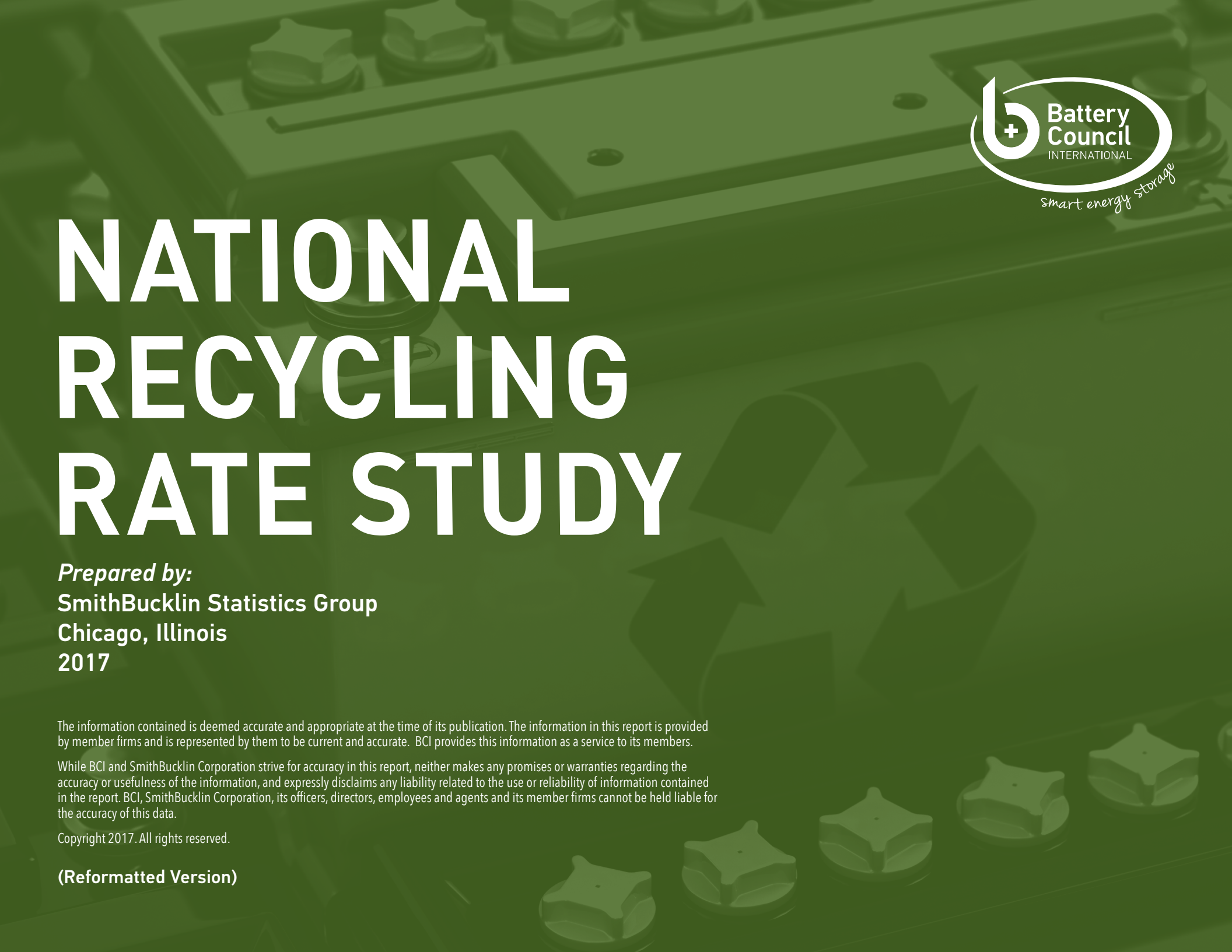

NATIONAL RECYCLING RATE STUDY

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I. INTRODUCTION

The National Recycling Rate Study, commissioned by Battery Council International (BCI), is designed to calculate the recycling rate of lead available from lead batteries in the United States.[1] The first study was conducted in 1990. This most recent study completed finds the recycling rate for the years 2012 – 2016[2] to be 99.3% with a standard deviation of ±0.2%.

Part II of this report includes a review of the methodology used to determine the domestic recycling rate for battery lead during the years 2012 – 2016. Part III contains the data from which the recycling rate was calculated along with footnotes listing sources from which the data was obtained.

