Calendar Year 2017
Carbon Footprint Report

IMPROVING THE QUALITY OF THE ENVIRONMENT IN WHICH WE LIVE, ONE PROJECT AT A TIME®

Prepared by

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

%	Percent
CFR	Code of Federal Regulations
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent(s)
CY	Calendar Year
EA	EA Engineering, Science, and Technology, Inc., PBC
eGRID	Emissions & Generation Resource Integrated Database
EPA	U.S. Environmental Protection Agency
ESOP	Employee Stock Ownership Plan
FedEx	Federal Express
FTE	Full-time equivalent
gal	Gallon(s)
GHG	Greenhouse gas
GRI	Global Reporting Initiative
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
kg	Kilogram(s)
kW	Kilowatt(s)
kWh	Kilowatt hour(s)
MGD	Millions of gallons per day
MPG	Mile(s) per gallon
$MTCO_2$	Metric ton(s) carbon dioxide
$MTCO_2e$	Metric ton(s) carbon dioxide equivalent
MWh	Megawatt hour(s)
N_2O	Nitrous oxide
PBC	Public benefit corporation
POV	Privately-owned vehicle
PV	Photovoltaic
REC	Renewable Energy Certificate
SF	Square foot (feet)
Standards	Greenhouse Gas Protocol Initiative Corporate Standards
SUV	Sport utility vehicle
th	Therm(s)

UPS	United Parcel Service
WARM	Waste Reduction Model
WRI	World Resource Institute

EXECUTIVE SUMMARY

EA Engineering, Science, and Technology, Inc., PBC (EA) is a 100 percent (%) Employee Stock Ownership Plan (ESOP)-owned public benefit corporation (PBC) that provides environmental, compliance, natural resources, and infrastructure engineering and management solutions to a wide range of public and private sector clients. Headquartered in Hunt Valley, Maryland, EA employs approximately 500 professionals through a network of 24 commercial offices across the continental United States, as well as Alaska, Hawaii, and Guam. This report is based on EA's calendar year (CY) 2017 operations.

In 2017, EA maintained 25 commercial offices and an average employment of 502 employees. This is EA's sixth tabulation of greenhouse gas (GHG) emissions and resulting carbon footprint, first initiated in 2009. The previous tabulation was completed for CY 2016. Previous reports were prepared biennially to cover two full calendar years. This is EA's second annual report and represents EA's Carbon Footprint Report for CY 2017.

This report strives to portray an accurate picture of EA's practices as a company. In the interest of achieving this goal, the 2017 Report incorporates data from our Headquarters location as well as office-specific data from many of our other commercial offices. Earlier assessments of company-wide emissions were made by extrapolating data from EA's leased Headquarters space across all offices based on their headcount and square footage. This and future carbon footprint reports will continue to build on the practice of collecting and incorporating raw data from other commercial offices, when and where available.

In CY 2017, EA generated an estimated total of 4,483.0 metric tons of carbon dioxide equivalents (MTCO_2e) from its operations. Approximately 16.8% (754 MTCO_2e) was offset, resulting in net emissions from operations of 3,728.6 MTCO_2e. The largest single source of GHG emissions arose from employee commutes, which generated an estimated 1,370.5 MTCO_2e, or 30.6% of the total carbon footprint. Purchased electricity and steam contributed 805.9 MTCO_2e (18.0%), followed by EA's business travel by air that contributed 722.8 MTCO_{2e} (16.1%) and EA-owned and operated vehicles at 422.5 MTCO_2e (9.4%). Shipping contributed 132.3 MTCO_2e (3.0%), and natural gas consumption for building heating contributed 219.9 MTCO_2e (4.9%). ***Normalized by total labor hours worked, EA's 2017 carbon footprint is 7.2 metric tons per Full-Time Equivalent (FTE)—a decrease from 7.5 metric tons per FTE based on 2016 net emissions[1].*** This decrease is attributed to increases in purchased offsets and improved data gathering techniques. Future reports will further analyze normalized results to establish potential trends resulting from EA activities influencing emissions (e.g., headcount changes, implementation of composting programs, etc.).

Figure ES-1 (page ES-3) and ***Table ES-1*** (page ES-4) summarize the findings of EA's CY 2017 Carbon Footprint Report.

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[1] EA's previous normalized calculations were based on headcount for the calendar year reported. Normalization based on total labor hours worked (taken from EA's calendar year Occupational Safety and Health Administration 300 Logs) to calculate metric tons per FTE (2,080 labor hours per year) allows for consistent normalization and comparisons between calendar year data in future reporting.

In preparing this CY 2017 Carbon Footprint Report[2], EA continued to improve its annual inventory process by incorporating factors not previously included, and further streamlined underlying computations to enhance the ease and efficiency of annual reporting.

Key Computational Improvements in Calculation of EA's 2017 Carbon Footprint:

- Actual purchased energy (electricity and natural gas) data were used for several commercial offices, rather than using factored estimates based on square footage. More office-specific data were acquired for 2017 than 2016, resulting in improved precision of emissions estimates.

- Tracking of mileage for EA fleet vehicles and other EA equipment (i.e., boats, outboard motors, and generators) has improved compared to previous years; improved tracking allows for increased accuracy in carbon emissions estimates.

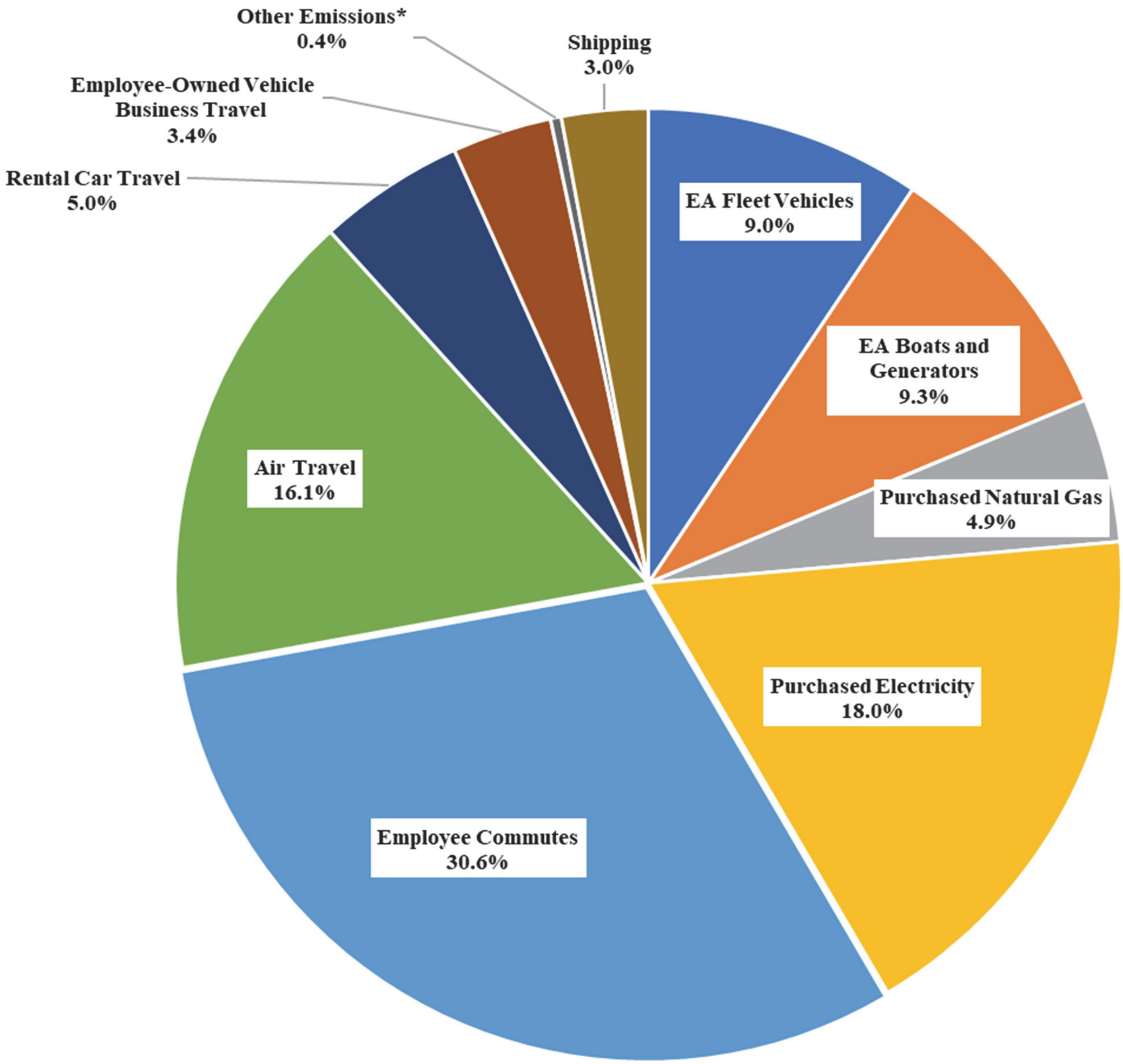
- Improved methods were used for estimating emissions from employee-owned vehicles used for business travel and mileage associated with rental car use.

