2015 Carbon Footprint Report

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

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TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CSBR	Center for Sustainable Building Research
CY	Calendar Year
EA	EA Engineering, Science and Technology, Inc., PBC
EPA	U.S. Environmental Protection Agency
ft	Foot (feet)
gal	Gallon(s)
GHG	Greenhouse gas
IPCC	United Nations Intergovernmental Panel on Climate Change
kg	Kilogram
kW	Kilowatt
kWh	Kilowatt hour
LEED®	Leadership in Energy and Environmental Design
MPG	Mile(s) per gallon
MSW	Municipal solid waste
$MTCO_2$	Metric ton carbon dioxide
$MTCO_2e$	Metric ton carbon dioxide equivalent
PV	Photovoltaic
REC	Renewable Energy Certificate
SUV	Sport utility vehicle
th	Therm
TJ	Terajoule
WARM	Waste Reduction Model
WRI	World Resource Institute

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EXECUTIVE SUMMARY

EA Engineering, Science, and Technology, Inc., PBC (EA) is an environmental consulting firm with an average 2015 employment of 494 people in 25 commercial offices nationwide. First initiated in 2009, this is the fourth tabulation of greenhouse gas (GHG) emissions and carbon footprint for EA, which is calculated biennially. This report represents EA's Carbon Footprint Report for Calendar Years (CY) 2014 and 2015.

The previous tabulation was calculated for CY 2013. In August 2012, EA consolidated its corporate and mid-Atlantic operations consisting of more than 200 employees from offices in Hunt Valley and Sparks, Maryland, into new office facilities in Hunt Valley, Maryland. EA's corporate and mid-Atlantic personnel now occupy the top two floors of EA's Headquarters, a new 4-story Leadership in Energy and Environmental Design (LEED®) Platinum-Certified office building. CY 2013 was the first full calendar year in which EA occupied the new facilities.

In CY 2015, EA generated an estimated total of 4,742.5 metric ton carbon dioxide equivalents ($MTCO_2e$) from its operations. Approximately 11.1 percent (528.2 $MTCO_2e$) was offset, resulting in a net carbon footprint of 4,214.3 $MTCO_2e$. The largest single source of GHG emissions arises from purchased electricity, which generated approximately 1,465 $MTCO_2e$ (31 percent) of the total 2015 carbon footprint. Employee commuting contributed 1,302.6 $MTCO_2e$ (27.5 percent), followed by EA-owned and -operated vehicles at 624.9 $MTCO_2e$ (13.2 percent). EA's business travel by air contributed 572.1 $MTCO_2e$ (12.1 percent), shipping contributed 137.2 $MTCO_2e$ (2.9 percent), and natural gas consumption for building heating contributed 298.4 $MTCO_2e$ (6.3 percent). Most of these values are slightly higher than corresponding values calculated for 2013, and possible explanations are provided within each section of this report. ***Figure ES-1*** (page ES-2) illustrates EA's sources of carbon by percentage of total emissions.

In preparation of this 2015 Carbon Footprint Report[1], EA continued to improve its annual inventory process by incorporating factors not previously included and further refining carbon emission calculations included in past years. EA utilizes general guidance on carbon footprint reporting provided by the U.S. Environmental Protection Agency (2012c).

Key Factors in the EA 2015 Carbon Footprint:

- Approximately 40 percent of EA's staff is located in the LEED Platinum-Certified office building in Hunt Valley, Maryland. Since energy and resource consumption data are readily obtained for this complex, they serve as the basis for extrapolation in calculation of carbon footprint contributions from other EA offices.
- In 2013, EA initiated the development of Sustainable Business Practices to support our Sustainability Mission and Goals, and to guide our operations in growing in a sustainably conscious manner.
- EA developed a Sustainable Operations Checklist to identify the business practices to achieve our Sustainability Mission and Goals. It is intended to be used as a guideline for

[1] EA's Carbon Footprint Report contains emissions-specific Standard Disclosures from the *GRI G4 Sustainability Reporting Guidelines* and data provided are consistent with *GRI G4 Implementation Manual* requirements.

operating units to periodically assess conformance to requirements and best practices, as well as support future reporting and communication.

Figure ES-1. EA's Sources of Carbon by Percentage of Total Emissions[2]