II. METHODOLOGY

The National Recycling Rate Study is conducted by SmithBucklin Statistics Group, Chicago, Illinois. The national recycling rate (R) was calculated by dividing the total pounds of battery lead recycled (LR) by the total pounds of battery lead available for recycling (LA) in the United States. The calculation is as follows:

R = (LR/LA) x 100.

A. Total Pounds of Lead Recycled from Batteries

To determine the total pounds of lead recycled from batteries, questionnaires were sent to all U.S. secondary lead recyclers. The data gathered from the questionnaires indicates the total pounds of lead recycled from batteries at U.S. recyclers. This total includes lead from whole batteries and lead from battery scrap.

All starting, lighting and ignition (SLI), industrial batteries (motive power and stationary), and small sealed lead batteries are included in this analysis. However, since the secondary lead recyclers record the receipt of batteries by weight rather than by type, it is impossible to determine the recycling rate for each category of battery.[3]

B. Total Pounds of Battery Lead Available for Recycling

When calculating the total pounds of lead available for recycling, the following data was included in the equation:

1. New battery shipments (including new battery imports shipped)
2. New battery exports
3. Imports and exports of vehicles/products containing a battery
4. Imports and exports of scrap lead and used batteries

1. Battery Shipments

New battery shipment data, including domestic and export, for SLI batteries was obtained from BCI's statistical database.[4] Imported batteries that are shipped to U.S. destinations are reported to BCI and classified as a shipment. Since the SLI shipment data is in units, an average lead weight was applied to each battery category to determine the total pounds of lead available for recycling from that category.

To determine the amount of lead available for recycling from industrial batteries, BCI surveys industrial battery manufacturers on the amount of lead used in the production of motive power batteries and stationary batteries shipped during the relevant years.

In addition, average battery life must be taken into account when identifying the number of batteries available for recycling. For the purpose of this study, a battery becomes available at the expiration of its average operating life. The batteries included in the analysis, and their average operating lives, are:

Average Operating Life by Battery Type			
	Number of Years		Number of Years
Passenger Car & Light Truck	4	Aircraft	2
Truck & Heavy Duty Truck	3	Military	6
Tractor	3	Miscellaneous & Others[5]	3
Marine & RV	3	Motive Power	6
General Utility (Wheelchairs, Small Lifts, Autonomous Vaccums, etc.)	2	Stationary	10
Golf Car & Floor Scrubber	3	Small Sealed Lead (SSL)	5
Motorcycle	2		

1/ BCI is a not–for–profit trade association whose members are engaged in the production of lead storage batteries for automotive, marine, industrial, stationary, specialty, commercial and consumer uses. BCI's members also include entities engaged in the reclamation or recycling of used lead batteries.

2/ Copies of previous National Recycling Rate Study reports can be obtained from BCI, 330 North Wabash Avenue, Chicago, Illinois 60611, email: bcistats@batterycouncil.org.

3/ When a recycler receives a truckload of batteries, it weighs the truck with and without the batteries to determine the net weight of the shipment. After determining the types of batteries received, the recycler multiplies the weight of the shipment by a pre–determined factor to identify the amount of battery lead received for recycling. These pre–determined factors are adjusted annually.

4/ BCI collects data regarding shipments of SLI and industrial batteries on a monthly basis from its members. BCI's database includes SLI battery shipment figures back to 1937.

5/ Including specialty batteries which are used in such applications as trolley cars, etc.

2. Battery Imports and Exports

As mentioned earlier, imported SLI batteries that are shipped to U.S. destinations are classified as a shipment and reported to BCI monthly. However, small sealed lead (SSL) battery shipments are not reported to BCI. Since virtually all SSL batteries are imported, those numbers are obtained, along with other data on imports and exports of new batteries, from the Department of Commerce.

3. Vehicle/Product Imports and Exports

Data was collected on the imports and exports of vehicles known to contain batteries when shipped into or out of the United States. The imports and exports of passenger cars, trucks, buses, motorcycles were obtained from the Department of Commerce.

Based on consultation with industry experts, it is estimated that in addition to the total number of SSL batteries imported into the United States, and reported in Department of Commerce data, an additional 34% of that volume of SSLs comes into the United States within products. It is also estimated that about 2% of the imported SSL batteries are placed into products and exported back out of the United States. Those product imports and exports have been included in the equation.

All data was adjusted for each battery category's average life and assigned an average lead weight.

4. Scrap Lead and Used Battery Imports and Exports

Imports and exports of lead waste and scrap and used batteries were obtained from the Department of Commerce.