- Actual solid waste generation and disposal data were used for the Warner Robins, Georgia; Lewisville, Texas; and Seattle, Washington offices for the first time, rather than using factored estimates based on employee headcount at each office.

- Actual carbon emissions data arising from Federal Express shipments were obtained rather than using factored estimates based on United Parcel Service (UPS) shipping data. Additionally, CY 2017 represented EA's first year as a formal partner in the UPS Carbon Neutral Program, which not only provides more accurate reporting related to UPS shipments, but also ensures all of EA's UPS shipments are carbon neutral resulting in additional shipping offsets.

[2] EA's Carbon Footprint Report contains disclosures for Topic-Specific Standards from the Global Reporting Initiative (GRI) Standards sustainability reporting guidelines associated with GRI 300: Environmental Standards.

Figure ES-1. Sources of Emissions by Percentage of Total 2017 Carbon Footprint



** Other emissions are the sum of emissions related to EA's Solid Waste Disposal, Rail Travel, Potable Water, and Wastewater Treatment.*

Table ES-1. Summary of Emissions Contributing to EA's 2017 Carbon Footprint

EA's Carbon Footprint for 2017 (in $MTCO_2e$)		
Scope	**$MTCO_2e$**	**% of Total**
Scope 1: Direct GHG Emissions		
EA Fleet Vehicles	422.5	9.4
EA Boats and Generators	415.7	9.3
Natural Gas	219.9	4.9
Scope 2: Electricity Indirect GHG Emissions		
Purchased Electricity and Steam (Indirect)	805.9	18.0
Scope 3: Other Indirect GHG Emissions		
Employee Commutes	1,370.5	30.6
Air Travel*	722.8	16.1
Rail Travel*	0.6	0.0
Rental Car Travel*	224.4	5.0
Employee-Owned Vehicle Business Travel	152.5	3.4
Solid Waste Disposal	13.0	0.3
Shipping	132.3	3.0
Potable Water	1.2	0.0
Wastewater Treatment	1.7	0.0
Total Emissions	**4,483.0**	**100.0**
Single Stream Recycling	(91.0)	(2.0)
Air Travel Offsets	(100.0)	(2.2)
Renewable Energy Certificates Purchased	(515.3)	(11.5)
Offsets from Shipping	(48.1)	(1.1)
Net Emissions**	**3,728.6**	**83.2**

* Travel data provided by EA's corporate travel agent, Safe Harbors.

** Carbon offsets result in a decrease in net emissions and are denoted by parentheses. Net emissions represent the sum of EA's Scope 1, 2, and 3 emissions less earned/purchased offsets.

1. INTRODUCTION

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This report strives to portray an accurate picture of EA's practices as a company. To that end, the 2017 report incorporates data from our Headquarters location as well as office-specific data from many of our other commercial offices. Earlier assessments of company-wide emissions were made by extrapolating data from EA's leased Headquarters space across all offices based on headcount and square footage. Similar to CY 2016, this report continues to build on the practice of collecting and incorporating actual data from other commercial offices, where available.

The method employed for tabulating this inventory accords with the Greenhouse Gas Protocol Initiative Corporate Standards (hereafter referred to as the Standards), developed and published by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WRI and World Business Council for Sustainable Development 2004). This method is the most widely used international accounting tool for governments and businesses to identify, quantify, and manage GHG emissions. The Standards require accounting for the six "Kyoto Protocol" GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons, emissions of which are reported in terms of carbon dioxide equivalents (CO_2e). Other gases with global warming potential may be included in such analyses, but are not included herein.

This report accounts primarily for CO_2 emissions. Where GHG calculator tools were used to estimate emissions in the form of CO_2e, other GHGs may be included. Aside from these equivalencies, emission estimates for other GHGs have not been directly calculated for this report. These emissions (typically CH_4 and N_2O from combustion of fuels) are usually several orders of magnitude smaller than CO_2 emissions, as is the case for EA's footprint; as such, it is not currently practicable to calculate carbon equivalents for these other GHGs from all activities.

The Standards divide GHG emission sources into three categories: Scope 1, Scope 2, and Scope 3. The typical contributing sources to these categories are described in the remainder of this section.

1.1 SCOPE 1: DIRECT GREENHOUSE GAS EMISSIONS

Scope 1 GHG emissions arise from equipment and operations owned or directly controlled by an organization, including:

- Generation of electricity, heat, or steam from fuel combustion in stationary emission units
- Physical or chemical processing operations that release GHGs
- Transportation of materials, products, waste, and employees
- Fugitive emissions of GHGs resulting from accidental releases, leaks, or other unintentional releases.

Scope 1 GHG emissions from EA's business operations include emissions from fleet vehicle operations, boat operations, generators used in the field, and emissions associated with natural gas utilized for heating offices.

1.2 SCOPE 2: ELECTRICITY INDIRECT GREENHOUSE GAS EMISSIONS

Scope 2 GHG emissions arise from electric power generated by third parties and purchased (consumed) by the organization. Scope 2 emissions can also arise from thermal energy (heating or cooling) generated by third parties (e.g., steam heating in a multi-use office building) and purchased by the organization. Scope 2 GHG emissions from EA's business operations are limited to emissions from power generating stations supplying electric energy to EA's offices.

1.3 SCOPE 3: OTHER INDIRECT GREENHOUSE GAS EMISSIONS

Scope 3 GHG emissions arise from indirect sources related to activities supporting the organization, including:

- Extraction and production of purchased materials and fuels
- Transportation by common carriers of materials, fuels, personnel, and products
- Employee commuting
- Employee-owned vehicle travel for business
- Emissions from recycling and solid waste disposal
- Emissions from potable water supply and wastewater treatment
- Emissions from freight shipments.

Scope 3 GHG emissions arise from EA's business operations, and include emissions from:

- Employee commutes to and from EA commercial office locations and employee business travel using personal vehicles
- Emissions from recycling and disposal of solid wastes generated at EA offices and other work locations

- Emissions from potable water consumption and wastewater treatment

- Emissions arising from shipment of samples, work products, and other materials to and from EA offices and to client/project sites.

2. SCOPE 1: DIRECT GREENHOUSE GAS EMISSIONS

Scope 1 GHG emissions in this inventory were calculated, as shown in ***Table 2-1***, for the following assets and operations owned or controlled directly by EA:

- Fleet vehicles
- Miscellaneous engines (i.e., power boat engines and portable generators)
- Natural gas combustion for building heat and hot water[3].

Table 2-1. Scope 1 Emissions Summary

Source	$MTCO_{2}e$
EA Fleet Vehicles	422.5[4]
Miscellaneous Engines	415.7[5]
Natural Gas	218.9
Net Scope 1 Emissions	**1,057.1**
NOTE: $MTCO_{2e}$ = Metric ton carbon dioxide equivalent.	

2.1 FLEET VEHICLES

EA's vehicle fleet includes passenger cars, small trucks/sport utility vehicles (SUVs), and large trucks/SUVs. EA maintained 92 fleet vehicles in CY 2017 (***Table 2-2***), including 6 hybrid vehicles. With the exception of electrical power provided to plug-in hybrid vehicles, EA's fleet vehicles are powered by gasoline and/or diesel fuel. Two electric charging stations for electric and hybrid technology vehicles are available at EA's Corporate Headquarters in Hunt Valley, Maryland. These charging stations are openly available for public use, not just EA; associated energy usage is included in monthly electric bills for the 225 Schilling Circle building.
A summary of the fleet vehicles and their estimated fuel economy is shown in ***Table 2-2***.

Table 2-2. Summary of Fleet Vehicle Data

Vehicle Type	Average MPG	Number of Vehicles
Passenger Cars	43.1	12
Small Trucks/SUVs	16.4	46
Large Trucks/SUVs	12.2	34
Total	**Not applicable**	**92**
NOTES: MPG = Mile(s) per gallon. Average MPG for Passenger Cars is high due to the number of hybrid cars in the fleet.		

The average MPG shown for passenger cars and small truck/SUV categories is the simple average, by category, of the combined MPG values for the fleet passenger cars and the small

[3] Building heat at certain EA office locations is provided by electric resistance heat; however, to normalize data herein, it has been assumed that in all cases natural gas is burned for building heat.

