

Los Angeles County
Metropolitan Transportation Authority

Metro's 2016 Energy and Resource Report



Metro®

ACKNOWLEDGMENTS

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List of Acronyms and Abbreviations

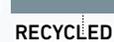
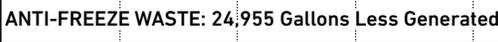
AB	Assembly Bill	MT	metric tons
APTA	American Public Transportation Association	MW	megawatt
BMP	best management practice	N₂O	nitrous oxide
BRT	bus rapid transit	NO_x	oxides of nitrogen
CH₄	methane	PFC	perfluorocarbon
CMF	Central Maintenance Facility	pLAN	City of Los Angeles' Sustainable City Plan
CNG	compressed natural gas	PM	particulate matter
CO	carbon monoxide	PMT	passenger miles traveled
CO₂	carbon dioxide	PSM	produced seat miles
CO₂e	carbon dioxide equivalent	PV	photovoltaic
EMS	Environmental Management System	RVL	revenue vehicle length
ETI	Environmental Training Institute	UPT	unlinked passenger trips
EV	electric vehicle	VMT	vehicle miles traveled
FTA	Federal Transit Administration	VRH	vehicle revenue hours
GCP	Green Construction Policy	VRM	vehicle revenue miles
GGE	gasoline gallon equivalent		
GHG	greenhouse gas		
GWP	Global Warming Potential		
HC	hydrocarbon		
HFC	hydrofluorocarbon		
ISO	International Standards Organization		
kW	kilowatt		
kWh	kilowatt hour		
lbs	pounds		
LEED	Leadership in Energy and Environmental Design		
Metro	Los Angeles County Metropolitan Transportation Authority		
MSIP	Metro Sustainability Implementation Plan		



EXECUTIVE SUMMARY

Metro's 2016 Energy and Resource Report analyzes the sustainability and environmental performance of its operational activities. Metro's sustainability data are presented for calendar year 2015 in comparison to the previous year's environmental performance. This report compares trends by monitoring and analyzing the increases and decreases in environmental impacts and by assessing Metro's ongoing progress toward sustainability. This trend analysis can be used to improve sustainable performance in a cost-effective manner in years to come.

Figure 1: Indicator Area Summary for 2015 Compared to 2014

INDICATOR	← REGRESSED		IMPROVED →	
	Compared to 2014		Compared to 2014	
Greenhouse Gas Emissions			 1.8% 8,198 Less Tons Emitted	
Greenhouse Gas Displacement	 3.7% Decrease in Metric Tons of CO ₂ e Displaced from Metro's Transit Operations			
Energy Use > Fuel Use > Rail Propulsion > Facility Electricity Use			 1.6% FUEL USE: 1 Million Gallons Fewer Used  5.7% RAIL PROPULSION POWER: 12 Million kWh Less Used  17.3% FACILITY ELECTRICITY USE: 2 Additional Metro Facilities In Operation	
Water Use			 15.1% 47 Million Less Gallons Consumed	
Waste and Recycling > Solid Waste > Recycled Waste > Used Oil Waste > Hazardous Liquid Waste > Nonhazardous Liquid Waste > Anti-Freeze Waste	 4.4% SOLID WASTE: 420 Tons More Generated  17% RECYCLED WASTE: 293 Tons Less Recycled		 5.5% USED OIL WASTE: 7,885 Gallons Less Produced  8.1% HAZARDOUS LIQUID WASTE: 50,470 Gallons Less Generated  15.6% NONHAZARDOUS LIQUID WASTE: 72,080 Gallons Less Generated  33.1% ANTI-FREEZE WASTE: 24,955 Gallons Less Generated	
Criteria Air Pollutant Emissions			 8.2% 24 Tons Less Emitted	
Vehicle Miles Traveled per Capita (Los Angeles County)			 0.6% 44 Miles Less Traveled	
Unlinked Passenger Trips per Capita	 4.9% 22.9 Million Less Boardings			
Operating Expenses per Boarding	 7.9% 23 Cents More per Boarding			

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 sustainability and environmental performance. This report addresses environmental performance in five key areas: ridership, energy, emissions, water, and waste management. Trends within 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's sustainability reporting framework. In addition, this report reflects the Recommended Practice for Quantifying and Reporting Transit Sustainability Metrics, prepared by the American Public Transportation Association (APTA) Standards Sustainability Metrics Working Group.

The goal of this report is twofold: (1) to provide information that can be used to improve Metro's sustainability performance, and (2) to inform the public of Metro's sustainability performance.

This report demonstrates Metro's commitment to meeting social, financial, and environmental goals by highlighting the Environmental Management System (EMS) and key accomplishments.

An overview of each indicator's performance as compared to 2014 is represented in **Figure 1**.

Table 1 provides an overview of each indicator's progress over the last few years. A few highlights of this past year include:

- > Metro's water consumption dropped by 15%.
- > Greenhouse gas (GHG) emissions decreased by over 8,000 metric tons (MT) of carbon dioxide equivalent (CO₂e).
- > A number of waste recycling initiatives have been implemented at Metro's divisions to curb the increase in solid waste produced this year.

Table 1: Historic Indicator Performance

INDICATOR	2012	2013	2014	2015	UNIT
Greenhouse Gas Emissions	474,537	471,932	465,598	457,400	MT CO ₂ e
Greenhouse Gas Displacement	491,118	475,269	482,182	464,493	MT CO ₂ e
Fuel Use	42,490,623	43,930,100	44,710,242	43,995,037	GGE
Rail Propulsion	199,093,552	229,866,746	210,937,940	198,921,473	kWh
Facility Electricity Use	97,500,044	90,099,301	94,144,097	110,400,270	kWh
Water Use	359,895,712	414,570,076	312,029,809	264,933,372	gallons
Solid Waste Generation	9,145	9,741	9,500	9,920	tons
Used Oil Waste	141,735	147,260	142,220	134,335	gallons
Hazardous Liquid Waste	667,794	658,986	620,320	569,850	gallons
Nonhazardous Liquid Waste	503,862	476,918	461,130	389,050	gallons
Anti-Freeze Waste	79,440	81,405	75,300	50,345	gallons
Criteria Air Pollutant Emissions	341	312	295	271	tons
Vehicle Miles Traveled per Capita (Los Angeles County)	7,870	7,867	7,867	7,823	miles
Unlinked Passenger Trips per Capita	472,706,561	476,299,313	468,124,396	445,192,783	trips
Operating Expenses per Boarding	\$2.77	\$2.83	\$2.93	\$3.16	2015 dollars

* MT = metric tons, GGE = gasoline gallon equivalent, kWh = kilowatt hour

MESSAGE FROM THE CEO

As we work to continue being the best, most flexible and most innovative transportation agency in the world, we must remind ourselves of our goals and ideals. Recognizing that we are the custodians of the taxpayers' monies, it's important to implement solutions and innovations that make us the most efficient agency possible. Sustainability goes hand in hand with such a mission, and provides the avenue through which silos are broken down to look for new ways to do things better. Moving forward with the sustainability program, I want to encourage us to think boldly and to challenge ourselves. We have a responsibility to provide mobility service in the most environmentally sound and fuel efficient manner possible. As we expand our efforts in sustainability, we will build a system in which we can continue to provide excellence in service and support.



Sincerely,

A handwritten signature in black ink that reads "Philip A. Washington". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Philip A. Washington
Chief Executive Officer

MESSAGE FROM THE CHAIRMAN



As Board Chair, I have witnessed the progression of Metro's aggressive construction program as well as the agency's commitment to providing the County with a transit system that is safe, sustainable, and well-connected. As our agency continues to grow, our riders must continue to be our foremost priority. Providing our riders with a system that remains in stellar condition is essential to attract new ridership, while also continuing to serve our current riders. Through the strategic implementation of sustainable and resilient practices, Metro will ensure that our projects are regional, rational, and equitable. Furthermore, we can explore additional opportunities for public-private partnerships to invest in smart and efficient technology that supplement our existing resource management portfolio.

Sincerely,

A handwritten signature in black ink that reads "Mark Ridley-Thomas". The signature is cursive and flows across the page.

Mark Ridley-Thomas
Chair, Board of Directors



INTRODUCTION

The word “Metro” conjures up a number of images: the flash of orange buses gliding down city streets, the glow of the platform lighting as you await the approaching train, or the warm, familiar greeting from the morning bus operator. These images illustrate Metro’s integral role in the fabric of Los Angeles County. With a service area encompassing 88 cities over 1,400 square miles, it is no wonder that Metro serves 450 million riders every year who rely on its daily services. In order to continue to provide excellence in service while supporting a growing population, Metro is expanding its system even further over the next few years. Through partnerships with local, federal, and private entities, Metro ensures that the County’s streets, highways, and transit infrastructure meet the needs of the community.



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. For access to these reports, please visit <http://www.metro.net/projects/ecsd>. Metro's 2016 Energy and Resource Report is a continuation of this effort and reflects the agency's sustainability performance for calendar year 2015. The report continues to bring visibility to Metro's sustainability efforts and helps to explore new ways to manage environmental impacts, while maintaining Metro's mission of providing quality transit services for the region. This report strives to be consistent with the strategies and recommendations of the City of Los Angeles' Sustainable City Plan (pLAN).

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. This is the seventh Energy and Resource Report that Metro has published. The following section describes key elements of this report.



ENVIRONMENTAL MANAGEMENT SYSTEM ▼

One avenue for approaching sustainability is through the utilization of best management practices (BMPs) to streamline maintenance and operations in a more environmentally friendly manner. For Metro, this approach encouraged the implementation of an EMS. Metro's Environmental Policy (2009) calls out EMS as the primary tool for ensuring compliance with federal, state, and local environmental regulations, as well as outlining Metro's commitment to the protection of the environment through prevention of pollution, and resource conservation and efficiency.

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

Since then, Metro's EMS has increased both in size and reputation. In 2014, Columbia University conducted a study that rated Metro's EMS as the most successful implementation relative to 13 other regional transit agencies with a similar program.

Metro has recently concluded an aggressive enrollment schedule, which resulted in simultaneously certifying seven facilities at once in June 2015. As it is an agency-wide system, all of Metro's 19 major operating facilities, including the three maintenance facilities newly opened this year, will be enrolled in the program by 2017. There will be a total of six rail divisions, 12 bus divisions, and one non-revenue vehicle division.

EMS relies on a continual improvement process to identify BMPs 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 actively participate in their facility's EMS meetings. Environmental challenges identified through monthly inspections and issues raised by employees often result in site-specific Action Plans, which help EMS teams track and measure the effectiveness of current practices. Trainings are provided to personnel, standard operating procedures are developed, and BMPs are shared between facilities to better manage environmental processes. Since 2014, 540 trainings have been administered, and over 1,000 employees attended these courses. EMS relies on a "Plan-Do-Check-Act" model, which represents the four critical stages in the process.



1

PLAN

Metro's EMS has resulted in the development of both system-wide and site-specific "Objectives and Targets," which set goals for the program's continued successes. The central objectives focus on increasing agency-wide solid waste diversion rates, achieving water reduction goals outlined by the Board of Directors, and developing of more sustainability-driven trainings through Metro's Environmental Training Institute (ETI). At the division level, each division evaluates its facility to determine major environmental impacts (referred to as "Environmental Aspects") and creates Action Plans to address those impacts identified 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 agency-wide and division-level meetings are scheduled to track progress and keep records of these efforts.

