KEY

SEE:
Table 6, p14 "Underway section"
page 21
page 23:
"Thermal recovery" means CHPs (combined heat and power plants.)
ENTERING INTO ESCO AGREEMENTS AT THEIR HEADQUARTERS means putting a small gas plant on their roof to make electricity for the building and replace the steam heat they get from the gas plant in Grays Ferry. The Nicetown "Midvale Complex" isnot mentioned here because it is not a NEW agreement with ESCO. It is already agreed to.

SEPTA+ SUSTAINABILITY™

SEPTA 2018 ENERGY ACTION PLAN

A Strategy to Reduce Energy Consumption & GHG Emissions

February 2018

SEPTA Energy Action Plan

A Strategy to Reduce Energy Consumption & GHG Emissions

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EXECUTIVE SUMMARY

In 2012, SEPTA published its first comprehensive Energy Action Plan with goals to reduce energy consumption and greenhouse gas emissions, while simultaneously adhering to a Board-adopted Sustainability Program Plan goal of "budget-neutrality". From 2012 to 2016, implementation of initiatives outlined in the 2012 Energy Action Plan, reduced SEPTA's emissions 94,058,748 lbs CO2-equivalent (9 percent from baseline 2006) and energy consumption by 266,951 mmBtu.

Now, SEPTA is publishing its second generation Energy Action Plan. The 2018 Plan will update and extend SEPTA's commitment to reduce energy consumption and GHG emissions by introducing 15 new initiatives through 2026. The 2018 plan continues the principle of "budget neutrality" for initiatives included in the plan and offers three strategies for achieving this standard:

- Leveraging energy savings to finance capital projects
- Securing grants and financial incentives; and
- Implementing operational strategies that achieve energy savings

The 2018 Energy Action Plan's emissions reduction targets are based on a goal to reduce GHG emissions by 80 percent by 2050 ("80x50"), a widely accepted target around the world as a benchmark for avoiding the catastrophic impacts of climate change. The Plan takes a ten year outlook (2016-2026) consisting of two, five year phases. The first phase, from 2016-2021, includes initiatives that SEPTA has committed to executing. The second phase of the Plan, from 2021-2026, includes initiatives that SEPTA is committed to explore as a way to further reduce emissions and improve energy efficiency.

A commitment included in this plan is to issue an expression of interest (EOI) for future renewable energy procurements from off-site power purchase agreements, the results of which could accelerate emission reductions from electricity consumption. To be conservative, the Plan does not model these additional prospective emission reductions. Even without them, the modeled results of the Plan exceed the 80x50 benchmark.

Implementation of the 2018 Energy Action Plan will achieve several of SEPTA's Sustainability Program goals, including:

- GHG Emissions Reductions
- Energy Consumption Reductions
- Infrastructure & Operational Resilience
- Budget Neutrality

The 2018 plan reaffirms SEPTA's continued efforts to reduce energy consumption and GHG emissions related to the operation of both facilities and vehicles through constant evaluation and continual improvement. This plan does not focus on opportunities for the broader transportation sector to reduce energy consumption and GHG emissions through various policies and actions that encourages increase transit ridership and reduced private automobile use, which has an even greater emissions reduction impact. Those strategies are being pursued as part of SEPTA's broader Sustainability Program.

Summary of 2018 Energy Action Plan

	Initiative Category	Initiative	Focus Area	Source Impact	Energy Impact (mmBtu)	GHG Impact (lbs CO_2-E)
1	Committed	**ESCO Master Plan (pg 23)**	Energy Efficiency & Clean Energy	Natural Gas, Electricity, Steam & Heating Oil	(185,924)	(21,071,783)
2		**Hybrid-Electric Buses (pg 22)**	Energy Efficiency	Diesel	(91,468)	(15,549,624)
3		**Bus Network Planning (pg 25)**	Energy Efficiency	Diesel	(49,816)	(8,463,737)
4		**WESS Build-Out (pg 24)**	Energy Efficiency	Electricity	(23,202)	(5,672,026)
5		**Solar Power Purchasing Agreement (pg 27)**	Clean Energy	Electricity	(12,480)	(3,050,993)
6		**Employee Engagement (pg 28)**	Employee Engagement	Electricity	(44,067)	(5,431,322)
7		**Electric Buses (pg 26)**	Clean Energy	Diesel & Electricity	(14,290)	(2,101,777)
8		**Service Vehicle Normal Replacements (pg 24)**	Energy Efficiency	Diesel	(4,525)	(764,290)
9	Possible Opportunities	**Convert 300 Hybrid-Electric Buses to Zero Emission Buses (pg 34)**	Energy Efficiency & Clean Energy	Diesel & Electricity	(250,102)	(35,474,434)
10		**Convert Remaining 100 Diesel Buses to Hybrid-Electric or Zero Emission (pg 34)**	Energy Efficiency & Clean Energy	Diesel & Electricity	(99,058)	(14,539,258)
11		**ESCO at Remaining Backshops/Depots (pg 30)**	Energy Efficiency	Electricity	(74,797)	(10,793,422)
12		**Phase 2 : Solar PPA (pg 33)**	Clean Energy	Electricity	(21,844)	(5,340,205)
13		**Expanded Use of Thermal Recovery (pg 32)**	Energy Efficiency	Natural Gas & Heating Oil	(18,193)	(2,446,886)
14		**VW Settlement Funding for Utility Fleet Upgrades (pg 32)**	Energy Efficiency	Diesel & Gasoline	(21,653)	(193,734)
15		**Offsite Renewable Power Purchasing Agreements (pg 34)**	Clean Energy	Electricity	N/A	N/A
2018 ENERGY ACTION PLAN IMPACT			**TOTAL POTENTIAL IMPACT**		**(911,419)**	**(130,893,492)**

SECTION 1: INTRODUCTION

1.1 - CONTEXT FOR PLAN

The GHG emissions reduction goals outlined in the 2018 Energy Action Plan are pursuant to SEPTA's Sustainability Program's, Board-adopted SEP-TAINABLE 2020 framework. Both the 2018 Energy Action Plan and SEP-TAINABLE 2020 track SEPTA's production of GHG emissions from electricity and fuel consumed to power vehicle fleets and facilities.

While SEP-TAINABLE 2020 reports both gross (total, non-normalized) and normalized (total, divided by passenger miles traveled) GHG emissions, goals are only established for normalized GHG. Normalizing emissions is an industry best practice and recommendation from the American Public Transportation Association (APTA). Normalizing emissions by passenger miles traveled measures the positive environmental impact of a transit system. While transit is inherently sustainable, a full bus is more sustainable than a half-full bus. SEPTA's goal is to increase ridership with no increase to GHG emissions.

Unlike SEP-TAINABLE 2020, the 2018 Energy Action Plan will only report the gross (total, non-normalized) GHG associated with implemented initiatives, committed initiatives and future opportunities. However, all initiatives outlined in this plan will assist in SEPTA's ability to meet the SEP-TAINABLE 2020 normalized GHG goal to reduce normalized GHG emissions by 20 percent by 2020 from a 2015 baseline.

The 2018 Energy Action Plan's gross emissions reduction targets are based on a goal to reduce GHG emissions by 80 percent by 2050, a target that has become widely accepted and adopted in the United States. The Plan takes a ten year outlook (2016-2026) consisting of two, five year phases. The first phase, from 2016-2021, includes initiatives that SEPTA has committed to executing. The second phase of the Plan, from 2021-2026, includes initiatives that SEPTA is committed to explore as a way to further reduce emissions and improve energy efficiency.

1.2 - PURPOSE & PRINCIPLES

SEPTA transports 1.1 million trips across southeastern Pennsylvania each day on buses, trolleys, and trains. These services pay economic dividends: the five counties of southeastern Pennsylvania represent 41 percent of the Commonwealth of Pennsylvania's economic output with 32 percent of its population and 24 percent of its registered vehicles on just five percent of its land mass.[6] It would be impossible to sustain this degree of economic productivity and density without a high-caliber transit system moving people throughout the region.

SEPTA's services pay environmental dividends as well, reducing GHG emissions from regional transportation by more than 3:1 ratio – for every unit of emissions from SEPTA's system and services, three units are displaced through fewer and shorter trips in less environmentally friendly private auto travel.

Nevertheless, public transportation is itself an energy intensive business. Acknowledging this, SEPTA has committed to continually evaluating new methods to reduce energy consumption and GHG emissions from vehicle fleets and facilities. The goal of this plan is to carry that commitment forward with a measurable plan to achieve ambitious yet attainable reduction goals.

1Findings from Economy League of Greater Philadelphia & Econsult Solutions, Inc's "Understanding SEPTA's Statewide Economic Value" Report.

The 2018 Energy Action Plan carries forward the principled implementation approach from the 2012 plan, pursuing projects that meet the following criteria:

- Budget Neutrality: Strategies must be able to stand on their own financial merit, either through revenue generation, cost savings, grant funding, or performance contracting
- Leveraging Existing Assets: Strategies must focus on improving the efficiency of SEPTA's existing system and services
- Providing Multiple Benefits: Strategies must adhere to SEPTA's triple bottom line (economic - social - environmental) framework for determining return on investment

These principles will support energy consumption and GHG emissions reduction goals regardless of budgetary conditions. Implementing the strategies recommended in this plan will increase organizational efficiency, reduce costs, and improve upon SEPTA's position as a sustainable mobility clean for southeastern Pennsylvania.

1.3- DATA SOURCES & ASSUMPTIONS

SEPTA uses six energy sources in its system and services. Four of the six sources represent on-site combustion: diesel, natural gas, gasoline, and heating oil. The remaining two sources (electricity and steam) represent purchased energy, where combustion occurs elsewhere. Transmission losses from local grid electricity consumption are applied where data is available.

This plan uses globally accepted and region-specific conversion factors to create a comprehensive energy and GHG emissions inventory. For historical reference Table 1 provides a summary of conversion factors and energy factors for 2006, Table 2 shows 2012 factors, and Table 3 shows current 2016 factors. GHG emissions from electricity have reduced as the grid's emission factor has improved from 2010-2016. Energy conversion factors were applied based on guidance from the Federal Transit Administration (FTA).[2] GHG emissions factors published in The Climate Registry (TCR), Energy Information Administration (EIA), and the Delaware Valley Regional Planning Commission (DVRPC) were applied based on guidance established by the American Public Transportation Association (APTA)[3] and are in line with the City of Philadelphia's emissions reporting. All data is reported on a calendar year (CY) in accordance to The Climate Registry. Energy units are normalized and reported in mmBtu[4] ; GHG emissions are reported in pounds of carbon-dioxide equivalents (CO2-E).[6]

Carbon dioxide, methane, and nitrous oxide are all greenhouse gases released in the burning of fossil fuels. To account for the cumulative warming impact of these three gases, the warming impact of methane and nitrous oxide are normalized to the same warming potential as carbon dioxide to create a streamlined metric through units of CO2-E measuring the total warming impact of use of any particular fuel.

2 Factors were derived from guidance published for the Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER) discretionary grant program.
3 Methodology derived from guidance published under the APTA "Recommended Practice for Quantifying & Reporting Greenhouse Gas Emissions."
4 A unit of energy (heat) content used to normalize values across different energy sources – mmBtu = 1,000,000 mBtus.
5 SEPTA's greenhouse gas inventory tracks the following emissions sources and their global warming potential (GWP) to measure carbon-dioxide equivalents (CO2-e): carbon dioxide (GWP: 1); methane (GWP: 21); nitrous oxide (GWP: 310). For the purposes of this analysis, a multiplier of 1.00505 was used to reflect the estimated incremental value of methane and nitrous oxide emissions.