[4] Emissions were 32% lower than in 2016 due to passenger car fuel efficiency increases in 2017 and fewer overall miles driven.

[5] Emissions were 140% higher than in 2016 due to a new, large boat (the *Marine Vessel Jane. B*, which is >23 feet) placed into service in 2017 and higher utilization of all large boats (5 total) in 2017.

trucks/SUVs owned by EA. The average MPG for large trucks/SUVs was calculated using a weighted average of the MPG ratings for Class 2b trucks/SUVs (8,501–10,000 pounds) and Class 3 trucks/SUVs (10,001–14,000 pounds).

Calculation of GHG emissions from fleet vehicles was based on the total vehicle miles traveled based on EA *Equipment Tracker* information and tracking forms completed by EA employees following project-related travel, and average MPG for each vehicle type. Total logged mileage for EA fleet vehicles in 2017 was 791,734 miles, the majority of which (>516,249 miles) were logged by small trucks/SUVs. The total gasoline consumption by EA fleet vehicles in 2017 was approximately 47,951 gallons (gal). Total gasoline consumption calculation is displayed in ***Table 2-3***.

Table 2-3. Fleet Vehicle Gasoline Consumption Estimations

Vehicle Type	Average MPG	Miles Traveled	Estimated Gasoline Consumption (gal)
Passenger Cars	43.1	100,230.0	2,517.2
Small Trucks/SUVs	16.4	516,249.4	31,116.0
Large Trucks/SUVs	12.2	175,254.6	14,318.2
Total	**Not applicable**	**791,734**	**47,951.4**

A gallon of gasoline is assumed to produce 8.81 kilograms (kg) of CO_2 based on calculated values from 40 Code of Federal Regulations (CFR) 600.113-78, which the U.S. Environmental Protection Agency (EPA) uses to calculate vehicle fuel economy. This number also relies on assumptions consistent with United Nations Intergovernmental Panel on Climate Change (IPCC) guidelines. The total emission calculation is displayed in ***Table 2-4***. The total calculated emissions of EA fleet vehicles in 2017 were 422.5 metric tons, compared to 450.7 metric tons in 2016. In 2017, a total of 791,734 EA fleet vehicle miles were driven, as compared to 841,803 in 2016.

Table 2-4. 2017 Fleet Vehicle Emissions Data

Total Gasoline Consumption (gal)	Emissions Factor (kg CO_2/gal)[6]	Total Emissions (kg CO_2)	Total Emissions ($MTCO_2e$)
47,951.4	8.81	422,451.8	422.5

During the 2017 reporting year, EA retired four small and large trucks/SUVs with model years ranging from 2007 to 2010, replacing them with more fuel efficient 2017 model year vehicles. Additionally, during the same timeframe, EA retired two 2010 passenger cars, replacing them with hybrid model year 2017 passenger cars.

2.2 MISCELLANEOUS ENGINES

EA owns and operates powered watercraft, including boats powered by inboard, 4-stroke gasoline engines, and by outboard, 2-stroke gasoline engines[7]. EA's watercraft fleet includes 22 powered watercrafts with 8 standalone outboard motors with engine power ranging from

6 40 CFR 600.113-78; Subchapter Q – Energy Policy, Part 600 – Fuel Economy of Motor Vehicles.
7 Boat-specific engine type information could not be determined using EA's current tracking system; for the purposes of this report, calculations assumed a mechanically maintained (i.e., in-tune), 4-stroke engine.

10 to 300 horsepower. EA-powered watercraft were utilized a total of 448 days in 2017. EA owns multiple vessels in its fleet; therefore, utilization exceeds 365 calendar days per year. An average daily use of 8 hours was used for boats; multiplying 8 by the total days utilized yielded total hours used in 2017.

To find total gallons of fuel used by EA watercraft in 2017, a specific fuel consumption of 0.5 pounds/hour per unit of horsepower was used, with a fuel-specific weight of 6.1 pounds/gal. Multiplying specific fuel consumption by horsepower and dividing the product by fuel-specific weight yielded gallons of fuel consumed per hour by a boat engine. Total EA boat fuel used in 2017 was estimated at 45,744 gal.

A total of 14 EA-owned field generators were also used during 2017, and have been included in this portion of emissions calculations. EA generators were used for a total of 516 days in 2017. Gallons of fuel burned per day of generator use (1.97 gal/day) was calculated using manufacturer specifications for fuel consumption at the rated load of the models in EA's generator inventory[8] and was based on 4 hours of generator use per day. Total generator fuel consumption was the product of total EA generator usage days and gallons of fuel burned per day of generator use. Total EA generator fuel use was computed at 1,021 gal.

This estimate of fuel use was multiplied by the EPA published emissions factor for gasoline combustion, providing the estimated CO_2 emissions displayed in ***Table 2-5***.

Table 2-5. Emissions Data for Miscellaneous Engines

Total Gasoline Consumption (gal)	Emissions Factor (kg CO_2/gal)[9]	Total Emissions (kg CO_2)	Total Emissions ($MTCO_2e$)
46,765	8.89	415,740.9	415.7

One of the more challenging aspects of calculating carbon emissions from EA fleet vehicles and other engines is the availability of data. The simplest and most accurate approach would be to use records of all fuel purchased for these vehicles and engines, by fuel type, in a calendar year and fuel-specific emission factors. Unfortunately, data come from many different sources (only 70–80% of these data are available through EA purchase records (i.e., fuel vendor accounts) and, in some cases, is too labor intensive to extract. As a result, activity level data (e.g., mileage and hours of operation) are used with assumed mileage data to estimate emissions. These data are also incomplete because EA's *Equipment Tracker* system is not used at all commercial office locations (i.e., some EA offices utilize paper forms to track mileage and reservations). It should be noted that *Equipment Tracker's* use continues to improve annually; consequently, it is anticipated that the accuracy of emissions calculations will continue to improve as a result.

8 Generator model specifications were not available for three EA offices (Deerfield, Illinois; Lincoln, Nebraska; and Albuquerque, New Mexico). In these instances, the average fuel consumption per day of use from the remaining EA generator inventory was used.

9 40 CFR 600.113-78; Subchapter Q – Energy Policy, Part 600 – Fuel Economy of Motor Vehicles.

2.3 NATURAL GAS

2.3.1 Directly Billed Natural Gas Usage

Natural gas usage for 9 EA offices (accounting for 66% of EA employees) is known from direct utility billing for the buildings. Where EA occupies less than the entire building, actual gas usage was calculated in proportion to the building space occupied by EA. Five EA offices reported no gas usage in 2017. Natural gas usage is reported in therms (th). Emissions are based on the factor 0.0053 $MTCO_{2e}$/th (EPA Greenhouse Gases Equivalencies Calculator [EPA 2017]). A summary of gas usage and GHG emissions from gas and steam is displayed in ***Table 2-6***, sorted by highest total GHG emissions.

Table 2-6. Emissions Associated with Known Natural Gas Consumption

Building	EA-Occupied Space (SF)	Natural Gas Consumption (th)	Total GHG Emissions ($MTCO_2e$)
Hunt Valley (225), Maryland	65,400	9,016	47.8
Hunt Valley (231), Maryland	10,000	4,520	24.0
Cockeysville, Maryland (Warehouse)	7,500	3,058	16.2
Lincoln, Nebraska	10,800	1,845	9.8
Albuquerque, New Mexico	8,500	1,219	6.5
Oswego, New York	2,400	888	4.7
Lewisville, Texas	12,800	486	2.6
Brighton, Michigan	1,900	560	3.1
Sacramento, California	860	221	1.2
Warner Robins, Georgia	1,500	0.0	0.0
Houston, Texas	1,800	0.0	0.0
Alameda, California	5,100	0.0	0.0
Barrigada, Guam	2,700	0.0	0.0
Honolulu, Hawaii	2,500	0.0	0.0
Total	**133,760**	**21,813**	**115.9**

NOTES: SF = Square feet.
SF values are taken directly from EA's official property leases; numbers provided in the leases have been rounded to the closest whole number by the leasing agent/property manager.

2.3.2 Estimated Natural Gas Usage

Natural gas usage could not be determined for some EA offices, typically because lease payments include utility charges and property owners were not able to provide separated utility usage data. EA estimated gas usage for these offices by using regional intensity factors based on building size, local climate, and use (U.S. Energy Information Administration 2012). GHG emissions related to natural gas consumption for offices where usage was estimated are displayed in ***Table 2-7*** *(page 2-5)*.