Lead Waste and Scrap:

Data reported by gross weight in the scrap lead category was multiplied by 90% to reflect the amount of battery lead believed typically to be represented by the category.[6]

Used Batteries:

For the purpose of this analysis, the number of used batteries was multiplied by the average lead weight of a passenger car or light commercial battery[7] during the years the batteries were assumed to be produced.

5. Units Recycled

The units recycled based on a recycling rate of 99.3% is as follows:

Category	Units Recycled
Passenger Car & Light Truck	416,089,008
Truck & Heavy Duty Truck	26,246,724
Tractor	4,308,313
Marine & RV	47,715,291
General Utility (Wheelchairs, Small Lifts, Autonomous Vaccums, etc.)	14,519,712
Golf Car & Floor Scrubber	56,375,752
Motorcycle, Aircraft, Military, & all other	23,533,306
Stationary Small Sealed Lead (SSL)	24,144,761

6. Notes

Average Lead Weight for Automotive Batteries

Major battery manufacturers are surveyed annually to identify the weight of lead contained in the various automotive battery categories produced each year. This data is used to estimate the total pounds of battery lead available for recycling during each year of the study.

Average Battery Life and Recycling Rate

As mentioned earlier, average battery life is taken into account when identifying the number of batteries available for recycling in a given year. However, these averages are estimates and some batteries may not enter the recycling stream during the estimated year (i.e., some after, some before). Thus, aggregating the data over a five–year period provides a more accurate picture of battery recycling activity in the U.S.

6/ Source: U.S. secondary lead recycler sources, 2016.

7/ The average lead weight for a passenger car and light commercial battery was calculated at 22.2 pounds for the 2012 – 2016 recycling rate.

III. RECYCLING RATE WORKSHEET

The following pages contain the worksheet from which the recycling rate for the years 2012 – 2016 was calculated and footnotes listing sources from which relevant data were obtained. Stationary SSLA ≤ 25Ah was previously included in the Total Automotive.

A. BCI RECYCLING RATE: 2012 – 2016

AVERAGE BATTERY LIFE 1/	YEAR OF MFR. 2/	BATTERY TYPE AUTOMOTIVE:	BATTERY SHIPMENTS (units) 9/	BATTERY EXPORTS (units) – 3/	BATTERY IMPORTS (units) +15/	VEHICLE/ PRODUCT IMPORTS (units) + 4/	VEHICLE/ PRODUCT EXPORTS (units) – 5/	BATTERIES CONSUMED DOMESTICALLY (units) = 6/	AVERAGE LEAD WEIGHT (lbs) * 7/	LEAD IN BATTERIES (lbs) CONSUMED DOMESTICALLY = 8/
4	'8 – '12	Passenger Car & Light Truck	355,620,063	18,932,727		36,424,730	10,916,970	362,195,096	22.3	8,084,343,486
3	'09 – '13	Truck & Heavy Duty Truck	54,590,248	38,035,583		2,339,034	1,793,379	17,100,320	29.8	509,957,069
3	'09 – '13	Tractor	2,240,724					2,240,724	37.4	83,707,762
3	'03 – '13	Marine & RV	32,232,763					32,232,763	28.8	927,077,600
2	'10 – '14	General Utility (Wheelchairs, Small Lifts, Autonomous Vaccums, etc.)	33,163,407					33,163,407	8.5	282,108,723
3	'08 – '12	Golf Car & Floor Scrubber	27,374,833					27,374,833	40.0	1,095,344,838
2	'10 – '14	Motorcycle **10/**	*****	2,489,891		3,066,718	618,110	*****	4.8	*****
2	'08 – '12	Aircraft	*****					*****	40.0	*****
6	'04 – '08	Military	*****					*****	46.4	*****
3	'07 – '11	Miscellaneous & Others	*****					*****	25.0	*****
		TOTAL AUTOMOTIVE:						617,424,446	units	11,439,776,581 *
6	'06 – '10	**MOTIVE POWER:**								1,814,984,710
10	'02 – '06	**STATIONARY >25Ah:**								1,097,494,314
5	'06 – '10	**STATIONARY SSL <25Ah:**	0	40,448,215	112,263,953	37,047,104	2,245,279	106,617,563	4.4	469,117,279 *