TABLE 1: 2006 CONVERSION FACTORS

ENERGY				GHG EMISSIONS			
Source	Unit of Use	Factor	Unit	Unit of Use Conversion		Factor	Unit
Diesel	Gal	0.1290	mmBtu/gallon	22.38	Lbs CO_2-E/Gal	174.30	CO_2-E /mmBtu
Electricity	kWh	0.0034	mmBtu/kWh	1.146	Lbs CO_2-E/kWh	337.60	
Natural Gas	ccf	0.1029	mmBtu/ccf	11.90	Lbs CO_2-E/ccf	116.28	
Gasoline	Gal	0.1150	mmBtu/gallon	19.42	Lbs CO_2-E/Gal	169.74	
Heating Oil	Gal	0.1387	mmBtu/gallon	22.33	Lbs CO_2-E/Gal	161.83	
Steam	mlbs	1.1940	mmBtu/mlbs	273.66	Lbs CO_2-E/mlbs	230.40	

TABLE 2: 2012 CONVERSION FACTORS

ENERGY				GHG EMISSIONS			
Source	Unit of Use	Factor	Unit	Unit of Use Conversion		Factor	Unit
Diesel (B2)	Gal	0.1290	mmBtu/gallon	21.93	Lbs CO_2-E/Gal	170.90	CO_2-E /mmBtu
Electricity	kWh	0.0034	mmBtu/kWh	1.06	Lbs CO_2-E/kWh	312.04	
Natural Gas	ccf	0.1029	mmBtu/ccf	11.90	Lbs CO_2-E/ccf	116.28	
Gasoline	Gal	0.1150	mmBtu/gallon	19.42	Lbs CO_2-E/Gal	169.74	
Heating Oil	Gal	0.1387	mmBtu/gallon	22.33	Lbs CO_2-E/Gal	161.83	
Steam	mlbs	1.1940	mmBtu/mlbs	134.1	Lbs CO_2-E/mlbs	112.90	

TABLE 3: 2016 CONVERSION FACTORS

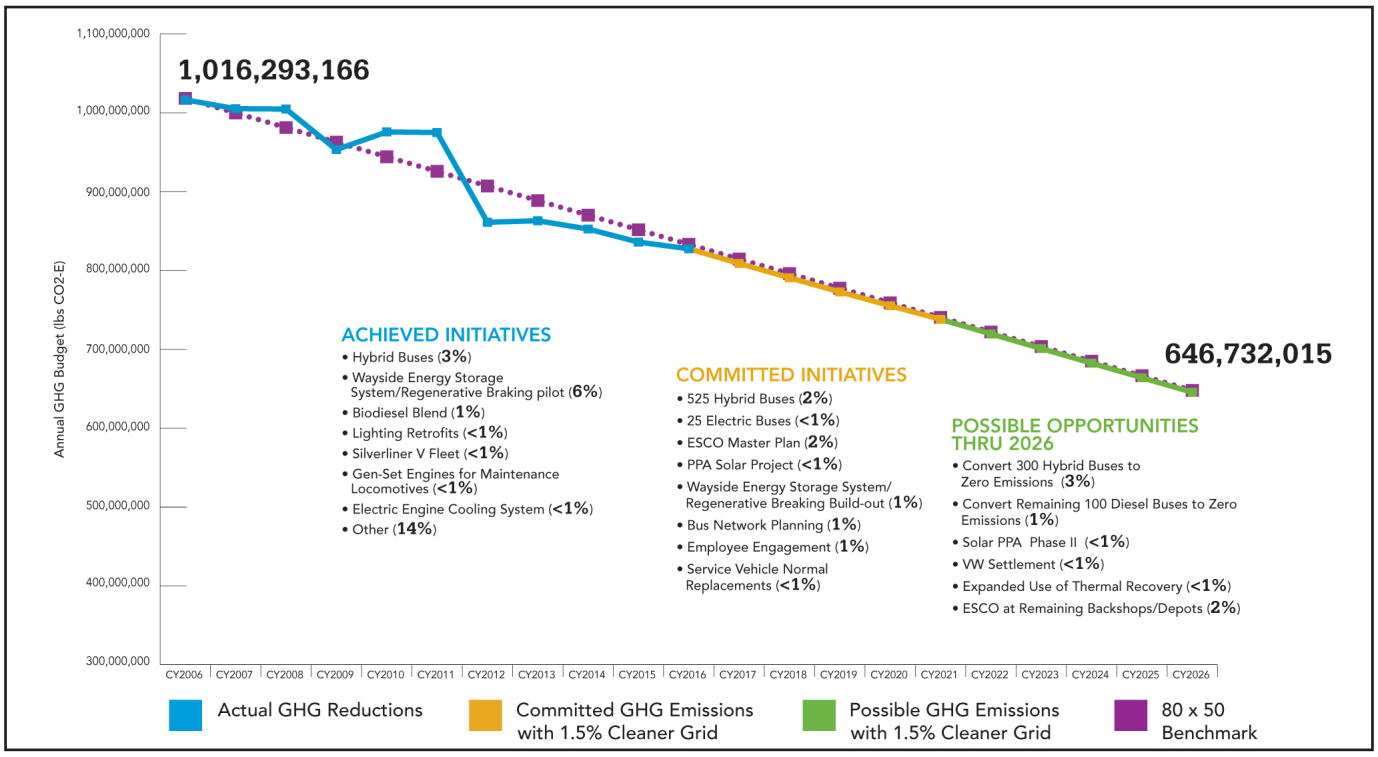
ENERGY				GHG EMISSIONS			
Source	Unit of Use	Factor	Unit	Unit of Use Conversion		Factor	Unit
Diesel (B2)	Gal	0.1290	mmBtu/gallon	21.93	Lbs CO_2-E/Gal	170.90	CO_2-E /mmBtu
Electricity	kWh	0.0034	mmBtu/kWh	0.834	Lbs CO_2-E/kWh	245.70	
Natural Gas	ccf	0.1029	mmBtu/ccf	11.90	Lbs CO_2-E/ccf	116.28	
Gasoline	Gal	0.1150	mmBtu/gallon	19.42	Lbs CO_2-E/Gal	169.74	
Heating Oil	Gal	0.1387	mmBtu/gallon	22.33	Lbs CO_2-E/Gal	161.83	
Steam	mlbs	1.1940	mmBtu/mlbs	132.1	Lbs CO_2-E/mlbs	111.20	

1.4 - EMISSION REDUCTION TARGETS

One nationally accepted goal for localized GHG emissions reduction is to reduce emissions by 80 percent by 2050 from a 2006 baseline in order to mitigate consequences from the effects of climate change. Cities like New York City, Denver, Boston, and Philadelphia have all committed to this goal in recognition of their contribution to GHG emissions and climate change.

In the 2018 plan, SEPTA will track emission reductions against the 80 percent by 2050 benchmark. Doing this will better enable SEPTA to track emission reduction progress.

FIGURE 1: "80 X 50" FRAMEWORK



1.5 - SUMMARY OF FOCUS AREAS

SEPTA has established three focus areas to categorize the 2012 and 2018 Energy Action Plan initiatives:

- Energy Efficiency
- Clean Energy
- Employee Engagement

Energy Efficiency

Improvements in energy efficiency offer pathways to decrease SEPTA's GHG emissions. For the purposes of this report SEPTA defines energy efficiency as initiatives that reduce utility consumption or fuel consumption. The largest source of SEPTA's GHG emissions is vehicles, comprising approximately 84 percent of the Authority's emissions. The remaining 16 percent of SEPTA's GHG emissions inventory is from facilities. Since 2012, SEPTA has improved the energy efficiency of both vehicles and buildings through a number of innovative strategies and budget neutral financing solutions, summarized in the following section.

Clean Energy

In combination with energy efficiency projects, cleaner energy sourcing further enables SEPTA to meet GHG reduction goals. For the purposes of this report, SEPTA defines clean energy as less GHG intensive energy sources like natural gas and renewable energy sources like solar energy. The proposed clean energy projects included in the 2018 plan offer a means of transitioning away from the dirtiest fossil fuels to further reduce carbon emissions and provide more resilient power sources.

Employee Engagement

In an effort to increase company-wide participation and support for SEPTA's sustainability and energy conservation initiatives, more engagement and educational opportunities are being offered to employees. Greater employee support is essential to decrease SEPTA's energy consumption by promoting and targeting sustainable behavior changes.

Educational outreach helps to not only enhance employee understanding of how energy efficient systems function but increased employee engagement and education has resulted in additional payoffs from energy efficiency upgrades and retrofits. Employees are reminded to turn off non-censored lights, close windows and doors when HVAC systems are in use, and report leaky faucets, toilets, or pipes. Increased employee participation in energy conservation efforts is crucial to maximize energy savings and maintain budget-neutrality.

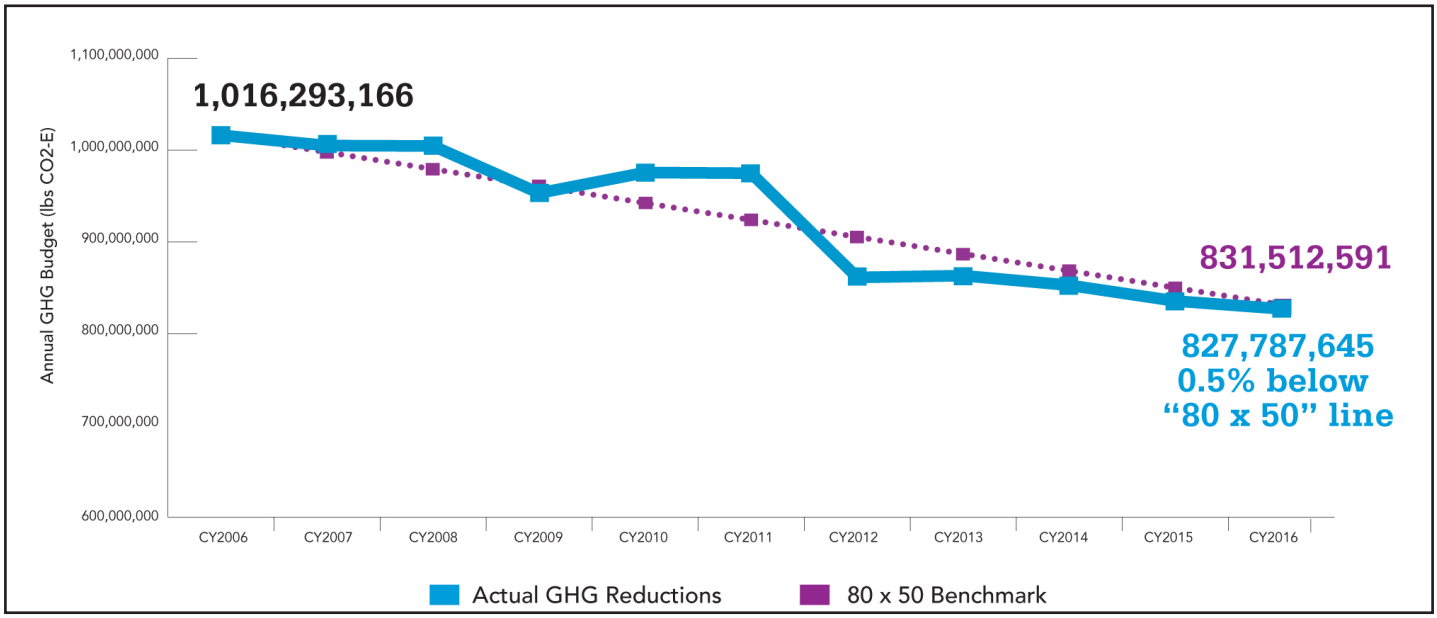
SECTION 2: ENERGY & GHG TRENDS (2006-2016)

2.1 - 2006-2016 ENERGY & GHG PERFORMANCE

SEPTA began tracking its gross energy consumption and GHG emissions in 2006, which is one year after the established standard baseline for the "80 x 50" framework in the United States.

In 2006, SEPTA's gross GHG emissions totaled 1,016,293,166 lbs CO2-E, and over the past decade, SEPTA has reduced its emissions by 189,211,664 lbs CO2-E, equivalent to 19 percent of its 2006 baseline performance. SEPTA has not only gradually reduced its energy consumption but the emissions factor for electricity and steam has improved, as shown in Tables 1, 2, and 3, which has positively impacted SEPTA's GHG emissions performance.

FIGURE 2: GROSS GHG EMISSIONS PERFORMANCE (CY2006-CY2016)



2.2 - 2016 BASELINE PERFORMANCE

SEPTA powers its vehicle fleets and buildings using six sources of energy. In 2016, SEPTA's energy consumption totaled 4,191,679 mmBtu. Figure 3 provides a summary of consumption level by source, which was driven in large part by diesel (44 percent) and electricity (41 percent). The remaining 15 percent, were comprised of gasoline (7 percent), natural gas (6 percent), heating oil (1 percent) and steam (1 percent). GHG emissions from these sources, including grid loss, totaled 827.8 million pounds of CO2-e.

TABLE 4: BASELINE ENERGY SOURCE CONSUMPTION & GHG EMISSIONS PROFILE (CY2016)

Vehicle or Building	Source	Unit of Use	Unit Usage	Grid Losses	Total Use (mmBtu)	GHG Emissions (lbs CO_2-E)	GHG Emissions from Grid Losses (lbs CO_2-E)
Vehicle	Diesel	Gal	14,312,284	--	1,846,285	314,849,115	--
	Electricity	kWh	386,661,925	18,946,434	1,383,936	322,520,535	15,803,506
	Gasoline	Gal	2,459,852	--	282,883	48,289,090	--
Building	Electricity	kWh	99,665,036	4,883,587	356,720	83,132,108	4,073,473
	Natural Gas	ccf	2,431,368	--	250,188	28,986,852	--
	Heating Oil	Gal	298,113	--	41,347	6,698,747	--
	Steam	mlbs	25,395	--	30,322	3,355,648	--
TOTAL					4,191,679	827,787,645	

From a usage perspective, 84 percent of energy consumption was associated with vehicle operations. The remaining 16 percent was associated with building operations, Figure 3. Within the category of vehicle operations, buses and paratransit vehicles are the most energy intensive mode SEPTA operates followed closely by trains and trolleys, Table 4.

