

Appendix A – Sustainability Inventory

This document presents key data snapshots from Sound Transit’s 2015 Annual Sustainability Progress Report and identifies patterns of resource use compared to earlier years of performance.¹ The report provides a snapshot of performance data in 2015 as well as, for the first time, illustrating performance data trends over a multiple year period.

Sound Transit has made a number of valuable improvements to the quality and sustainability of its service over time. Notably, the agency continued to grow its ridership more quickly than its use of natural resources, resulting in increased efficiency in nearly all resource categories compared to baseline years (2010-2011). Some key findings include the following:

- Ridership continued to grow, reaching nearly 35 million boardings - an increase of nearly two million from 2014.
- Total resource use and emissions increased in some areas as the agency expanded service on the existing system, ramped up for new service in 2016 and beyond, and increased staffing. However, per boarding and passenger mile traveled, resource use generally decreased.
- Air pollution from Sound Transit operations decreased significantly due to improved emissions control technologies on newer ST Express buses and upgrades to Sounder commuter rail engines. Nearly all Criteria Air Pollutants have decreased since 2011, including particulate matter, volatile organic compounds, nitrogen oxides, and carbon monoxide.

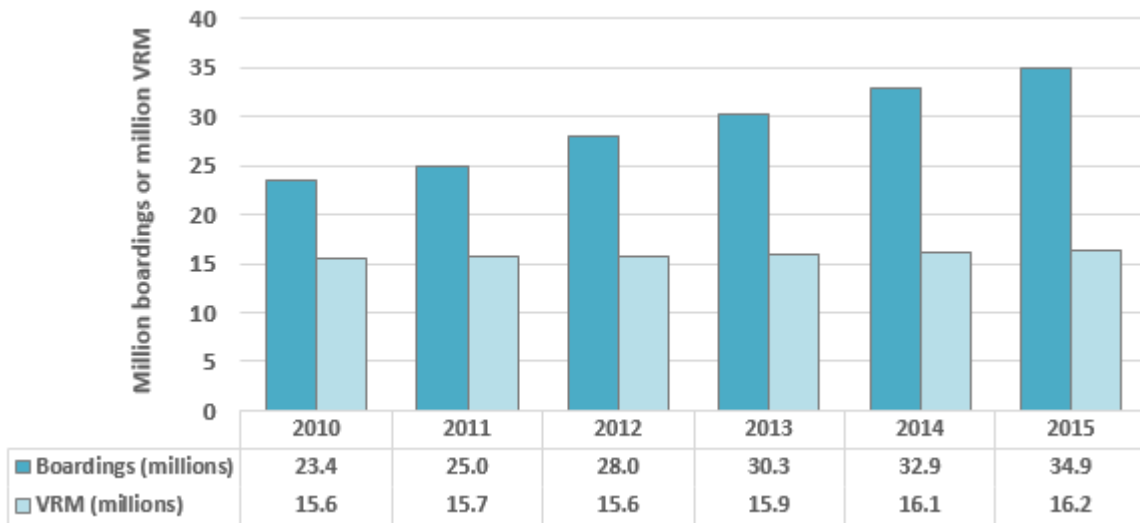
The rest of this document illustrates resource use trends over time from baseline years (2010 or 2011, depending on data) and the preceding inventory year, 2014. In the following graphs, solid bars indicate total emissions, resource use and resource costs. The trend lines show the relationship between the totals and passenger miles traveled to illustrate how efficiently Sound Transit is using that resource as the agency grows.

Ridership

Ridership has increased, growing by 49 percent since 2010 and reaching nearly 35 million boardings (unlinked passenger trips) in 2015. Ridership has increased while the level of service, measured by vehicle revenue miles, has remained relatively constant, demonstrating that more and more people are using Sound Transit service every year. Figure 1 below shows the total growth plus the increasing trend of boardings per mile of service.

¹ Baseline year data vary for certain resource categories due to data constraints. Sounder data are available at the granularity needed to use the AFLEET tool starting in 2011; therefore, the data categories that draw on Sounder data—criteria air pollutants, greenhouse gases and energy use—show trends with a baseline year starting in 2011. Trends for all other data type have a baseline year of 2010.

Figure 1. Ridership, 2010-2015



Measuring Efficiency

Ridership has important implications for resource use; as the agency grows and serves more passengers, total resource use increases. To understand how efficiently the agency is growing and operating, Sound Transit tracks resource use normalized by passenger boardings as well as vehicle revenue miles and passenger miles traveled.