3

CHECK

This phase focuses on monitoring and measuring Metro's EMS activities. Internal and external auditors are tasked with verifying that procedures are followed and that the agency's environmental objectives are being properly managed. Metro has chosen to upgrade its current ISO 14001:2004 Certification to the new requirements within the revised ISO 14001:2015 standard, and is on track to achieve this goal by June 2016. This ISO Certification provides an internationally recognized framework for EMS that formalizes the continual improvement process, and Metro continues to lead the way for other transit agencies throughout the nation.

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.

EMS provides benefits to reduce environmental impacts, increase employee awareness and engagement, and maximize operational efficiencies by sharing BMPs. Many project examples are summarized throughout this report. 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. The ETI program was created for that very reason. Since 2013, over 650 training sessions have been provided to all EMS facilities. Over 50 training modules have been developed since the program's inception, with topics including hazardous waste management, solar panel preventative maintenance, and construction stormwater management. Trainings 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).

In 2014, Columbia University conducted a study that rated Metro's EMS as the most successful implementation relative to 13 other regional transit agencies with a similar program.

Innovative solutions continually emerge through EMS and affect decisions made throughout the entire agency's various business units, 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. 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.

THIS REPORT CONTINUES TO BRING VISIBILITY TO METRO'S SUSTAINABILITY EFFORTS AND HELPS TO EXPLORE NEW WAYS TO MANAGE ENVIRONMENTAL IMPACTS, WHILE MAINTAINING METRO'S MISSION OF PROVIDING QUALITY TRANSIT SERVICES FOR THE REGION.





LINGS

6S

CAS CÚT IN

A decorative graphic in the top right corner of the page. It features several overlapping gears of different sizes and colors (shades of orange and yellow) and a stylized leaf or flower shape with five petals, also in shades of orange and yellow.

HOW DID WE DO?

Metro's environmental performance throughout 2015 is assessed by its performance in each indicator area. This analysis provides Metro with the data to track progress from year to year, set new targets, establish strategies, and recommend goals for future years. Each indicator section presents Metro's progress and key accomplishments, followed by general indicator information and trends. Finally, next steps are provided for future implementation.

GREENHOUSE GAS EMISSIONS AND DISPLACEMENT

Metro recognizes that the transportation sector in California contributes to over one-third of the State's overall GHG emissions. Metro is the principal planner and operator of public transportation in Los Angeles County. As a public transit agency, Metro recognizes its role and responsibility in addressing GHG, and has put in place goals, policies, and actions that will expand its network of services while reducing the agency's own carbon footprint. These efforts complement the momentum around GHG mitigation planning exhibited by other agencies in the Los Angeles region, such as the City of Los Angeles' Sustainable City Plan (pLAN), which sets short-, medium-, and long-term GHG reduction targets and identifies high-impact measures to achieve reductions.

METRO'S PROGRESS 

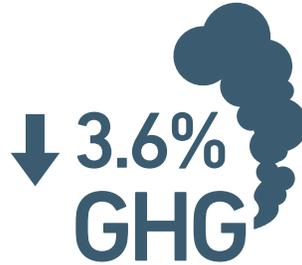
2012



Prepared of a Climate Action and Adaptation Plan.

Launched in 2012, this plan establishes a framework to identify key areas of opportunity for Metro to reduce GHG emissions and evaluates opportunities based on their costs and GHG reduction potential.

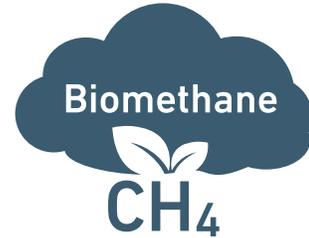
2015



Reduced GHG emission by 3.61% from 2012 to 2015.

Metro achieved a net reduction of 17,137 MT of GHG emissions from 2012 to 2015, representing approximately 3.61% improvement.

2015



Released an Invitation for Bids in 2015 for the procurement of biomethane.

Pursuant to Metro's 2013 Biomethane Implementation Plan, the Board directed for procurement of biomethane in May 2014. Because biomethane is sourced from landfills, dairy digesters, and wastewater treatment plants, Metro can significantly reduce the carbon footprint of its transit operations with no operational changes.

METRO DISPLACED MORE GHG EMISSIONS (AN ADDITIONAL 7,093 METRIC TONS OF CO₂e) THAN IT PRODUCED IN 2015.





OVERVIEW

Climate change is one of California's most pressing issues and is a major global challenge for the 21st century. Driven primarily by GHG emissions from human activities, the global climate is changing as evidenced by higher air and ocean temperatures, reduction in the extent of sea ice, and rising sea levels. These changes in the global climate have resulted in local impacts, such as heat waves, drought, and wildfires. The activities that generate GHG emissions, such as the consumption of natural gas and electricity generated from fossil fuel combustion, have led to local impacts in the Los Angeles Metropolitan Area, such as the deterioration of air quality. Reducing GHG emissions can yield many near-term local benefits, including improved air quality, lower energy costs, and improved public health.

Recognizing the need for action on climate change migration, the State has developed a robust regulatory framework to enable public agencies to reduce their GHG footprint. At the cornerstone of this framework is the California Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32), which provides a statewide target to reduce GHG emissions to 1990 levels by 2020.

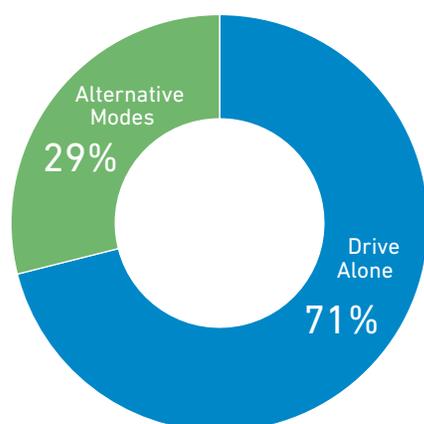
This section provides a summary of Metro's agency-wide GHG emissions for calendar year 2015, and depicts multi-year trends in Metro's GHG footprint, highlighting changes in emissions from various operations, such as bus and rail services. The section concludes with a summary of actions that Metro plans to undertake in the near future to continue to mitigate the GHG footprint of its operations.

KEY ACCOMPLISHMENTS



CONTINUE TO PURCHASE ELECTRIC BUSES AND TRANSITION TO ZERO-EMISSIONS BUS FLEET

Metro continues to purchase electric buses and transition to a zero-emission bus fleet. Metro currently has five electric buses and is looking to expand its electric fleet in the near future. A zero-emission bus fleet would substantially reduce the agency's overall carbon footprint and bring major air quality benefits to the region.



METRO EMPLOYEES WALK THE WALK (AND BUSES, BIKES...)

Metro's employees are committed to sustainability practices. In addition to utilizing Metro's bus and rail systems to get to work, many Metro employees bike and vanpool. In 2015, approximately 29% of the agency's employees used alternative modes of transport to commute to work.



GREEN PLACES TOOLKIT

On the newly updated Sustainability in Countywide Planning site, visitors can access Metro's new Green Places Toolkit for ideas on urban greening and placemaking improvements for their communities and ways to implement such projects. If visitors are looking for a comprehensive set of sustainability tools, they can access the Sustainability Toolkit, which draws from a variety of different efforts within Metro and beyond. In addition to these resources, visitors will find upcoming events, Metro's First Last Mile Strategic Plan, the Countywide Sustainability Annual Report, among many others.

TRENDS IN METRO'S GHG EMISSIONS

In 2015, Metro emitted approximately 457,400 MT CO₂e. Approximately 87% of Metro's total GHG emissions were derived from fuel consumption associated with moving passengers. In general, Metro's GHG emissions are directly calculated using activity data. Major emissions-generating activities include Metro's bus services, rail services, vanpool services, and stationary facilities (**Figure 2**).

Total GHG emissions in 2015 were approximately 2% lower than in 2014 (**Figure 3**). A detailed analysis of major emission-generating activities shows that emissions increased from some activities but decreased in others. For example, emissions from light rail services decreased by 20% while heavy rail services showed an increase in emissions by 13% between 2014 and 2015.

Metro also experienced a significant decrease in emissions from its gasoline-powered support vehicles (50%) and diesel bus services (13%). Emissions from Metro's contracted vanpool services increased by 5%, and this increase is proportional to the expansion in Metro's vanpool services.

Figure 2: Total Greenhouse Gas Emissions by Activity

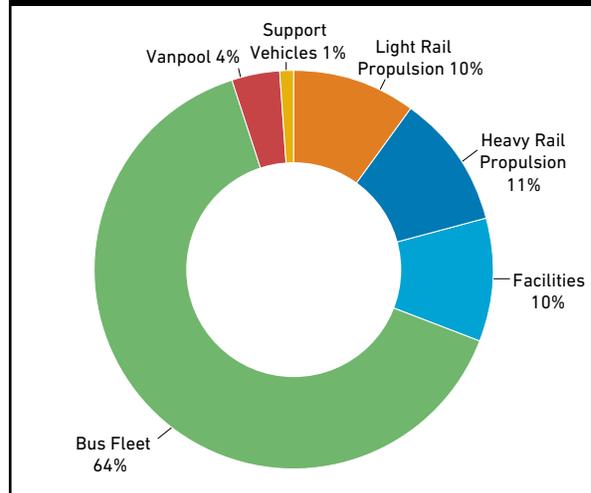
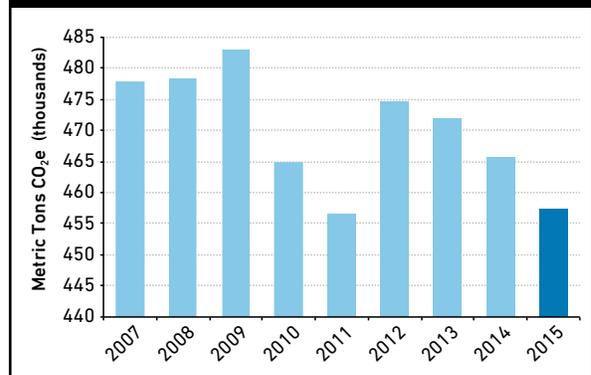


Figure 3: Historic Greenhouse Gas Emissions



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 light rail services were the most efficient transit mode in 2015, emitting 1.69 pounds (lbs) CO₂e per boarding (**Table 2**). Another way of assessing efficiency is by examining GHG emissions per passenger mile traveled. When calculated by passenger mile,

vanpool and light rail services were the most efficient. 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 appear to be the most efficient transit mode in terms of GHG emissions per vehicle mile, emitting 1.3 lbs CO₂e per vehicle mile. In addition to being the most efficient transit mode, Metro's vanpool services have been successful in increasing ridership by 4% from 2014 to 2015. Lastly, when evaluated on a revenue hour basis, Metro's vanpool and contracted bus services show the highest GHG efficiency per revenue hour.

PERFORMANCE METRICS

Table 2: Total Greenhouse Gas Emissions by Activity

MODE	lbs CO ₂ e per Boarding	lbs CO ₂ e per Vehicle Mile	lbs CO ₂ e per Revenue Hour	lbs CO ₂ e per Passenger Mile
Heavy Rail	2.37	15.28	345.51	0.47
Light Rail	1.69	7.25	152.19	0.26
Contracted Buses	2.34	5.43	76.51	0.5
Metro Buses	1.74	6.68	84.85	0.4
Vanpool	10.29	1.3	55.73	0.23
Support Vehicles	NA	1.07	NA	NA
Average	1.90	5.90	96.53	0.38

EMISSIONS PER BOARDING

Between 2014 and 2015, Metro's total GHG emissions per boarding from all transit modes increased by 3%, although there was variation in emissions per boarding within each transit mode (Figure 4). GHG emissions per boarding for light rail decreased by 16%. Conversely, GHG emissions per boarding for heavy rail increased by 19%.