FIGURE 3: 2016 BASELINE ENERGY PROFILE SOURCE & USE

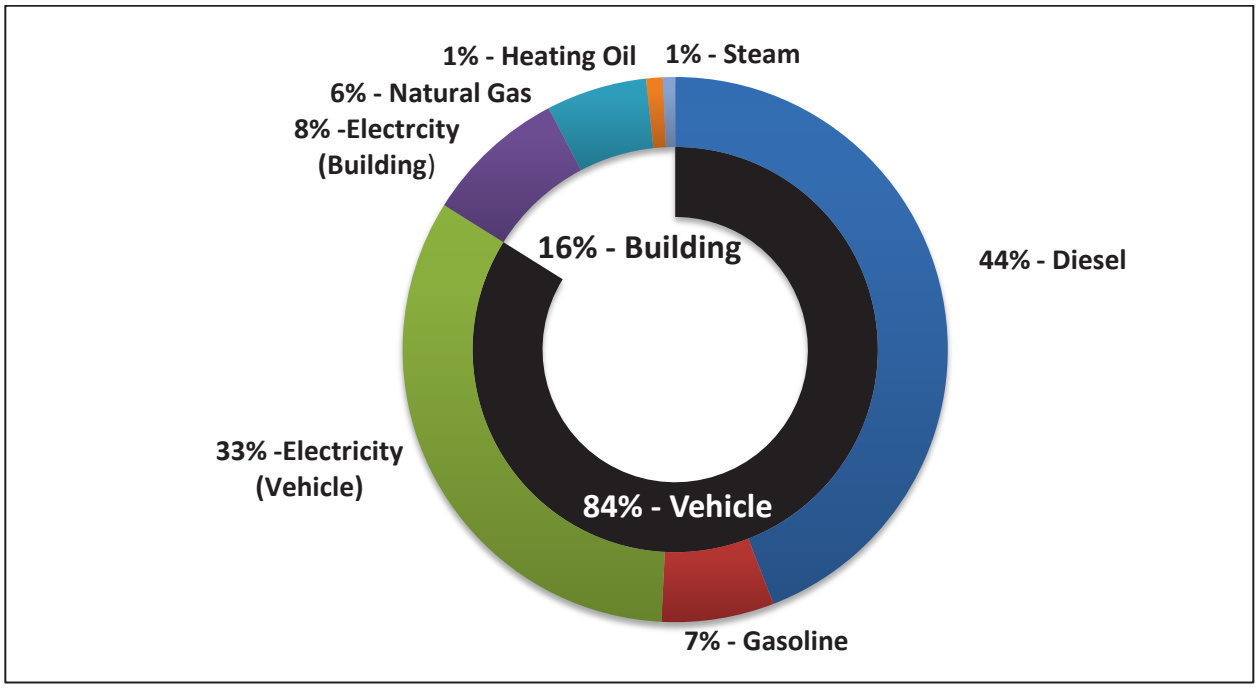


TABLE 5: BASELINE USES OF ENERGY & GHG EMISSIONS (CY2016)

Vehicle or Building	Use	Usage (mmBtu)	Grid Losses (mmBtu)	GHG Emissions (lbs CO_2-E)	GHG Emissions from Grid Losses (lbs CO_2-E)
Vehicle	Buses & Paratransit	2,017,577	--	342,746,510	--
	T Cars & Utility Fleet	111,591	--	20,470,266	--
	Trolleys & Trains	1,319,290	64,645	322,520,535	15,803,506
Building	Natural Gas	250,188	--	28,986,852	--
	Heating Oil	41,346	--	6,698,747	--
	Steam	30,322	--	3,355,648	--
	Facility Electric	340,057	16,663	83,132,108	4,073,473
TOTAL		**4,191,679**		**827,787,645**	

SECTION 3: ACHIEVED INITIATIVES (2012-2016)

The initiatives outlined in Table 6 were published in SEPTA's 2012 Energy Action Plan as a means to reduce SEPTA's energy consumption and GHG emissions through facility efficiency projects, vehicle replacements and upgrades, and operational changes. The initiatives completed between 2012 and 2016 have reduced SEPTA's GHG emissions by 94,058,748 lbs CO2-E, equivalent to 9 percent of its 2006 GHG performance. Details about the completed projects and their contribution to SEPTA's energy consumption and GHG emissions reduction progress can be found in Section 2.3, Section 2.4 and Section 2.5.

While many of the 2012 Energy Action Plan initiatives are completed, others are still underway and will carry over to the 2018 Energy Action Plan as committed initiatives. More information regarding the underway initiatives can be found in Section 4: Committed Initiatives.

TABLE 6: 2012 ENERGY ACTION PLAN PROGRESS

#	Status	Initiative	Energy Impact (mmBtu)	GHG Impact (lbs CO_2-E)
1	Completed	**Wayside Energy Storage/Regenerative Braking Pilot (pg 15)**	(92,182)	(59,375,279)
2		**Hybrid-Electric Buses (pg 16)**	(124,225)	(21,105,996)
3		**Biodiesel Blend (pg 19)**	0	(6,575,771)
4		**Silverliner V Fleet (pg 18)**	(16,928)	(4,996,332)
5		**Electric Engine Cooling System (pg 17)**	(17,031)	(2,893,666)
6		**Lighting Change-Out Projects (pg 18)**	(9,490)	(2,379,192)
7		**Gen-Set Engines for Maintenance Locomotives (pg 18)**	(25,741)	(50,410)
8		**Paratransit Vehicle Normal Replacements (pg 19)**	18,646	4,302,878
9	Additional Funding Required	**Barracks Railyard Storage to Reduce RRD Dreadheading**	TBD	TBD
10	Underway	**ESCO Master Plan (Formerly Midvale Complex, 1234 Market St., Center City RRD Stations/ Tunnels, & Five Backshops/Depots)**	TBD	TBD
11		**Service Vehicle Normal Replacements**	TBD	TBD
12		**Bus Network Planning**	TBD	TBD
13		**Employee Engagement (pg 20)**	TBD	TBD
TOTAL IMPACT			**(266,951)**	**(93,073,768)**

3.1 - ENERGY EFFICIENCY

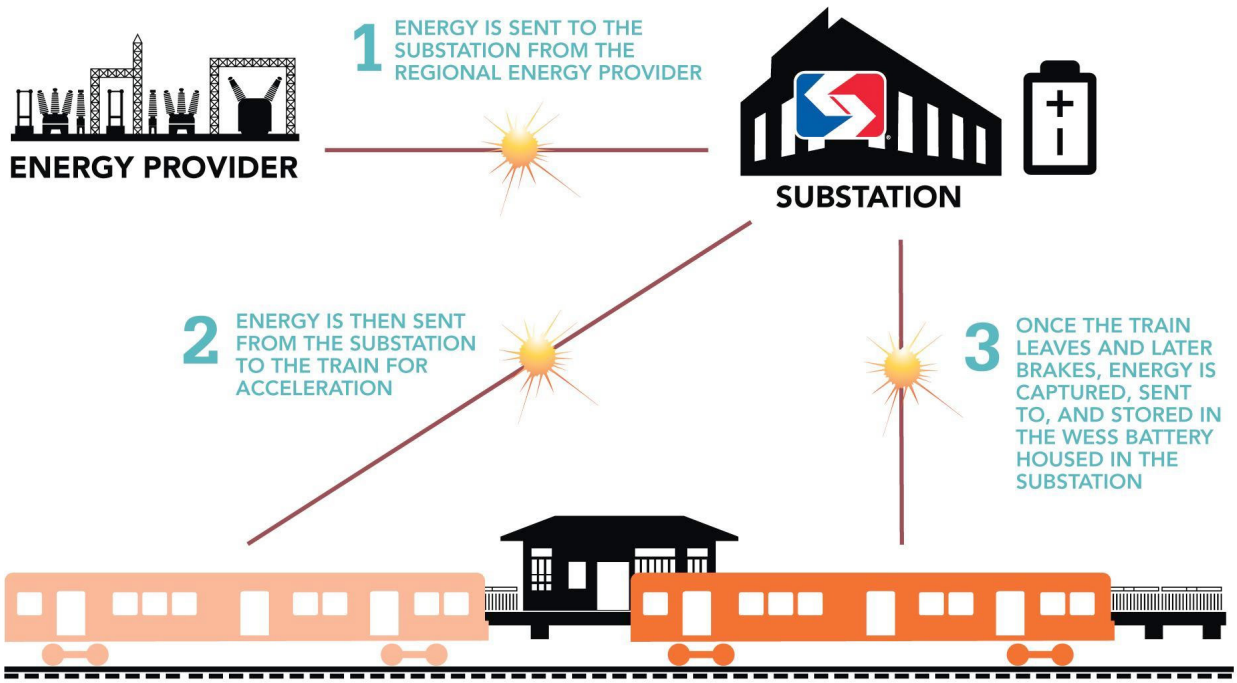
The following energy efficiency initiatives were published in the 2012 Energy Action Plan and have been completed prior to publishing the 2018 Energy Action Plan:

- Wayside Energy Storage Pilot
- Hybrid-Electric Vehicles
- Electric Engine Cooling Systems
- Silverliner V Fleet
- Lighting Change-Out Projects
- Gen-Set Engines
- Paratransit Vehicle Normal Replacement

Wayside Energy Storage Pilot

On June 27, 2012, SEPTA officially unveiled a "wayside energy storage system" (WESS) at the Letterly Substation located in the Kensington neighborhood of Philadelphia. The system allows SEPTA to capture, store, and reuse the regenerative braking energy from railcars on the Market-Frankford Line, Figure 4.

FIGURE 4: WAYSIDE ENERGY STORAGE SYSTEM DIAGRAM



Shortly after the Letterly Substation WESS became operable, SEPTA received a $1.44 million grant from the Federal Transit Administration (FTA) to install a second storage device at the Griscom Substation in Northeast Philadelphia. The two WESS pilot projects provided SEPTA the opportunity to pilot WESS technology to determine if SEPTA should pursue a buildout for the Market-Frankford and Broad Street Lines.

During WESS project planning stage, SEPTA discovered that the regenerative braking set-points could be increased to capture and reused by vehicles on the Market-Frankford and Broad Street Line. Increasing the regenerative braking capacity on the vehicles in combination with the installation of the WESS increased the efficiency of SEPTA's subway and elevated rail lines resulting in reduced kWh consumption from 175,000,271 kWh in 2009 to 147,983,273 kWh in 2016, an annual savings of 27,016,998 kWh and 59,375,279 lbs CO2-E.[6]

6 The grid's emissions factor and energy loss factor decreased in 2013.

TABLE 7: SUBSTATION ENERGY & GHG EMISSIONS REDUCTIONS

	Consumption (kWh)	Grid Losses (kWh)	GHG Emissions (lbs CO_2-E)	GHG Emissions From Grid Losses (lbs CO_2-E)	Energy Saved (kWh)	Emissions Saved (lbs CO_2-E)
Pre	160,300,697	14,699,574	192,401,259	14,803,070	**27,016,998**	**59,375,279**
Post	141,070,804	6,912,469	142,064,051	5,764,999		

SEPTA was one of the first in the public transportation industry to install WESS technology. In a transit environment, the project has upgraded SEPTA's energy-consuming trains into rolling power generators and has transformed the facility into a cutting edge home of an emerging power technology. In 2016, SEPTA earned the Pennsylvania Governor's Award for Environmental Excellence for its WESS pilots and SEPTA's overall commitment to innovative projects that deliver positive economic and environmental results.

Hybrid-Electric Vehicles

Emissions from diesel-powered vehicles accounted for 41 percent of SEPTA's gross GHG emissions performance in 2016. Since 2002, SEPTA has replaced less fuel efficient diesel buses with more efficient hybrid-electric buses, Figure 5. When comparing SEPTA's bus fleet fuel consumption in 2012 to 2016, bus fleet diesel fuel consumption was reduced from 14,512,513 gallons of diesel fuel in 2012 to 13,549,527 gallons of diesel fuel in 2016, an annual savings of 962,986 gallons of diesel fuel and 21,105,996 lbs CO2-E, Figure 6.