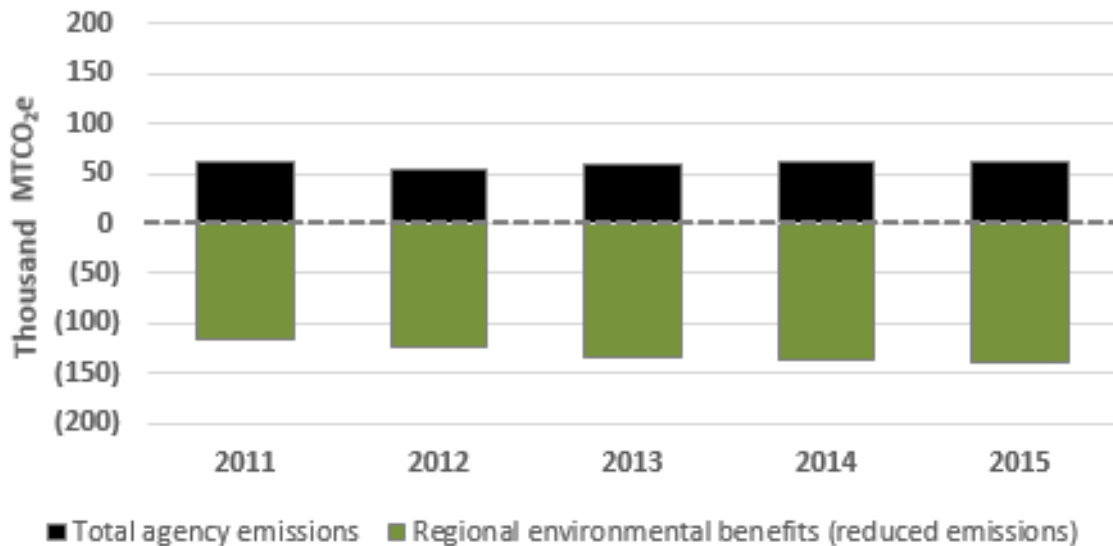
Using National Standards

Sound Transit and the other signatories of the American Public Transportation Association (APTA) Sustainability Commitment use a standard set of metrics developed by APTA to measure annual progress. Passenger miles traveled represents both a measure of boardings and vehicle revenue miles, tracking both growth in service and increases in ridership. Using passenger miles traveled to normalize data allows Sound Transit to compare resource use over time using a single, consistent metric.

Regional Environmental Benefit

Increased transit reduces regional environmental impacts. As more people choose transit over driving, fuel and greenhouse gas (GHG) emissions are saved throughout the region. Greenhouse gas emissions savings are one strong measure of the regional environmental benefit produced by transit. Sound Transit follows a methodology developed by APTA and The Climate Registry to account for savings from transit ridership, measured as carbon dioxide equivalents (CO₂e), as shown in Figure 2 and Table 1. Greenhouse gas emissions can also serve as a proxy for fuel use savings.

Figure 2. Regional Greenhouse Gas Emissions (CO₂e) and Benefits, 2011-2015



As seen in Figure 2, Sound Transit saves more GHG emissions than it emits. For every ton of GHG Sound Transit emits, in 2015 the region avoids 2.2 tons of emissions through the benefits of transit. The regional environmental benefits shown in Figure 2 (in green) include the benefits from people taking transit instead of driving (mode shift) and the related congestion relief; these benefits have consistently been at least twice the agency's emissions (in black) over the past five years.

Table 1. Regional Greenhouse Gas Emissions Benefits, 2015

Regional tonnes CO ₂ e Saved			
Mode Shift Benefits	Congestion Benefits	Land-Use Benefits	Total Benefits
98,459	39,178	259,610	397,248
Displacement ratios - CO ₂ e units saved in the region per unit of CO ₂ e from Sound Transit operations			
Mode Shift Benefits	Congestion Benefits	Land-Use Benefits	Total Benefits
1.6	0.6	4.2	6.4

In the 2015 Sustainability Progress Report, Sound Transit reports the benefits from mode shift and congestion relief, but not land use change, because the data for this metric are not yet as robust as for the other two metrics. As shown in Table 1, the land use change benefits appear even more substantial, however, with a 4 to 1 ratio of benefits to emissions based on Sound Transit's ridership. The definitions for each of the identified types of benefits are below:

- **Mode shift benefits** measure the reduced GHG emissions (amount displaced) resulting from shifting from one mode of transportation (e.g., single occupancy vehicle) to another (e.g., transit), measured on a per-passenger-mile basis.
- **Congestion benefits** quantify the secondary effect of transit—opening roadway capacity, which may result in smoother traffic flow and fewer stops, starts, and traffic jams. (Note: The number reported above was calculated using data from Texas Transportation Institute’s 2012 Urban Mobility Report, the most recently published report.)
- **Land use change benefits** measure the reduced carbon outputs due to the denser land use patterns supported by transit systems.

Resource Use

Overall resource use has been increasing over time, reflecting Sound Transit’s expanded system and service. Most increases in resource use have been in line with service changes and ridership increases as well as operational equipment changes, as described further in the sections below. Figure 3 below shows the change in total resource use and emissions from 2014 to 2015, while Figure 1 shows the efficiency of resource use from 2014 to 2015 (the total normalized by passenger mile traveled [PMT]). Remaining figures show trends in specific resource categories over time.