TOTAL POUNDS OF LEAD IN BATTERIES CONSUMED DOMESTICALLY:	14,821,372,884
LEAD RECYCLED FROM BATTERIES :	12,156,184,159

TOTAL LBS. LEAD IN BATTERIES CONSUMED DOMESTICALLY	BATTERY SCRAP LEAD IMPORTS + 11/	BATTERY SCRAP LEAD EXPORTS – 12/	BATTERY LEAD AVAILABLE IN U.S. FOR RECYCLING = 13/
14,821,372,884	408,150,350	2,984,258,414	12,245,264,820

2012-2016 RECYCLING	LEAD RECYCLED:	=	12,156,184,159	=	99.3%
RATE 14/=	LEAD AVAILABLE:		12,245,264,820		

** - Stationary SSLA ≤ 25Ah was previously included in the Total Automotive.*

B. Footnotes

1/ Source: BCI Lead Content and Expected Life by Battery Type Survey (for automotive batteries). Collected for the years 2012 – 2016.

Note: The average life for industrial batteries was developed in consultation with industrial battery manufacturer experts. The average life for SSLA batteries was developed in consultation with SSLA battery manufacturer/importer experts.

2/ "Year of Manufacture" is equivalent to the year the product shipped.

3/ Source: Department of Commerce, Battery Exports

HTS # 8507.100030 (LEAD–ACID BATTERIES OF A KIND USED FOR STARTING PISTON ENGINES, NEW, 12 VOLTS, NOT EXCEEDING 6KG IN WEIGHT), 2010 – 2014 Export Data, Motorcycle Batteries

HTS # 8507.100060 (LEAD–ACID BATTERIES OF A KIND USED FOR STARTING PISTON ENGINES, NEW, 12 VOLTS, EXCEEDING 6KG IN WEIGHT), 2008 – 2012 Export Data, Passenger Car Batteries

HTS # 8507.100090 (LEAD–ACID BATTERIES OF A KIND USED FOR STARTING PISTON ENGINES, NEW, OTHER THAN 12 VOLT), 2009 – 2013 Export Data, Truck and Heavy Duty Commercial Batteries

HTS # 8507.200030 (LEAD ACID STORAGE BATTERIES, NEW, NESOI, 6 VOLTS), 2007 – 2011 Export Data, SSLA Batteries

HTS # 8507.200040 (LEAD ACID STORAGE BATTERIES, NESOI, NEW, 12 VOLTS), 2007 – 2011 Export Data, SSLA Batteries

HTS # 8507.200060 (LEAD ACID STORAGE BATTERIES, NEW, NESOI, 36 VOLTS), 2006 – 2010 Export Data, Motive Power Batteries estimated at 1800 pounds per battery

HTS # 8507.200090 (LEAD ACID STORAGE BATTERIES, NEW, NESOI, EXCEPT 6 VOLTS, 12 VOLTS, AND 36 VOLTS), 2007 – 2011 Export Data, SSLA Batteries

4/ Source: Department of Commerce (2008 – 2012 data for Passenger Car Imports, 2009 – 2013 data for Truck and Bus Imports).

HTS # 8703.101000 through HTS # 8703.900000 (PASSENGER MOTOR VEHICLES)

HTS # 8704.101000 through HTS # 8704.900000 (MOTOR VEHICLES FOR THE TRANSPORT OF GOODS)

HTS # 8702.103000 through HTS # 8702.906000 (PUBLIC TRANSPORT TYPE PASSENGER MOTOR VEHICLES)

Source: Department of Commerce, 2010 – 2014 Import Data (for Motorcycle Imports).

HTS # 8711.100000 through HTS # 8711.500060 (MOTORCYCLES)

Estimate: 2007 – 2011 imports for products containing an SSLA battery are estimated. The estimate is determined by taking SSLA battery imports and multiplying it by 33%; the estimated number of additional SSLA batteries that are coming into the United States in a product.

5/ Source: Department of Commerce (2008–2012 data for Passenger Car Exports, 2009–2013 data for Truck and Bus Exports).

HTS # 8703.101000 through HTS # 8703.900000 (PASSENGER MOTOR VEHICLES)

HTS # 8704.101000 through HTS # 8704.900000 (MOTOR VEHICLES FOR THE TRANSPORT OF GOODS)

HTS # 8702.100000 through HTS # 8702.900000 (PUBLIC TRANSPORT TYPE PASSENGER MOTOR VEHICLES)

Source: Department of Commerce, 2010 – 2014 Export Data (for Motorcycle Exports).

HTS # 8711.100000 through HTS # 8711.500060 (MOTORCYCLES)

Note: Vehicle imports/exports are included for those vehicles known to contain a battery when shipped.