FIGURE 5: BUS FLEET MAKEUP (CY2012-CY2016)

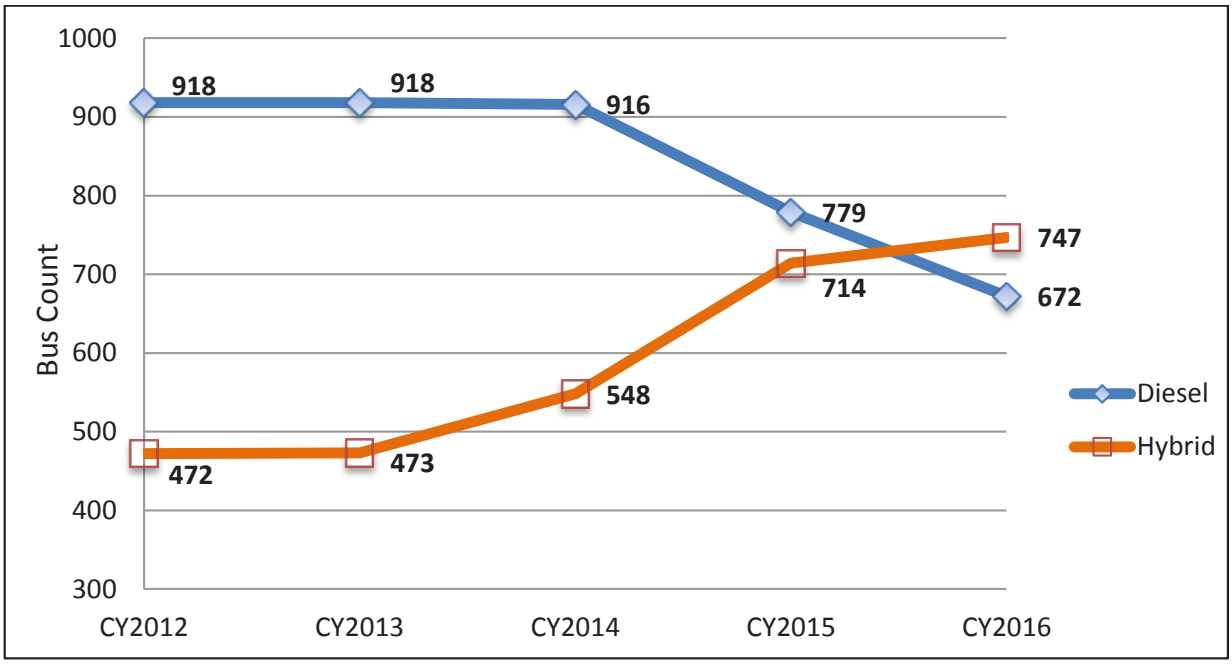
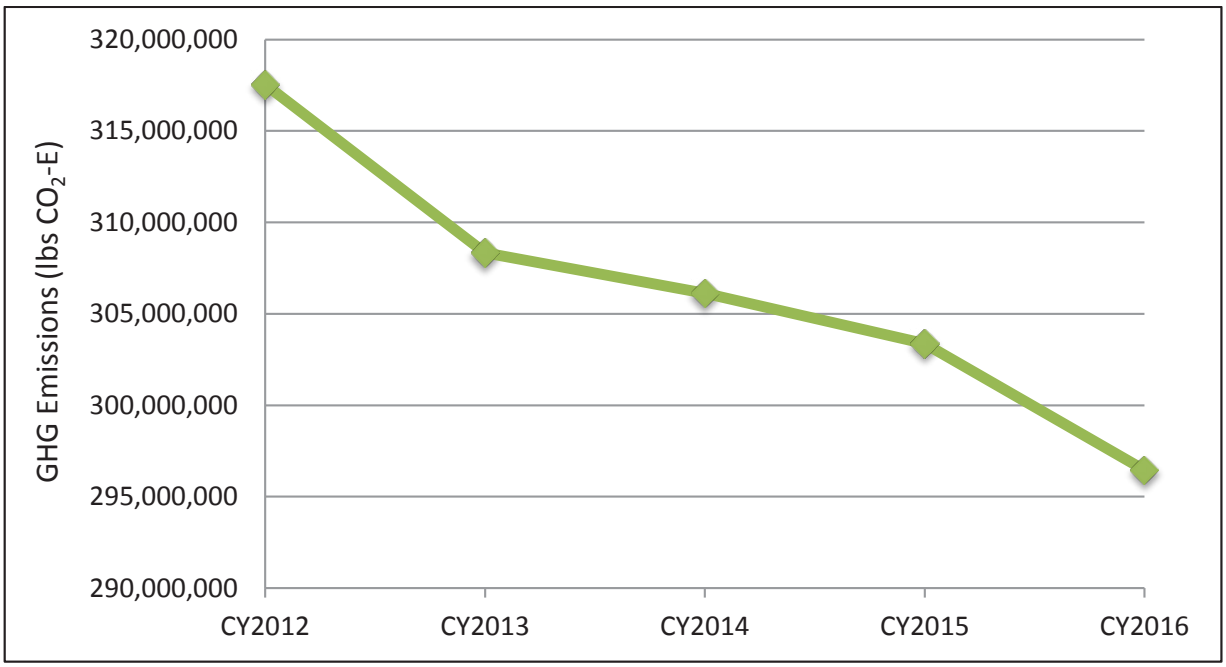


FIGURE 6: BUS FLEET GHG EMISSIONS (CY2012-CY2016)



Since FY2011, SEPTA has received $23 million in grants to cover the incremental costs of hybrid-electric buses that has allowed SEPTA to purchase the fuel efficient hybrid-electric buses while still maintaining budget neutrality.

Electric Engine Cooling System

Electric engine cooling system retrofits were performed on 119 buses at Frontier Depot and Southern Depot. The new system replaced out dated mechanical engine cooling systems which resulted in improved fuel efficiency of the buses, thus contributing to reduced diesel fuel consumption and GHG emissions. Table 8 shows the pre and post MPG applied to the post miles traveled to calculated total reductions. Overall, this project reduced SEPTA's diesel fuel consumption in the effected fleet from 2,531,032 in 2012 to 2,429,005 in 2016, a savings of 132,027 gallons and 2,893,666 lbs CO2-E.

TABLE 8: FRONTIER & SOUTHERN BUS ROUTE ENERGY & GHG EMISSIONS REDUCTIONS

Fleet	Pre/ Post	Miles	Fuel (Gal)	MPG	Fuel w/pre MPG (Gal)	Fuel w/post MPG (Gal)	Gallons Saved	GHG Emissions Saved (lbs CO_2-E)
2005 New Flyer D40LF (Frontier)	Post	3,404,475	774,632	4.39	820,355	774,632	45,723	1,002,131
	Pre	1,961,549	472,096	4.15				
2005 New Flyer D40LF (Southern)	Post	5,117,589	1,654,373	3.09	1,740,677	1,654,373	86,304	1,891,535
	Pre	2,725,895	926,719	2.94				
TOTAL					**2,561,032**	**2,429,005**	**132,027**	**2,893,666**

Silverliner V Fleet

The Silverliner V fleet regenerative braking system improvements allowed SEPTA to improve the efficiency of the rail fleet. Table 9 shows the kWh per car mile improvement from pre and post regenerative braking system implementation. The 0.19 kWh per car mile improvement reduced SEPTA's kWh energy consumption from 112,169,200 in 2010 to 107,207,800 in 2016, a savings of 4,961,400 kWh and 4,996,332 lbs CO2-E.

TABLE 9: TRACTION POWERED FLEET ENERGY & GHG EMISSIONS REDUCTIONS

Pre/Post	kWh/Car Mile	Avg. Annual Car Miles	kWh Consumed	Grid Losses (kWh)	GHG Emissions (lbs CO_2-E)
Pre	5.30	20,000,000	106,000,000	6,169,200	112,958,958
Post	5.11		102,200,000	5,007,800	107,962,625
TOTAL REDUCTIONS			**3,800,000**	**1,161,400**	**4,996,332**

Lighting Change-Out Projects

Lighting fixtures throughout various SEPTA facilities were retrofitted with LED lights, which have a longer life span and are more energy efficient than traditional light bulbs. Table 10 shows the rebates received each year from the energy saved from these lighting retrofits. SEPTA receives an average of 8 cents per kWh saved, which directly correlates to energy and GHG emissions reductions. Lighting change-outs that occurred from 2012 thru 2016 reduced electricity consumption by an estimated 2,781,243 kWh and 2,379,109 lbs CO2-E.

TABLE 10: ENERGY & GHG EMISSIONS REDUCTIONS FROM LIGHTING CHANGE-OUTS

	Total Rebates	Cents Per kWh	kWh Saved	Grid Losses (kWh)	GHG Emissions Saved (lbs CO_2-E)
2012	$34,706	8	433,825	39,782	340,059
2013	$139,597	8	1,744,963	85,503	1,432,113
2014	$29,383	8	367,288	17,997	291,308
2015	$2,713	8	33,913	1,662	26,897
2016	$29,123	8	364,038	17,838	288,731
TOTAL SAVINGS			**2,781,243**		**2,379,109**

Gen-Set Engines for Maintenance Locomotives

Installation of Gen-Set engines in SEPTA's maintenance locomotives increased fuel efficiency and decreased diesel consumption from regional rail non-revenue vehicles. Gen-set locomotives have a number of smaller diesel engines rather than a single large engine. Fuel savings occur when excess engines are turned off when extra power is not needed. Table 11 shows the diesel fuel and GHG emissions reduced from pre and post retrofit implementation on the non-revenue locomotive fleet. Gen-Set engine technology reduced SEPTA's diesel fuel consumption in the effected fleet from 199,546 gallons in 2012 to 197,246 gallons in 2016, an annual savings of 2,300 gallons and 50,410 lbs CO2-E.

TABLE 11: GEN-SET ENGINE ENERGY & GHG EMISSIONS REDUCTIONS

Pre/Post	Diesel Consumed (Gal)	GHG Emissions (lbs CO_2-E)	Fuel Saved (Gal)	GHG Emissions Saved (lbs CO_2-E)
Pre	199,546	4,373,498	**2,300**	**50,410**
Post	197,246	4,323,088		

Paratransit Vehicle Normal Replacements

Fuel efficiency of vehicles more than offset increased use. However, Table 12 shows the decreased fuel efficiency of this fleet as service needs increased. SEPTA will continue to evaluate this increase and further evaluate system improvements that could lead to increased efficiency and reduced fuel consumption and GHG emissions.

TABLE 12: PARATRANSIT FLEET FUEL CONSUMPTION & MPG

Pre/Post	Annual Mileage	Gasoline Consumed (Gal)	MPG	GHG Emissions (lbs CO_2-E)
Pre	14,809,278	1,974,570	7.5	38,351,145
Post	14,938,808	2,136,712	7	42,654,023

3.2 - CLEAN ENERGY

Biodiesel Blend

Beginning in 2010, SEPTA transitioned to fueling diesel powered vehicles with a biodiesel blend. Emissions from this biodiesel blend (B2) are approximately 2 percent less emissions-intensive than traditional diesel. In 2016 diesel fuel consumption totaled 14,312,284. The emissions resulting from the use of 14,312,284 gallons of biodiesel fuel in 2016 was 313,685,771 CO2-E, compared with, the emissions that would have resulted from 14,312,284 gallons of a less clean diesel fuel in 2016 320,261,542 CO2-E, is equal to a savings of 6,575,771 CO2-E.

TABLE 13: GHG EMISSIONS REDUCED BY BIODIESEL BLEND

Diesel Type	Emissions Factor (lbs CO_2-E/Gal)	Post Fuel Consumption (Gal)	GHG Emissions (lbs CO_2-E)
Diesel	22.38	14,312,284	320,261,542
Biodiesel	21.93		313,685,771
TOTAL EMISSIONS SAVED			**6,575,771**

3.3 - EMPLOYEE ENGAGEMENT

In 2015, SEPTA's headquarters at 1234 Market Street received ENERGY STAR certification for the fourth time. The facility gained special recognition for employing energy reduction strategies in extreme weather events using various measures, such as reducing the number of main circulation fans throughout the building, shutting down an extra set of escalators and turning off lights during peak afternoon energy usage times, and encouraging employees to turn off non-essential appliances.

Beginning in 2009, SEPTA transitioned the cleaning schedule at SEPTA Headquarters building to begin at 6 AM rather than 12 AM, which reduced building runtime by 6 hours. The change led to reduced energy consumption and continues to save over $250,000 in utility costs per year.

As an educational and promotional effort of SEPTA's Sustainability Program, a Tour of Sustainable Sites takes employees to various sites and facilities containing unique sustainability retrofits and projects. The tour includes 1234 Market Street, the Letterly Wayside Energy Storage System, and one of SEPTA's green roofs at the 33rd & Dauphin bus loop. This specific tour enables employees from various SEPTA departments to learn about initiatives employed by the Sustainability Program, in addition to recognizing the role that each department plays in reducing SEPTA's environmental footprint. Roughly 60 employees participate in the tour every year and 180 have already participated since it began three years ago.

Lastly, SEPTA developed an Environmental & Sustainability Management System (ESMS) and earned ISO management certification in 2013 and recertification in 2016. In compliance with ISO 14001 standards and its ESMS, SEPTA will create future employee engagement opportunities in accordance to the ISO framework.

SECTION 4: COMMITTED INITIATIVES (2016-2021)

As part of the 2018 Energy Action Plan, SEPTA has committed to eight initiatives that will increase efficiency and reduce emissions. Four of the initiatives are continuations from the 2012 Energy Action Plan. Completion of the Energy Service Company (ESCO) Master Plan, Bus Network Planning, and Service Vehicle Normal Replacements are underway as a result of the 2012 Energy Action Plan and will be completed prior to 2021. Employee Engagement was also introduced in the 2012 plan and will continue as part of the 2018 Energy Action Plan. SEPTA will continually strive to engage employees in order to inspire behavior changes that will lead to reduced energy consumption and emissions.

The remaining four initiatives expand SEPTA's energy efficiency and emission reduction planning efforts. They include purchasing additional Hybrid-Electric Buses, purchasing Electric Buses, completing a Wayside Energy Store System Buildout and a executing a Solar Power Purchasing Agreement.

Projected energy and emissions reductions listed for all eight initiatives are listed in Table 14. For the purposes of the Committed Initiatives section, SEPTA will use the measured 2016 baseline of 827,787,645 lbs CO2-E. Once all eight initiatives are completed, SEPTA anticipates an annual savings of 62,105,552 lbs CO2-E. Detailed descriptions of the committed initiatives are included in sections 4.1, 4.2 and 4.3.