Metro-operated bus services experienced a 4% increase in GHG emissions per boarding while contracted bus services demonstrated a 6% decrease. The carbon efficiency of vanpool services on a per boarding basis decreased by 4%, as the rate of increase in emissions from gasoline consumed by Metro's contracted van fleet (5%) outpaced the rate of increase in ridership (4%).

EMISSIONS PER VEHICLE MILE

Between 2014 and 2015, Metro experienced a 4% decrease in GHG emissions per vehicle mile, based on mileage from transit vehicles (Figure 5). Significant improvements in GHG efficiency per vehicle mile were observed for light rail (17%) and Metro's contracted bus services (7%). Vanpool services showed a minimal increase in GHG emissions per mile (1%), while heavy rail services experienced a significant increase (20%). GHG efficiency per vehicle mile increased by 3% for Metro operated bus services.

Figure 4: Greenhouse Gas Efficiency per Boarding

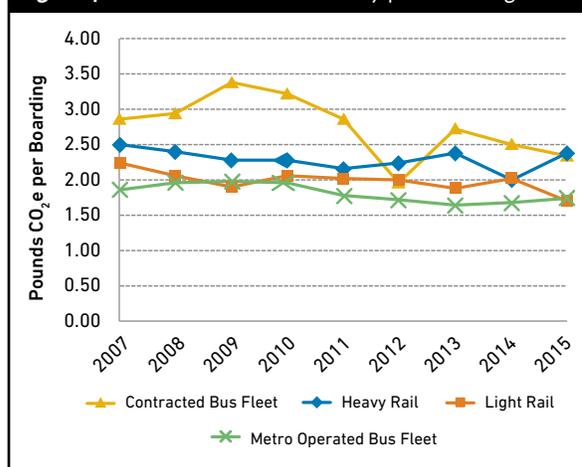
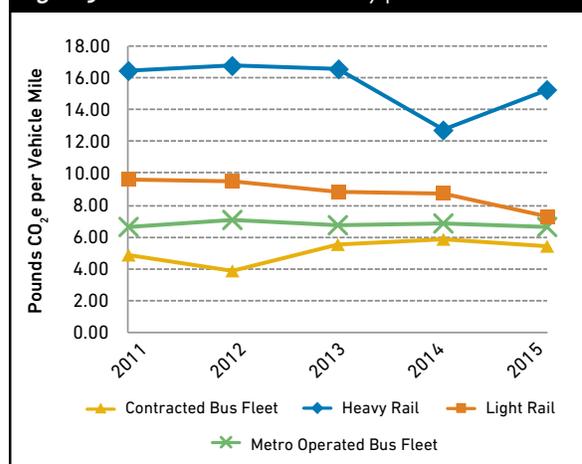


Figure 5: Greenhouse Gas Efficiency per Vehicle Mile



PERFORMANCE METRICS



A similar trend occurred for emissions per revenue hour, as Metro showed a 3% decrease in GHG emissions per revenue hour, based on revenue hours from transit services. The largest improvements in GHG efficiency per revenue hour were observed for light rail (19%) and Metro's contracted bus services (11%). GHG efficiency per revenue hour decreased significantly for heavy rail (13%).

Between 2014 and 2015, Metro showed a 1% increase in GHG emissions per passenger mile, based on passenger miles from transit services. The GHG emissions per passenger mile for light rail and Metro contracted buses decreased by 14% and 4%, respectively. However, the GHG emissions per passenger mile for heavy rail increased by 22%.

Vanpool services are a very efficient transit mode in terms of GHG emissions per vehicle mile, emitting 1.3 lbs CO₂e per vehicle mile. In addition, Metro's vanpool services have been successful in increasing ridership by 4% from 2014 to 2015.

GREENHOUSE GAS DISPLACEMENT



Metro continues to implement actions 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 prevents more GHG emissions than it produces. In 2015, Metro achieved GHG displacement of approximately 464,493 MT CO₂e by shifting passengers from individual vehicular travel to transit, as shown in **Table 3**. This alone results in more GHG emissions displaced by passengers not driving than by all of Metro's operational emissions (457,400 MTCO₂e). These avoided or displaced emissions are not as directly quantifiable as Metro's operational emissions, but APTA provides guidance for estimating displaced emissions from three factors:

- > 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 mile is 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 Change refers to emissions displaced when transit enables denser land-use patterns, which encourage shorter trips and increased walking and cycling instead of vehicle use.

While APTA provides high-level guidance on estimating the impacts of congestion relief and land use changes on GHG emissions, the methodology for estimating GHG displacement from these factors is still evolving. Therefore, these estimates are not included in the quantification of GHG displacement achieved by Metro. Once

robust methodologies are developed for estimating GHG reductions from congestion relief and land use changes, Metro will incorporate them in future reports. They will demonstrate even greater emissions avoidance and Metro's central role in creating a more sustainable region.

Table 3: Net Greenhouse Gas Emissions from Metro Operations

Source	Quantity of Emissions Displaced (MT CO ₂ e)
Total Emissions Displaced from Mode Shift	(464,493)
Emissions from Metro Operations	457,400
NET EMISSIONS FROM METRO OPERATIONS	(7,093)

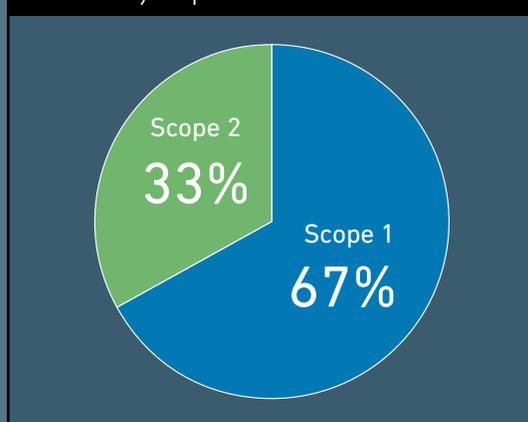
NEXT STEPS

> Metro to collaborate with CDP: Over the course of 2016, Metro will work with CDP's supply chain program in a pilot effort to benchmark, manage, and provide meaningful reporting on supply chain impacts as they relate to climate change, resiliency, and GHG emission reductions. CDP is a global nonprofit offering companies the ability to publicly disclose their GHG emissions and management practices in a standardized, comparable format. As a leader in this field, CDP has the credibility and experience to help Metro successfully manage this effort. In doing so, Metro joins the ranks of 88 other large purchasing organizations, including the California Department of Governmental Services and the US Navy. This program will help Metro operate more sustainably, and will give participating suppliers an opportunity to plan more comprehensively to cut costs and carbon emissions. With assistance from CDP, Metro plans to report GHG emissions from its suppliers, which are categorized as Scope 3 emissions by the Association of Public Transportation. In contrast, Scope 1 emissions refer to those occurring directly from Metro activities, such as



the combustion of fuel by buses or stationary facilities, and Scope 2 emissions include those from purchased electricity, heating, cooling, and steam. Currently, Metro primarily reports Scope 1 and 2 emissions as shown in Figure 6.

Figure 6: Breakdown of Metro Greenhouse Gas Emissions by Scope



Scope 1: Direct Emission | Scope 2: Indirect Emission

ENERGY USE

Metro's main consumers of energy are fuel, rail propulsion, and facility electricity. Metro is continuing to conduct energy opportunity assessments at a number of divisions to better understand energy consumption and to implement appropriate energy conservation measures. Metro is in the process of rolling out comprehensive energy efficiency upgrades and renewable energy installations at multiple bus and rail divisions.

METRO'S PROGRESS 

2015



Attained LEED certification on new buildings and facilities.

Division 13, a new bus maintenance and operations facility, was constructed as a LEED Certified Gold Building and included several sustainability features to increase water and energy efficiency at the division. Sustainable features include reflective roofing, skylights, 271 kilowatts (kW) of solar panels, and a green roof.

2018



Install submeters for electricity at all of Metro's facilities.

Submetering systems allow for more detailed tracking and analysis, leading to more improved performance in the future. Submeters are installed at 14 major facilities to support data collection.

2020



Achieve 33% renewable energy use by 2020.

Metro has invested over \$17 million in renewable energy projects since 2005. Metro's current installed capacity of solar is 2.4 megawatts (MW), with an additional 1.7 MW planned by the end of 2018.

NATURAL GAS CONTINUES TO BE THE PRIMARY FUEL TYPE USED BY METRO-OPERATED VEHICLES, ACCOUNTING FOR MORE THAN 97% OF TOTAL FUEL USED.



KEY ACCOMPLISHMENTS

**EXPAND EV CHARGERS**

In March 2016, Metro officially opened Phase I of the Foothill Extension of the Gold Line. A total of 15 electric vehicle (EV) chargers were installed at five of the new stations. In addition, Metro is installing 20 chargers at five park-and-ride lots throughout the Metro network. Once they are completed, Metro will have more than 50 EV chargers installed across its network.

**CONTINUE PHOTOVOLTAIC TECHNICAL AND PREVENTATIVE MAINTENANCE TRAINING PROGRAM**

In 2014, a training course on photovoltaic (PV) preventative maintenance was developed specifically for Metro's facilities maintenance crews and electricians who maintain the PV systems throughout the region. Metro continues to offer the training sessions, which cover the history and theory of PV, safety, and the Preventative Maintenance Plan.

**INTEGRATED LIGHTING CONTROL SYSTEM**

Metro completed the installation and commissioning of an integrated lighting control system at a rail maintenance facility. The resulting measured energy savings are over 975,000 kilowatt hours (kWh) per year.

FUEL USE

Metro's vehicle fleet is composed of revenue and non-revenue buses, and does not include contracted operations. In 2015, Metro's vehicle fleet used 39.6 million gasoline gallon equivalent (GGE) of fuel, which is a decrease of 1.4% from 2014 (Figure 7). These savings can generally be attributed to these factors:

- > Metro's transition of its non-revenue fleet from diesel/gasoline to hybrid, resulting in a decrease in diesel and gasoline consumption (15% and 4%, respectively) (Figure 8).
- > Metro's replacement and repowering of compressed natural gas (CNG) buses with the newest technology engines, resulting in a 1.3% reduction in CNG consumption. CNG accounts for more than 97% of total fuel used by Metro.

In addition to Metro-operated vehicles, buses operated by Metro contractors used an additional 2.1 million GGE of fuel in support of Metro's direct fleet, a 15% reduction from last year. Unlike Metro's direct fleet, which is 100% CNG-powered, 43% of the fuel consumption for Metro-contracted buses is from diesel-powered buses, with the remaining 56% from CNG-powered buses. There is a significant reduction of 23% in CNG consumption in 2015 compared to 2014.