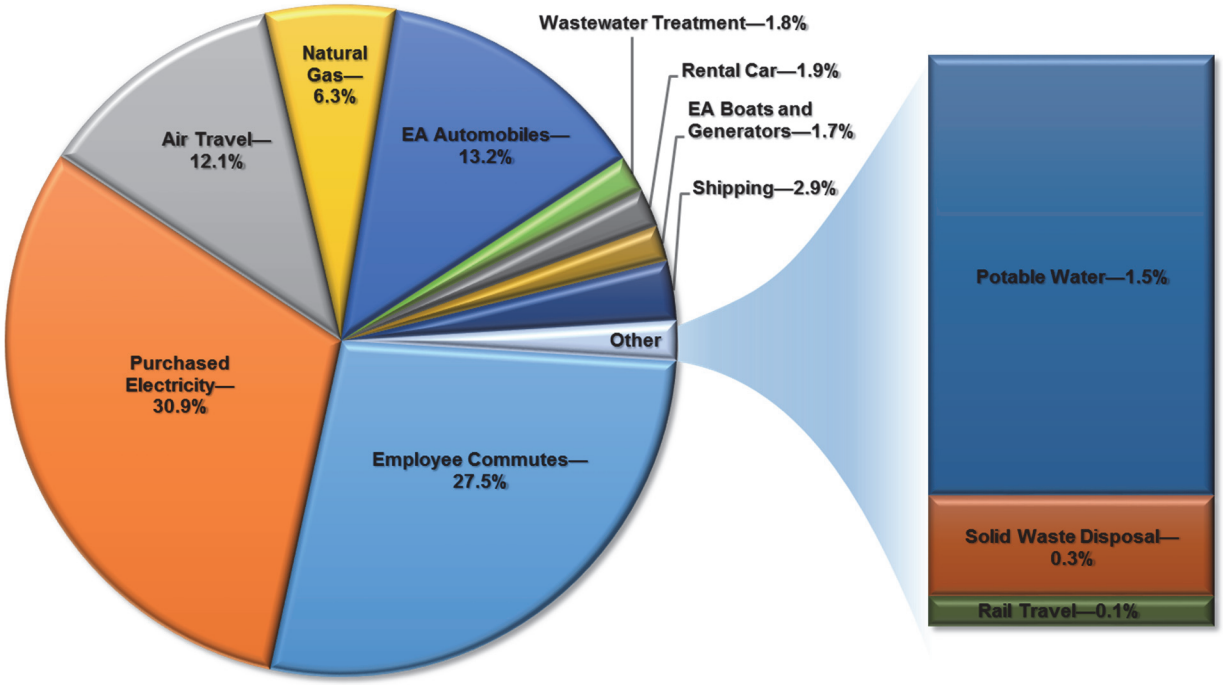

Table ES-1 (page ES-2) provides a summary of EA's carbon footprint for 2015.

Table ES-1. Summary of EA's 2015 Carbon Footprint

Carbon Sources	$MTCO_2e$	Percentage of Total Footprint
Employee Commute	1,302.6	27.5
Purchased Electricity	1,465.0	30.9
EA Automobiles	624.9	13.2
Air Travel	572.1	12.1
Natural Gas	298.4	6.3
EA Boats and Generators	81.7	1.7
Wastewater Treatment	83.4	1.8
Potable Water	70.0	1.5
Solid Waste Disposal	16.0	0.3
Shipping	137.2	2.9
Rental Car Travel	88.5	1.9
Rail Travel	2.8	0.1
Total Carbon Footprint	**4,742.6**	**100.0**
Carbon Offsets		
Carbon Solutions Group Renewable Energy Certificates Purchased	*(322.1)*	*(6.8)*
United Parcel Service Carbon Neutral Offsets	*(38.1)*	*(0.8)*
Air Travel Offsets	*(100.0)*	*(2.1)*
Recycling	*(68.0)*	*(1.4)*
Net Carbon Footprint	**4,214.4**	**89.1**
NOTE: Carbon offsets result in a decrease in gross emissions and are denoted by parentheses.		

[2] Calculations in this report have been rounded to one decimal place. As a result, if calculated individually, totals for column data may not exactly match totals shown.

1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) is an environmental consulting firm with a 2015 average employment of 494 people in 25 commercial offices nationwide. First initiated in 2009, this is the fourth tabulation of greenhouse gas (GHG) emissions and carbon footprint for EA, which is calculated biennially. This report represents EA's Carbon Footprint Report for Calendar Years (CY) 2014 and 2015. The previous tabulation was performed for CY 2013.

In August 2012, EA consolidated over 200 employees from its corporate and mid-Atlantic operations in Hunt Valley and Sparks, Maryland, into new office facilities in Hunt Valley, Maryland. EA's corporate and mid-Atlantic personnel now occupy the top two floors of a new 4-story Leadership in Energy and Environmental Design (LEED®) Platinum-Certified office building, which serves as EA's Headquarters. CY 2013 was the first full calendar year in which EA occupied the new office facilities. Approximately 36 percent of EA's office space company-wide is LEED certified. This is down slightly from 2013, when the fraction was 41 percent, due to EA having opened several new offices that were leased in buildings without LEED certification.

The method employed for tabulating this inventory was in accordance with the *Greenhouse Gas Protocol Initiative Corporate Standards* (the Standards), and developed and published by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (2004)[3]. This 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, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons. Other gases with global warming potential may be included in such analyses, but have not been included herein. This particular report accounts primarily for CO_2 emissions. Where GHG calculator tools were used to estimate emissions in the form of carbon dioxide equivalents (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 methane and nitrous oxide from combustion of fuels) are typically several orders of magnitude smaller than CO_2 emissions, as is the case for EA's footprint; and it is not currently practicable to calculate carbon equivalents for these other GHGs from all activities.

The WRI Standard divides GHG emission sources into three categories: Scope 1, Scope 2, and Scope 3. These categories are described in the following paragraphs.

1.1 SCOPE 1: DIRECT GREENHOUSE GAS EMISSIONS

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

[3] EA's Carbon Footprint Report contains emissions-specific Standard Disclosures from the *GRI G4 Sustainability Reporting Guidelines.* Data provided are consistent with *GRI G4 Implementation Manual* requirements.

- Combustion of fossil fuels for self-generation of electricity, heating, or cooling
- 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 emissions from EA's business operations include emissions from fleet vehicle operations, boat operations, generators used in the field, and emissions from burning natural gas for heating office space.