TABLE 14: 2018 ENERGY ACTION PLAN COMMITTED INITIATIVES SUMMARY

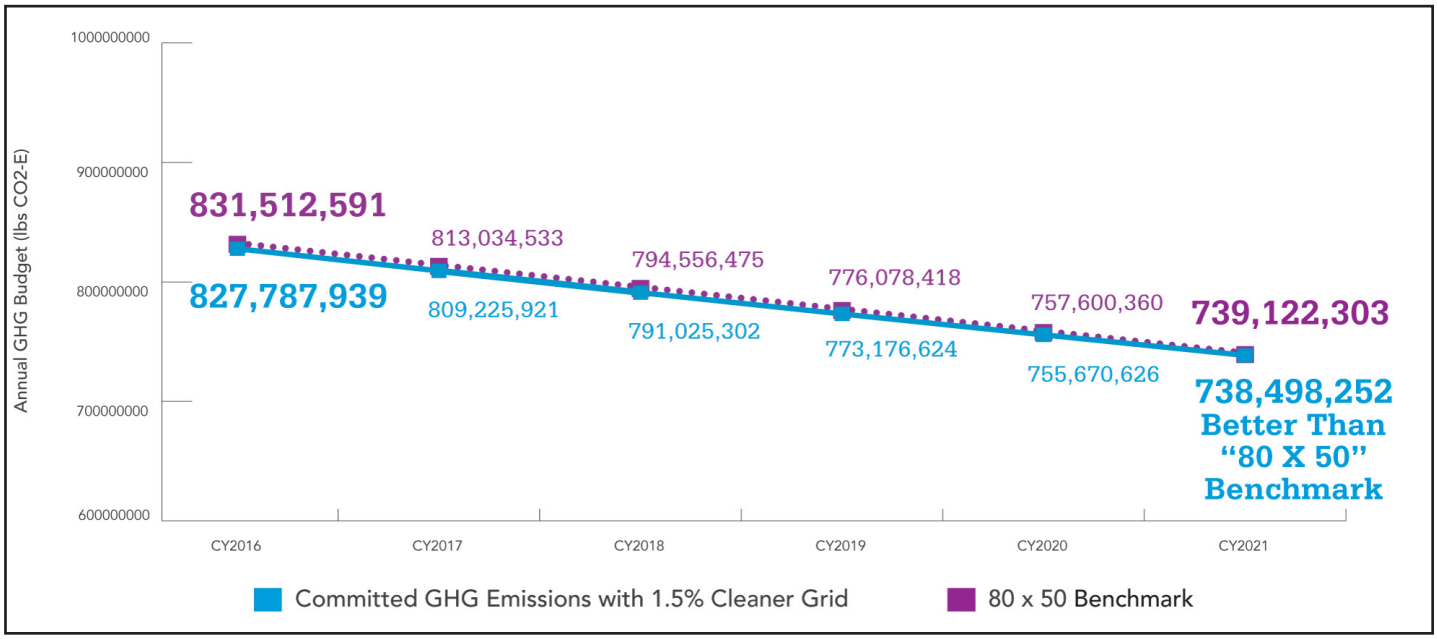
	Initiative Category	Initiative	Focus Area	Source Impact	Energy Impact (mmBtu)	GHG Impact (lbs CO_2-E)
1	Committed	**ESCO Master Plan (pg 23)**	Energy Efficiency & Clean Energy	Natural Gas, Electricity, Steam & Heating Oil	(185,924)	(21,071,783)
2		**Hybrid-Electric Buses (pg 22)**	Energy Efficiency	Diesel	(91,468)	(15,549,624)
3		**Bus Network Planning (pg 25)**	Energy Efficiency	Diesel	(49,816)	(8,463,737)
4		**WESS Build-Out (pg 24)**	Energy Efficiency	Electricity	(23,202)	(5,672,026)
5		**Solar Power Purchasing Agreement (pg 27)**	Clean Energy	Electricity	(12,480)	(3,050,993)
6		**Employee Engagement (pg 28)**	Employee Engagement	Electricity	(44,067)	(5,431,322)
7		**Electric Buses (pg 26)**	Clean Energy	Diesel & Electricity	(14,290)	(2,101,777)
8		**Service Vehicle Normal Replacements (pg 24)**	Energy Efficiency	Diesel	(4,525)	(764,290)
				TOTAL REDUCTIONS	**(425,772)**	**(62,105,552)**

Because this sections includes estimated emissions savings from future projects with varying implementation schedules, SEPTA has averaged the total emissions savings to estimate the step-down in emissions during the five year period (2016 – 2021).

In addition to per project emission reductions listed in the committed initiatives section, SEPTA has assumed that between 2016-2021, the grid will become 1.5 percent cleaner every year reducing SEPTA emissions an additional 27,184,135 lbs CO2-E. SEPTA considers this to be a conservative estimate, half of the 3 percent average annual reduction in the grid emissions from the period of 2006-2016.

Figure 7 shows SEPTA's past emissions performance and projected performance resulting from its 2018 committed initiatives and a 1.5 percent annual cleaner grid in comparison to the "80 x 50" benchmark.

FIGURE 7: 2016-2021 GHG PERFORMANCE TREND & OUTLOOK



4.1 - ENERGY EFFICIENCY

The following energy efficiency initiatives will be completed as part of the 2018 Energy Action Plan:

- 525 Hybrid-Electric Buses
- ESCO Master Plan
- Wayside Energy Storage/Regenerative Braking Build-Out
- Service Vehicle Normal Replacements
- Bus Network Planning

Hybrid-Electric Buses

As existing SEPTA buses reach the end of their usable life, they are retired and replaced with hybrid-electric buses. Moving forward, every retired vehicle will be replaced by either a hybrid-electric or zero emission bus. By 2021, hybrid-electric buses will comprise over 90 percent of SEPTA's bus fleet. Given SEPTA's current and approved procurement plans to purchase an additional 525 hybrid-electric buses, traditional diesel vehicles will be gradually transitioned out of SEPTA's bus fleets.

In 2016, SEPTA's bus fleet consumed a total of 13,549,527 gallons of diesel fuel. In 2021, once 525 diesel buses are replaced by hybrid-electric buses, annual fuel consumption is estimated to be 12,840,470 gallons of diesel fuel, an annual savings of 709,057 gallons of diesel fuel and 15,549,624 lbs CO2-E.

TABLE 15: FUEL & GHG EMISSIONS REDUCTIONS FROM CY2016 BUS FLEET PERFORMANCE

Bus Type	Miles Traveled	MPG	Fleet Makeup	Avg. Miles Per Bus	Miles for 525 Diesel Buses	Diesel Used by 525 Buses (Gal)	GHG Emissions (lbs CO_2-E)
Diesel	21,363,633	3.16	672	31,791	16,690,338	5,281,752	115,828,835
Hybrid	24,251,799	3.65	747	32,466		4,572,694	100,279,211
TOTAL SAVINGS						**709,057**	**15,549,624**

ESCO Master Plan

The Pennsylvania Guaranteed Energy Savings Act (GESA) enables public agencies to enter energy performance contracts with energy service companies (ESCOs). ESCOs finance the initial costs of energy-related investments with private capital and guarantee a certain amount of money in energy savings to the public agency. The public agency's role includes making payments to the ESCO using money from energy savings in a predetermined repayment period outlined in the lease agreement. The Pennsylvania GESA requires the lease payments to be less than or equal to the project's guaranteed energy savings, which acts as a built-in assurance of a project's budget-neutrality.

SEPTA is committed to executing an ESCO Master Plan, which consists of entering into ESCO agreements at SEPTA's headquarter building, maintenance shops, depots and Center City railroad stations. Improvements could include energy conservation measures such as:

- Lighting Upgrades
- Lighting Controls
- Building Envelope Improvements
- HVAC Building Controls
- Water Conservation Measures
- Window Replacements
- Duct Seal and Cleaning
- Boiler Replacements
- Bare Pipe Insulation
- Micro Grid Technologies (Combined Heat & Power / Onsite Renewables)
- Thermal Heat Recovery

Based on the investment grade audits from executed ESCO agreements and a preliminary assessment of potential energy reductions at future ESCO sites, SEPTA will increase total mmBtu consumption from 678,576 mmBtu in 2016 to 881,333 mmBtu in 2021, however, SEPTA will realize a savings of 21,071,783 lbs of CO2-E.

Wayside Energy Storage/Regenerative Braking Build-Out

The success of the WESS pilots prompted SEPTA to install seven new storage systems along the Market-Frankford and Broad Street lines in 2016 as a budget-neutral project financed by a 20-year battery services agreement with Constellation. The public private partnership will increase SEPTA's energy storage capacity at transit substations by five times to 8.75 MW and will provide resiliency in the event of a power outage by offering enough power to limp trains into the next station. In 2016, the seven substations consumed 62,385,795 kWh of electricity. In 2021, the seven substations will consume an estimated 55,585,743 kWh of electricity, an annual savings of 6,800,052 kWh, and 5,672,026 lbs CO2-E.

TABLE 16: ENERGY & GHG EMISSIONS REDUCTIONS FROM WESS BUILD-OUT

Substations	Avg. Annual Usage (kWh)	Grid Losses (kWh)	Savings Rate	Energy Savings (kWh)	GHG Emissions Savings (lbs CO_2-E)	Total Energy Savings (kWh)	Total GHG Emissions Savings (lbs CO_2-E)
Allison	5,356.277	262,458	10.9%	612,442	510,847	**6,800,052**	**5,672,026**
McKean	9,697,221	475,164	10.9%	1,108,790	924,858		
Pine	8,331,212	408,229	10.9%	952,599	794,577		
Butler	3,195,325	156,571	10.9%	365,357	304,749		
Park	7,256,091	355,548	10.9%	829,669	692,039		
Louden	15,412,764	755,225	10.9%	1,762,311	1,469,970		
Sansom	10,222,793	500,917	10.9%	1,168,884	974,984		

Service Vehicle Normal Replacements

In 2018, SEPTA will be replacing approximately 111 of its supervisory vehicles with more fuel efficient models. Most of the replacements will occur by 2018, helping to reduce SEPTA's fuel consumption and GHG emissions. The three primary models to be replaced include: 2008 Ford Escape XLT 4WD, 2009 Ford Escape XLT 4WD, and 2010 Ford Escape Hybrid XLT 4 WD. Table 17 shows the baseline information of these vehicles pre replacement, in addition to the projected MPG post replacement and ensuing fuel consumption and GHG emissions reductions.

In 2016, supervisory vehicles consumed 100,603 gallons of fuel. Upon fleet replacement in 2018, it is estimated that more fuel efficient vehicles will consume 61,252 gallons of fuel, an estimated annual savings of 39,351 gallons of fuel and 764,290 lbs CO2-E.

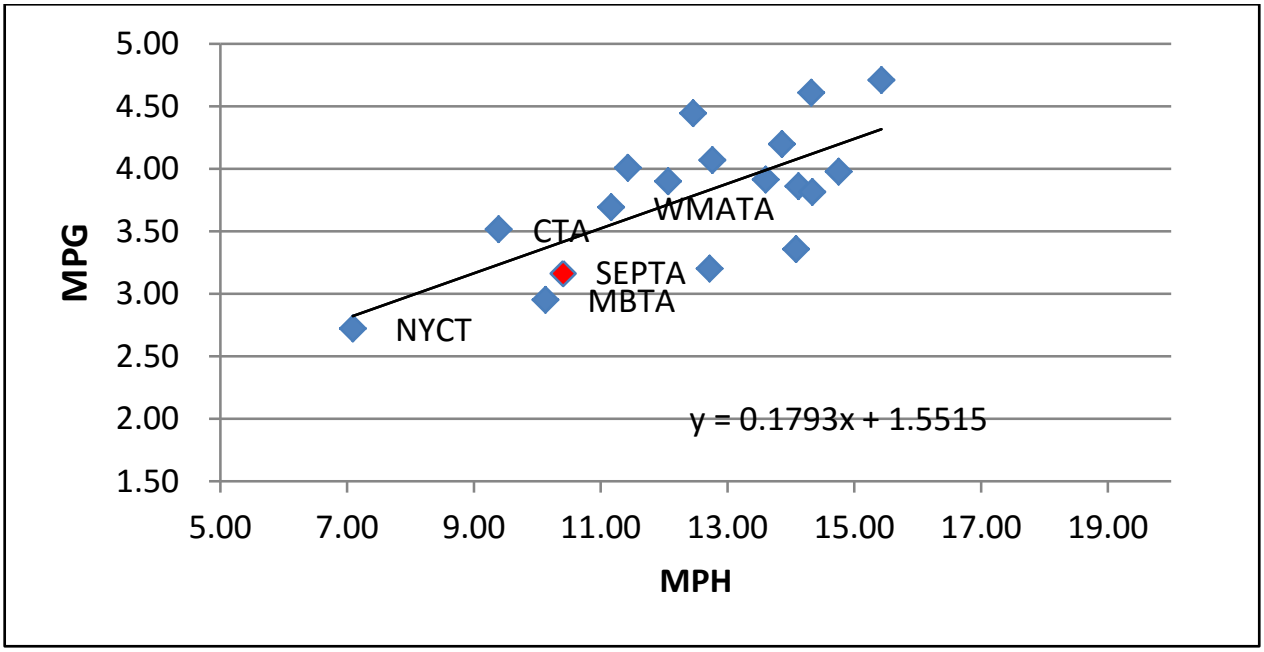
TABLE 17: FUEL & GHG EMISSIONS REDUCTIONS POST T CAR REPLACEMENT

Year & Model	Car Count	Pre Mileage	Pre Fuel (Gal)	Avg. MPG	Pre GHG Emissions (lbs CO_2-E)	Post MPG	Post Fuel (Gal)	Post GHG Emissions (lbs CO_2-E)	Total Fuel Savings (Gal)	Total GHG Savings (lbs CO_2-E)
2008 Ford Escape	41	552,147	42,270	12.58	820,990	25	22,086	428,964	39,351	764,290
2009 Ford Escape	33	515,620	37,491	15.95	728,170	25	20,625	400,586		
2010 Ford Escape Hybrid	37	519,165	20,842	25.45	404,804	28	18,542	360,125		
TOTAL	**111**	**1,586,932**	**100,603**	**19**	**1,953,964**	**78**	**61,252**	**1,189,674**		

Bus Network Planning

As part of this initiative, SEPTA is evaluating the potential to increase bus fleet speeds, which increases fuel economy. Figure 8 shows the correlation between increased miles per hour and increased miles per gallon based on data from SEPTA's public transportation peers throughout the country.