Figure 7: Historic Fuel Use, Metro Operated Vehicles

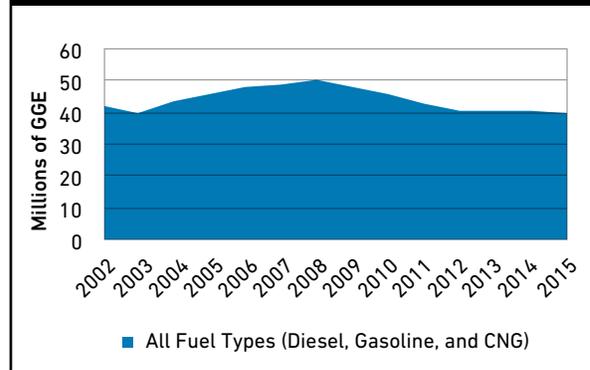
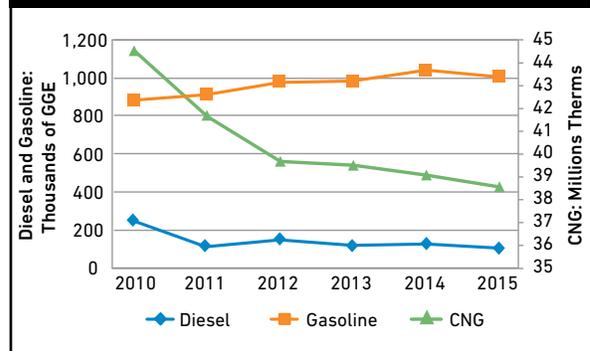


Figure 8: Historic Diesel and Gasoline Consumption



RAIL PROPULSION

The operation of Metro's extensive rail lines is the largest overall consumer of electricity. Rail propulsion required 199 million kWh of electricity in 2015, a 6% decrease from 2014 (Figure 9). Los Angeles Department of Water and Power continues to be the major provider of rail propulsion, supplying 68% of the total demand.

The Red/Purple Line remains the largest consumer of rail propulsion (Figure 9). The overall reduction in rail propulsion, despite a relatively constant ridership, may be attributed to a number of factors:

- > Savings from lighting retrofits and installation of the Wayside Energy Storage Substation energy recovery system on the Red Line.
- > Meters were reclassified this year to more accurately reflect usage.

With additional rail lines and service, Metro expects energy costs associated with rail propulsion to increase (Figure 10; Figure 11). Efforts to mitigate these rising costs include designing energy efficient stations, retrofitting existing stations, and analyzing the rate structure of traction power meters.

A significant portion of Metro's total energy consumption is used to move people. Metro's total energy use is driven by fuel use, rail propulsion, and facility electricity. The combination of fuel use and rail propulsion results in about 94% of overall energy use and 84% of overall energy cost.

Figure 9: Energy Consumption

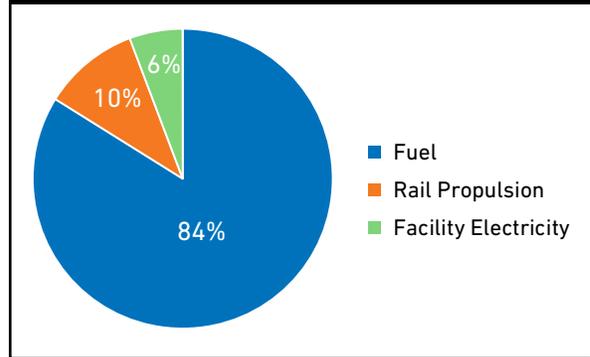


Figure 10: Energy Costs

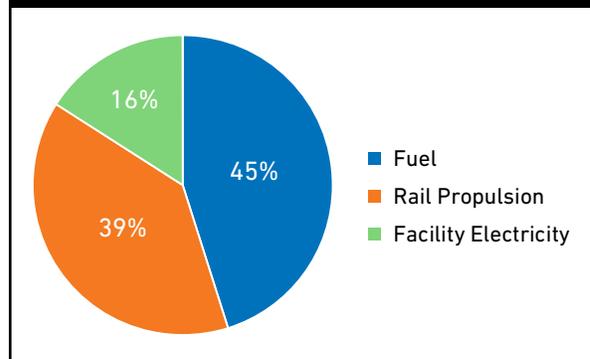
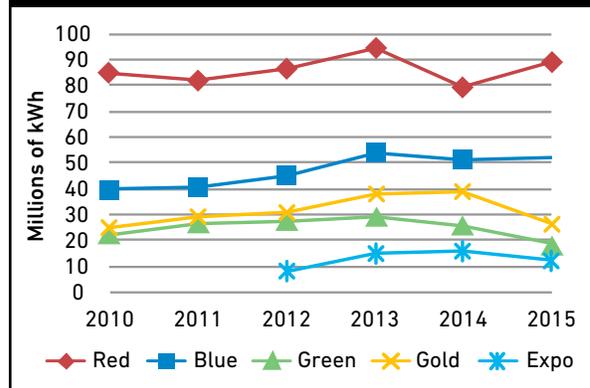


Figure 11: Rail Propulsion by Line Trend



FACILITY ELECTRICITY USE

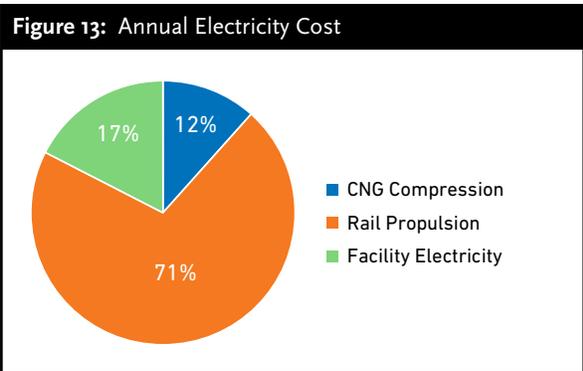
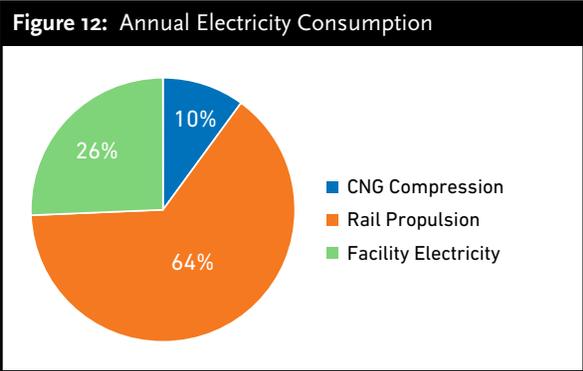
New facilities are required to support Metro's growing transit services. In 2015, two new facilities were constructed to support bus and rail operations. Although more facilities means more electricity, Metro's new maintenance buildings are designed with energy efficiency in mind. Division 13 was constructed to LEED Gold standards.

Improving the energy performance of Metro's existing infrastructure is necessary to reduce Metro's overall carbon footprint and ensure efficient transit operations. In the past few years, Metro has invested almost \$2 million in green facility improvements including lighting, heating, ventilation, and air conditioning submeters. This investment has resulted in over \$1 million in annual avoided cost on electricity. Metro has also received over \$4 million in incentives and utility rebates to support these projects. An additional \$3.3 million in projects are in development, including a full-building lighting upgrade at Metro's Headquarters, the agency's largest energy consuming building.

Despite an overall increase at Metro in facility electricity usage, over half of its major facilities experienced a decrease in electricity use compared to 2014.



FACILITY ELECTRICITY USE ✦



Metro's facilities typically experience a rise in electricity use in the summer months due to an increased demand for air conditioning.

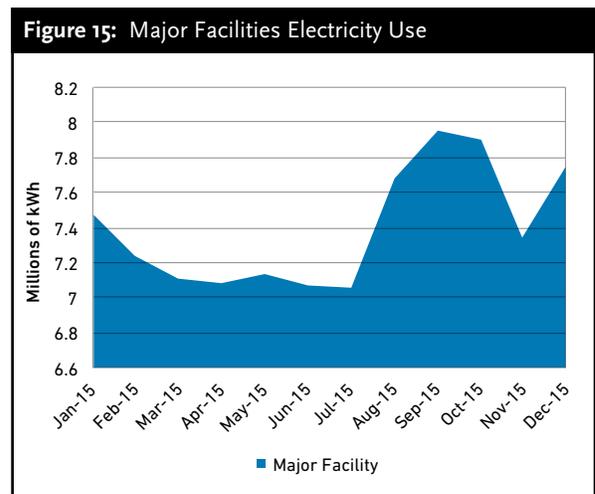
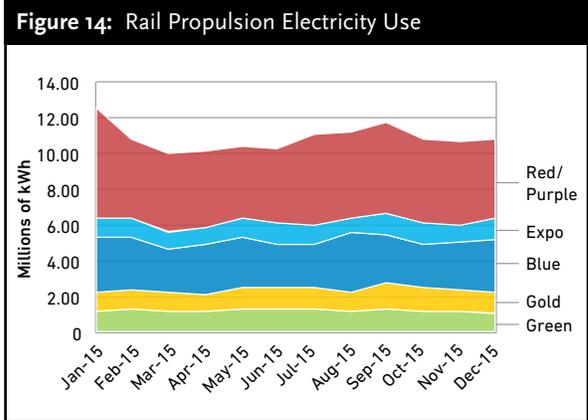
Metro has embarked on initiatives to install new electrical meters and submeters to better understand energy consumption throughout its facilities. These additional meters have led to reporting of electricity use that was previously unreported and/or unaccounted for. In 2015, Metro used 309 million kWh of energy, an increase of 1.4% from 2014. Approximately 36% of electricity consumption was attributed to meeting facility electricity demand and the remainder (64%) to rail propulsion (Figure 12). Compared to 2014, facility electricity use increased by 17% and rail propulsion decreased by 6% in 2015 (Figure 12). This overall slight increase in electricity, despite Metro's implementation of energy conservation programs, may be attributed to the addition of previously unreported electricity use. The increase in facility electricity versus rail propulsion may be attributed to the addition of new meters and the reclassification of existing electrical meters from rail propulsion to facility electricity (Figure 13).

Over ¾ of Metro electricity consumption and costs are attributable to moving people. Natural gas compression is a significant portion of Metro's electricity costs. Metro has been looking into ways to reduce this cost by changing bus fueling schedules to off-peak hours, when feasible.

SEASONAL ANALYSIS

A monthly analysis of major facilities, facility electricity, and rail propulsion provides a glimpse into the variation in seasonal energy consumption trends.

- > Energy consumption for rail propulsion remains constant throughout the year, as is expected due to the constant demand for rail use that is typically not impacted by weather (**Figure 14**).
- > Major facility electricity meters demonstrate a rise in electricity demand during the summer months of July through October. This increase is typical for summer months when cooling demand (air conditioning) increases in facilities (**Figure 15**).



NEXT STEPS

- > Nearly \$20 million in additional energy reduction projects have been identified for implementation.
- > Expand current portfolio of LEED certified facilities.
- > Complete installation of four additional solar PV systems under a Power Purchase Agreement to increase Metro's use of renewable energy.



INDICATOR AREA

WATER USE

A key element of Metro's Sustainability Implementation Plan is the continual reduction of water consumption while continuing to provide transit services to local residents. Metro's overall water consumption continued to decrease in 2015, which may be attributed to improved efficiency and the continued utilization and implementation of effective water saving programs, such as implementing an alternate bus washing schedule and adjusting bus wash cycle timers to be more efficient.

METRO'S PROGRESS 

2014



Mayor Eric Garcetti challenged Metro to reduce potable water use by 20% by 2017.

Water use has decreased from a peak of 415 million gallons in 2013 to 265 million gallons in 2015.