Figure 3. Change in Total Resource Use and Emissions, 2014 - 2015

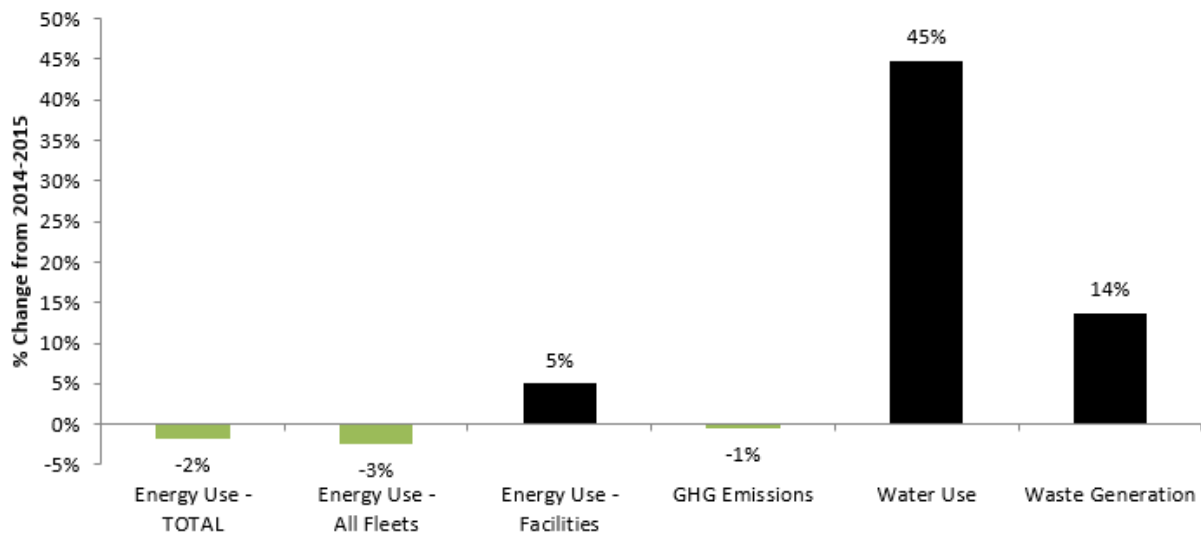
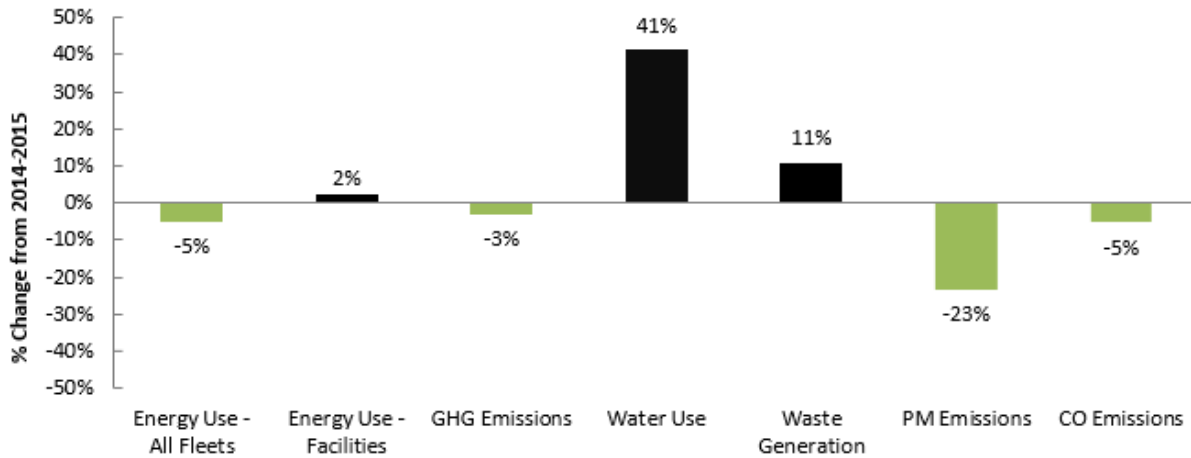


Figure 4. Change in Resource Use and Emissions per PMT, 2014-2015



Fleet Energy Use

Fleet energy use across Sound Transit’s three modes—ST Express bus service, Sounder commuter rail and Link light rail—has been increasing slowly over time as more service has been provided. However, service has generally become more efficient per passenger and PMT.

- Sounder fuel use varies slightly from this trend over the past five years due to weather and service changes. Sounder trains idle when the outside temperature is below 45 degrees F. Sounder diesel usage can vary with changes in weather; thus, warmer winter weather in 2015 led to a reduction in fuel used for idling. However, operational efficiencies were also implemented - Sounder train engines were upgraded, and wayside power was fully implemented in 2015, further reducing overall diesel fuel usage.
- Fleet energy use overall has increased 7 percent since 2011, although fleet energy use per PMT has decreased 16 percent.
 - Traction power electricity use for Link light rail grew by 13 percent during that time period;
 - Diesel fuel for Sounder and ST Express bus service increased by 7 percent; and compressed natural gas (CNG) use in ST Express buses decreased by 4 percent.

Figure 5 below shows the trend in fleet fuel use over time. Table 2 below shows the percent change in energy use between 2014 and 2015 per mode, as well as the percent change in efficiency (the total normalized by PMT).

Table 2 shows the change in fleet fuel use since 2014 by mode.

Figure 5. Revenue Fleet Energy Use, 2011-2015

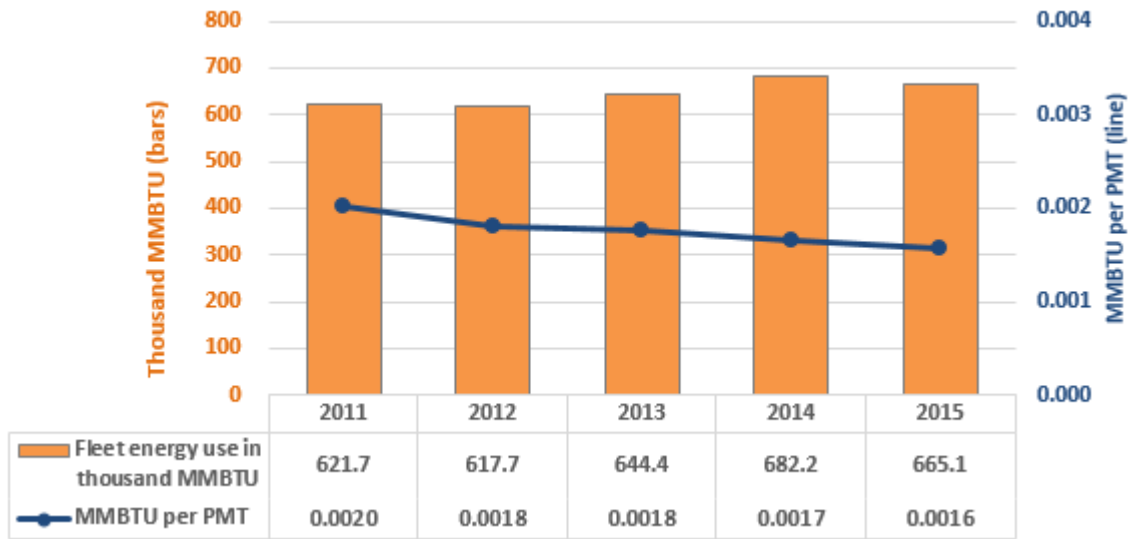


Table 2 below shows the percent change in energy use between 2014 and 2015 per mode, as well as the percent change in efficiency (the total normalized by PMT).

