will include a recycling system to filter grey water for reuse. These two installations, along with low-flow fixtures, are expected to reduce potable water use for landscaping by 53% and interior potable water usage

by 44%. Additionally, to promote natural ventilation, the facility's buildings are oriented for exposure to westerly winds from the ocean, optimizing the interior for natural airflow distribution and buoyancy. The OMF will also include sustainability features such as underfloor air distribution, LED lighting, and acoustical mitigation.





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