2014



Analyzed water reduction opportunities using new technology.

In Fall 2014, Metro began an alternate bus washing schedule to complement other water conservation efforts. Since then, water consumption has reduced by 11% at these facilities, or over 10 million gallons per year.

2015



Continued proactive conservation programs and strategies.

Metro continues to pursue conservation programs such as reclaiming and reusing vehicle wash water, as well as exploring the possibilities of utilizing purple-pipe recycled water.

IN 2015, METRO'S OVERALL WATER CONSUMPTION EXPERIENCED A SIGNIFICANT DECREASE OF 15% FROM 2014.



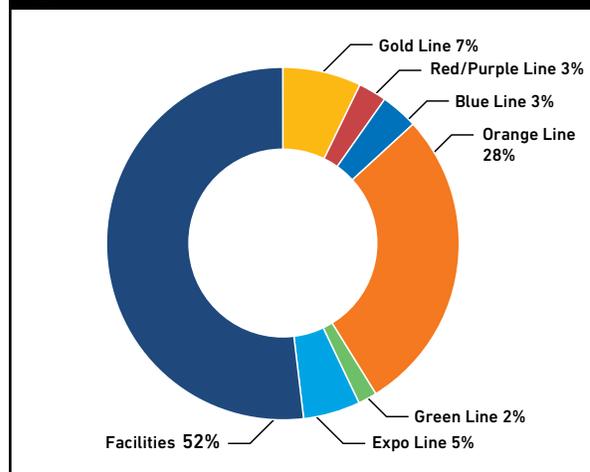
OVERVIEW



In 2015, Metro operations consumed approximately 265 million gallons of water, a significant decrease of 15% from 2014. Daily water use includes bus and rail car washing, maintenance operations, daily water use by employees, and facility landscape irrigation.

About 35% of Metro's total water consumption is attributable to activities at bus maintenance facilities. Metro is focusing on its bus washing activities, which represent a major use of water at these facilities. A significant portion of water use along right-of-ways is attributable to irrigation. Drought tolerant landscaping and smart controllers are just a few of the ways Metro can reduce irrigation water use. (Figure 16)

Figure 16: Annual Water Use



Metro's drop in water consumption may be attributed to proactive conservation programs and strategies, such as 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.

KEY ACCOMPLISHMENTS



SMART LANDSCAPING

California's prolonged drought has prompted Metro to re-evaluate the way it designs and maintains its landscapes across Los Angeles County. Metro is taking steps to replace ornamental turf across its properties with drought tolerant and California native landscaping. Planting native and drought tolerant plants will serve a crucial role in Metro's efforts to implement water conservation strategies throughout the organization.



PERMEABLE "TEMPORARY" PAVEMENTS

On November 16, 2015, Metro completed construction of a permeable "temporary" pavement to be used as a parking area for riders at the Metro Red and Orange Line North Hollywood Station. The permeable pavement reduces the need to install extensive drainage infrastructure to control stormwater run-off and promotes infiltration into the soil below.



WATER-EFFICIENT FIXTURES

To better conserve water, a fountain-type handwash station was installed in the restrooms at Division 13 to only dispense water at the position where it is turned on rather than at all positions. A reverse osmosis drinking water fountain is available at Division 15 for Metro staff to refill their water bottles.

NEXT STEPS

- > Explore ways to further conserve water during bus washing, such as efficiency retrofits or utilizing purple-pipe recycled water.
- > Explore ways to reduce water use for irrigation such as replacing landscaped areas with drought tolerant plants and limiting ornamental turf.
- > Track specific and largest areas of water usage with water submeters and data loggers.



WASTE AND RECYCLING

Beginning in 2013, Metro contracted a new waste hauler, Republic Services, Inc., to enhance the waste management program through more detailed documentation strategies. In 2015, Metro continued to expand its waste-related best practices, programs, and initiatives. Metro has implemented several internal programs to divert waste from landfills, focusing on recycling, reusing, reducing, rebuilding, and repairing products. For example, Metro started a Pallet Return Program, in support of AB 1826, which focuses on recycling organic waste. In addition, Metro recycles rubber scraps, metal wheels, cardboard boxes, bottles/cans, toner cartridges, fluorescent lamps, scrap metal, batteries, e-waste, and other office products.

METRO'S PROGRESS



2013



Contracted a new waste hauler to better track Metro's waste streams.

Metro implemented more detailed documentation strategies to accurately report waste production and recycling efforts.

2015



Increased landfill diversion rates through increased on-site recycling.

Metro has initiated a number of recycling efforts, such as recycling of non-revenue tires and reusing pallet, to reduce waste sent to the landfills.

2016



Conducted waste audits to find opportunities for improvement.

Metro will complete waste audits to provide a better understanding of each division's waste contribution and recommend opportunities for improvement. Waste and recycling audits will continue to be conducted at remaining bus and rail divisions.



METRO HAS IMPLEMENTED SEVERAL INTERNAL PROGRAMS TO DIVERT WASTE FROM LANDFILLS, FOCUSING ON RECYCLING, REUSING, REDUCING, REBUILDING, AND REPAIRING PRODUCTS.

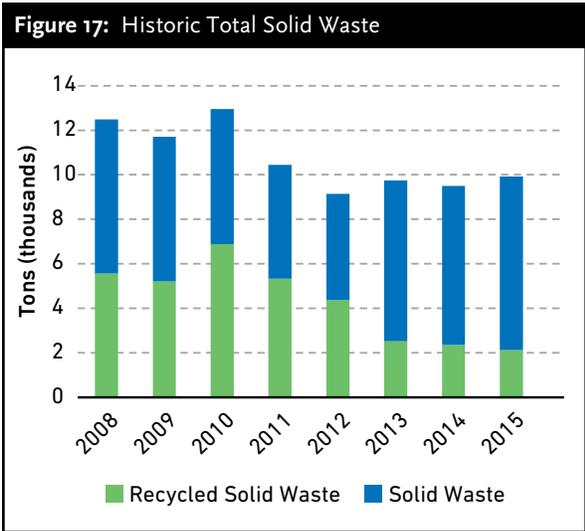


OVERVIEW



To further reduce waste, Metro has implemented a number of internal paper-reduction strategies, such as printing through online viewing and encouraging double-sided printing. Paper towel dispensers that do not require batteries have been installed, and unbleached paper towel rolls have replaced standard paper towels. Other waste reducing efforts include rebuilding engines and parts; introducing a new fabrication material in place of nylon; a tire leasing program; tire re-grooving practice; metal wheel/hub refurbishing, repair, and recycling; and improved workflow in mechanical maintenance areas.

In terms of overall waste production, total solid waste output increased by 4% since last year, from approximately 9,500 tons in 2014 to 9,920 tons in 2015 (Figure 17). Metro's waste hauler, Republic Services, Inc., reported a decrease of 10% in the amount of recycled solid waste collected at Metro in comparison to 2014. This decrease may be partly attributed to the new strategies implemented by Metro to reuse materials and divert recyclable materials from the landfills.



Foothill Gold Line's Operations Campus has a newly installed Bauer metal grinder that recovers scrap metal shavings from the rail car maintenance divisions. The machine captures the metal shavings from the inspection pit level and transports them to a metal bin on the maintenance floor level for recycling.

KEY ACCOMPLISHMENTS

**PALLET RETURN PROGRAM**

Metro's Central Maintenance Facility (CMF) purchases heavy duty block pallets that are used throughout Metro for distribution of inventory. These clearly identifiable pallets are then stored and returned to CMF, both empty or with product. The reuse of the pallets eliminates wood waste and the need to buy additional pallets at either end of the distribution process. This is particularly important in regards to AB 1826, which targets organics being sent to the landfill.

**TIRE RE-GROOVING**

Metro has established specific protocols regarding the practice of re-grooving select tires. This now occurs at every bus division, and recently, Metro contracted for the recycling of the rubber scraps that are being set aside as part of the process.

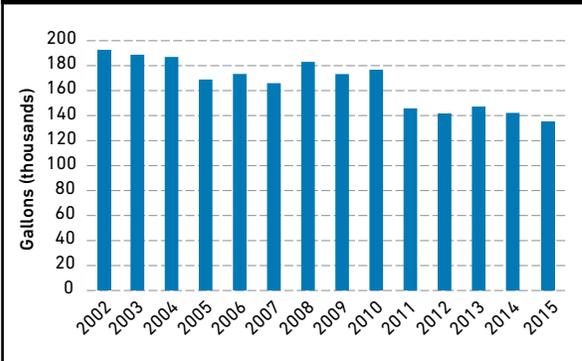
**TREE-TO-DRUM PROGRAM**

As part of the 8.5 mile Crenshaw/LAX Line's construction, many trees needed to be removed for the new light rail alignment. Metro's Sustainability Program encourages the reuse and recycling of all allowable materials. With financial assistance provided by Director Mark Ridley Thomas' office as well as input from the local community, the project initiated a Tree-to-Drum Program. The wood from removed trees that meet a diameter criteria are donated to the non-profit World Stage, an educational and performance arts gallery in Leimert Park. The first 40 drums were made from the Canary Island Pine trees removed on Crenshaw Boulevard and were formally donated to local community arts, music, and dance organizations.

USED OIL WASTE

During 2015, Metro produced approximately 134,000 gallons of used oil, which represents a 6% decrease from 2014 and a 30% decrease from 2002 (**Figure 18**). Metro has implemented some strategies to more efficiently capture and dispose of used oil waste. For instance, Division 13 obtained an oil filter crusher that captures any remaining oil and renders the filter recyclable with regular scrap metal recycling. In addition, Metro continues to use synthetic oils and other alternative oil products to reduce used oil waste.

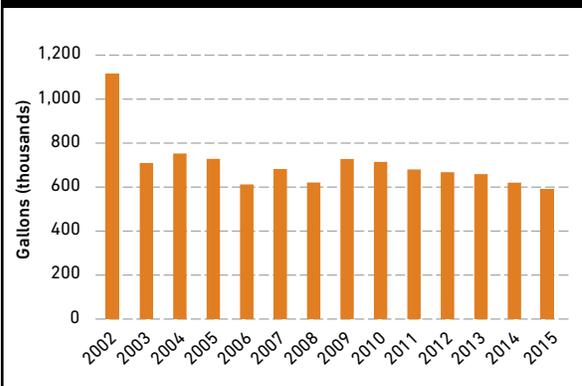
Figure 18: Historic Used Oil Waste



HAZARDOUS LIQUID WASTE

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 continues to schedule and track hazardous and universal waste removal from divisions. Metro's Chemical Committee reviews potential products that are proposed to be used at Metro, and the Quality Assurance team conducts periodic testing of hazardous waste streams to reassess their use and check if nonhazardous alternatives can be used instead. In 2015, Metro produced approximately 570,000 gallons of hazardous liquid waste, representing an 8% decrease from 2014 (**Figure 19**).