FIGURE 8: BUS MPG VS. MPH FROM U.S. TRANSIT INDUSTRY PEERS



SEPTA estimates that every 0.5 MPH increase results in a fuel economy improvement of 0.09 MPG. In 2016, SEPTA's bus fleet consumed 14,361,757 gallons of diesel fuel. In 2021, SEPTA's bus fleet is estimated to consume 13,975,589 gallons of diesel fuel, and annual savings of 386,168 gallons of diesel fuel and 8,468,664 lbs CO2-E, as shown in Table 18.

TABLE 18: FUEL & GHG EMISSIONS REDUCTION FROM INCREASED MPH

	MPG	MPH	Gallons	GHG Emissions (lbs CO_2-E)
SEPTA Baseline (Actual)	3.16	10.41	14,361,757	314,770,083
SEPTA Baseline (Adjust)	3.16	8.97	14,361,757	314,770,083
SEPTA Baseline (+.5 MPH)	3.25	9.47	13,975,589	306,306,346
TOTAL SAVINGS			**386,168**	**8,463,737**

4.2 - CLEAN ENERGY

The following clean energy initiatives will be completed as committed initiatives as part of the 2018 Energy Action Plan:

- Battery Electric Buses
- Solar Power Purchasing Agreement

Electric Buses

SEPTA has recently purchased 25 Proterra electric buses, which will replace 25 diesel/hybrid-electric buses by 2018 and will eliminate diesel consumption from those vehicles along Routes 29 and 79.

In 2016, buses on Routes 29 and 79 consumed an average of 144,687 gallons of diesel fuel, the equivalent of 18,665 mmBtu. In 2021, the estimated energy consumption of electric buses traveling on routes 29 and 79 is 4,170 mmBtu, an estimated annual savings of 14,290 mmBtu and 2,101,777 lbs CO2-E. Table 20 shows the projected energy and GHG emissions savings by replacing 25 diesel/hybrid-electric buses on Routes 29 and 79 with Proterra electric buses.

TABLE 19: ELECTRIC BUS ENERGY & GHG REDUCTION SIMULATION FOR ROUTES 29 & 79

Routes	Avg. Annual Hybrid/Diesel Fuel Use (mmBtu)	GHG Emissions from Hybrid/Diesel (lbs CO_2-E)	Annual Simulated Electricity Use (mmBtu)	Annual Grid Losses (mmBtu)	Electric Bus GHG Emissions (lbs CO_2-E)	Energy Saved from Hybrid/Diesel to Electric (mmbtu)	GHG Emissions Saved from Hybrid/Diesel to Electric (lbs CO_2-E)
Route 29	10,093	1,714,849	2,238	110	573,849	14,290	2,101,777
Route 79	8,571	1,456,291	1,932	95	495,514		
TOTAL	18,665	3,171,139	4,170	204	1,069,362		

Solar Power Purchasing Agreement

In 2018, SEPTA selected SunVest Solar, Inc. for a power purchase agreement (PPA) through a competitive process to install solar panels at our facilities. Through the PPA agreement, SEPTA will purchase the power generated from the solar panels installed on the rooftops of four SEPTA properties. SunVest Solar was agreed to sell the power at a rate that was budget-neutral to SEPTA's current utility supplier, PECO. This project is the second largest solar project in the City of Philadelphia.

FIGURE 10: AERIAL IMAGES OF ROOFTOPS TO RECIEVE SOLAR PANELS

The project is projected to provide a total of 3,657,760 kWh of solar capacity. In 2016, the emissions from 3,657,760 kWh of capacity generated from the grid were equal to 3,050,992 lbs CO2-E. Once panels are installed at the four locations, an annual savings of 3,050,992 lbs CO2-E will be realized as solar power generation emits no GHGs. Table 20 shows the projected energy savings and CO2 reductions from each location once the panels are installed.

TABLE 20: SOLAR PPA ENERGY & GHG EMISSIONS REDUCTIONS

Location	System Size (KW)	Year 1 Output (kWh)	mmBtu Saved	Emissions Saved (lbs CO_2-E)
2nd & Wyoming	1,208	1,434,454	4,894	1,196,500
Callowhill	1,048	1,244,460	4,246	1,038,023
Fern Rock	649	777,920	2,654	648,875
Roberts	162	200,926	685	167,595
TOTAL	**3,067**	**3,657,760**	**12,480**	**3,050,993**

4.3 - EMPLOYEE ENGAGEMENT

Employee engagement was an operationally strategic initiative originally published in the 2012 Energy Action Plan and will be completed as a committed initiative as part of the 2018 Energy Action Plan.

In compliance with SEPTA's Environmental & Sustainability Management System (ESMS) and ISO 14001 standards, SEPTA will continue to encourage employee engagement in energy conservation and GHG emissions reduction initiatives to maximize savings in combination with facility energy efficiency retrofits.

SEPTA is modeling a 5 percent reduction in energy consumption and GHG emissions at its facilities from increased employee engagement. In 2021, it is estimated that SEPTA will consume a total of 881,334 mmBtu at maintenance shops, depots, and office buildings. A 5 percent reduction in energy consumption would provide an annual savings of 44,067 mmBtu and 5,431,322 lbs CO2-E.

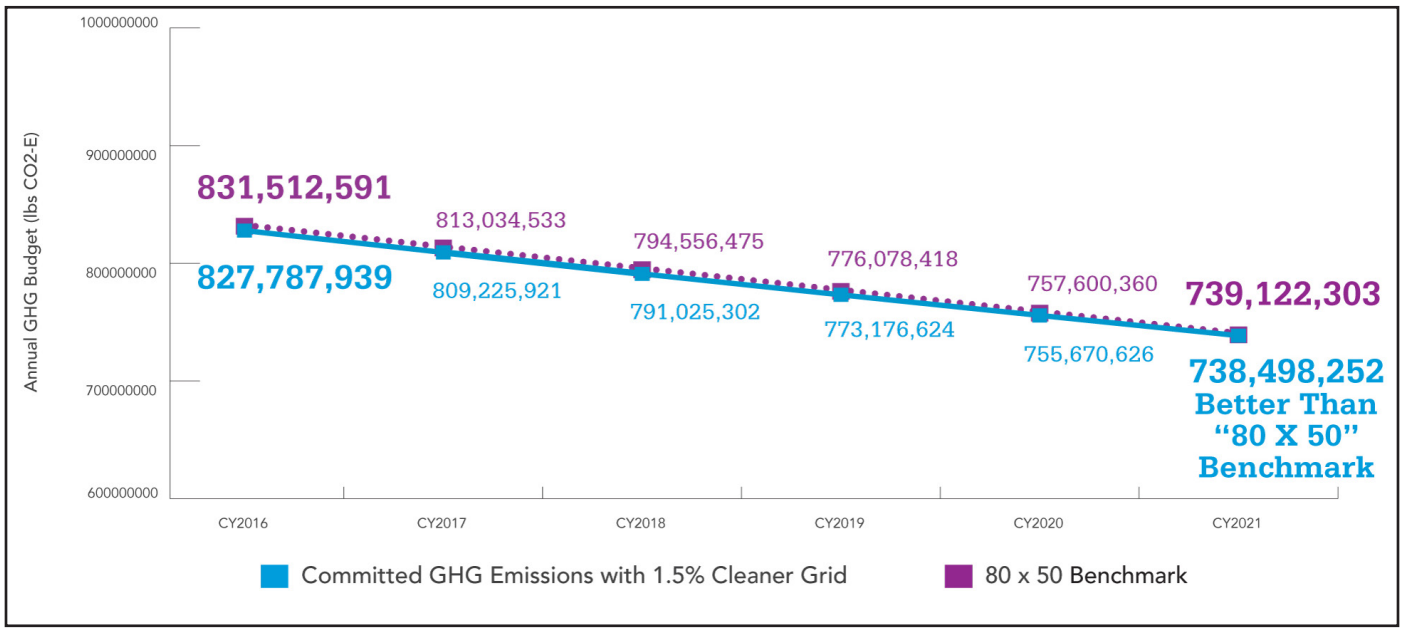
TABLE 21: ENERGY & GHG EMISSIONS REDUCTIONS FROM EMPLOYEE ENGAGEMENT

	Post Plan	Projections with 5% Reduction	Total Reductions
Facility Energy Consumption (mmBtu)	881,334	837,267	**44,067**
Facility GHG Emissions (lbs CO_2-E)	108,626,441	103,195,118	**5,431,322**

4.4 - COMMITTED INITIATIVES PERFORMANCE OUTLOOK

Projected energy and GHG emissions reductions from the eight committed initiatives in combination with emission reductions associated with a cleaner grid (1.5 percent annually) will result in a combined total savings of 89,289,687 lbs CO2-E from the 2016 baseline, outpacing the "80x50" emissions goal in 2021.

FIGURE 10: 2016-2021 GHG PERFORMANCE OUTLOOK



SECTION 5: POSSIBLE OPPORTUNITIES (2021-2026)

As part of the 2018 Energy Action Plan, SEPTA has identified seven possible opportunities that will increase efficiency and reduce emissions. Initiatives listed in the possible opportunity chapter will require further evaluation to determine the feasibility of executing the initiatives over the established five year time period, 2021-2026.

SEPTA has projected emission reductions for six of the seven initiatives list in this chapter, a combined savings of 68,787,939 lbs CO2-E from a 2021 baseline. It is important to note that SEPTA did not model emission reductions as a result of renewable energy procurements from an off-site power purchasing agreement (PPA). If SEPTA successfully procures renewable energy through an off-site PPA, the emission reductions would be even greater. For more information about SEPTA's commitment to issue an RFI for off-site renewable energy, see section 5.2.

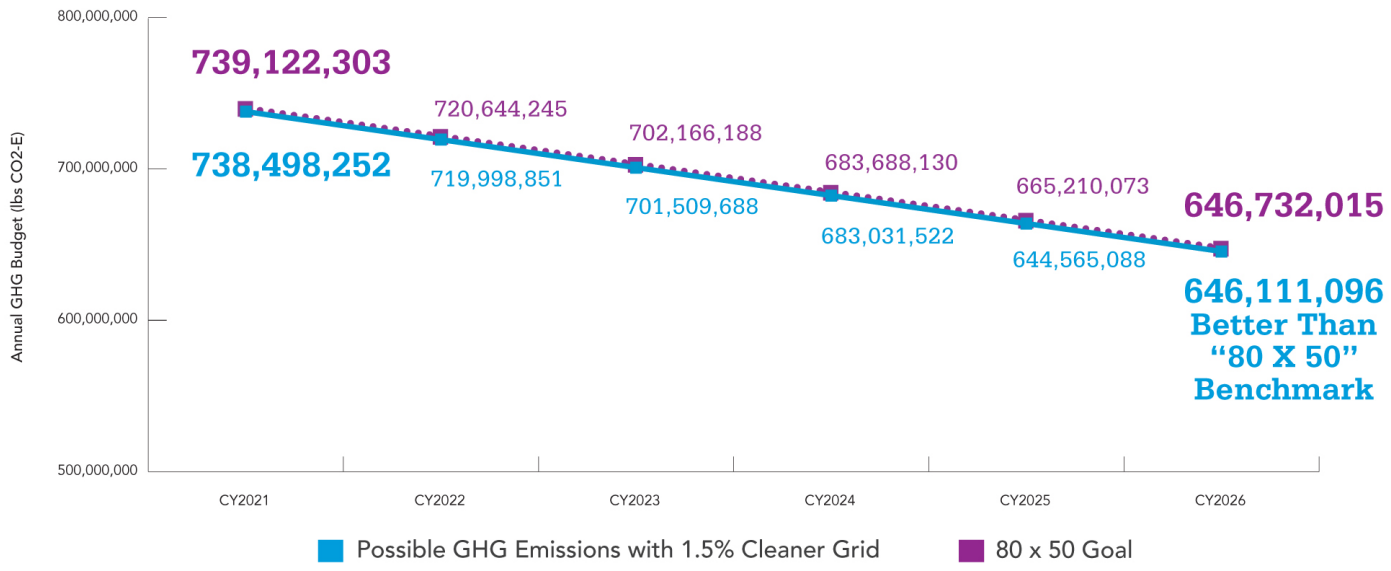
TABLE 22: 2018 ENERGY ACTION PLAN POSSIBLE OPPORTUNITIES SUMMARY

	Initiative Category	Initiative	Focus Area	Source Impact	Energy Impact (mmBtu)	GHG Impact (lbs CO_2-E)
9	**Possible Opportunity**	**Convert 300 Hybrid-Electric Buses to Zero Emission Buses (pg 34)**	Energy Efficiency & Clean Energy	Diesel & Electricity	(250,102)	(35,474,434)
10		**Convert Remaining 100 Diesel Buses to Hybrid-Electric or Zero Emission (pg 34)**	Energy Efficiency & Clean Energy	Diesel & Electricity	(99,058)	(14,539,258)
11		**ESCO at Remaining Backshops/Depots (pg 30)**	Energy Efficiency	Electricity	(74,797)	(10,793,422)
12		**Phase 2 : Solar PPA (pg 33)**	Clean Energy	Electricity	(21,844)	(5,340,205)
13		**Expanded Use of Thermal Recovery (pg 32)**	Energy Efficiency	Natural Gas & Heating Oil	(18,193)	(2,446,886)
14		**VW Settlement Funding for Utility Fleet Upgrades (pg 32)**	Energy Efficiency	Diesel & Gasoline	(21,653)	(193,734)
15		**Offsite Renewable Power Purchasing Agreements (pg 34)**	Clean Energy	Electricity	N/A	N/A
				TOTAL REDUCTIONS	**(485,651)**	**(68,787,939)**