Table 2-7. Emissions Associated with Estimated Natural Gas Consumption

Building	EA-Occupied Space (SF)	Regional Energy Intensity Factor (th/SF)	Estimated Natural Gas Consumption (th)	Total GHG Emissions ($MTCO_2e$)
Deerfield, Illinois	10,300	0.5	5,192	27.5
Abingdon, Maryland	6,300	0.5	3,154	16.7
Syracuse, New York	6,300	0.4	2,383	12.6
Warwick, Rhode Island	4,500	0.4	1,884	10.0
Anchorage, Alaska	3,700	0.4	1,584	8.4
Denver, Colorado	3,000	0.4	1,315	7.0
Kennewick, Washington	2,600	0.4	1,131	6.0
Fairbanks, Alaska	2,200	0.5	984	5.2
Ocean Pines, Maryland	1,600	0.5	785	4.7
Newburgh, New York	1,500	0.4	596	3.7
Portland, Oregon	600	0.4	578	1.5
Salt Lake City, Utah	300	0.4	133	0.7
Total	**42,900**	**Not applicable**	**19,719**	**104.0**

NOTE: Some offices have multiple facilities with difference regional energy intensity factors due to different building uses (warehouse and offices). The factor is a weighted average of all facilities at an office location. Some values are rounded.

A summary of natural gas usage and GHG emissions resulting from natural gas and steam usage is displayed in ***Table 2-8***.

Table 2-8. 2017 Natural Gas Consumption Emissions Summary

Building	Total EA-Occupied Space (SF)	Total Natural Gas Consumption (th)	Total Emissions ($MTCO_2e$)
Buildings with known usage (Table 2-6)	133,760	21,813	115.9
Buildings with estimated usage (Table 2-7)	42,900	19,719	104.0
All EA Buildings	**176,660**	**41,532**	**219.9**

With respect to the emissions data presented in ***Table 2-8***, it should be noted that natural gas consumption totals are similar between offices with known and estimated usage despite the significant difference in total occupied space; this is a result of regional intensity factors used for estimates. Regional intensity factors provided by the U.S. Energy Information Administration for estimating gas usage are considered conservative compared to actual usage data. As a result, estimated usage calculations appear higher on a square-footage basis compared to buildings with office-specific/known usage data. For future reports, EA will continue to work to collect more office-specific natural gas consumption data to decrease reliance on conservative regional intensity factors.

3. SCOPE 2: INDIRECT GREENHOUSE GAS EMISSIONS

GHG emissions were calculated using the electricity usage and Subregion Output Emissions Factors from EPA's Emissions & Generation Resource Integrated Database (eGRID) (EPA 2016). Subregion Output Emissions Factors are used to convert usage to emissions and accounts for types of electricity generating stations and fuel mix within a geographic region.

3.1 DIRECTLY BILLED POWER UTILITY USAGE

Utility usage for 19 EA offices (accounting for 86% of EA employees and 85% of total leased space) is known from direct utility billing for the locations. Where EA occupies less than the entire building, actual usage was calculated in direct proportion to the building space occupied by EA. The Seattle, Washington office utilized district steam heating instead of natural gas. The emissions calculation for steam assumes an industry standard boiler efficiency and that the fuel used to create steam is wood or wood waste (Oregon Department of Environmental Quality 2016). The Lewisville, Texas office utilizes a power plan where all electricity purchased is generated by wind power; therefore, even though usage is reported, GHG emissions are assumed to be zero. Electricity usage is reported in kilowatt-hours (kWh). GHG emissions for purchased power utility are displayed in ***Table 3-1***.

Table 3-1. Emissions Associated with Known Power Utility Consumption

Building	EA-Occupied Space (SF)	Electricity Purchased (kWh)	Subregion Output Emission Rate[1] ($MTCO_2e$ / kWh)	Total Emissions ($MTCO_2e$)
Hunt Valley (225), Maryland	65,400	1,244,000	3.44×10^{-4}	427.8
Lincoln, Nebraska	10,800	72,950	5.62×10^{-4}	41.0
Honolulu, Hawaii	2,500	41,820	5.23×10^{-4}	21.9
Seattle, Washington (electricity)	5,500	59,750	2.95×10^{-4}	17.7
Barrigada, Guam	2,700	33,400	5.23×10^{-4}	17.5
Seattle, Washington (steam)	5,500	0	Not applicable	14.0
Abingdon, Maryland	6,300	37,450	3.44×10^{-4}	12.9
Alameda, California	5,100	44,090	2.39×10^{-4}	10.6
Albuquerque, New Mexico	8,500	18,870	4.99×10^{-4}	9.4
Warner Robins, Georgia	1,500	17,430	4.94×10^{-4}	8.6
Brighton, Michigan	1,900	13,090	5.77×10^{-4}	7.6
Warwick, Rhode Island	4,500	28,300	2.53×10^{-4}	7.2
Ocean Pines, Maryland	1,600	13,140	3.44×10^{-4}	4.5
Cockeysville, Maryland (Warehouse)	7,500	10,030	3.44×10^{-4}	3.5
Hunt Valley (231), Maryland	10,000	9,450	3.44×10^{-4}	3.3
Houston, Texas	1,800	6,340	4.58×10^{-4}	2.9
Sacramento, California	860	8,070	2.39×10^{-4}	1.9
Oswego, New York	2,400	4,630	1.34×10^{-4}	0.6
Kennewick, Washington	2,600	1,850	2.95×10^{-4}	0.6
Lewisville, Texas[2]	12,800	112,540	4.58×10^{-4}	0.0
Total	**159,760**	**1,777,200**	**Not applicable**	**613.5**

1. Subregion Output Emission Rates obtained from eGrid2016 summary tables (EPA 2016).
2. Lewisville office emissions assumed to be 0.0 due to power source (wind).

Subregion Output Emissions Rates used in **Table 3-1** and **Table 3-2** vary significantly between EA offices as a result of the subregion in which they are located. The EPA eGRID rates are derived based on the type of electricity predominantly utilized within the region. For example, offices located in regions such as the Midwestern United States, where electricity is predominantly coal-derived, correspond to a higher subregion output emissions rate as a result of fossil fuel emissions; whereas, offices in the Northeastern United States correspond to lower subregion output emissions rates as a result of electricity being purchased from a higher percentage of cleaner sources, such as nuclear and/or hydroelectric plants.

3.1.1 Solar Array at 225 Schilling Circle

EA's Headquarters building at 225 Schilling Circle (Hunt Valley, Maryland) has a photovoltaic (PV) array installed on the roof. This array is rated at 25.08 kilowatt (kW) direct current and 20.94 kW alternating current. Energy generated by the array is fed directly into the building electrical distribution system; therefore, its output displaces energy that would otherwise be purchased from the local utility (Baltimore Gas and Electric). In 2016, the PV array produced 27,707 kWh. Production data for the PV array were not readily available for 2017. As a result, this section assumes that production during 2017 was similar to production during 2016.

The proportion of onsite energy generation used by EA in 2017 (based on EA's occupancy of 51.2% of the building) was approximately 14,330 kWh; therefore, the PV array provided:

$$14{,}330 / (1{,}244{,}000 + 14{,}330) = 1.14\%$$

of the total electricity consumption associated with the building and provided a Scope 2 CO_2 emissions reduction of:

$$14{,}330 \times 3.44 \text{ x } 10^{-4} = 4.93 \text{ MTCO}_2\text{e}$$

This renewable energy benefit is noted here, but is not included in the Scope 2 emissions calculation.

3.2 ESTIMATED ELECTRICITY USAGE

Electricity usage data were not available for some EA offices, typically because lease payments include utility charges and/or property owners do not provide separate utility usage data for these buildings. In such instances, EA estimated electricity usage by using regional energy intensity factors based on building size, local climate, and use (U.S. Energy Information Administration 2012).

GHG emissions related to electricity consumption for offices where usage was estimated are summarized in ***Table 3-2***.

Table 3-2. Emissions Associated with Estimated Power Utility Consumption

Building	EA-Occupied Space (SF)	Regional Energy Intensity (kWh/SF)	Estimated Electricity Usage (kWh)	Subregion Output Emission Rate[1] ($MTCO_2e$ / kWh)	Total Emissions ($MTCO_2e$)
Deerfield, Illinois	10,300	18.9	194,000	5.64×10^{-4}	109.6
Denver, Colorado	3,000	12.9	39,300	6.20×10^{-4}	24.4
Anchorage, Alaska	3,700	11.6	43,480	4.86×10^{-4}	21.1
Fairbanks, Alaska	2,200	18.9	41,580	4.86×10^{-4}	20.2
Syracuse, New York	6,300	13.1	82,860	1.34×10^{-4}	11.9
Portland, Oregon	650	12.9	8,360	2.95×10^{-4}	2.5
Newburgh, New York	1,500	7.4	10,830	1.34×10^{-4}	1.5
Salt Lake City, Utah	310	12.9	3,970	2.95×10^{-4}	1.2
Total	**27,960**	**Not applicable**	**424,380**	**Not applicable**	**192.4**

NOTE: Some offices have multiple facilities with different regional energy intensity factors due to different building uses (warehouse and offices). The factor is a weighted average of all facilities at an office location. Some values are rounded.