Figure 19: Historic Hazardous Liquid Waste

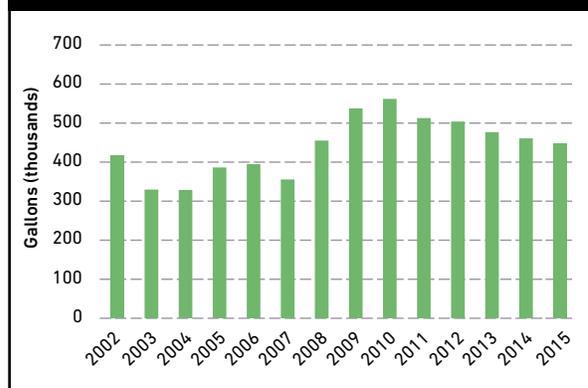


NONHAZARDOUS LIQUID WASTE

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 2015, Metro produced approximately 389,000 gallons of nonhazardous liquid waste, representing a 16% decrease from 2014 (**Figure 20**). 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 a program to alternate the bus washing schedule to reduce water consumption by washing buses every other day rather than daily. In addition, a new water conditioning system using Linear Kinetic Cell technology began in 2015.

The decrease in nonhazardous liquid waste production correlates to a 16% decrease in nonhazardous liquid waste disposal fees paid by Metro (\$140,000) from 2014.

Figure 20: Historic Nonhazardous Liquid Waste



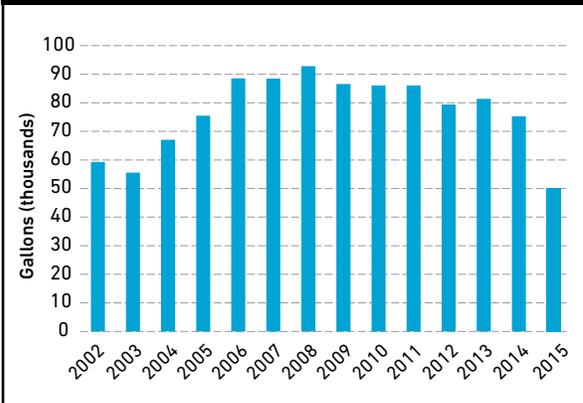
In 2015, Metro produced approximately 389,000 gallons of nonhazardous liquid waste, representing a 16% decrease from 2014.



ANTI-FREEZE WASTE

Anti-freeze is mainly used in Metro's bus maintenance facilities. In 2015, Metro produced approximately 50,000 gallons of anti-freeze waste, a large decrease of 33% from 2014 (**Figure 21**). Since 2008, anti-freeze waste production has been trending downward, which can be partly attributed to enhanced recycling efforts and programs and the fully implemented coolant recovery system at all the bus divisions.

Figure 21: Historic Anti-Freeze Waste



NEXT STEPS

- > Enhance existing programs and expand to include new programs as resources, technology, and markets become available.
- > Adopt an Integrated Waste Management Hierarchy that describes the preferential order of waste management options.
- > Evaluate and adopt a Zero Waste Policy.





CRITERIA AIR POLLUTANT EMISSIONS

Metro's bus and rail emissions in 2015 reflect Metro's continued expansion of rail service and continued modernization of the bus fleet. Total fleet emissions in 2015, including hydrocarbon (HC), oxides of nitrogen (NO_x), and exhaust particulate matter (PM), are 8.2% lower as compared to 2014, and 72.4% lower as compared to 2008. As Metro continues to replace and repower buses with the newest technology engines, emission reductions will continue as all of the older, higher-emitting buses are replaced or repowered with state-of-the-art engines.

METRO'S PROGRESS



2011



Adopted Green Construction Policy (GCP).

Metro's GCP ensures all construction projects utilize less polluting equipment and employ best practices to meet or exceed air quality standards.

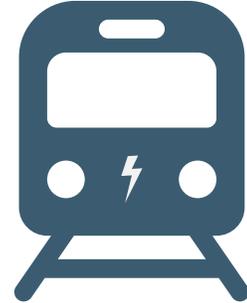
2015



Reduced 8.2% criteria air pollutant emissions due to modernization of Metro's CNG bus fleet.

Transit buses were repowered with low-emitting state-of-the-art CNG engines, directly contributing to the reductions in HC, NO_x, and PM criteria air pollutant exhaust emissions.

2022



Reduce NO_x emissions.

Metro is on track to achieve its goal of reducing 80% NO_x emissions by 2022 compared to 2008.

METRO REDUCED ITS NO_x EMISSIONS, AN OZONE PRECURSOR CRITERIA POLLUTANT, BY 72.6% COMPARED TO 2008 LEVELS.

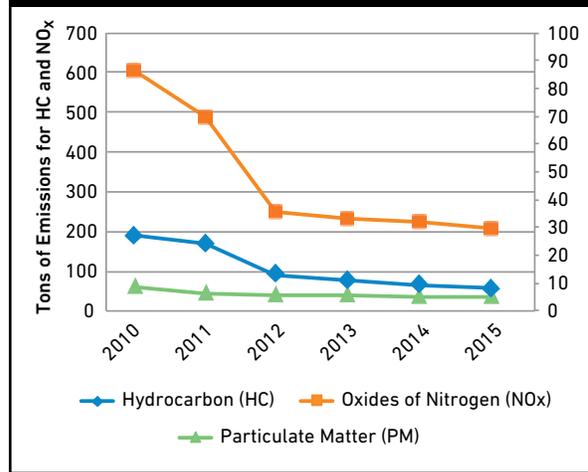


OVERVIEW

A comparison of 2015 fleet criteria air pollutant emission levels to 2014 levels shows reductions in all criteria air pollutants with the exception of carbon monoxide (CO) (Figure 22). In comparing 2015 fleet criteria air pollutant emission levels to those previously calculated for 2014, Metro's overall fleet emission levels for HC, NO_x, and PM have been reduced by approximately 11.2%, 7.4%, and 5.9%, respectively. This is shown below in Table 4. These 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.

A notable consequence of bus engine repowering is the increase in CO emissions. The current state-of-the-art urban bus engine is the 2016 Cummins-Westport ISL G 8.9 liter engine, and while this engine offers reductions in NO_x emissions, it does so at the expense of higher CO emissions. Thus, it is anticipated that total fleet emissions will show an overall increase in future years due to increased CO emissions, even as NO_x and PM emissions continue to decline. This engine has certified NO_x emissions that represent a 90% decrease in NO_x emissions as compared to previous engine models. Thus, the new Cummins-Westport ISL G engine offers Metro an effective criteria air pollutant strategy

Figure 22: Historic Criteria Air Pollutant Emissions



for future transit bus repowers and purchases. 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. As the current level of CO emissions is well under the limit established for the Los Angeles region, it is more critical to reduce NO_x emissions in Metro's operation.

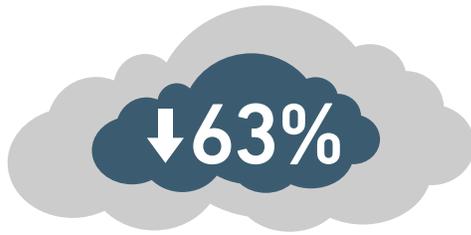
Table 4: Historic Criteria Air Pollutant Emissions

Fleet Emissions (tons per year)	2014 Bus	2014 Rail	Total 2014 Emissions	2015 Bus	2015 Rail	Total 2015 Emissions	Fleet Wide Change (Tons)	Percent Change
Hydrocarbon (HC)	62.4	2.7	65.1	55.2	2.6	57.8	-7.3	-11.2%
Oxides of Nitrogen (NO ₂)	133.5	91.2	224.7	120.8	87.3	208.1	-16.6	-7.4%
Particulate Matter (PM)	2.5	2.7	5.2	2.3	2.6	4.9	-0.3	-5.9%
TOTALS	198.4	96.6	295.0	178.3	92.5	270.8	-24.2	-8.2%

"+"= Increase in fleet emissions

"-"= Decrease in fleet emissions

KEY ACCOMPLISHMENTS



NO_x reduction in LAX Crenshaw Project

GREEN CONSTRUCTION POLICY

Metro adopted the GCP in 2011 to help reduce air quality impacts to surrounding communities by utilizing less polluting equipment and employing best practices to meet or exceed air quality emission standards. As a result of the GCP, the use off-road vehicles with Tier-4 rated engines resulted in a 63% reduction in emissions of NO_x during the extension of the Crenshaw/LAX Metro Line.



RETIREMENT OF DIESEL BUS FLEET

Metro retired 100% of its diesel transit bus fleet. This eliminated Metro's contribution of diesel PM, which is classified as a toxic air contaminant by the California Air Resources Board and is a known carcinogen.

NEXT STEPS

- > Continue to transition Metro's bus fleet to utilize cleaner fuel and advanced technology.
- > Expand the GCP.



INDICATOR AREA

OPERATION AND EFFICIENCY

Metro serves as Los Angeles County's premier transportation agency and is dedicated to providing the County with safe, clean, and reliable transit options. Planning, developing, and operating the region's transportation system requires an all-encompassing outlook on its role in the region. Metro is dedicated to the continuous development of an efficient and effective transportation system for the County. 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 its impact on the environment.

OVERALL PERFORMANCE 

2013



Vehicle miles traveled (VMT) has been on a downward trend since 2007, despite the increasing population in Los Angeles County.

There were 215.8 million daily VMT in 2013, which is the latest year this system has been updated.

2015



Bus service remained the dominant transit mode among Los Angeles County's transit rider population.

Approximately 76% of transit trips are occurring by bus (includes Metro-operated and non-Metro-operated bus service and bus rapid transit [BRT]). Bus ridership has decreased as a portion of Metro's overall transit services, consistent since peaking in 2007.

2016



Metro has focused dollars on long-term rail investments.

Metro's current major investments lie in expanding the rail system, which will continue to influence declining bus services. This is supported by Measure R spending on high-profile rail systems that are less used per unit cost than the more heavily used bus service.

METRO AIMS TO ADD AND IMPROVE TRANSPORTATION AMENITIES THROUGHOUT THE COUNTY TO INCREASE BOARDING AND PASSENGER MILES, WHILE COMMITTING TO REDUCE ITS IMPACT ON THE ENVIRONMENT.



VEHICLE MILES TRAVELED PER CAPITA

VMT has been on a downward trend since 2007, despite the increasing population in Los Angeles County. According to the Census Bureau's population estimate for 2015, the total population of Los Angeles County was 10.2 million, an increase of 1% since 2014. According to the Highway Performance Monitoring System California Public Road Data, there were 215.8 million daily VMT in 2013, which is the latest year this system has been updated. 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.

In 2008, 43% of transit stations had no bike parking. Now that number is below 18%.



UNLINKED PASSENGER TRIPS

In 2015, Metro experienced a 4.9% decrease in overall ridership, from 468 million boardings in 2014 to 445 million boardings in 2015. Declines in ridership can be attributed to a variety of factors such as lower gas prices, rise of ride-sharing services, fare increases, and a variable rate of employment in the region. The largest decline in ridership occurred in Metro-operated bus service and heavy rail, which experienced ridership decreases of 5.2% and 4.9%, respectively. Light rail, non-Metro-operated bus service, and BRT also experienced ridership declines of 3.9%, 4.3%, and 3.7%, respectively. Vanpool experienced a slight increase in ridership of 0.5%, but accounted for less than 1% of total Metro ridership.

Vehicle revenue hours (VRH) increased by 1% in 2015 from 2014. This constitutes the third consecutive year of increases in VRH. The most significant increase in revenue hours occurred in vanpool services, which increased 5.6% in 2015 from 2014. Historically, the trend for VRH has generally followed the ridership trend. However, in 2015, the increase in VRH is opposite the ridership trend, which decreased by 4.9%.