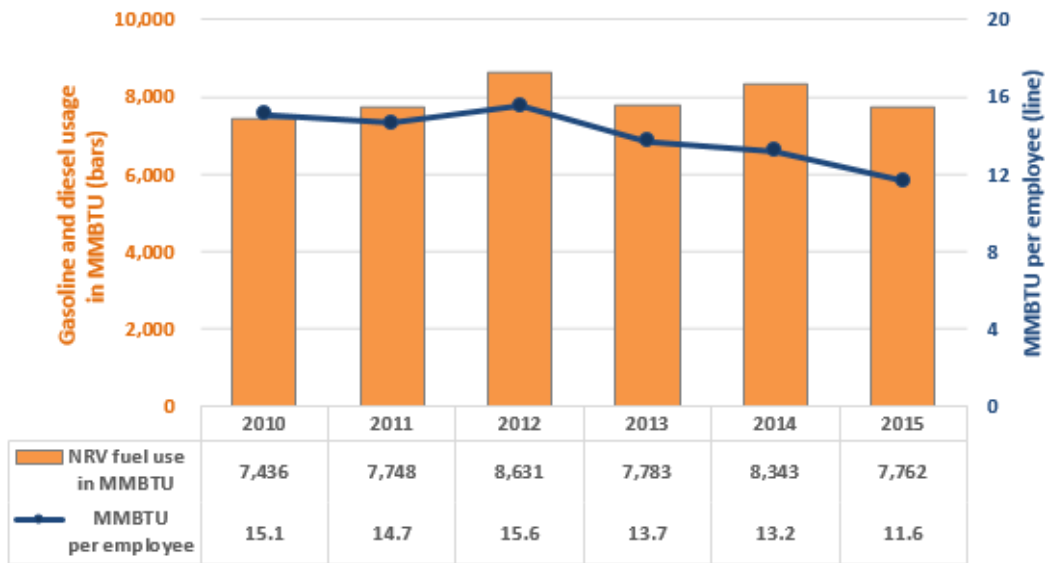
Table 2. Change in Energy Use by Mode, 2014-2015

Mode	% Change in Total Energy Use	% Change in Energy Use per PMT
Sounder Commuter Rail (diesel)	-9%	-23%
ST Express Buses (diesel and natural gas)	-1%	-3%
Link light rail traction power (electricity)	5%	16%

Non-Revenue Fleet Energy Use

Energy use for the agency’s non-revenue fleet has remained relatively stable over time as shown in Figure 6; since 2010, it has increased less than 1 percent. While the agency’s headcount and active projects have increased every year, resulting in more driving, Sound Transit has also purchased more hybrid vehicles, helping to reduce per-mile energy use and air pollutant emissions.

Figure 6. Non-Revenue Fleet Energy Use, 2010-2015

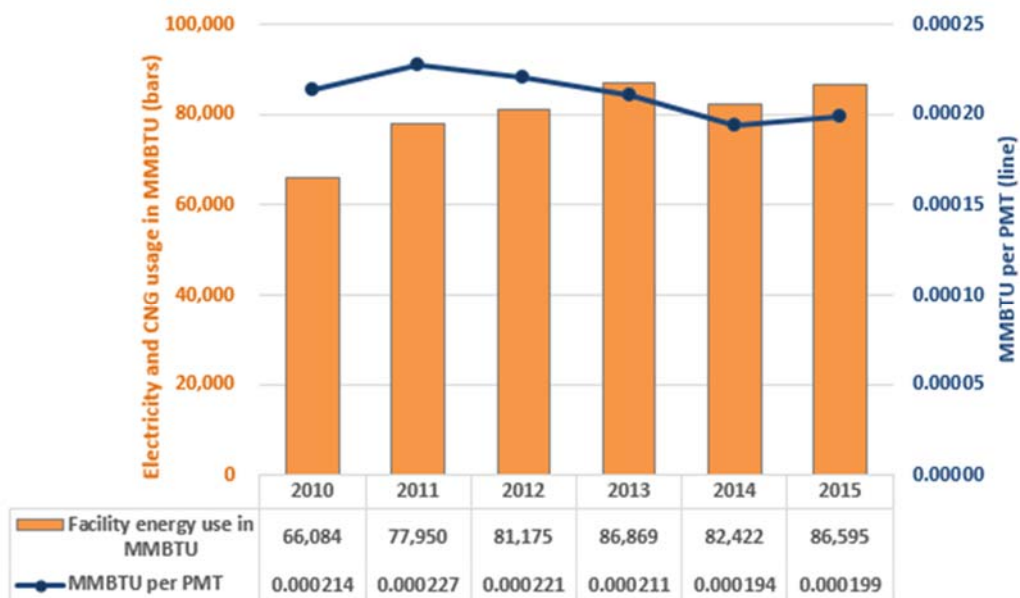


Facility Energy Use

Energy use at Sound Transit facilities, shown in

Figure 7, is generally dependent on agency growth and weather. Facility energy use has increased 11 percent over the past five years as the agency has increased its staff as well as brought new stations and facilities online. The drop in energy use in 2014 was due to fewer heating degree days that winter, reducing the need for space heating, a boiler upgrade at the Link Operations and Maintenance Facility and improved operational practices at other maintenance facilities. Sound Transit also conducted LED lighting upgrades at several facilities as well as HVAC upgrades at Union Station in 2013.