1. Subregion Output Emission Rates obtained from eGrid2016 summary tables (EPA 2016).

A summary of electricity usage and the resulting GHG emissions resulting is displayed in ***Table 3-3***.

Table 3-3. Scope 2 Emissions Summary

Building	Total EA-Occupied Space (SF)	Total Electricity Consumption (kWh)	Total Emissions ($MTCO_2e$)
Buildings with known usage (Table 3-1)	159,760	1,777,200	613.5
Buildings with estimated usage (Table 3-2)	27,960	424,380	192.4
Total Scope 2 Emissions	**187,720**	**2,201,580**	**805.9**
Purchased Renewable Energy Certificates (RECs)			**(515.3)**
Net Scope 2 Emissions			**290.6**

3.3 RENEWABLE ENERGY CERTIFICATE OFFSETS

A REC is a tradable asset that represents the environmental attributes of 1 megawatt hour (MWh) of renewable electricity. RECs are sold separately from actual power generated to consumers who want to essentially “green” their existing power sources by contributing to the use of renewable energy sources.

To proactively mitigate EA’s day-to-day operations that result in emissions, EA purchased 1,000 RECs (MWh) from Carbon Solutions Group for CY 2017. Purchased RECs correspond to 515.3 $MTCO_2e$ from carbon-free renewable energy, which was used to offset Scope 2 emissions in 2017.

4. SCOPE 3: OTHER INDIRECT GREENHOUSE GAS EMISSIONS

EA's other indirect GHG emissions, as shown in ***Table 4-1***, arise from the following sources:

- Employee commuting
- Business travel in employee-owned vehicles
- Business air travel
- Business rail travel
- Business rental car travel
- Recycling and solid waste disposal
- Potable water supply and wastewater treatment
- Shipping.

Table 4-1. Scope 3 Emissions Summary

Carbon Source	$MTCO_2(e)$
Employee Commutes	1,370.5
Employee Vehicle Business Travel	152.5
Air Travel	722.8
Wastewater Treatment	1.7
Potable Water	1.2
Solid Waste Disposal	13.0
Shipping	132.4
Rental Car Travel	224.4
Rail Travel	0.6
Total Scope 3 Emissions	**2,619.1**
Carbon Emissions Offsets	
Shipping Offsets	(48.1)
Air Travel Offsets	(100.0)
Recycling	(91.0)
Net Scope 3 Emissions	**2,380.0**

4.1 EMPLOYEE COMMUTING

Data used to determine emissions produced from employee commutes to each EA workplace were compiled using a voluntary employee survey. A survey of commuting habits in 2017 was sent out to all EA employees in early 2018, and 279 valid employee responses were received—a 56% overall response rate, similar to response rates for previous years' commuter surveys.

Survey questions addressed modes and details of commuting (including type, fuel, mileage, and frequency of use of conventional and hybrid electric privately-owned vehicles [POVs]), as well as frequency of use of other modes such as mass transit (e.g., train, bus, etc.), or carpooling; bicycle and pedestrian modes; and telecommuting. Emissions calculations were based on these sampling data extrapolated to the Company's 2017 average employment of 502 people. Emission factors from the most recent EPA Emissions Factor Greenhouse Gas Inventory protocol were used. ***Table 4-2*** (page 4-2) summarizes the findings.

Table 4-2. Emissions Attributed to Employee Commutes

Fuel Type	Emissions Factor ($kg\ CO_2$/Unit)	Unit
Gasoline	8.8	Gallon
Diesel	10.2	Gallon
Bus	0.0	Passenger-mile
Intercity Rail[1]	0.1	Passenger-mile
Commuter Rail[2]	0.2	Passenger-mile
Average Commuter Emissions per Employee	**Total Employees**	**Total Emissions ($MTCO_2e$)**
2.73	502	1,370.5

1. Defined as long-distance rail between major cities (i.e., Amtrak).
2. Defined as rail service between a central city and adjacent suburbs (also called regional rail or suburban rail.

4.2 EMPLOYEE BUSINESS TRAVEL

4.2.1 Employee Business Travel Utilizing Personal Vehicles

EA employees logged 439,640 vehicle miles for business travel utilizing personal vehicles in 2017. The average self-reported personal vehicle MPG value (25.4) from EA's employee commuter survey was used to calculate total GHG emissions from business travel in employee-owned vehicles. The total gasoline consumption calculation related to the use of POVs to complete business-related travel is displayed in ***Table 4-3***.

Table 4-3. Gasoline Consumption for Business Travel Utilizing POVs

Average Self-Reported MPG	Miles Traveled	Total Gasoline Consumption (gal)
25.4	439,640	17,308.7

As in Section 2.1 (Fleet Vehicles), the combustion of a gallon of gasoline is assumed to produce 8.81 kg of CO_2. The total emission calculation is displayed in ***Table 4-4***.

Table 4-4. Emissions Attributed to POV Use during Business Travel

Total Gasoline Consumption (gal)	Emissions Factor ($kg\ CO_2$/gal)	Total Emissions ($kg\ CO_2$)	Total Emissions ($MTCO_2e$)
17,308.7	8.81	152,489.3	152.5

4.2.2 Employee Business Travel by Air, Rental Car, and Rail

In 2017, data provided by Safe Harbors, EA's corporate travel agent, were used to calculate GHG emissions from business travel by air, rail, and rental car. Emissions attributed to air and rental car travel increased compared to 2016 values, while rail travel-related emissions decreased. Further, EA continued to include 2017 GHG emissions from business travel using POVs (first included during the 2015 report), which also increased total emissions associated with business travel. ***Tables 4-5, 4-6,*** *and* ***4-7*** (page 4-3) show emission calculations broken out by additional methods of business travel.

Table 4-5. Emissions Attributed to Business Travel – Airlines

Airlines	Miles Traveled	Total Emissions ($MTCO_2e$)
Short Haul	127,492	36.5
Medium Haul	1,534,687	311.2
Long Haul	2,119,186	375.1
Total	**3,781,364**	**722.8**
Definition		**Distance (miles)**
Short Haul		<281
Mid Haul		281-994
Long Haul		>994

Table 4-6. Emissions Attributed to Business Travel – Rental Cars

Miles Traveled	Average MPG	Gas Used (gal)	Emissions Factor (kg CO_2/gal)	Total Emissions ($MTCO_2e$)
541,590	23.0	25,464	8.8	224.4

Table 4-7. Emissions Attributed to Business Travel – Railways

Miles Traveled	Total Emissions ($MTCO_2e$)
12,177	0.6

4.2.3 Air Travel Offsets

In 2016, EA purchased emissions offsets to reduce the net impact of employee air travel. EA purchased 100 metric tons of verified CO_2 offsets through TerraPass (TerraPass 2012), effectively reducing the impact of company air travel by one quarter. Net air travel emissions calculations using offsets and net emissions are broken out in ***Table 4-8***.

Table 4-8. TerraPass Offsets and Net Emissions Attributed to Air Travel

Source	Total Emissions ($MTCO_2e$)
Air Travel Emissions	722.8
TerraPass Offsets	(100.0)
Net Air Travel Emissions	**622.8**
NOTE: Carbon offsets result in a decrease in net emissions and are denoted by parentheses.	

All TerraPass carbon offsets have been verified by independent third parties using the Verified Carbon Standard and the Climate Action Reserve. All TerraPass emissions reduction projects currently occur in North America, and the 2017 portfolio included projects for landfill gas capture, wind farm power, clean energy, and *BEF* (formerly Bonneville Environmental Foundation) Water Restoration Certificate® projects.

4.2.4 Green Lodging

While not a source of emissions within EA's carbon footprint, EA has completed supply chain research to allow personnel to make more sustainable lodging choices while on travel. EA analyzed our hospitality/lodging spending to identify the percentage of lodging completed at facilities with in-place sustainability programs. While not the primary decision factor, green lodging commitments are a consideration in the hotel selection process when traveling, along with cost, availability of government per diem rates, proximity to client location/project site, etc.

In 2017, of the approximately 950 business-related travel bookings, approximately 87% of the lodging partners were recognized, multi-national brands with well-established sustainable practices and green commitments. Most major hospitality brands have robust reporting systems that are publicly available for review on their websites. Additionally, there are a number of voluntary hospitality-specific sustainable rating systems such as TripAdvisor's *greenleaders* program, which recognizes eco-friendly hotels committed to green housekeeping practices, recycling, transportation services, and locally-sourced and/or organic food options. Of note, EA's use of Marriott-branded lodging partners, which have robust environmental and sustainability initiatives in-place, increased by 8% to 42.7% of total booking in 2017.