1.2 SCOPE 2: ELECTRICITY INDIRECT GREENHOUSE GAS EMISSIONS

Scope 2 GHG emissions primarily arise from electric power that is generated by third parties and purchased 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 emissions from EA's business operations only include 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 emissions arising from EA's business operations include emissions from employee commutes to and from work locations and employee business travel; emissions from recycling and disposal of solid wastes generated at EA offices and other work locations; emissions from supply of potable water to and disposal of wastewater from EA offices; and emissions from shipping samples, deliverables, and other materials to and from EA offices.

2. SCOPE 1: DIRECT 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
- Power boats
- Portable generators
- Natural gas combustion for building heat and hot water[4].

Table 2-1. Scope 1 Emissions

Source	$MTCO_2e$	Percentage of Carbon Footprint
EA Fleet Vehicles	449.8	9.5
EA Boats and Generators	81.7	1.8
Natural Gas	298.4	6.3
Net Scope 1 Emissions	**829.9**	**17.6**
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 has 83 fleet vehicles (further details below in ***Table 2-2***), including 6 hybrid vehicles. EA's hybrid fleet includes two Ford Escapes, two Ford Fusions, and two Ford C-Maxes. With the exception of electrical power provided to plug-in hybrid vehicles, EA's fleet vehicles are powered by gasoline and/or diesel fuel. Additionally, electric charging stations for electric and hybrid technology vehicles are available in corporate Headquarters parking lot; these charging stations are available to all building leases, not just EA. A summary of the fleet vehicles and their estimated fuel economy is shown below in ***Table 2-2***.

Table 2-2. EA Fleet Vehicles

Vehicle Type	Average MPG	Number of Vehicles
Passenger Cars	35.6	10
Small Truck/SUV	16.9	32
Large Truck/SUV	5.9	41
Total	**Not applicable**	**83**
NOTE: MPG = Mile(s) per gallon.		

The average MPG shown for Passenger Cars and Small Truck/SUV categories is the simple average, by category, of the combined MPG values for all 10 fleet Passenger Cars and all 32 Small Trucks/SUVs. The Large Truck/SUV average MPG was calculated using a weighted average of the MPG ratings for Class 2 Trucks/SUVs (6,001–10,000 pounds) and Class 3 Trucks/SUVs (10,001–14,000 pounds). EA's fleet in the reporting year was comprised of 90 percent Class 2 and 10 percent Class 3 Large Trucks/SUVs.[5]

[4] Building heat at certain EA office locations may be provided by burning fuel oil and, in some cases, from electric resistance heat; however, in order to normalize data herein, it has been assumed that in all cases natural gas is burned.

[5] Vehicle Type categories in EA's mileage reporting system were modified between 2013 and 2015 reporting periods to improve accuracy by allowing for different average MPG ratings for each of EA's Fleet Vehicle types. EA tracks vehicle mileage of three vehicle categories (Table 2-2). In 2013, an average MPG of 26.7 was applied to all fleet vehicle miles driven. In this year's report, fleet vehicle miles were multiplied by the average MPG of their respective vehicle class to reflect the different

Calculation of GHG emissions from fleet vehicles was based on the total vehicle miles traveled and average MPG for each Vehicle Type. Total logged mileage for EA fleet vehicles in 2013 was 887,463 miles, the majority of which (nearly 600,000) were logged by Small Trucks/SUVs. The total gasoline consumption by EA fleet vehicles in 2015 was 50,050.6 gallons (gal). The total gasoline consumption calculation is displayed in ***Table 2-3***.

Table 2-3. EA Fleet Vehicle Gasoline Consumption

Vehicle Type	Average MPG	Miles Traveled	Total Gasoline Consumption (gal)
Passenger Cars	35.6	77,450	2,175.6
Small Truck/SUV	16.9	555,990	32,898.8
Large Truck/SUV	15.9	254,022	15,976.2
Total		**887,462**	**51,050.6**

A gallon of gasoline is assumed to produce 8.81 kilograms (kg) of CO_2. This number is calculated from values in the 40 Code of Federal Regulations 600.113-78, which the U.S. Environmental Protection Agency (EPA) uses to calculate the fuel economy of vehicles, and relies on assumptions consistent with the 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 2015 were 449.8 metric tons, compared to 312 metric tons in 2013. In 2013, a total of 791,200 EA fleet vehicle miles were driven, as compared to 887,463 in 2015. Recommended EPA mileage estimates were used in 2013 for all three Vehicle Type categories rather than using average MPG ratings for specific vehicles in EA's fleet, as done in 2015 for Passenger Cars and Small Trucks/SUVs.

Table 2-4. EA Fleet Vehicle Emissions

Total Gasoline Consumption (gal)	Emissions Factor (kg CO_2/gal)	Total Emissions (kg CO_2)	Total Emissions ($MTCO_2e$)
51,050.6	8.81	449,755.8	449.8

During the 2014 and 2015 reporting years, EA retired 11 Small and Large Trucks/SUVs with model years ranging from 2000 to 2008, replacing them with 14 more fuel efficient 2014 and 2015 model year Small and Large Trucks/SUVs. As none of the new vehicles were passenger cars, no new hybrid vehicles were added to the fleet. As a result, the percentage of hybrid vehicles in the fleet has decreased from 11 to 7 percent. However, it is worth noting that two of the Large Trucks/SUVs purchased were 6-cylinder versus 8-cylinder which, over the lifetime of the vehicles, will result in cost and emissions savings associated with improved fuel efficiency.