Figure 7. Facility Energy Use, 2010-2015



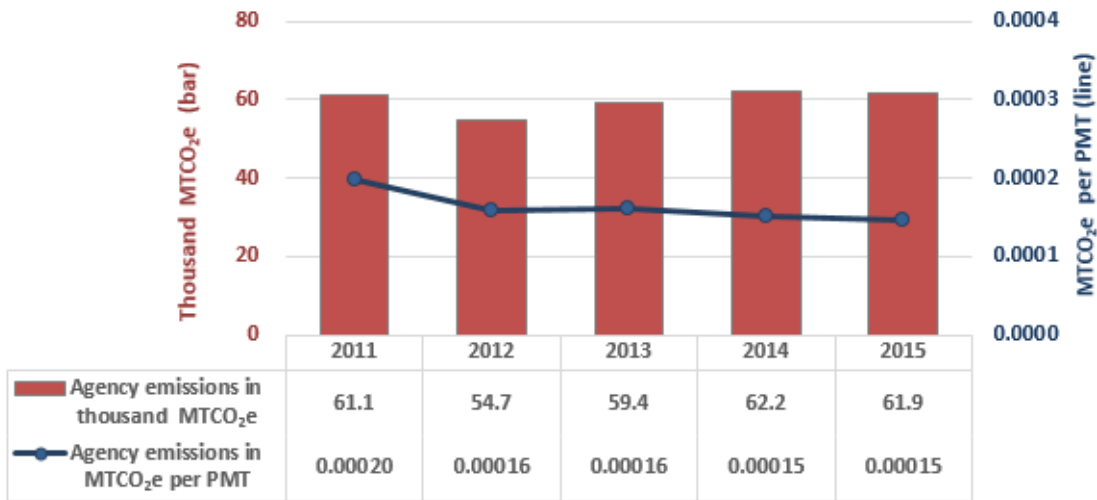
Air Pollutant Emissions

Sound Transit’s air pollutant emissions are a result of its fuel and electricity consumption. The sections below shows the trends in GHG emissions and criteria air pollutant production.

Greenhouse Gas Emissions

As service and ridership has increased, total agency GHG emissions have remained relatively stable over the past five years. Additionally, emissions per PMT have been decreasing, as shown in Figure 8.

Figure 8. GHG Emissions, 2011-2015



Criteria Air Pollutants

Criteria air pollutants (CAPs) contribute to smog and health issues such as asthma and heart attacks. Sound Transit’s CAPs—including particulate matter (PM₁₀), volatile organic compounds, nitrogen oxides, carbon monoxides (CO) and sulfur dioxides—have declined significantly over the past few years. This decrease is primarily driven by fleet turnover as older, less efficient vehicles are used less and newer vehicles with better emissions control technologies make up a larger percentage of the agency’s fleet. The agency has also worked to overhaul all Sounder commuter rail engines to reduce air pollution.

Figures 9 and 10 below show the decrease in total PM₁₀ and CO production over time as well as the decrease per PMT since 2011. These CAPs were down 21 percent and 3 percent overall since 2011, respectively. These reductions are even more dramatic per PMT.

Figure 9. Particulate Matter (PM₁₀), 2011-2015

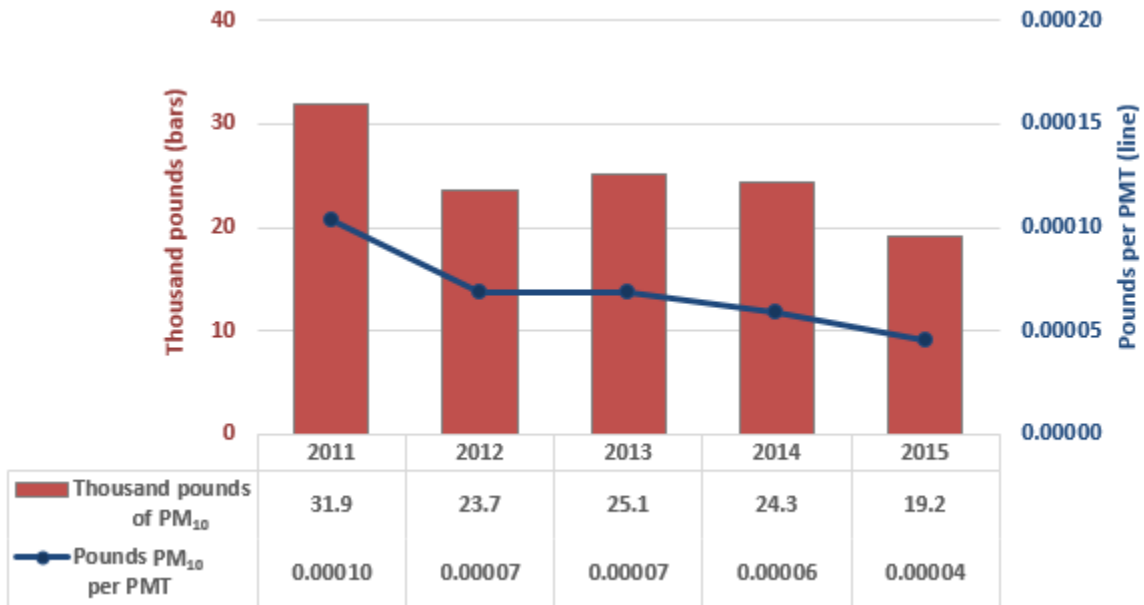
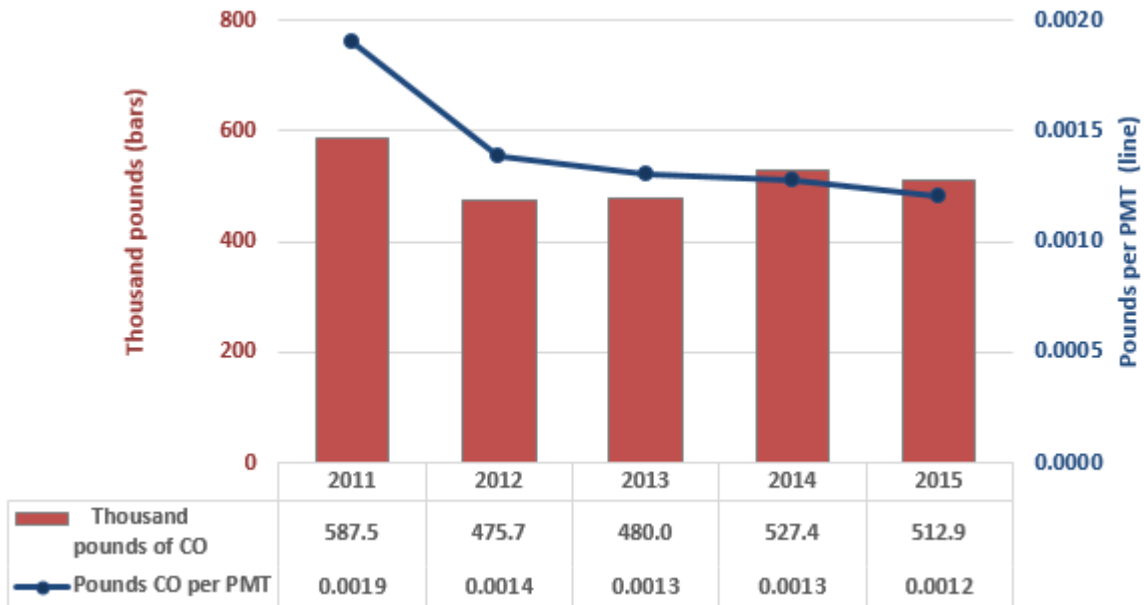