In 2015, bus service remained the dominant transit mode among Los Angeles County's transit rider population, with 76% of transit trips occurring by bus (includes Metro-operated, non-Metro-operated bus service, and BRT) (**Figure 23**). Similar to the last two years, heavy rail and light rail combined accounted for 24% of total transit trips.

Vanpool service experienced a 5.6% increase in ridership from 2014, which equates to a cumulative 67% growth since 2010. Despite this growth, vanpool represents less than 1% of the ridership for all of Metro's services. BRT service was reported as a separate transit mode starting in 2012. BRT ridership continued to decline since 2013, with a 3.7% decrease in ridership from 2014 to 2015. Similarly, Metro-operated bus service and non-Metro-operated bus service experienced a 5.2% and 4.3% decrease,

Figure 23: Boardings by Transit Mode

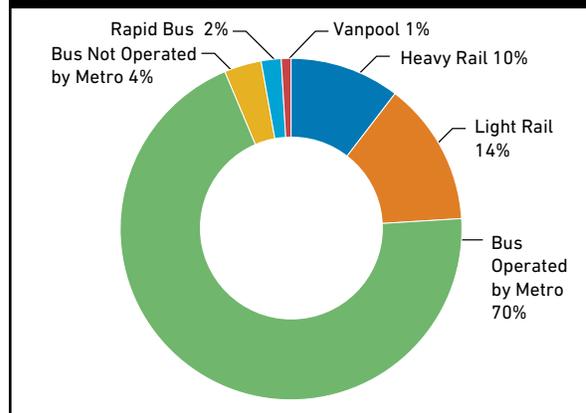
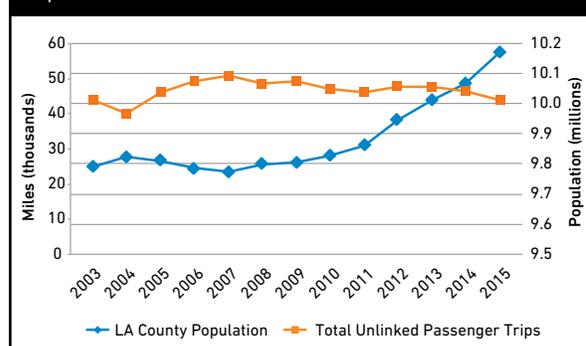


Figure 24: Unlinked Passenger Trip per Capita vs. Population Growth



respectively, in ridership from 2014 to 2015. Bus ridership has decreased as a portion of Metro's overall transit services, consistent since peaking in 2007. Metro's current major investments lie in expanding the rail system, which will continue to influence declining bus services. Despite this, as of 2015, bus ridership still remains an overwhelming majority of Metro's services.

Contrary to historical trends, unlinked passenger trips (UPT) per capita show that ridership decreased between 2009 and 2011 and again between 2013 and 2015 despite increases in regional population. Los Angeles County has steadily increased in population every year since 2007. In 2015, UPT per capita declined to 43.8 after remaining steady at 46 to 48 trips per capita since 2010 (**Figure 24**).

OPERATING EXPENSES

As a measure of the sustainability triple bottom line (economic, environmental, and social), annual operating expenses and efficiency data reveal trends over the years to track Metro's progress towards achieving its sustainability goals.

OVERALL PERFORMANCE

In 2015, overall boarding for all transit modes decreased 4.9% and overall passenger miles traveled (PMT) decreased 3.7% from 2014. The dominant transit mode for boardings in 2015 was Metro-operated bus (**Figure 25**). In 2015, Metro's operating expenses were approximately \$3.16 per boarding, which represents a 7.9% increase (23 cents) from 2014 after adjusting for inflation. Metro's operating expenses were approximately \$10.95 per revenue mile, which represents a 2% increase (22 cents) from 2014.

Overall, the number of boardings per \$1,000 of operating expenses has decreased since 2012, resulting in a reduction of operating expense efficiency per boarding (**Figure 26**). Operating expense efficiency per revenue mile has decreased marginally to 91 revenue miles per \$1,000 (**Figure 26**). Metro spent 69% of total operating expenses on bus service, while 74% of Metro's total ridership rode a Metro-operated or non-Metro-operated bus in 2015. In 2012, a new category was added for Metro-operated BRT, which constitutes approximately 2% of the overall boarding and operating expenses in 2015. Light rail continues to be the only transit mode whose portion of operating expenses exceeds its ridership contribution.

Figure 25: Operating Expenses by Transit Mode

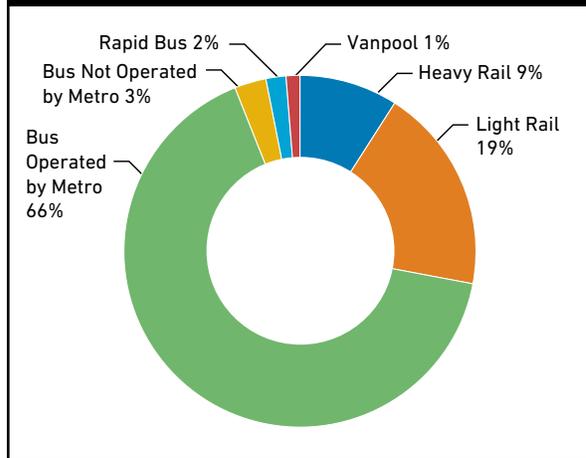


Figure 26: Historic Operating Expense Efficiency



In 2015, overall boarding for all transit modes decreased 4.9% and overall passenger miles traveled decreased 3.7% from 2014.



BUS SERVICE

In 2015, Metro-operated bus service had approximately 334 boardings per \$1,000 operating cost, totaling 32 fewer boardings than in 2014. In 2015, non-Metro-operated bus had approximately 383 boardings per \$1,000 operating cost, 19 fewer boardings than in 2014.

In terms of revenue miles per operating cost, there were 74 revenue miles traveled per \$1,000 operating cost, which is a slight decrease from 2014 at 76 revenue miles. Non-Metro-operated bus continued to decline in revenue miles traveled per operating cost at 135 revenue miles per \$1,000 operating cost in 2015, compared to 136 revenue miles in 2014. Bus service continues to be more efficient in the number of revenue miles per cost compared to rail service but less efficient compared to vanpool.

LIGHT RAIL

Boardings per operating expense for light rail decreased to 228 boardings per \$1,000 in 2015 compared to 244 boardings in 2014. In terms of revenue miles, there were approximately 51 boardings per \$1,000 in operating expenses in 2015, compared to 54 boardings in 2014. This represents a continuation of decreased efficiency in light rail since 2013.

HEAVY RAIL

Boardings per operating expense for heavy rail decreased each year since 2010 with 365 boardings per \$1,000 in 2015. This is a slight decrease from 369 boardings per \$1,000 operating expense in 2014. In terms of revenue miles, there were approximately 54 revenue miles traveled for every \$1,000 operating cost. Despite a decrease in heavy rail ridership from 2014 to 2015, there is a slight uptick in efficiency from 2014, which had 53 revenue miles traveled per \$1,000 operating cost, but still less than 2013, which had 58 revenue miles traveled per \$1,000 operating cost.

RAPID BUS

As a new transit category item beginning in 2012, Metro-operated Rapid Bus (BRT) 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 with 326 boardings per \$1,000 operating cost in 2015. Compared to 2014, boardings per operating expense decreased 2%, a slight decrease in efficiency. These decreases in efficiency may be attributed to expected fluctuations in ridership in the beginning years of a new transit mode. Similar to Metro-operated bus, revenue miles traveled per \$1,000 operating expense for BRT remained the same as 2014 at 76 revenue miles per \$1,000 operating cost.

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 27). In 2014 and 2015, there were 231 and 230 boardings, respectively, per \$1,000 operating cost as efficiency remained fairly constant. Overall, compared to other modes, vanpool operating cost per boarding is on the higher side with a cost of \$4.35/boarding, which is only exceeded by light rail at \$4.39/boarding. Other Metro mode choices range from \$2.61/boarding for non-Metro operated bus to \$3.07/boarding for BRT.

When capturing cost per revenue mile, vanpool becomes a much more effective means of travel. Vanpool has the lowest operating cost by far of all modes at \$0.55/mile. In 2015, PMT for vanpool was approximately 45.6 miles, which far exceeded other Metro transit modes that ranged from 4.2 miles to 6.6 miles per trip (Figure 28). This makes sense as vanpool by nature is more direct and faster from Point A to Point B, allowing people to travel further distances more efficiently. As a result, compared to other modes, which vary from \$0.47 to \$0.70 operating cost per passenger mile, vanpool has a very low operating cost per passenger mile at \$0.10 (Figure 29). In situations where other modes may not be appropriate, vanpool can provide a good alternative to single occupant vehicle use.

Metro opened 34 new miles of carpool lanes.

Figure 27: Vanpool Ridership and Operating Expenses

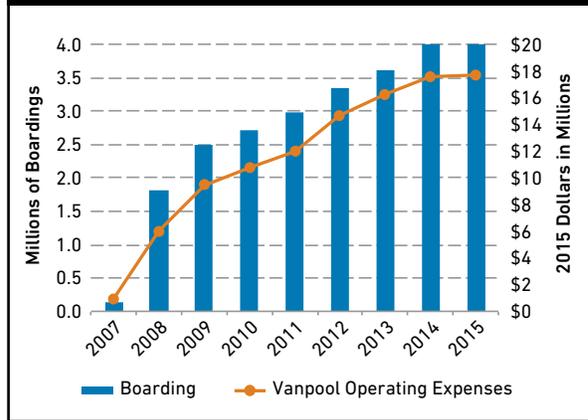


Figure 28: Passenger Miles Traveled per Trip

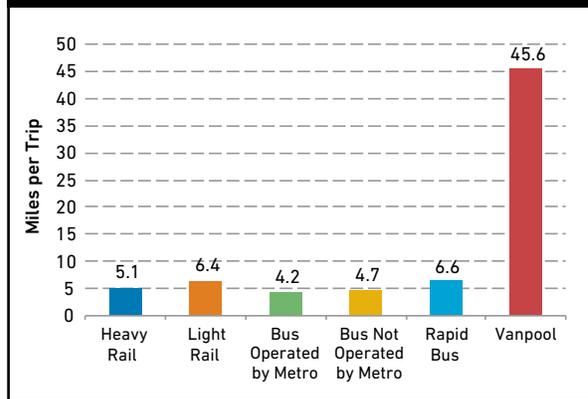
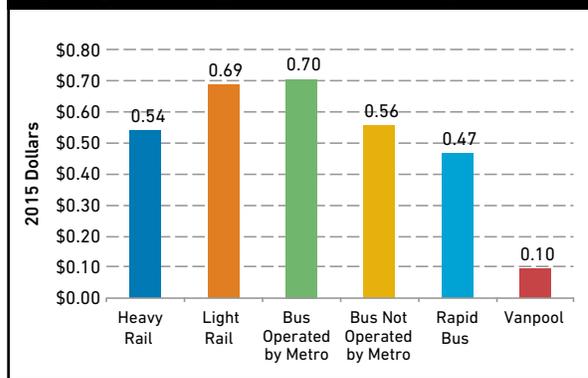


Figure 29: Operating Expenses per Passenger Miles





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MOVING FORWARD

Metro strives to be responsible for the continuous improvement of an efficient and effective transportation system in Los Angeles County. Metro focuses on efforts to ensure that the agency equitably continues to balance a growing presence in the region while seeking to reduce its overall impact on the environment.