In order to remain consistent with the committed initiatives chapter, SEPTA has assumed that between 2021-2026, the grid will become 1.5 percent cleaner every year. SEPTA considers this a conservative estimate, far below historic trends. From 2006-2016, the grid's emissions factor decreased by 27 percent, equivalent to approximately 3 percent annually.

Figure 11 shows SEPTA's past emissions performance and projected performance resulting from its 2018 possible opportunites and a 1.5 percent annual cleaner grid in comparison to the "80 x 50" benchmark from a 2006 baseline.

FIGURE 11: 2021-2026 GHG PERFORMANCE OUTLOOK



5.1 - ENERGY EFFICIENCY OPPORTUNITIES

The following energy efficiency initiatives will be evaluated for potential future implementation as part of the 2018 Energy Action Plan:

- ESCO at Remaining Backshops/Depots)
- VW Settlement for Utility Fleet Upgrades
- Expanded Use of Thermal Recovery

ESCO at Remaining Backshops/Depots

In 2015, an Investment Grade Audit (IGA) of five back shops/depots was conducted after an ESCO contract was awarded to Constellation New Energy Inc. For the purposes of this report, SEPTA assumed that the post-ESCO energy savings for the remaining backshops/depots would be similar to those that were assessed by Constellation Energy Inc (Table 23).

Based on the assumption that heating oil consumption from the remaining backshops/depots would be eliminated in combination with a 14% electricity reduction and a 51% natural gas reduction, an ESCO project at the remaining backshops/depots would yield a savings of 10,793,422 lbs CO2-E in 2021. (Table 23).

TABLE 23: REMAINING ESCO ELECTRICITY & NATURAL GAS REDUCTIONS

Remaining Backshops /Depots	Baseline Electricity Consumption & Grid Losses (mmBtu)	Baseline Natural Gas Consumption (mmBtu)	% Reduction in Electricity Consumption	Total Electricity Reduction (mmBtu)	% Reduction in Natural Gas Consumption	Total Natural Gas Reduction (mmBtu)
Allegheny	10,360	6,961	14%	12,369	51%	51,546
Bridge Street	2,104	-				
Broad & Lehigh	-	1,626				
Callowhill	9,442	20,525				
Comly	5,522	12,189				
Frankford	8,075	12,824				
Frazer	4,520	8,131				
Frontier	1,341	6,989				
Midvale	27,214	16,642				
Overbrook	6,302	9,615				
Powelton	2,128	-				
Woodland	5,862	5,552				
NHSL-MSHL	3,165	-				
100 Victory	1,447	-				
5800 Bustleton	869	16				
Total (mmBtu)	**88,351**	**101,071**				

TABLE 24: TOTAL REMAINING ESCO ENERGY & GHG EMISSIONS REDUCTIONS

Energy Source	Energy Reductions (mmBtu)	GHG Emissions Reductions (lbs CO_2-E)
Electricity	12,369	3,038,673
Natural Gas	51,546	5,933,640
Heating Oil	10,882	1,761,109
TOTAL REMAINING REDUCTIONS	**74,797**	**10,793,422**

VW Settlement for Utility Fleet Upgrades

As part of the VW settlement proposal, SEPTA has suggested various replacement upgrades for its heavy duty trucks (HDTs) with model years ranging from 1983 to 2005. First and foremost, VW Settlement funding will be deployed to reduce NOx fuel emissions, however, vehicle upgrades will also improve fuel economy. The EPA set new standards for heavy duty vehicle manufacturers, which requires a 10 percent reduction in fuel consumption and GHG emissions for 2018 models. If HDT's are replaced with more efficient vehicles it will reduce SEPTA's diesel fuel consumption in the effected fleet from 88,342 gallons in 2016 to 79,507 gallons in 2021, an savings of 193,734 lbs CO2-E.

TABLE 25: FUEL & GHG EMISSIONS REDUCTIONS FROM VW SETTLEMENT

Pre/Post	Fuel Consumption (Gal)	GHG Emissions (lbs CO_2-E)
Pre	88,342	1,937,340
Post	79,507	1,743,606
TOTAL SAVINGS	**8,835**	**193,734**

Expanded Use of Thermal Recovery

Expanding use of thermal recovery would eliminate heating related natural gas consumption at SEPTA's Midvale Complex and heating oil consumption at Roberts Shop & Liberty Yard. In 2016, heating oil consumption at Roberts Shop and Liberty Yard produced 1,192,806 lbs CO2-E. If SEPTA was able to expand thermal recovery to those two facilities, it would eliminate heating oil emissions completely, a net new savings. Similarly, if the remaining natural gas consumption at Midvale Complex were to be eliminated through expand thermal recovery; SEPTA would see an additional savings of 1,254,086 lbs CO2-E.

TABLE 26: ENERGY & GHG EMISSIONS REDUCTIONS FROM THERMAL RECOVERY

Energy Source	Baseline Source Consumption (mmBtu)	Baseline Source GHG Emissions (lbs CO_2-E)
Natural Gas	10,785	1,254,080
Heating Oil	7,408	1,192,806
TOTAL SAVINGS	**18,193**	**2,446,886**

5.2 - CLEAN ENERGY OPPORTUNITIES

The following clean energy initiatives will be evaluated as part of the 2018 Energy Action Plan:

- Phase 2 Solar Power Purchasing Agreement (Rooftop)
- Offsite Renewable Power Purchasing Agreements
- Purchase Additional Zero Emission Buses

Phase 2 Solar Power Purchasing Agreement

In 2018, SEPTA selected SunVest Solar, Inc. for a power purchase agreement (PPA) through a competitive process to install solar panels at our facilities. In order to increase renewable energy procurement, SEPTA has compiled a list of locations to be considered for future on-site solar PPAs.

Table 27 shows the potential annual kWh output and direct GHG emissions savings from these solar installations based on averages and estimations from the first Solar PPA. As explained in Section 4.2, solar energy production directly correlates to reduced grid consumption and GHG emissions. Moving forward with Phase 2 of the project would enable SEPTA to further decrease its dependence on regional grid energy, and move SEPTA closer to reach energy consumption and GHG reduction goals. Completion of Phase 2 will reduce SEPTA's grid based electricity consumption from 6,402,480 kWh in 2016, to 0 kWh electricity from grid based electricity consumption in 2021, a saving of 6,402,480 kWh or 5,340,205 lbs CO2-E.

TABLE 27: PHASE 2 SOLAR ENERGY & GHG EMISSIONS REDUCTIONS

Location	Rooftop Area (Sq. Ft.)	Estimated Solar Capacity Per Sq. Ft. (KW)	Estimated Annual Output per Sq. ft.(kWh)	Solar Capacity Per Location (KW)	Annual Output Per Location (kWh)	GHG Emissions Saved (lbs CO_2-E)
Courtland	52,780	**0.005**	**6**	264	316,680	264,148
Southern	204,830			1,024	1,228,980	1,025,111
Frontier	33,737			169	202,422	168,843
Allegheny	183,562			918	1,101,372	918,671
Comly	103,400			517	620,400	517,485
Overbrook	57,331			287	343,986	286,924
Midvale	431,440			2,157	2,588,640	2,159,023
TOTAL	**1,067,080**			**5,335**	**6,402,480**	**5,340,205**

Renewable Power Purchasing Agreements

As part of this plan, SEPTA commits to explore, first through an expression of interest (EOI), off-site renewable energy through power purchase agreements to cover a yet to be determined percentage of electricity demand. In order to move forward with an executed contract for off-site renewable energy power purchase agreements, the price per kWh must be equal to or less than the current price that SEPTA pays per kWh. As stated previously, budget-neutrality is a requirement of any sustainability project.

To be conservative, the Plan does not model these additional prospective emission reductions. Even without them, the modeled results of the Plan exceed the 80x50 benchmark. If SEPTA is successful in procuring renewable energy through an off-site PPA, emission reductions for electricity-based initiatives would accelerate.

Purchasing Additional Zero Emission Buses

SEPTA's possible future procurement of electric buses will be based on several factors. In order to commit to replacing SEPTA's current fleet of buses with zero emission vehicles several factors will be considered:

- Range: current vehicle technology enables SEPTA to meet current and future service routes distances in miles
- Price Competitiveness: life-cycle costs of electric vehicles and charging infrastructure is less than or equal to the life-cycle cost of a traditional hybrid-electric vehicle
- Facility Readiness: current maintenance and bus depots will be able to support electricity and space demands electric vehicle charging technology.

Between 2021-2026, SEPTA will have the opportunity to replace its last 100 diesel buses and 300 of the first generation hybrid-electric buses with zero emission buses.

If all three factors positively resolve and the 100 remaining diesel buses are replaced with zero emission buses, it will eliminate SEPTA's diesel fuel consumption by 1,006,048 gallons of diesel fuel in 2021 and is estimated to increase energy consumption at facilities from 83,132,108 in 2016 to 92,136,307 kWh in 2026, resulting in a savings of 14,539,258 lbs CO2-E.

TABLE 28: FUEL & GHG EMISSIONS REDUCTIONS FROM DIESEL BUS REPLACEMENTS

Bus Type	Unit of Use	Avg. Annual Miles Per Bus	Fuel Economy	Miles for 100 Diesel Buses	Energy Used for 100 Buses	Grid Losses	mmBtu Conversion	GHG Emissions (lbs CO_2-E)
Diesel	Gal	31,791	3.16/MPG	3,179,112	1,006,048	--	129,780	22,049,796
Electric	kWh	48,886	2.7 kWh/mile		8,583,603	420,597	30,722	7,510,538
TOTAL SAVINGS							**99,058**	**14,539,258**

*Mileage and fuel economy for diesel buses are based on CY2016 baseline performance data, and electric bus projections are based on Proterra bus simulations for Routes 29 and 79.

If the 300 first generation hybrid-electric buses are replaced with zero emission buses, it will eliminate SEPTA's diesel fuel consumption by 2,668,405 gallons of diesel fuel in 2021 and is estimated to increase energy consumption at facilities from 83,132,108 in 2016 to 110,717,799 kWh in 2026, resulting in a savings of 35,474,434 lbs CO2-E.

TABLE 29: ENERGY & GHG EMISSIONS REDUCTIONS FROM HYBRID BUS REPLACEMENTS

Bus Type	Unit of Use	Avg. Annual Mileage	Efficiency	Bus Count	Avg. Miles Per Bus	Miles for 300 Hybrid Buses	Energy Used for 300 Buses	Grid Losses	mmBtu Conversion	GHG Emissions (lbs CO_2-E)
Hybrid	Gal	24,251,799	3.65 MPG	747	32,466	9,739,678	2,668,405	--	344,224	58,484,075
Electric	kWh	1,222,147	2.7 kWh/mile	25	48,886		26,297,131	1,288,559	94,122	23,009,640
TOTAL SAVINGS									**250,102**	**35,474,434**

*Mileage and fuel economy for diesel buses are based on CY2016 baseline performance data, and electric bus projections are based on Proterra bus simulations for Routes 29 and 79.

In order to properly evaluate the viability of transitioning to a zero emission fleet, SEPTA is conducting an electric vehicle readiness assessment. This will help inform future zero emission vehicle purchases.

Thus far, a facility capacity assessment was completed to determine the number of zero emissions buses that could be supported by currently available excess electricity capacity at SEPTA's bus depots without installing additional charging infrastructure. Table 30 shows that based on current facility capacity - not including the 25 electric buses SEPTA has already purchased – SEPTA could support an additional electric buses 105 buses.