Figure 10. Carbon Monoxide (CO), 2011-2015

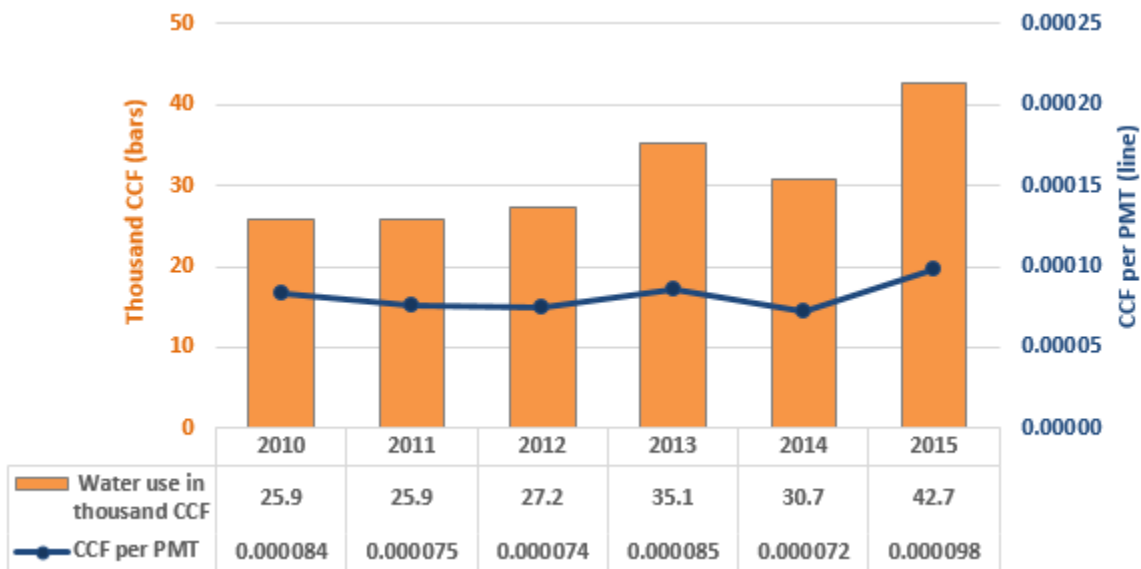


Water Use

Water use overall has increased 70 percent over the past five years with increased agency headcount and expanded service, although water use for various functions has fluctuated considerably. This is an area that the agency will continue to monitor closely in order to better manage water resources and understand the fluctuating trends.

- Water use at customer facilities has generally grown over time, and the increases in 2013 and 2015 were substantial. Customer facility water use is largely driven by landscape irrigation, and the drought conditions of summer 2015 as well as a drier summer in 2013 led to much higher water use.
- In 2014, water use decreased as several large leaks were repaired, landscaping plants at several facilities reached maturity, and a rain sensor was installed at Union Station.
- Usage increased again in 2015, however, due to drought, a leak at SODO Station, and the addition of new facilities, including Sounder’s Tukwila Station and the Bonney Lake Park-and-Ride lot.
- Maintenance facilities also substantially increased water use over time as the fleet of revenue and non-revenue vehicles has grown, resulting in additional vehicle washings.