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. EA's watercraft fleet includes 41 powered watercraft with an average engine power of approximately 40 horsepower. EA powered watercraft was used a total of 406 days in 2015. An average daily use of 8 hours was used for boats. Multiplying horsepower, days utilized, fuel efficiency, and an average daily use

average fuel economies of each vehicle class. The 2013 report used the EPA recommended values for average fuel economy (MPG) for each vehicle class.

of 8 hours per day produced an estimate of gallons of gasoline consumed. Total EA boat fuel use was 8,519 gal.

A total of 14 EA-owned generators were also used during 2015, and have been included in the emissions calculation. EA generators were used for a total of 447 days in 2015. Gallons of fuel burned per day of generator use (1.68 gal/day) was calculated using manufacturer specifications for fuel consumption at the rated load of the models in EA's generator inventory[6], 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 750 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. Miscellaneous Engines Total Carbon Dioxide Emissions

Total Gasoline Consumption (gal)	Emissions Factor (kg CO_2/gal)	Total Emissions (kg CO_2)	Total Emissions ($MTCO_2e$)
9,271.68	8.81	81,683.5	81.7

One of the most challenging aspects about 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, these data necessarily come from many different sources (only 70-80 percent of these data are available through Exxon purchase records) and, in some cases, would be very 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 universally (i.e., some EA offices utilize paper slips to track mileage/reservations). However, its use was wider in 2015 than in 2013, which likely accounts for the differences in the results in these years.

2.3 NATURAL GAS

Natural gas emissions were established directly only for 225/231 Schilling Circle, Hunt Valley, Maryland (Headquarters Office and Toxicology Laboratory) using the utility bills (Baltimore Gas and Electric). Natural gas usage is reported in therms (th) from the utility company. Therms are converted to terajoules (TJ) using the conversion factor 1.055 E-04 TJ/th for usage of a 50 metric ton carbon dioxide ($MTCO_2$)/TJ emission factor. These data are displayed in ***Table 2-6*** (page 6).

[6] Generator model specifications were not available for three of EA's 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.

Table 2-6. Hunt Valley, Maryland Office Natural Gas Summary

Hunt Valley, Maryland Buildings	Total Area (square ft)	Total Natural Gas Consumption (th)	Emissions Factor ($MTCO_2/TJ$)	Total Emissions ($MTCO_2e$)
225 Schilling Circle	65,400	5,821.39	50.0	30.71
231 Schilling Circle	10,000	5,442.74	50.0	28.71
Total	**75,400**	**11,264.13**	**N/A**	**59.42**
NOTE: ft = foot (feet).				

Due to utility reports not being available for other EA offices, an estimate was generated for other EA offices by using a national average emission factor for natural gas combustion for various building types in cubic foot per square foot. First, natural gas consumption for each office/building was calculated in therms using the emission factor and total square footage of 134,130 square ft (for all EA offices other than Hunt Valley, Maryland offices), and the therms were then converted to terajoules using the conversion factor 1.055 E-04 TJ/th for proper usage of the 50 $MTCO_2/TJ$ emission factor. These data are displayed in ***Table 2-7***.

Table 2-7. Estimated EA Natural Gas Summary

Total Natural Gas Consumption (th)	Total Area (square ft)	Emissions Factor ($MTCO_2/TJ$)	Total Emissions ($MTCO_2e$)
56,559.5	209,530	50.0	298.4

3. SCOPE 2: INDIRECT EMISSIONS

Scope 2 GHG emissions in this inventory were calculated for purchased electricity. CO_2e emission factors for United States power plants, generating companies, states, and regions of the power grid are available from the EPA *E-Grid* database. The CO_2e emissions from the Hunt Valley, Maryland office buildings were calculated using the electricity consumption from the utility bills and the EPA *E-Grid* database emission factor of 5.155E-04 $MTCO_2e$/kilowatt hour (kWh).

At some EA office locations, electricity is purchased directly from the connected utility. At others, utilities such as electric and water are included in the rent. GHG emissions from purchased electricity for 225/231 Schilling Circle, Hunt Valley, Maryland (Headquarters Office and Toxicology Laboratory) were calculated based on actual utility bills, factored for actual square footage occupied by EA, and using an emission factor for regional power obtained from the EPA *E-Grid* database.

Table 3-1 presents GHG emissions for purchased electricity for the Hunt Valley, Maryland buildings.

Table 3-1. Hunt Valley, Maryland Office Purchase Electricity Emissions

Hunt Valley, Maryland Buildings	Total Area (square ft)	Electricity Purchased (kWh)	Emission Factor ($MTCO_2e$/kWh)	Total Emissions ($MTCO_2e$)
225 Schilling Circle	65,400	1,307,054.1	5.155E-04	673.7
231 Schilling Circle	10,000	165,648.1	5.155E-04	85.4
Total	**75,400**	**1,472,702.2**	**Not applicable**	**759.1**

Total estimated emissions from the Hunt Valley complex are approximately 5 percent higher than those estimated for CY 2013. This may be attributable to a slightly higher head count at Hunt Valley than in 2013, and local weather data showing approximately 20 percent more cooling degree days in central Maryland in 2015 than 2013.