Virtually 100% of cars and trucks contain a battery when they are imported/exported (otherwise they would be unable to move them)–per Tim Lafond,

Johnson Controls Battery Group, Inc. (2009).

Most motorcycles contain a battery when imported/exported – per Motorcycle Industry Council (January 1991).

Typically, forklifts that are imported into the US do not contain lead acid batteries – per Troy Greiss, East Penn Mfg. Co., Inc. (2009).

Estimate: 2007 – 2011 exports for products containing an SSLA battery are estimated. The estimate is determined by taking SSLA battery imports and multiplying it by 2%; the estimated number of SSLA batteries that are exported back out of the United States in a product.

B. Footnotes (continued)

6/ Batteries Consumed Domestically is found by taking battery shipments, subtracting battery exports, adding vehicle imports and subtracting vehicle exports.

7/ Source: BCI Lead Content and Expected Life by Battery Type Survey (for automotive batteries). Collected for the years 2012 – 2016.

The average lead weight for Motorcycle and SSLA batteries was developed in consultation with Motorcycle and SSLA battery manufacturer/importer experts.

8/ Lead in Batteries Consumed Domestically is found by multiplying the Batteries Consumed Domestically (in units) by the Average Lead Weight for each product category.

The Lead Consumed in Motive Power and Stationary Batteries was collected in pounds and did not need to be converted from units.

9/ Source: BCI Monthly Shipment Report (covering domestic shipments and exports). Data utilized includes all batteries shipped (sold) in the U.S., including batteries imported and then shipped. To avoid duplication in reporting, shipments to other BCI manufacturers are not reported. Shipments are reported by the BCI member who ultimately ships to the distributor, retailer, etc. SSLA shipments are assumed to be 100% imported, therefore, shipments equal zero.

10/ Actual shipments of motorcycle, aircraft, military and all other batteries are confidential. However, the data has been included in the calculations.

Miscellaneous & Other batteries generally include specialty automotive batteries; i.e., floor sweeping, trolley car and mine car batteries.

11/ Source: Department of Commerce, 2012 – 2016 Import Data.

HTS # 7802.000030 (LEAD WASTE AND SCRAP FROM LEAD–ACID BATTERIES)

HTS # 8548.100540 (SPENT PRMRY CELLS & BATTRS, RECRY OF LED, LEAD–ACID)

HTS # 8548.100580 (OTH SPNT PRMRY CLLS & BTTRS, RECRY OF LD, OTH LD–ACD)

HTS # 8548.102500 (WASTE & SCRAP OF PRIMARY CELLS, BATTERIES & ELECTRIC STORAGE BATTERIES FOR RECOVERY OF LEAD)

12/ Source: Department of Commerce, 2012– 2016 Export Data.

HTS # 7802.000030 (LEAD WASTE AND SCRAP FROM LEAD–ACID BATTERIES)

HTS # 8548.100540 (SPENT LEAD–ACID STORAGE BATTERIES, OF A KIND USED FOR STARTING ENGINES)

HTS # 8548.100580 (SPENT PRIMARY BATTERIES & SPENT ELETRICAL STORAGE BATTERIES, NESOI, FOR RECOVERY OF LEAD)

HTS # 8548.102500 (WASTE & SCRAP OF PRIMARY CELLS, PRIMARY BATT. & ELECTRIC STORAGE BATT. FOR RECOV ERY OF LEAD)

13/ Battery Lead Available in the U.S. for Recycling is found by taking the Total Pounds of Lead in Batteries Consumed Domestically, plus the Battery Scrap Lead Imports and subtracting the Battery Scrap Lead Exports.

14/ The Recycling Rate for the years 2012 – 2016 is found by dividing the total pounds of Lead Recycled from Batteries by the total pounds of Battery Lead Available in the U.S. for Recycling.

15/ Source: Department of Commerce, Battery Imports

HTS # 8507.208030 (LEAD ACID STORAGE BATTERIES, 6 VOLT, NESOI), 2007 – 2011 Import Data, SSLA Batteries

HTS # 8507.208040 (LEAD ACID STORAGE BATTERIES, 12 VOLT, EXCEPT OF A KIND USED FOR STARTING PISTON ENGINES), 2007– 2011 Import Data, SSLA Batteries

HTS # 8507.208060 (LEAD ACID STORAGE BATTERIES, 36 VOLT, EXCEPT OF A KIND USED FOR STARTING PISTON ENGINES), 2006– 2010 Import Data, Motive Power Batteries estimated at 1,800 pounds per battery