Figure 11. Water Use, 2010-2015

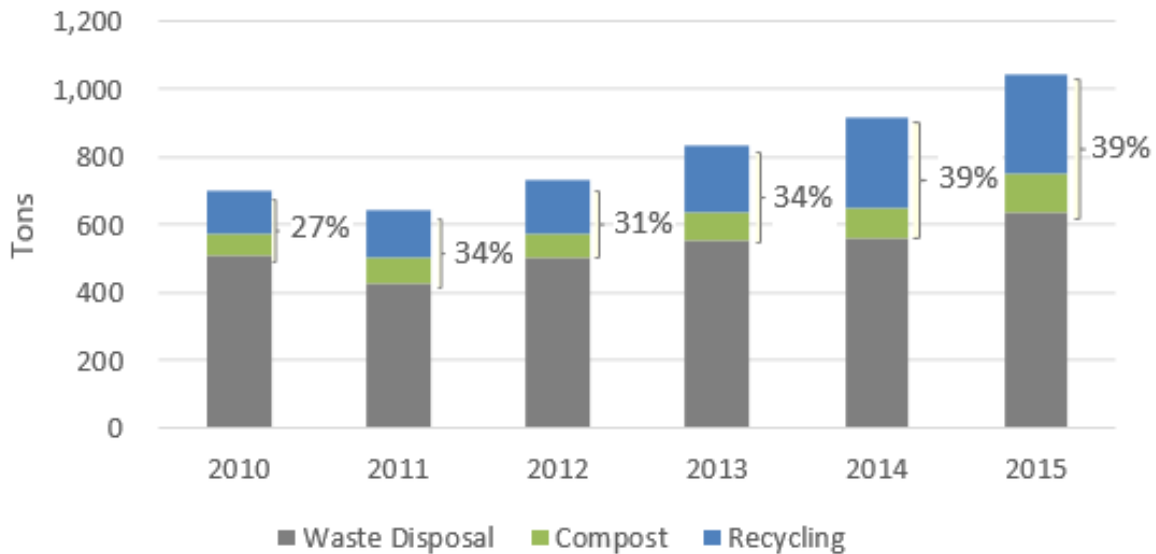


*1 CCF equals 100 cubic feet or 748 gallons

Waste Generation

Waste generation at Sound Transit facilities has increased 49 percent over the past five years as service and agency staff have increased. The rate at which recyclables and compost has been diverted from the landfill (diversion) has also trended upward. Diversion from the waste stream has increased since 2013 due to improved recycling education and implementation of paper towel composting in the restrooms at Union Station.

Figure 12. Waste Generation and Diversion, 2010-2015



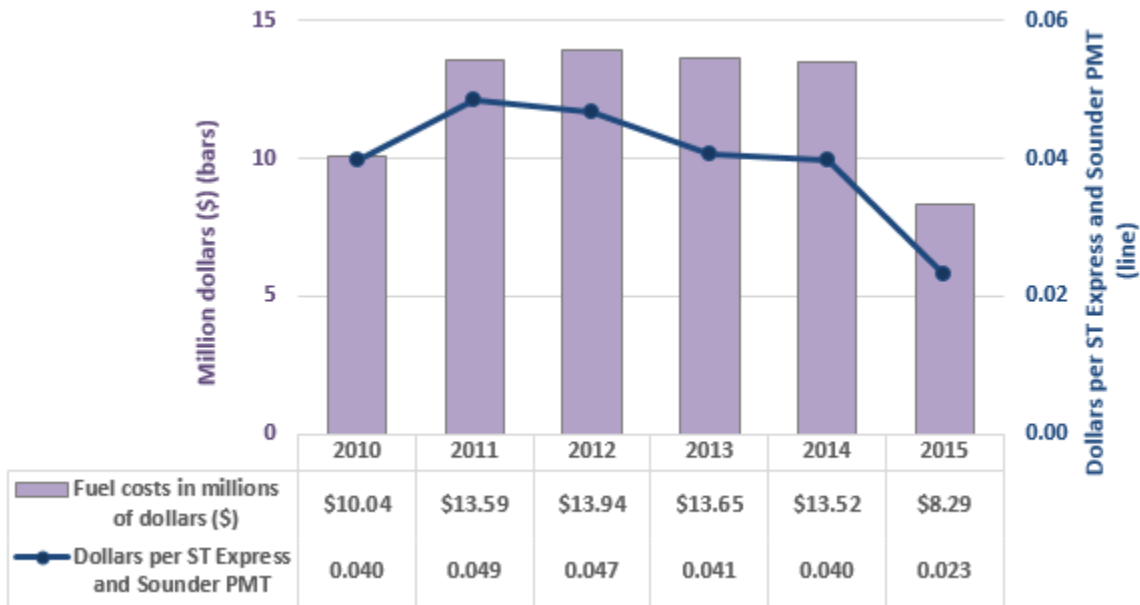
Utility Expenses

Costs for nearly every resource category have trended upward over the past five years, with the exception of diesel fuel and natural gas.

Fuel Costs

- Oil and gas prices nationally have fallen dramatically since 2014; diesel fuel prices dropped 37 percent from 2014 to 2015 (from \$2.98 to \$1.88), the lowest average price in the past five years.
- Transit vehicle fuel makes up the bulk of Sound Transit's utility expenses; from 2010 to 2014, transit vehicle fuel accounted for 83 percent of Sound Transit's total utility costs on average.
- Because fuel use decreased in addition to the lower price of diesel, transit vehicle fuel costs were down 39 percent and accounted for 72 percent of the agency's total utility expenses in 2015. The cost of fuel from Sounder and ST Express are shown in Figure 8.