The building at 225 Schilling Circle also has an installed photovoltaic (PV) array on the roof 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 2015, the PV array produced 29,132 kWh of electrical energy, of which 15,067 kWh (prorated) was consumed by EA. The portion of the total building electricity consumption used by EA in 2015 was approximately 1,307,054 kWh; therefore, the PV array provided:

$$15{,}067 / (1{,}307{,}054 + 15{,}067) = 1.14 \text{ percent of EA's total building electricity consumption}$$

$$(1{,}307{,}054 + 15{,}067) \times 5.155\text{E-}04 = 681.6\ MTCO_2e$$

Hence, approximately 681.6 – 673.7 = 7.9 $MTCO_2e$ of Scope 2 emissions from EA occupancy of 225 Schilling Circle were avoided through the use of the PV array.

Since utility bills are not uniformly available for all other EA offices, U.S. Energy Information Administration emission factors (2002 and 2003) for various building types in kilowatt hours per square foot were used to estimate CO_2e emissions associated with purchased electricity at all other EA offices, and work locations were developed using national average energy intensity factors in kilowatt hours per square foot for various building types and a total leased area in satellite facilities of 134,130 square ft.

The total estimated GHG emissions for the company from purchased electricity are presented in ***Table 3-2***.

Table 3-2. Estimated Total EA Emissions from Purchased Electricity

Carbon Source	$MTCO_2e$	Percentage of Total Footprint
Purchased Electricity	1,465.0	30.9
Net Scope 2 Emissions	**1,465.0**	**30.9**

Total estimated Scope 2 emissions from the company are approximately 3 percent higher than those estimated for CY 2013. This is most likely attributable to an increase in total headcount of approximately 10 percent since 2013 as well as the addition of new office space.

3.1.1 Renewable Energy Certificate Offset

A Renewable Energy Certificate (REC) is a tradable environment asset that represents the environment attributes of 1 megawatt hour of renewable electricity. RECs are sold separately from actual power generated to consumers who want to essentially "green" their existing power source. For CYs 2015 and 2016, EA purchased 1,250 RECs from Carbon Solutions Group. Hence, 625 RECs (megawatt hours) of renewable energy were used to offset Scope 2 emissions in 2015.

4. SCOPE 3: OTHER INDIRECT 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

Carbon Source	MTCO2(e)	Percentage of Total Footprint
Employee Commutes	1,302.69	27.5
Employee Vehicle Business Travel	175.2	3.7
Air Travel	572.1	12.1
Wastewater Treatment	83.4	1.8
Potable Water	70.0	1.5
Solid Waste Disposal	16.0	0.3
Shipping	137.2	2.9
Rental Car Travel	88.5	1.9
Rail Travel	2.8	0.1
Total Scope 3 Emissions	**2,447.89**	**51.8**
Carbon Emissions Offsets		
Shipping Offsets	*(38.1)*	*(0.8)*
Air Travel Offsets	*(100.0)*	*(2.1)*
Recycling	*(68.0)*	*(1.4)*
Net Scope 3 Emissions	**2,241.79**	**47.5**
NOTE: Carbon offsets result in a decrease in net emissions and are denoted by parentheses.		

4.1 EMPLOYEE COMMUTING

The data used to determine the emissions produced from employee commutes to each EA workplace were compiled using an employee survey. A survey of commuting habits in 2015 was sent out to all EA employees in 2016, and 282 employees responded—a 57 percent overall response rate. Emissions calculations were based on these sampling data extrapolated to the Company's 2015 average employment of 494 people. Emission factors from the WRI protocol were used. ***Table 4-2*** (page 10) summarizes the findings.

Table 4-2. EA Carbon Dioxide Commuter Emissions

Transportation Mode	Unit of Measure	Emissions Factor (kg CO_2/unit)
Car	Gasoline (gal)	8.81
Truck	Diesel (gal)	10.15
Light Rail	Light Rail miles	0.163
Train	Train miles	0.185
Bus	Bus miles	0.107
Walk/Bike	Walk/Bike miles	0.0
Average Metric Tons per Person	**Total Employees**	**Total Emissions ($MTCO_2e$)**
2.64	494	1,302.6

4.2 EMPLOYEE BUSINESS TRAVEL

EA employees logged 516,996 vehicle miles for business travel in their personal vehicles in 2015. The average of the self-reported personal vehicle MPG value (26) 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 employee-owned personal vehicles to complete business related travel is displayed in ***Table 4-3***.

Table 4-3. Employee-Owned Vehicle Business Travel Gasoline Consumption

Average Self-Reported MPG	Miles Traveled	Total Gasoline Consumption (gal)
26	516,996	19,884

As in Section 2.1 (Fleet Vehicles) and Section 2.2 (Miscellaneous Engines), 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. Employee-Owned Vehicle Business Travel Emissions

Total Gasoline Consumption (gal)	Emissions Factor (kg CO_2/gal)	Total Emissions (kg CO_2)	Total Emissions ($MTCO_2e$)
19,884	8.81	175,182.2	175.2

In 2015, 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 from these three categories all increased from the previous report in 2013. In addition, in 2015, GHG emissions from business travel by employee-owned vehicles were included for the first time, which also increased total emissions from business travel.

Tables 4-5, 4-6, and 4-7 (page 11) show emission calculations broken out by business travel methods (e.g., air, car rental, and rail).