To transition SEPTA's entire bus fleet of 1,454 buses to zero-emission vehicles would require 80.33 MW of energy for overnight charging. SEPTA's current capacity only supports approximately 7 percent of that demand.

TABLE 30: FACILITY ELECTRICITY CAPACITY ASSESSMENT

Location	Number of Buses	Capacity Needed for Overnight Charging (MW)	Current Excess Capacity (MW)	Number of Buses Supported by Current Excess Capacity
110 Victory	150	8.29	0.291	5
Allegheny	121	6.69	0.680	12
Callowhill	204	11.27	0.694	13
Comly	180	9.95	0.499	9
Frankford	141	7.79	0.210	4
Frontier	99	5.47	0.978	18
Germantown	35	1.93	0.643	12
Midvale	312	17.24	1.668	30
Southern	212	11.71	0.119	2
TOTAL	**1,454**	**80.33**	**5.781**	**105**

While SEPTA modeled future emissions from zero-emission fleets based off of electric vehicles, SEPTA will evaluate all zero-emission bus technologies, including electric and hydrogen fuel cell as technologies continue to emerge.

5.3 - EMPLOYEE ENGAGEMENT OPPORTUNITIES

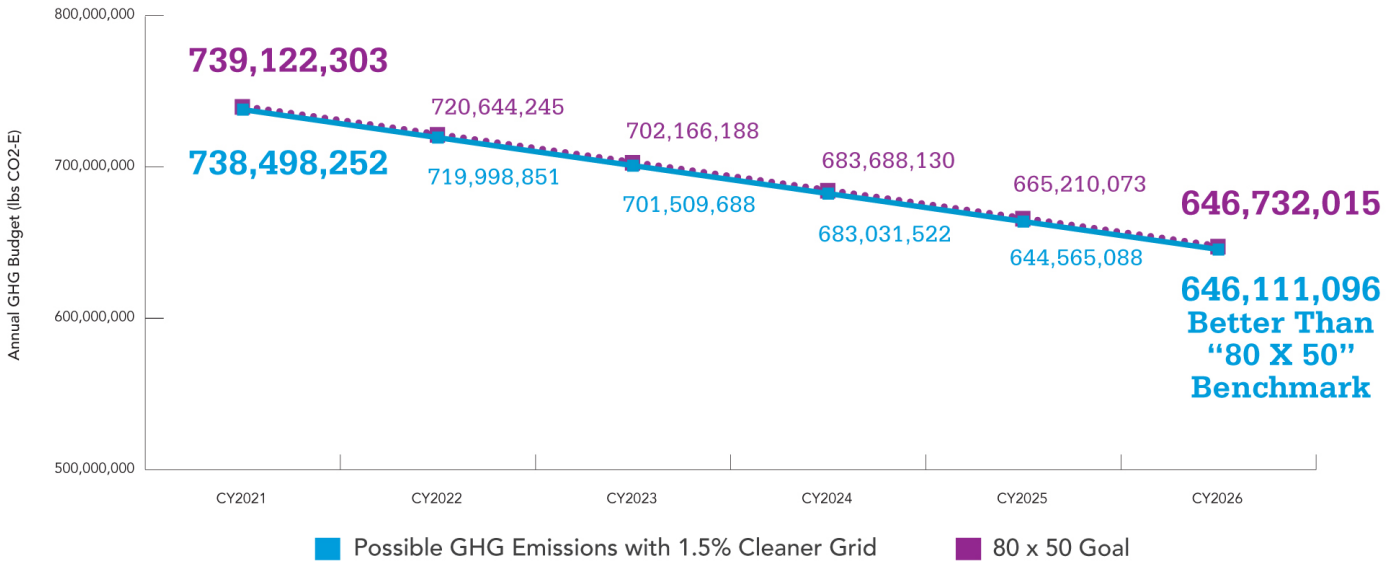
In compliance with ISO standards, future employee engagement opportunities will be developed to improve employees' understanding and participation in energy conservation and GHG emissions reduction strategies. Targeting behavioral changes through employee engagement is intended to maximize energy consumption and increase support for SEPTA's sustainability initiatives.

Additionally, various changes to building maintenance and operations across multiple SEPTA facilities, similar to the custodial time change at the 1234 Market Street headquarters building, are potential opportunities to further reduce SEPTA's energy consumption and GHG emissions. Doing so will also maintain SEPTA's commitment to ISO Lite standards that requires environmental compliance at SEPTA's remaining shops.

5.4 - POSSIBLE OPPORTUNITIES PERFORMANCE OUTLOOK

Projected energy and GHG emissions reductions from the seven possible opportunities in combination with emission reductions associated with a cleaner grid (1.5 percent annually) will result in a combined total savings of 92,387,156 lbs CO2-E from the 2016 baseline, putting SEPTA below the "80x50" emissions goal in 2026. If SEPTA successfully procures renewable energy through an off-site PPA, the emission reductions would be even greater.

FIGURE 12: 2021-2026 GHG PERFORMANCE OUTLOOK



SECTION 6: IMPLEMENTATION STRATEGIES

6.1 - FUNDING

SEPTA will continue to focus on ways to reduce energy consumption and GHG emissions while remaining budget neutral. Budget neutral strategies are a fundamental principle of the 2018 Energy Action Plan. Strategies to achieve 'budget neutrality' include:

- Leveraging energy savings to finance capital projects
- Power Purchasing Agreements to integrate renewable energy into energy profile
- Leveraging grants and other programs for energy initiatives
- Behavioral strategies that decrease facility energy consumption

Leveraging Energy Savings

SEPTA has executed budget neutral energy efficiency projects through Energy Performing Contracts with ESCOs. ESCOs allow SEPTA to complete comprehensive sustainability projects without spending capital dollars. Guaranteed savings repay capital investment over time. SEPTA will continue to leverage ESCOs for future projects.

Power Purchasing Agreement

SEPTA has entered a power purchasing agreement (PPA) with a private developer to install solar photovoltaic panels on the roof tops of four facilities. SEPTA has agreed to purchase the power generated from the PV systems at a price that is budget neutral to SEPTA's current utility provider, PECO. PPAs can reduce reliance on grid energy and decrease GHG emissions associated with SEPTA's energy consumption. SEPTA will continue to leverage PPAs to complete clean energy projects.

Leveraging Grants

Leveraging grants is vital for SEPTA to remain budget-neutral with its energy action initiatives. Federal and state agencies like the Federal Transit Authority, the Environmental Protection Agency (EPA), and the Pennsylvania Energy Development Authority (PEDA) all offered grant programs that launched many of SEPTA's proposed projects from the 2012 Energy Action Plan. SEPTA will continue to explore grants to fund many of its newly committed projects, as shown in Table 31.

TABLE 31: RECENT COMPETITIVE GRANT PROPOSALS

Fiscal Year	Federal Agency	Grant Program	Federal Funding
FY2011	EPA	National Clean Diesel Campaign	$1,200,000
FY2011	FTA	State of Good Repair (Hybrid Buses)	$15,000,000
FY2011	FTA	Clean Fuels (Hybrid Buses)	$5,000,000
FY2011	FTA	TIGGER (Wayside Energy Storage)	$1,440,000
FY2013	FHWA	CMAQ (Locomotive Engine Repower)	$1,280,000
FY2015	FTA	Resilience Grant	$86,800,000
FY2016	FTA	NoLo (Electric Buses)	$2,600,000
TOTAL			**$113,320,000**

Employee Engagement

Operational strategies have been a primary focus area for SEPTA throughout this Energy Action Plan, which includes targeting behavioral changes to reduce SEPTA's energy consumption and GHG emissions. Educating employees and encouraging their participation in energy conservation initiatives is a budget-neutral strategy to reduce each facility's energy consumption, GHG emissions, and utility costs.

SECTION 7: CONCLUSION

SEPTA's 2018 Energy Action Plan charts a course to achieve GHG emissions reductions that exceeds the "80 x 50" benchmark by 2026. It does so by continuing to invest in energy efficiency, clean energy, and employee engagement. Projected emissions reductions from SEPTA's committed initiatives will occur gradually and increase over the long-term as each project is completed.

Moving forward, mitigating the effects of climate change and continuing to take a proactive approach to energy consumption and GHG emissions reductions will prepare SEPTA for future sustainability and resiliency. By implementing this plan with budget neutrality as a key principle, the 2018 Energy Action Plan will achieve triple bottom line objectives of the SEP-TAINABLE 2020 Program plan. Overall, the plan's impact will be to reinforce SEPTA's position as a leader in sustainability, both in the Philadelphia region and throughout the industry.

APPENDIX

ENERGY USAGE DATA

Energy usage data for the Energy Action Plan was obtained from the following sources:

- Diesel: Purchase records maintained by SEPTA General Accounting Department, plus estimates provided by SEPTA Customized Community Transport (CCT) Department
- Electricity: PECO, PSE&G, Lansdale Electric, and third-party supplier invoices maintained by SEPTA Operating Budgets Department
- Natural Gas: Philadelphia Gas Works (PGW), PECO, and PSE&G utility invoices maintained by SEPTA Operating Budgets Department
- Gasoline: Purchase records maintained by SEPTA General Accounting Department, plus estimates provided by SEPTA CCT Department
- Heating Oil: Purchase records maintained by SEPTA Operating Budgets Department
- Steam: Utility invoices maintained by SEPTA Operating Budgets and Real Estate Departments

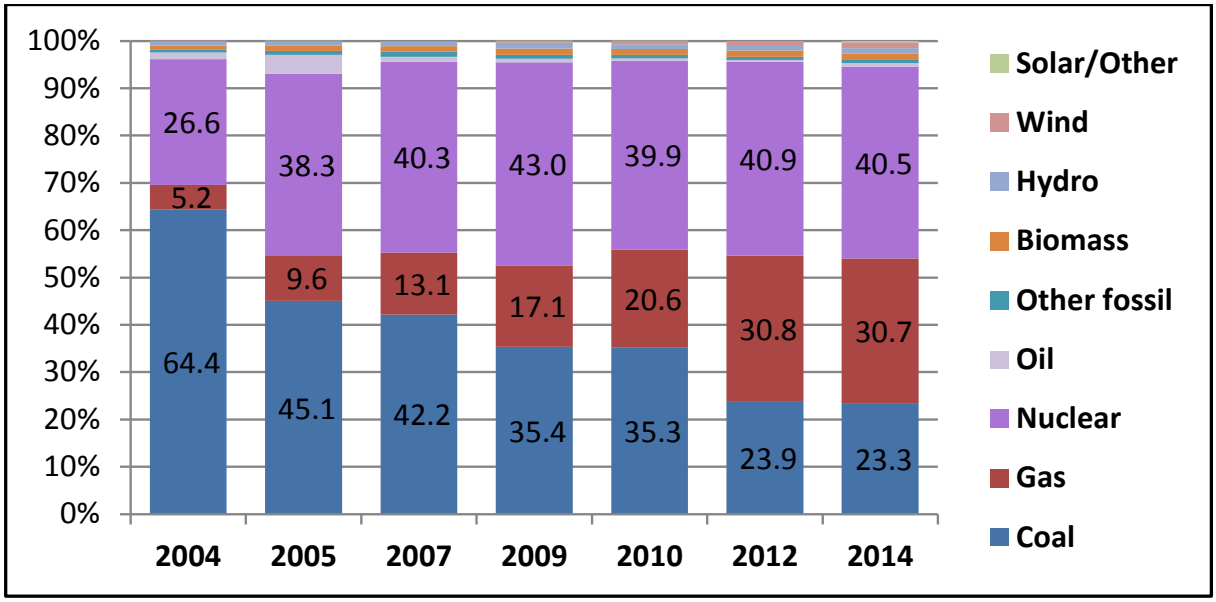
ENERGY SOURCING

Internal energy production is important for SEPTA to meet its GHG and energy efficiency goals for several reasons. First, greater reliance on the local grid brings associated and uncontrollable fluctuations in energy sources entering the grid. Each energy source has different impacts on GHG emissions, which directly affects SEPTA's GHG emissions profile when extracting energy from the grid. Being unable to control energy sources entering the grid consequently correlates to less control over changes to SEPTA's GHG emissions profile in an effort to meet short-term and long-term goals. Second, generating energy, specifically from clean and renewable energy sources, decreases SEPTA's utility costs.

While the sourcing of nuclear energy to power the grid has remained relatively stable over the past ten years, this is expected to change with the premature closing of Three Mile Island in fall 2019[6]. Consequently, changes in the grid makeup will ensue, thus impacting total GHG emissions associated with the energy source or sources employed to compensate for the loss of nuclear power. Ultimately, changes in energy sourcing and GHG emissions will reflect either positively or negatively on SEPTA's GHG emissions profile, however, SEPTA has minimal influence in regards to this issue.

6 http://www.pennlive.com/politics/index.ssf/2017/05/tmis_potential_retirement_to_s.html

MID-ATLANTIC ELECTRICAL GRID SOURCE MIX



7 http://www.pennlive.com/politics/index.ssf/2017/05/tmis_potential_retirement_to_s.html