The remaining 13% of EA's lodging was at other branded or sole proprietor hotels. Through analysis, EA determined that within this group, there are hotels that have received TripAdvisor *greenleaders* awards and/or Leadership in Energy and Environmental Design accreditation. Additionally, local hotels were selected based on proximity to field project locations or meeting sites to reduce travel between locations.

4.3 RESOURCE CONSUMPTION, RECYCLING, AND DISPOSAL

EA's carbon emissions (as CO_2e) arising from recycling and disposal of solid waste were calculated using EPA's Waste Reduction Model (WARM) Version 14 (EPA 2012). The emission factors in the WARM model represent the life cycle emissions of various materials, and capture the upstream emissions associated with the raw material extraction, manufacturing processes, and transportation involved in producing the material, in addition to those for recycling and/or disposing of the material.

4.3.1 Emissions from Solid Waste

Recycling or disposing of solid waste may generate either a net increase or a net decrease in GHG emissions, depending on material type and waste management options employed. The waste management options considered for EA waste include recycling, landfilling (with and without landfill gas recovery and conversion to energy), composting, and combustion with energy recovery. Each of these waste management options may release and/or offset GHGs depending on the situation.

Recycling may result in a net reduction in GHG emissions if recycling generates less GHG than manufacturing materials from raw resources. Landfilling generates GHG in the form of CO_2 and CH_4, byproducts of the aerobic and anaerobic decomposition of organic materials in the landfill.

This release of CH_4 increases GHG emissions if allowed to escape uncontrolled because the global warming potential of CH_4 is over 20 times greater than CO_2. However, some landfills collect and convert CH_4 for use as an alternative energy source, thereby displacing the use of conventional energy sources (i.e., fossil fuels). Landfills may also sequester some carbon, as most items landfilled will not fully decompose and the carbon contained in the items will remain in the landfill. While incineration with energy recovery generates GHGs (e.g., CO_2, CH_4, and N_2O), power generated from energy recovered during the combustion process replaces power that would have been generated by burning fossil fuels and would contribute higher amounts of GHGs. As a result, incineration with energy recovery causes a net reduction in GHGs.

The percentage of waste from the Hunt Valley complex (225 and 231 Schilling Circle), shown as "landfilled" in Waste Management, Inc.'s report[10], but being combusted at the Baltimore Refuse Energy Systems Company (commonly referred to as the Baltimore RESCO facility) waste-to-energy plant in 2017, increased from 20 to 30%. Therefore, 70% of EA's solid waste from the Hunt Valley offices was disposed in landfill(s) in 2017 through the Texas, Maryland transfer facility and then onto the Waste Management King George Landfill in southern Virginia. King George Landfill is equipped with landfill gas collection and energy conversion through combustion turbine driven generators; therefore, the full 70% was disposed of in facilities equipped with landfill gas-to-energy conversion. This information is required for calculating an accurate tonnage of waste landfilled to input into WARM since the report provided by the building manager (Merritt Properties, LLC) only shows "tons landfilled" without detail related to the waste's final disposition. These disposal methods are reflected in the WARM model run for Hunt Valley by breaking out the municipal solid waste category appropriately by percentage.

4.3.2 EA Waste Generation and Management

All EA offices have functional recycling programs in place. Estimates of the amounts of trash and recycling generated by EA personnel were calculated based on the generation rates for the Hunt Valley offices at 225/231 Schilling Circle and based on actual data from 7 of EA's commercial offices: Warner Robins, Georgia; Lewisville, Texas; Seattle, Washington; Alameda and Sacramento, California; Honolulu, Hawaii; and Barrigada, Guam.

Three variations of WARM were run:

1. One using only waste and disposition data from Hunt Valley and its occupants

2. One extrapolating the combined data from all offices by headcount (waste produced per person) and using national average disposition assumptions

3. One using only raw data from the additional commercial offices and national average disposition assumptions.

The amounts of recyclables and trash generated by the Hunt Valley offices were calculated using information provided by Waste Management, Inc., through the building manager Merritt

[10] Waste Management, Inc. summary of recycling and waste data provided to Merritt Properties, LLC for the reporting period of January 2017 through December 2017.

Properties, LLC. The amounts of trash and recycling generated by the other offices were calculated using information provided from EA employees based in those offices. Estimates of compost generated by EA employees for the offices with established composting programs were also calculated using employee reporting (Section 4.3.3 provides further detail).

Additionally, to meet company sustainability goals, paper purchased and used in each office meets one of the three following sustainable standards: Forest Stewardship Council-certified, Sustainable Forestry Initiative-certified, or at least 30% post-consumer recycled content.

Waste generation and diversion data for the company are shown in ***Table 4-9***.

Table 4-9. Waste Generation and Diversion Data

Waste Category	Amount of Waste by Category (short tons)
Trash	74.5
Recycling	31.9*
Compost	3.8*
Total	**110.2**
* EA's waste diversion rate of 32.4% is calculated by adding the total short tons of recycling and compost waste and dividing by total short tons waste: ((31.9 + 3.8)/110.2) × 100 = 32.4%. The overall diversion rate increased over 2016, primarily due to both recycling and composting.	

WARM provides estimates in metric tons of CO_2e for GHG emissions resulting from disposal of materials. For EA's calculations (***Table 4-10***), it was assumed that all trash is equivalent to "Mixed Municipal Solid Waste" and that all single stream recycling is equivalent to "Mixed Recyclables." The 2017 assumed breakdown of Mixed Recyclables was based on the national average: 24% paper, 2.2% plastic, 2.2% aluminum, 8% glass, and 68% cardboard.

Paper recycled by the Hunt Valley offices was assumed to be equivalent to the category "Mixed Paper (primarily from offices)." Compost generated by the Hunt Valley, Maryland; Alameda, California; and Seattle, Washington offices was assumed to be equivalent to the category "Food Waste."[11] Across all EA offices, 25% of trash was incinerated and 75% of trash was landfilled; national averages were used for landfill gas capture and destruction rates.

Table 4-10. Emissions and Offsets Related to Recycling and Solid Waste Disposal

Category	Treatment	Location	Quantity (short tons)	Total Emissions ($MTCO_2e$)
Trash	Landfilled	All offices	52.9	13
Trash	Combusted	All offices	21.6	
Mixed Recyclables	Recycled	All offices	31.9	(90)
Compost	Composted	Hunt Valley	3.8	(1)
Total			**110.2**	**(78)**

11 "Food Waste" category indicates products comprised of approximately 9% beef, 11% poultry, 13% grains, 49% produce, and 18% dairy. While EA's Hunt Valley office also composts paper and compostable kitchen ware (i.e., Eco-Products® plates and utensils), compost streams from other offices are predominantly food waste. The "Food Waste" category was selected to be representative of EA's company-wide compost content.

The annual waste disposal summary provided by Waste Management, Inc. is not based on actual weights. The Hunt Valley complex is provided with two, 8-cubic yard containers. At an assumed density of 78 pounds per cubic yard, the municipal solid waste container is assumed to hold 624 pounds each time it is emptied. At an assumed density of 5 pounds per cubic yard, the mixed recyclables container is assumed to hold 40 pounds each time it is emptied. Both containers are being emptied three times per week.

4.3.3 Composting Programs

EA implemented a kitchen waste reduction and composting program in the Hunt Valley office in 2016. The program includes the following components:

- A composting program launched in partnership with a 100% wind-powered, local, veteran-owned small business composter—Veteran Compost of Aberdeen, Maryland

- Implementation of use of disposable kitchen items that are made from 100% renewable resources and are 100% compostable

- Purchase of additional non-disposable cutlery and dishware to create a zero-waste option

- Phase-out of paper service with catering orders to prevent non-recyclable and non-compostable items from being mixed with in-house, compostable kitchen items.

In 2017, the Hunt Valley Composting Program diverted 5,668 pounds of biodegradable material such as food waste, paper products, and compostable kitchen products.

Two other EA offices had active composting programs in 2017. Employees in EA's Seattle office participate through a city-wide program and were able to divert 1,445 pounds of biodegradable materials to composting in 2017. Employees in EA's Alameda, California office were able to divert 463 pounds of material to composting in 2017. In total, EA was able to divert approximately 3.8 tons of compostable materials away from solid waste disposal options in 2017.

Employees at EA's offices in Deerfield, Illinois; Warwick, Rhode Island; and Syracuse, New York also began developing composting programs in 2017; however, program accounting procedures are still being developed. In the case of Warwick and Syracuse, the programs were implemented by employees who periodically take home collected materials for use with at-home, personal composting initiatives. While these take-home programs favorably impact EA's associated footprint by diverting additional solid waste, offsets have not been calculated as they are associated with personal efforts.