Table 4-5. Airline Travel

Airlines	Miles Traveled	Total Emissions ($MTCO_2e$)
Short Haul	118,703	34.4
Medium Haul	1,326,452	214.8
Long Haul	1,823,990	322.9
Total	**3,269,145**	**572.1**
Definition		**Distance (miles)**
Short Haul		<280.85
Mid Haul		280.85-994.19
Long Haul		>994.19

Table 4-6. Car Rental Travel

Total Days	Average Miles per Day	Miles Traveled	Average MPG	Gas Used (gal)	Emissions Factor (kg CO_2/gal)	Total Emissions ($MTCO_2e$)
3,054.6	33.7	261,240.9	26	10,047.73	8.81	88.52
NOTE: Average miles per day based on commuter survey. Domestic rentals are primarily gasoline. International rentals are variable, but are considered gasoline for the purposes of this report.						

Table 4-7. Rail Travel

Miles Traveled	Total Emissions ($MTCO_2e$)
14,506	2.77

4.2.1 Air Travel Offsets

In 2015, EA purchased emissions offsets to reduce the net impact of employee air travel. EA purchased 100 metric tons of verified CO_2 offsets from TerraPass, effectively reducing the impact of company air travel by one quarter.[7] Net Air Travel Emissions calculations using offsets and net emissions are broken out in ***Table 4-8***.

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 2015 portfolio included projects for landfill gas capture, farm power, and clean energy.

Table 4-8. Air Travel Offsets and Net Emissions

Source	Total Emissions ($MTCO_2e$)
Air Travel Emissions	572.08
TerraPass Offsets	(100.0)
Net Air Travel Emissions	**472.08**
NOTE: Carbon offsets result in a decrease in net emissions and are denoted by parentheses.	

4.3 RESOURCE CONSUMPTION, RECYCLING, AND DISPOSAL

Carbon emissions as CO_2e arising from EA's recycling and disposal of solid waste were calculated using EPA's Waste Reduction Model (WARM) Version 14 (EPA 2012a). The emission factors in the WARM model represent the life cycle emissions of various materials, and thus also capture the upstream emissions associated with the raw material extraction,

[7] TerraPass (2012). Available online at: http://www.terrapass.com/.

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 Waste Management

Recycling or disposing of solid waste may generate a net increase or net reduction in GHG emissions, depending on the type of material and the particular waste management option employed. The waste management options considered for EA waste include recycling, landfilling, with and without landfill gas recovery and conversion, 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 the material generates less GHG than manufacturing the material from raw resources. Landfilling generates GHG in the form of methane, a byproduct of the anaerobic decomposition of organic materials in the landfill. This methane increases GHG emissions if it is allowed to escape uncontrolled. However, some landfills collect this gas for conversion to energy, displacing 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. Incineration with energy recovery generates GHGs (CO_2 and nitrous oxide); however, the power generated from combusting the waste replaces power that would have been generated by burning fossil fuels, which release fossil carbon to the atmosphere. As a result, incineration with energy recovery causes a net reduction in GHGs.

4.3.2 EA Waste Generation and Management

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. The amounts of recyclables and trash generated by the Hunt Valley offices were calculated using information provided by Waste Management through the building manager Merritt Properties, LLC. In addition to the Hunt Valley offices, all other EA offices also have functioning and successful recycling programs in place. Across EA, over 75 percent of the paper purchases meet one of three sustainable standards: Forest Stewardship Council-certified, Sustainable Forestry Initiative-certified, or at least 30 percent post-consumer recycled content. Waste generation and diversion percentages are shown in ***Table 4-9***.

Table 4-9. Waste Generation and Diversion

Waste Category (short tons)	EA
Trash	55.4
Recycling	22.7
Total	78.1
Diversion Rate	**21.9%**

WARM provides estimates in metric tons of CO_2e for GHG emissions resulting from disposal of materials. For EA's calculations (***Table 4-10*** (page 13), it was assumed that all trash is equivalent to "Mixed MSW" (municipal solid waste) and that all single stream recycling is equivalent to "Mixed Recyclables." Paper recycled by the Hunt Valley offices was assumed to be equivalent to the category "Mixed Paper (primarily from offices)." Across all EA offices, 25

percent of trash was incinerated and 75 percent of trash was landfilled. National averages were used for landfill gas capture rates.

Table 4-10. Recycling and Solid Waste Disposal

Category	Treatment	Location	Quantity (short tons)	Metric Ton CO_2e
Trash	Landfilled	All offices	41.55	17.0
Trash	Combusted	All offices	13.85	(0.8)
Mixed Recyclables	Recycled	All offices	22.70	(68.0)
Total			**78.10**	**(51.8)**
NOTE: Carbon offsets result in a decrease in net emissions and are denoted by parentheses.				

The values shown in ***Table 4-10*** are significantly lower than those reported for CY 2013 for several reasons related to accounting for Hunt Valley waste, which is the basis for the calculation for the entire company. This includes the following:

- The amounts of waste reported as being removed from the Hunt Valley complex by Waste Management are significantly lower.

- Waste Management's disposal practices changed in 2015.