Figure 8. Sounder and ST Express Diesel Fuel Costs, 2010-2015

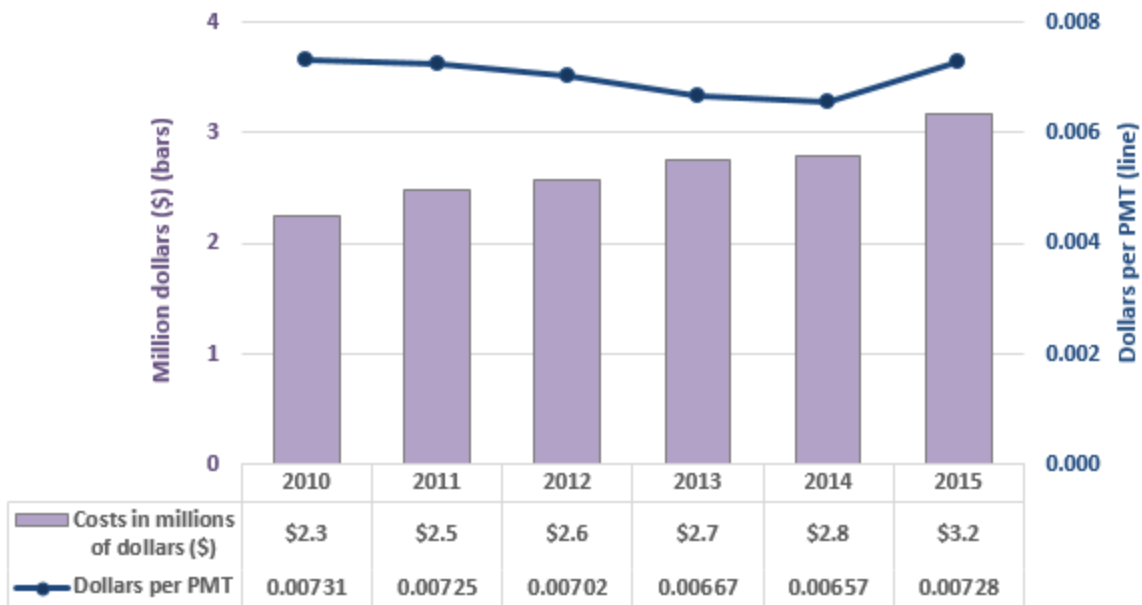


Utility Expenses

Other utility expenses for electricity, water, and waste have increased over time in line with usage trends. Figure 14 below demonstrates the change in utility costs since 2010.

- Total electricity costs have increased by 63 percent, water costs by 43 percent, and waste costs by 172 percent from 2010 to 2015. However, as natural gas prices have been more volatile, the agency’s gas expenses have fluctuated more than the other resource categories.

Figure 9. Utility Costs (excluding transit vehicle fuel), 2010-2015



Appendix B – 2015 Sustainability costs and savings

This table shows some of the major costs and savings from annual sustainability targets. Some significant program costs and savings are captured here. However, sustainability is integrated into many projects in ways that make it difficult to represent direct costs and benefits in these terms.

PROJECT	YEAR	CAPITAL COSTS	2015 SAVINGS	SAVINGS TO DATE	PAY-BACK YEAR	DESCRIPTION
CAPITAL INVESTMENT PAID BACK						
ST Express mid-day bus storage	2008	\$0	\$101,419	\$1,713,680	2008	This program allows Pierce County buses to stay in Seattle until the afternoon commute to avoid driving back and forth empty – saving over 60,000 gallons of fuel in 2015.
Souder Automatic Engine Start-Stop System	2009	\$230,596	\$60,455	\$483,019	2013	This equipment shuts down Souder commuter rail engines when not in use, reduces engine idling time by about 34 percent and significantly reduces air pollution.
Central Link OMF sewer deduct meter	2012	\$2,600	\$36,147	\$119,467	2012	This Central Link light rail Operations and Maintenance Facility meter reduces water costs by accounting for irrigation water that does not enter the wastewater stream.
Souder Lakewood-Seattle wayside power	2010 2013	\$490,000	\$95,809	\$535,914	2015	Electric wayside power units were installed in Tacoma in 2010 and then moved to Lakewood in 2013, where more units were added.

PROJECT	YEAR	CAPITAL COSTS	2015 SAVINGS	SAVINGS TO DATE	PAY-BACK YEAR	DESCRIPTION
CAPITAL INVESTMENT PAID BACK IN 5-7 YEARS						
Souder Everett-Seattle wayside power	2011	\$315,000	\$15,982	\$181,559	2017	Electric wayside power units are used instead of the commuter rail locomotives' diesel engines to heat and power coach cars during layover, reducing diesel use and air pollutants.
Federal Way Transit Center lighting upgrades	2013	\$603,000	\$31,626	\$83,126	2019	Four transit facilities were retrofit for energy efficiency upgrades. Lighting upgrades were made at Federal Way Transit Center and Kent and Auburn Souder commuter rail stations. Union Station had upgrades made to its heating, ventilation and air conditioning (HVAC) system and controls. The 2015 Savings and Savings to Date columns in this chart only electricity savings. However, the payback period estimate reflects grants and utility rebates
Kent Station lighting upgrades	2013	\$111,995	\$5,923	\$24,421	2019	
Auburn Station	2013	\$219,503	\$12,824	\$28,518	2019	

Appendix C – 2015 Sustainability–related grants

GRANT SOURCE	PROJECT NAME	YEAR	AWARD	DESCRIPTION
Washington State of Good Repair	Clean Green Fleet Replacement	2013	\$5M	This project replaced seven, 40-foot conventional diesel buses at the end of their useful life with high-capacity, diesel-hybrid buses. This provides additional seating capacity (20+ seats per bus) on some of the ST Express bus routes with the highest ridership in the region.
Puget Sound Regional Council & Federal Transit Administration CMAQ	Diesel Retrofit of Commuter Rail Locomotives	2014	\$5.3M	This grant enables Sound Transit to retrofit four to five Sounder Commuter Rail locomotive engines from Tier 0 to Tier 3 emissions standards. The 15-year old, locomotive engines will be upgraded to newer, Tier 3 EPA-certified engines, which are more fuel-efficient and have better emission control technology.
Puget Sound Regional Council & Federal Transit Administration Section 5307	Tacoma Link Expansion Vehicles	2014	\$6M	Funds will be used to procure approximately six additional light rail vehicles for the expansion of Tacoma Link light rail. Light rail service conserves fuel and reduces emissions because it is powered by electrical power, which is cleaner than gasoline and diesel fuel.
Federal Transit Administration	Transit-Oriented Development Planning Pilot Program	2015	\$2M	This project consisted of engineering and streetscape design for transit access improvements and station area enhancements around the Tacoma Link Expansion project. This project will also focus on job access needs and identify barriers that currently limit the Tacoma Hilltop residents from participation in existing workforce training and apprenticeship programs.