4.3.4 Additional Solid Waste Diversion Initiatives

EA's Information Technology (IT) Department in Hunt Valley fosters environmentally responsible recycling of electronic devices and equipment by holding an annual eWaste collection event and inviting employees to bring in personal eWaste for recycling through EA's corporate eWaste vendor. The first annual eWaste event was conducted during 2016 as an Earth Day activity; its success led to EA establishing an annual Spring eWaste event open to employees in all EA Maryland offices (Hunt Valley, Abingdon, and Ocean Pines). In addition, the IT Department accepts eWaste from employees at other times of the year and stores the material for later transfer to our supplier of recycling services.

To improve eWaste recycling and ensure maximum recycling of all components, EA's IT Department assessed 5 new eWaste recycling service providers in 2017, and ultimately selected a new vendor for these services—EZPC Recycling LLC. In 2017, EA was able to recycle 37 computers, 10 printers/scanners/fax machines, and hundreds of power supplies and other miscellaneous items of eWaste through its selected service provider. These totals reflect a combination of EA's corporate eWaste (i.e., company-owned materials that have reached end-of-life status and require replacement/upgrade) and personal eWaste from employees collected during the annual eWaste recycling event.

4.4 POTABLE WATER SUPPLY AND WASTEWATER TREATMENT

Due to the fact that the methods used in previous years to estimate GHG emissions from water and wastewater were no longer verifiable (i.e., references formerly utilized are no longer available online), the method used to estimate CO_2e generated from supplied potable water and treated wastewater was updated in 2017.

For data from the Hunt Valley, Maryland office complex, estimated CO_2e generated from potable water consumed and wastewater discharged was calculated using methods described in the Water Research Foundation's 2013 report, Electricity Use and Management in the Municipal Water Supply and Wastewater Industries (Pabi et al. 2013), including the full analysis of Baltimore City's Back River Wastewater Treatment Plant processes and input of the regional emission factor according to EPA's eGRID report (EPA 2016). This method was used to estimate CO_2e emissions for the remainder of EA's offices where water usage data were available—estimates were based on local wastewater treatment plant daily treatment volumes instead of calculating out the entire treatment system for each city or municipality.

Estimated emissions for the remainder of EA's offices where direct water usage data were unavailable were calculated using average water consumption per employee per day for an office building, which is 15 gallons per day (U.S. Department of Energy 2013). Emissions were then calculated as described above for offices where water usage data were available.

4.4.1 Emissions Related to Water and Wastewater Sector

Potable water and wastewater discharge emissions are associated with the use of energy required to pump and treat the water. These services are energy intensive and account for 5% of energy use in the United States (Griffiths-Sattenspield and Wilson 2009). The largest use of energy for potable water utilities is pumping water, while a combination of pumping and treating by aeration comprises the majority of energy use for wastewater treatment plants. The emissions factors used herein capture emissions generated from treating and delivering potable water, and emissions generated from pumping and treating wastewater.

In addition to GHGs generated by energy use at wastewater treatment plants, wastewater may also generate GHGs in the form of CH_4, N_2O, and CO_2 during the course of its transport and treatment. The amount of GHGs produced from wastewater varies considerably with the type of treatment utilized. Aerobic treatment processes that are well managed generally produce little or no CH_4, while anaerobic systems may produce a significant amount of CH_4. The net impact of these emissions may also be reduced if the CH_4 is recovered for energy. Nutrient removal systems may generate minor amounts of N_2O. CO_2 emissions are generally omitted from inventories as they are considered to be of biogenic origin, and thus part of the natural carbon cycle (IPCC 2006). The size of the wastewater treatment plant also plays a significant role in the quantity of emissions, with smaller plants typically having a higher energy intensity (e.g., a wastewater treatment plant with an average daily flow of 3 million gallons per day [MGD] has an energy intensity of 3,000 kWh/million gal whereas a wastewater treatment plant with an average daily flow of 200 MGD has an energy intensity of 1,600 kWh/million gal). It is equally important to note that each of these regions of the country obtains their energy from different sources; therefore, emissions of CO_2e per kWh may vary from a region powered by coal to a region powered by hydroelectric power. Thus, EA must also take this into consideration when calculating CO_2e emissions from each EA office.

4.4.2 EA Water Consumption and Wastewater Generation

The amount of potable water consumed and wastewater discharged by EA was calculated with usage statistics from water bills for EA's Hunt Valley, Maryland; Syracuse, New York; Alameda and Sacramento, California; Seattle and Kennewick, Washington; and Barrigada, Guam offices. Water usage at all other offices was estimated assuming usage of 15 gal per person per day. For each of these offices, the overall usage reported in these bills for the building was adjusted to account for the fact that EA does not occupy the entirety of these buildings.

Table 4-11 *and* ***Table 4-12*** provide a comparison breakout of potable water consumed and wastewater discharged for EA commercial offices (Hunt Valley and All Other EA Offices); company-wide totals are provided in ***Table 4-13***. Emissions for non Hunt Valley offices (i.e., All Other EA Offices) have been calculated separately as Hunt Valley numbers are based on actual water bills whereas other offices are factored based on headcount. Results are summed in the overall carbon footprint calculation.

Table 4-11. Emissions Associated with Potable Water Consumed and Wastewater Discharged – Hunt Valley, Maryland

Water Type	Amount (gal)	Total Emissions ($MTCO_2e$)
Potable Water	1,472,431	0.3
Wastewater	1,472,431	0.5
Total Potable Water and Wastewater		**0.8**

Table 4-12. Emissions Associated with Potable Water Consumed and Wastewater Discharged – All Other EA Offices

Water Type	Amount (gal)	Total Emissions ($MTCO_2e$)
Potable Water	1,436,302	0.9
Wastewater	1,436,302	1.2
Total Potable Water and Wastewater		**2.1**

Table 4-13. Emissions Associated with All Potable Water Consumed and Wastewater Discharged across EA

Water Type	Amount (gal)	Total Emissions ($MTCO_2e$)
Potable Water	1,842,754	1.2
Wastewater	1,842,754	1.7
Total Potable Water and Wastewater		**2.9**

The updated approach to calculating the carbon footprint associated with potable water usage and wastewater discharges requiring treatment resulted in a significant decrease in GHG emissions attributed to these sources. This decrease is believed to be attributable to an over-estimation of supply chain emissions contributions under the previous method.

4.5 SHIPPING

EA ships project/client deliverables and other freight using both United Parcel Service (UPS) and Federal Express (FedEx). In January 2017, EA became an official partner in the UPS Carbon Neutral Program, which provides more granular tracking of carbon emissions for UPS shipments and ensures all EA shipments are carbon neutral.

FedEx purchases offsets directly, rather than allowing customers to opt in to carbon neutral shipping. Upon request, FedEx provides estimates for both estimated total emissions as well as offsets for a given account and date range. Shipments for 2017 are summarized in ***Table 4-14***.

Table 4-14. Company-Wide Shipping Emissions and Offsets

Carrier	Total Shipped Weight (pounds)	Carbon Neutral Shipments	% Carbon Neutral	Total $MTCO_2$	Offset $MTCO_2e$	Net $MTCO_2e$
UPS	118,974	4,191	100%	45.4	(45.4)	0.0
FedEx	125,359	Not applicable	Not applicable	135.0	(2.7)*	132.3
Total Shipping Emissions						**132.3**

* Based on calculated emissions data from FedEx for offsets purchased by FedEx. This value was reported as lower in 2016 (109.2 Net $MTCO_2e$) due to a miscalculation related to offsets.

NOTE: $MTCO_2$ = Metric ton carbon dioxide.

5. SUMMARY

5.1 TOTAL CARBON FOOTPRINT

Table 5-1 compiles the emissions from all three scopes, and displays the total 2017 estimated carbon footprint and a comparison to 2016 data.