The annual waste disposal summary provided by Waste Management 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 MSW container is assumed to hold 624 pounds each time it is emptied; and, 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. Prior to September 2014, the MSW container was picked up 5 times a week and the mixed recyclables container was picked up 3 times a week. Due to evidence that the MSW container was not full when picked up, the schedule was changed in September 2014; since then, both containers are being picked up 3 times a week. This has resulted in a reduction in tonnage "on paper" since the 2013 carbon footprint calculation. However, although EA's internal practices, such as replacing disposable dishes, cups, and flatware with porcelain and metal items, have likely resulted in some reduction in solid waste generation, there is no quantifiable basis for concluding that waste reduction resulted in such significant changes in reported disposal volumes.

The percentage of EA waste shown as "landfilled" in the Waste Management report, but actually being combusted at the BRESCO waste-to-energy plant, as of 1 January 2015, was reduced from 100 to 20 percent. This is roughly equivalent to the national average and is used for both Hunt Valley and the entire company in this report for CY 2015.

4.4 POTABLE WATER SUPPLY AND WASTEWATER TREATMENT

An EPA model was not available for GHG emissions from potable water supply or wastewater treatment. Therefore, estimated CO_2e generated from supplying potable water and treating wastewater for the Hunt Valley, Maryland offices was calculated using water utility bills and the Minnesota Center for Sustainable Building Research's (CSBR) Site Building and Design Carbon Calculator Version 1.0 (2011). The CSBR calculator provides emissions factors of CO_2e generated per gallon of water for both potable water consumed and wastewater generated on an annual recurring basis.

Estimated CO_2e for the remainder of EA's offices was calculated using national average water consumption per employee per day for an office building. The CSBR calculator provided emission factors of CO_2e generated per gallon of water for both potable water consumed and wastewater generated.

4.4.1 Emissions from the Water Sector

Supplying potable water and treating wastewater generate GHGs through the energy used to treat and pump the water and wastewater. These services are energy intensive and account for 3-4 percent of energy use in the United States.[8] The largest use of energy for potable water utilities is pumping water. A combination of pumping and treating water by aeration comprises the majority of energy use for wastewater treatment plants.[9] The emissions factors used herein capture the emissions generated from treating and delivering the potable water and the emissions generated from pumping and treating the wastewater. CSBR developed these factors using national averages for energy use per gallon of water and energy use per gallon of wastewater.

In addition to the GHGs generated by energy use from wastewater treatment plants, wastewater may also generate GHGs in the form of methane, nitrous oxide, and CO_2 during the course of its transport and treatment. These GHGs are not captured by the CSBR emissions factors. 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 methane, while anaerobic systems may produce a significant amount of methane. The net impact of these emissions may also be reduced if the methane is recovered for energy. Nutrient removal systems may generate minor amounts of nitrous oxide. 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.[10]

4.4.2 EA Water Consumption and Wastewater Generation

The amounts of potable water consumed and wastewater generated by EA were estimated from per person averages for the Hunt Valley, Maryland offices, to include both 225 and 231 Schilling Circle. The amount of potable water consumed by the Hunt Valley offices was determined by the amounts supplied according to water bills for the four quarters of CY 2015. For the purposes of this calculation, it was assumed that none of the potable water supplied was consumed onsite (e.g., landscaping irrigation, cooling tower drift, etc.) and that the amount of wastewater generated was equal to the amount of potable water supplied.

Tables 4-11 and 4-12 (page 15) provide a comparison breakout of potable water supply and wastewater treatments by EA commercial offices (Hunt Valley and Other).

[8] Water and Wastewater (EPA 2012b). Available online at: http://www.epa.gov/statelocalclimate/local/topics/water.html.
[9] Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities (EPA 2008). Available online at: http://water.epa.gov/infrastructure/sustain/cutting_energy.cfm.
[10] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 5 Waste (IPCC 2006). Available online at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html.

Table 4-11. Hunt Valley, Maryland Potable Water Supply and Wastewater Treatment

	Amount (gal)	Kg CO_2e/gal	Total Emissions ($MTCO_2e$)
Potable Water	737,071.9	0.029	36.6
Wastewater	737,071.9	0.0346	30.7
Total Potable Water and Wastewater			**67.3**
NOTE: Kg CO_2e/gal is kilograms of carbon dioxide equivalent per gallon.			

An increase in total emissions ($MTCO_2e$) resulting from Hunt Valley offices' potable water supply and wastewater treatment between the 2013 (61.2) and 2015 (67.3) reports is primarily related to an increase in work performed by EA's Toxicology Laboratory located at 231 Schilling Circle.

Table 4-12. Other EA Offices Potable Water Supply and Wastewater Treatment

	Amount (gal)	Kg CO_2e/ gal	Total Emissions ($MTCO_2e$)
Potable Water	1,352,325	0.029	39.2
Wastewater	1,352,325	0.0346	46.8
Total Potable Water and Wastewater			**86.0**
NOTE: Kg CO_2e/gal is kilograms of carbon dioxide equivalent per gallon.			

Of note, EA's Hunt Valley office is equipped with two Elkay EZH2O Bottling Filling Stations (one per floor). Each station is equipped with a Green Ticker ™ that calculates the number of 20-ounce plastic bottles saved from landfills. Since moving into the building in August 2012, EA employees have saved more than 70,640 water bottles from landfills through use of the filling stations. According to the plastics manufacturing industry, it takes approximately 3.4 megajoules of energy to make a typical 1-liter plastic bottle, cap, and packaging (Pacific Institute 2007).