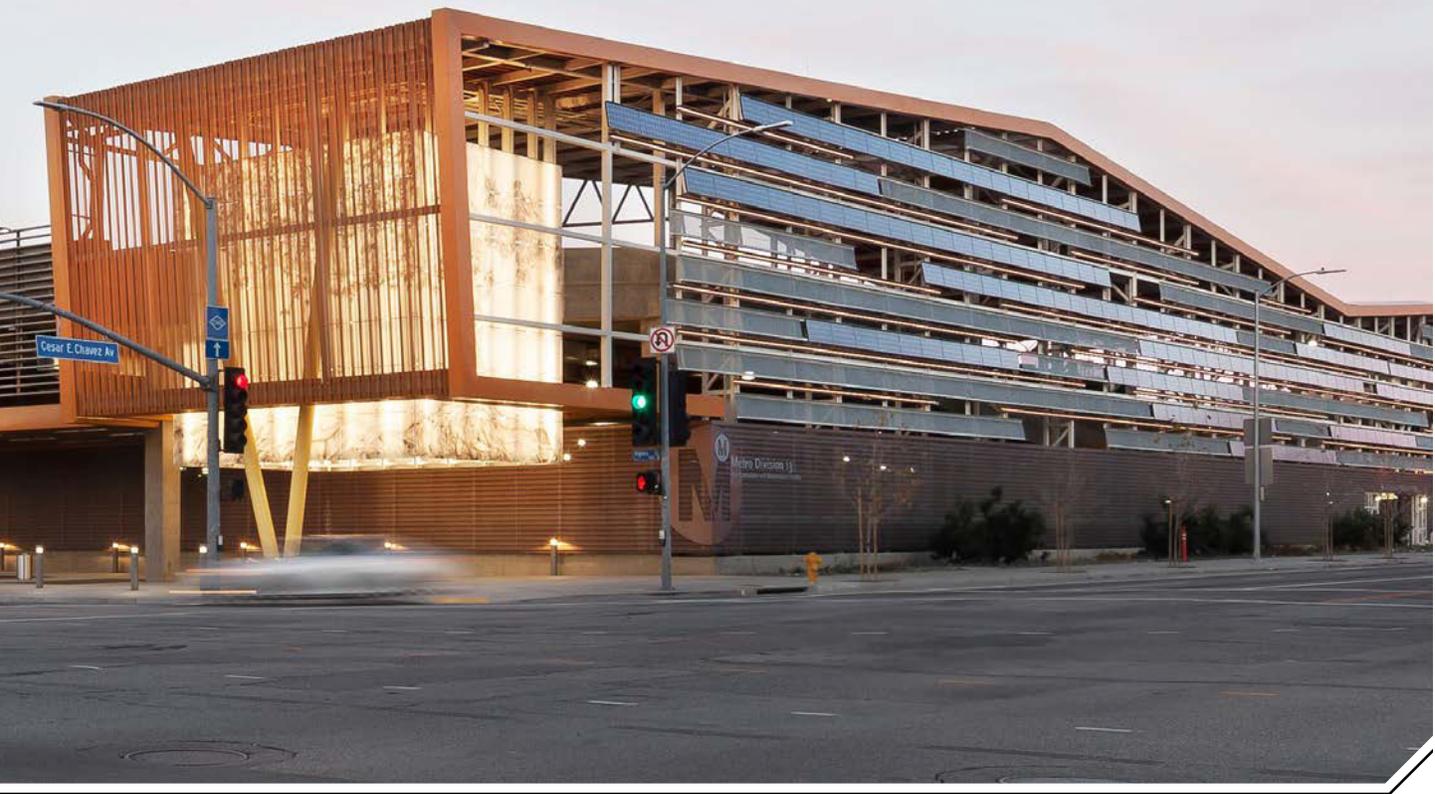
The passage of Measure R in 2008 has allowed Metro to establish and/or expand a number of transit services for residents of Los Angeles County. More than 480,000 residents gained access to new rail or BRT services, including:

- > Expo Line Phase I and II
- > Gold Line extension to East Los Angeles and Azusa
- > Orange Line extension to Chatsworth

These new rail and BRT services provide transit access to more than 300,000 jobs in the region. Altogether, these recently completed projects and those currently in the works are expected to create more than 425,000 construction jobs, benefiting the local economy with \$51 billion in direct spending on construction projects alone and \$80 billion in total economic output.

These expanded transit services also contribute to a reduction in regional emissions. With the completion of Expo Phase II and Foothill Extension (now in operation) and pending completion of Regional Connector, Crenshaw/LAX, and the Purple Line Extension, additional GHG emissions displacement as a result from mode-shift, congestion relief, and land use changes, are estimated to be as much as 3,300 MT CO₂/year.

Metro's commitment to sustainability plays an integral role in the agency's ability to provide clean, efficient transit services. Metro's extensive operations and ambitious capital program, which serve to expand public transit service, also provide a significant opportunity to support policies that aim to reduce impacts from future construction projects, foster economic growth and social equity, and promote agency resiliency. Metro will continue to disclose its sustainability performance in its annual Energy and Resource Report and strengthen its role as a sustainability-oriented transportation agency.



METRO'S PROJECTED CONTRIBUTIONS TO REGIONAL GHG EMISSION REDUCTIONS BY 2040

As Metro expands its rail, bus, or vanpool services, it will increasingly contribute to regional GHG emission reductions via mode-shift, congestion relief, and land use changes. Metro recently expanded or is in the process of expanding the following rail lines:

- > Exposition Light Rail Transit (opened in 2016)
- > Metro Gold Line Foothill Extension (opened in 2016)
- > Regional Connector
- > Purple Line Extension
- > Crenshaw/LAX

Based on the projected PMT on these lines, which is a function of the number of stops on the lines, their length, running time, and estimated boardings, by the next three decades, these lines will likely increase the displacement of GHG emissions by approximately 1,700 to 3,300 MT CO₂e on an annual basis. These estimated GHG reductions include the effects of mode-shift, congestion relief, and land use changes. The impacts of mode-shift and congestion relief are estimated using guidance from APTA. GHG reductions from land use changes are calculated based on guidance provided by APTA and a study by ICF on Quantifying the Influence of Transit on Land Use Patterns in Los Angeles County.



NOT IN SERVICE

Metro Rail

BIKE PATH
NO MOTOR VEHICLES
OR
MOTORIZED BICYCLES



APPENDIX

This appendix 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 2016 were used along with the most reliable sustainability guidelines to develop this report. Additional data constraints are discussed in the Reporting Methodology.

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 2016 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. More information can be found at <http://www.apta.com/mc/internationalpracticum/program/Documents/Quantifying-and-Reporting-Transit-Sustainability-Metrics.pdf>.

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 traveled (VMT); 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.

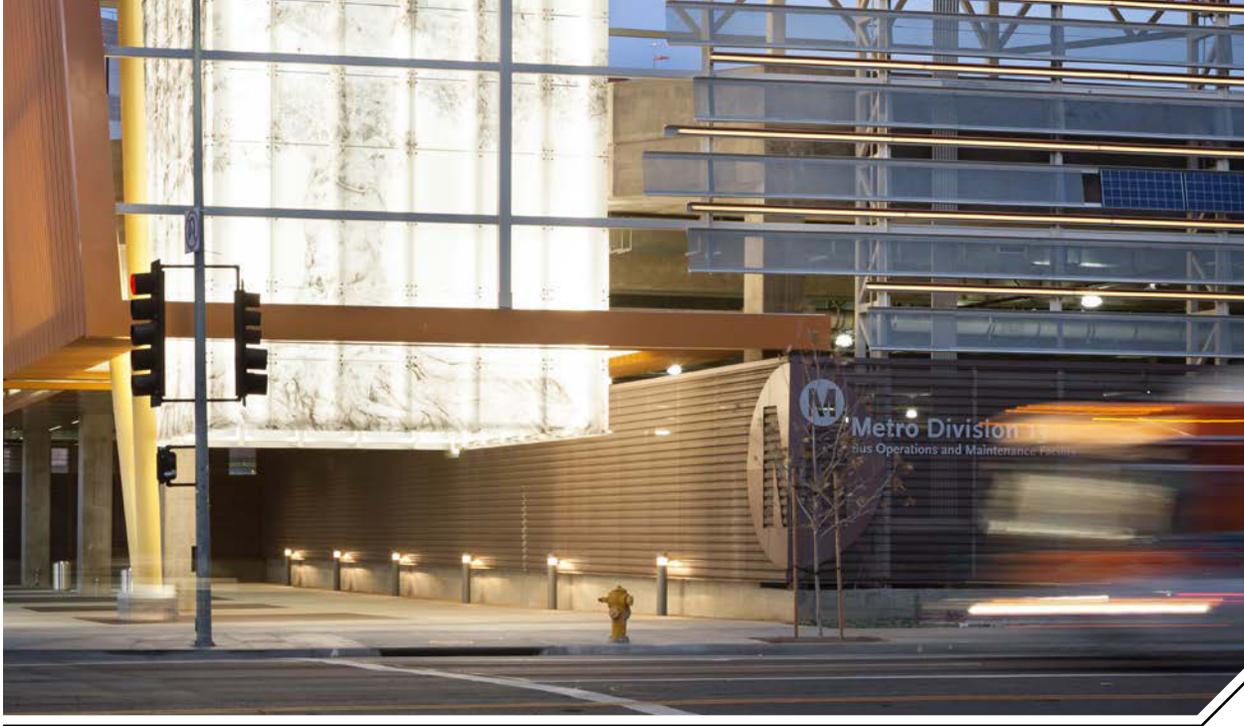
VEHICLE REVENUE HOURS (VRH)

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.

Metro's core mission is to provide efficient and effective transit service to the Los Angeles region.



GREENHOUSE GAS (GHG)

As with previous years, 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 metric tons of carbon dioxide-equivalent (MT CO₂e), which are derived by multiplying the tonnage of individual GHGs by their respective GWPs. 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 perfluorocarbons (PFCs) or hydrofluorocarbons (HFCs) are used as end-products in equipment for their 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 from 2012 to 2015 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 overcounting of emissions from gasoline and diesel consumption of Metro's non-revenue vehicles.
- > Overcounting 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, the GHG methodology used in the 2015 and 2016 reports may differ 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 2015 and 2016 reports; whereas in past years, this source of emissions was not included. Furthermore, the 2015 and 2016 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 Environmental Protection Agency guidance.

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 2016 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 Submeter 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. Submeters are currently being installed at a number of divisions so more accurate data will be available for subsequent reports.

> Meter Reclassification: In the 2016 report, some of the electricity meters classified as rail propulsion in the 2015 report analysis were moved to facility electricity, and similarly, meters were shifted from major facility to facility electricity. This rearrangement was conducted as more accurate information was provided for these meters. The reclassification of these meters between rail propulsion, major facility, and facility electricity partly attributes to the change in energy consumption of each of these three categories when compared to the 2015 report individually. However, this reclassification does not affect the overall electricity consumption analysis. In this year's analysis, there are many electricity and water meters which are new or were not present in the 2015 report's data; conversely, there are a number of meters in the 2015 report that are no longer online (i.e., no information is available). This can be attributed to a change in meter or service address name or to a meter closure.

> All dollars presented in this report are 2015 U.S. dollars, unless otherwise noted.





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Metro's 2016
Energy and Resource Report

Los Angeles County
Metropolitan Transportation Authority