Table 5-1. Comparison of Overall Emissions Data for 2017 and 2016 Reporting Years

Emissions Sources	2017 $MTCO_2e$	% of Total Footprint	2016 $MTCO_2e$
Scope 1: Direct GHG Emissions			
EA Fleet Vehicles	422.5	9.4	619.4
EA Boats and Generators	415.7	9.3	173.0
Natural Gas	219.9	4.9	229.7
Scope 2: Electricity Indirect GHG Emissions			
Purchased Electricity	805.9	18.0	1,224.8
Scope 3: Other Indirect GHG Emissions			
Employee Commutes	1,370.5	30.6	1,303.0
Air Travel*	722.8	16.1	582.7
Rail Travel*	0.61	0.0	2.9
Rental Car Travel*	224.4	5.0	115.6
Employee Vehicle Business Travel	152.5	3.4	-
Solid Waste Disposal	13.0	0.3	10.0
Shipping	132.3	3.0	235.4
Potable Water	1.2	0.0	70.7
Wastewater Treatment	1.7	0.0	84.3
Total Emissions	**4,483.0**	**100.0**	**4,651.5**
Carbon Offsets			
Single Stream Recycling	(91.0)	(2.0)	(89.0)
Air Travel Offsets	(100.0)	(2.2)	(100.0)
Renewable Energy Certificates Purchased	(515.3)	(11.5)	(494.2)
Offsets from Shipping	(48.1)	(1.1)	(160.8)
Net Emissions**	**3,728.6**	**83.2**	**3,807.5**

* Travel data provided by EA's corporate travel agent, Safe Harbors.
** Carbon offsets result in a decrease in net emissions and are denoted by parentheses. Net emissions represent the sum of EA's Scope 1, 2, and 3 emissions less earned/purchased offsets.

Normalized by total hours worked, EA's 2017 carbon footprint is 7.2 metric tons per Full-Time Equivalent (FTE)—a decrease from 7.5 metric tons per FTE based on 2016 net emissions. This decrease is largely attributable to increases in purchased offsets and improved data gathering techniques, as discussed throughout this report.

Future reports will further analyze normalized results to establish potential trends resulting from EA activities impacting emissions (e.g., total hours worked, implementation of additional composting programs, etc.).

5.2 REDUCING EA'S CARBON FOOTPRINT

Opportunities to reduce EA's carbon footprint in the future under the three scopes of GHG emissions source categories include the following.

5.2.1 Scope 1 Emissions

- ***EA Automobiles***—Use more fuel-efficient vehicles, including more hybrid vehicles. The average EA fleet vehicle is leased for 6 years/140,000 miles. Currently, fuel efficiencies and hybrid drive options are considered with all new fleet vehicle lease contracts.

- ***Miscellaneous Engines***—Practice energy conservation during fieldwork. Best management practices for green and sustainable cleanup should be further employed (e.g., turning off engines instead of idling for long periods of time and turning off generators when not in use). *Equipment Tracker* will be updated to ensure that new users of generators and other field equipment are advised about best operating practices for reducing emissions.

- ***Natural Gas Consumption***—Remain conscious of thermostat settings and hot water consumption. Energy usage intensity for each EA office will be calculated, to the extent practicable with the available data, and summarized in next year's carbon footprint report as an energy conservation incentive.

5.2.2 Scope 2 Emissions

- ***Purchased Electricity***—Practice energy-saving activities in the workplace:

  — Turn lights off when not in the office and late at night if you are the last one to leave the building, or communicate to the cleaning crew that they should make sure lights are off upon their exit.

  — Turn computer monitors and printers/copiers off at the end of the day, or ensure they are programmed to enter an energy saving "Sleep Mode" after a period of inactivity.

  Energy usage intensity for each EA office will be calculated, to the extent practicable with the available data, and summarized in next year's carbon footprint report as an energy conservation incentive.

5.2.3 Scope 3 Emissions

- ***Employee Commutes***—Provide additional incentives for employees to carpool, take public transportation, ride a bike, and/or walk. Encourage employees to live near the office or purposefully locate offices near public transportation access, when feasible.

  — EA has provided electric charging stations for electric and hybrid technology vehicles at its Corporate Headquarters, and seeks to expand this program to other offices. In

2018, EA will coordinate with Merritt Properties, LLC to install two new dual charging stations in the 231 Schilling Circle parking lot, behind EA's gated access. These new dual stations will result in a total of four new chargers that will be exclusively dedicated to EA use for fleet vehicles and EA employees with electric/hybrid vehicles.

— EA maintains a Commuter Flexible Spending Account to encourage employee use of public transportation while commuting, and seeks to increase the number of employees who are utilizing this program in the future. In 2018, EA will evaluate ways to improve use of this benefit, which is currently only utilized by approximately 1% of employees, per analysis by EA's Human Resources Department.

- ***Air Travel***—Utilize teleconferencing in lieu of air travel to a meeting. Employ more sophisticated conferencing systems (video conferences) in order to make this a more viable option. EA will evaluate making tutorials available to employees to encourage the use of teleconferencing in 2018. Continue to purchase offsets.

- ***Rental Car Travel***—Rent the most fuel-efficient vehicles available. Arrange to stay in a hotel near the project site to limit commutes. EA will evaluate the actual difference in carbon emissions from the business rental usage of SUVs versus compact cars and hybrids to determine if the difference justifies further emphasis on use of higher fuel efficiency vehicles.

- ***Solid Waste Disposal***—Continue to monitor waste diversion to composting programs at EA offices that are able to participate. However, smaller offices may not have the option to implement a composting program due to scale limitations, vendor availability, and pricing considerations.

5.3 RECOMMENDATIONS FOR FUTURE INVENTORIES

The following recommendations are offered for consideration for improving the accuracy of future carbon footprint tabulations:

- Improve the accuracy of calculating the contribution of carbon emissions associated with the operation of EA vehicles and other fuel burning equipment to Scope 1 emissions by:

— Estimating total vehicle fuel usage from fuel purchase records rather than using vehicle mileage and average fuel economy figures, and including estimates of onsite recharging energy consumption by hybrid and electric vehicles.

— Estimating total boat and generator fuel usage from fuel purchase records rather than making assumptions about fuel consumption from equipment usage.

— For 2017, the feasibility of using fuel purchase records was evaluated and determined that more calculations may be required to address several levels of assumptions and this may not produce greater accuracy in the calculations. Use of fuel purchase records will be reevaluated for the 2018 carbon footprint calculation.

- Continue to improve the accuracy of calculating the contribution of burning natural gas and fuel oil in offices and other EA buildings for heat and hot water to Scope 1 emissions by gathering more office-specific usage data. This increased use of site-specific data was utilized for the 2017 report and will be continued as practicable going forward.

- Continue to improve the accuracy of calculating the contribution of solid waste disposal to Scope 3 emissions by characterizing solid waste streams from each EA office and determine the actual disposition of each component (e.g., recycling, waste-to-energy, compositing, landfill [with and without landfill gas recovery and combustion], etc.). This increased use of actual, site-specific data was utilized for the 2017 report and will be continued as practicable going forward.

- Continue to develop tracking tools for compiling data from the beginning of the next reporting period rather than gathering information retrospectively for the next inventory. Evaluating methods to compile data during the reporting year will be evaluated in 2018.

- Expand the evaluation and inclusion of supply chain GHG emissions from acquisition and delivery of materials such as computers, paper and other office supplies, and catered food.

- Evaluate the need and manner in which to assess the contributions of emissions related to increased use of ride-share services such as Uber and Lyft.

6. REFERENCES

Griffiths-Sattenspiel, B. and W. Wilson. 2009. *The carbon footprint of water*. River Network, Portland. https://www.rivernetwork.org/wp-content/uploads/2015/10/The-Carbon-Footprint-of-Water-River-Network-2009.pdf.

Intergovernmental Panel on Climate Change (IPCC). 2006. *IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 5 Waste*. http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html.

Oregon Department of Environmental Quality. 2016. *Greenhouse Gas Steam Calculator – Oregon*. http://www.oregon.gov/deq/FilterDocs/ghgCalculatorSteam.xlsx.

Pabi, S., A. Amarnath, R. Goldstein, and L. Reekie. 2013. *Electricity use and management in the municipal water supply and wastewater industries*. Electric Power Research Institute, Palo Alto. 194.

TerraPass. 2012. TerraPass. http://www.terrapass.com.

U.S. Department of Energy. 2013. Water Efficiency in Federal Offices. https://www.energy.gov/sites/prod/files/2013/10/f3/waterefficiency_fedoffices.pdf.

U.S. Energy Information Administration. 2012. *2012 Commercial Buildings Energy Consumption Survey: Energy Usage Summary*. https://www.eia.gov/consumption/commercial/reports/2012/energyusage/.

U.S. Environmental Protection Agency (EPA). 2012. Waste Reduction Model (WARM) Version 12. https://www.epa.gov/warm.

———. 2016. Emissions & Generation Resource Integrated Database (eGRID). *eGRID Summary Tables 2016*. https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

———. 2017. Center for Corporate Climate Leadership Simplified GHG Emissions Calculator. https://www.epa.gov/climateleadership/center-corporate-climate-leadership-simplified-ghg-emissions-calculator.

World Resource Institute (WRI) and World Business Council for Sustainable Development. 2004. *Greenhouse Gas Protocol Initiative Corporate Standards*. http://www.ghgprotocol.org/.