1 liter = 33.8 fluid ounces

70,648 bottles = 1,412,960 ounces = 41,804 liters

41,804 liters * 3.4 megajoules = 142,134 megajoules of energy saved through use of the filling stations since August 2012

4.5 SHIPPING

EA ships deliverables and other freight using both United Parcel Service and Federal Express. Federal Express provides carbon emissions reports to its customers free of charge; however, United Parcel Service does not. As a result, the estimate of carbon emissions for freight shipments in CY 2015 has been based on Federal Express data. United Parcel Service offers carbon neutral shipping, and EA generally selects this option with shipments. EA utilized United Parcel Service carbon neutral shipping for 68 percent of all shipments in 2015.

EA's shipments for 2015 are summarized in ***Table 4-13*** (page 16).

Table 4-13. Shipping

Carrier	Total Shipped Weight (pounds)	Carbon Neutral Shipments	Percentage Carbon Neutral	Total $MTCO_2$	Offset $MTCO_2$	Net $MTCO_2$
United Parcel Service	72,219	45,498	68%	60.45	(38.08)	22.37
Federal Express	91,653	Not applicable	Not applicable	76.74	Not applicable	76.74
Total Shipping Emissions						**99.11**
NOTE: Carbon offsets result in a decrease in net emissions and are denoted by parentheses.						

5. CONCLUSION

5.1 TOTAL CARBON FOOTPRINT

Table 5-1 compiles the emissions from all three scopes, and displays the total 2015 estimated carbon footprint and a comparison to 2013.

Table 5-1. EA Carbon Footprint for 2015

	2015 CO_2	Percentage of Total Footprint	2013 CO_2
Scope 1 Emissions – Direct			
EA Automobiles	624.9	13.2	312.3
EA Boats and Generators	81.7	1.7	14.5
Natural Gas Consumption	298.4	6.3	289.3
Scope 2 Emissions – Indirect			
Purchased Electricity	1,465.0	30.9	1,408.0
Scope 3 Emissions – Other Indirect			
Employee Commutes	1,302.6	27.5	1,200.0
Air Travel	572.1	12.1	414.9
Rail Travel	2.8	0.06	1.2
Rental Car Travel	88.5	1.9	12.7
Solid Waste Disposal	16	0.3	32.3
Potable Water	70.0	1.5	68.2
Wastewater Treatment	83.4	1.8	81.3
All Shipping (United Parcel Service, Federal Express, U.S. Postal Service, etc.)	137.2	2.8	252.2
Total Carbon Footprint	**4,742.5**	**100.0**	**4,086.9**
Carbon Offsets			
Carbon Solutions Group RECs Purchased	*(322.1)*	*(6.8)*	*(257.7)*
Air Travel Offsets	*(100.0)*	*(2.1)*	*(100.0)*
Recycling	*(68.0)*	*(1.4)*	*(132.8)*
United Parcel Service Carbon Neutral Offsets	*(38.1)*	*(0.8)*	*(124.6)*
Net Carbon Footprint	**4,214.4**	**88.9**	**3,471.8**

NOTE: Carbon offsets result in a decrease in net emissions and are denoted by parentheses.

5.2 REDUCING EA'S CARBON FOOTPRINT

Opportunities to reduce EA's carbon footprint in the future include the following.

Scope 1 Emissions

- ***EA Automobiles***—Use more fuel efficient vehicles, including more hybrid vehicles.
- ***EA Miscellaneous Engines***—Practice energy conservation methods during fieldwork. Turn off boat engines instead of idling for long periods of time and turn off generators when not in use.
- ***Natural Gas Consumption***—Be conscious of thermostat settings and hot water consumption.

Scope 2 Emissions

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

  — Turn lights off when not in office.

  — Turn lights off 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.

Scope 3 Emissions

- ***Employee Commutes***—Provide more 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.

  — EA has implemented 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.

- ***Air Travel***—Utilize teleconferencing instead of air travel to a meeting. Employ more sophisticated conferencing systems (video conferences) in order to make this a more viable option. 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.

5.3 RECOMMENDATIONS FOR FUTURE INVENTORIES

The following is a list of recommendations 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.

- 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 detailed information about heating systems and fuel usage at EA offices other than the Headquarters complex in Hunt Valley.

- Improve the accuracy of calculating the contribution of rental car usage to Scope 3 emissions by using actual rental car gasoline consumption records.

- Improve the accuracy of calculating the contribution of freight shipments to Scope 3 emissions by working with United Parcel Service and Federal Express to gather more accurate data.

- Improve the accuracy of calculating the contribution of solid waste disposal to Scope 3 emissions by characterizing solid waste streams from each EA office more accurately and determining the actual disposition of each component (e.g., recycling, waste-to-energy, compositing, landfill [with and without landfill gas recovery and combustion], etc.).

- Improve the accuracy of calculating the contribution of carbon emissions associated with usage of water and wastewater treatment services to Scope 3 emissions by:

  — Estimating the actual usage of water and wastewater treatment services at all EA offices in addition to the Headquarters offices.

  — Investigating the actual carbon footprint of water and wastewater treatment operations serving EA offices, particularly the Baltimore Department of Public Works operations serving the Headquarters offices, and estimating site-specific carbon emission factors ($MTCO_2e$/1,000 gal) for these operations.

- Develop tracking tools for compiling data from the beginning of the next reporting period rather than gathering information retrospectively for the next inventory.

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