CASE STUDY

Inventory of POPs in the Transport Sector in Nigeria

Annex 3 to the Sectoral Guidance for Inventories of POPs and Other Chemicals of Concern in Buildings/Construction, Electrical and Electronic Equipment, and Vehicles

UNEP, 2024

UN environment programme

gef global environment facility INVESTING IN OUR PLANET

DISCLAIMER

UN environment programme

gef global environment facility INVESTING IN OUR PLANET

ACKNOWLEDGEMENT

This case study, authored by Dr. Roland Weber in 2024 for Knowledge and Risk Unit at United Nations Environment Programme's Chemicals and Health Branch – Industry and Economy Division, under the project ID 9884 entitled "Integrated SC Toolkit to Improve the Transmission of Information under Articles 07 and 15" and ID 10785 "Global Development, Review and Update of National Implementation Plans (NIPs) under the Stockholm Convention (SC) on Persistent Organic Pollutants (POPs)" funded by Global Environment Facility (GEF) and implemented by United Nations Environment Programme.

GEF is a family of funds dedicated to confronting biodiversity loss, climate change, pollution, and strains on land and ocean health. Its grants, blended financing, and policy support help developing countries address their biggest environmental priorities and adhere to international environmental conventions. Over the past three decades, the GEF has provided more than $23 billion and mobilized $129 billion in co-financing for more than 5,000 national and regional projects.

Recommended citation: *UNEP (2024), Inventory of POPs in the Transport Sector in Nigeria.* This citation ensures proper acknowledgment and attribution in accordance with applicable standards.

Annex 3[1]: INVENTORY OF POPs IN THE TRANSPORT SECTOR IN NIGERIA

Acknowledgement:

This case study has been developed by Dr. Roland Weber (POPs Environmental Consulting, Schwäbisch Gmünd, Germany), in cooperation with Assoc. Prof. Joshua Babayemi (University of Medical Sciences, Ondo, Nigeria) who compiled data from Nigeria and conducted the material and substance flow analysis and cooperation with Dr. Sabine Dworak (Technical University Vienna, Austria).
Further we acknowledge the support of Prof. Oladele Osibanjo (former director Basel Convention Regional Centre) and Prof. Cornelius Agbo and other members from ministries and other entities which supported the development of the first PBDE inventory of the transport sector in Nigeria.

[1] This case study is an Annex to the UNEP "Sectoral guidance for inventories of POPs and other chemicals of concern in buildings/ construction, electrical and electronic equipment, and vehicles" Geneva, January 2023.

1 Introduction

In 1902, Lagos witnessed the arrival of the first two motor vehicles in Nigeria. About 35 years later, the number was said to have increased to 7,507 all over the country, with the first public transport system commencing in Lagos in 1915 (Agbo, 2011)[2]. Today the transportation by car and minibus is the most common commuting system in Nigeria while train, subway and public bus systems have not yet been extensively developed. The imported cars, buses, trucks, and other transportation fleets such as planes and ships contain large metal resources (e.g. ferrous metals, copper and aluminium). On the other hand, cars and other vehicles contain also a wide range of POPs (c-PentaBDE, decaBDE, HBCD, SCCPs, PFOA), candidate POPs (DP, MCCP, UV-328) and other chemicals of concern (see details in this POPs sectoral guidance Chapter 4[3] and *PBDE BAT/BEP Guidance*[4]) which need a sound managed at the end-of-life.

A considerable share of used vehicles often with low environmental performance were and are exported from industrial countries to low- and middle-income countries where the vehicles are often used for a long time until they finally break down (*PBDE Inventory Guidance*[5]). Therefore, many vehicles imported since the 1970s are still in operation in developing countries.

An initial inventory for PBDEs listed 2009 had been established for the transport sector in 2012[6]. In this case study an inventory of different POPs present in the transport sector in Nigeria including a dynamic substance flow analysis of major POPs have been developed as suggested by the PBDE inventory guidance[5] and e.g. developed for Japan[7].

2 STEP 1: Planning of the inventory and identification of stakeholders

In this first step the objectives and scope of the inventory was defined and a work plan developed (see e.g. Section 3.1. of the *PBDE Inventory Guidance*[5]). The POP inventory of the transport sector is expected to address the following life cycle stages:

- Vehicles imported/exported in the inventory year.
- Import data of previous years as a basis for estimating/evaluating stocks and service life;
- Current registered vehicles (vehicles in use of consumers/corporates);
- End-of-life vehicles entering the waste stream;
- Export of vehicles
- Total amount of plastic and other polymers from end-of-life vehicles recycled;
- Polymers of end-of-life vehicles disposed in the past.

For the initial inventory 2012, the inception workshop on new POPs held in early March 2012 in Nigeria was used to develop a working group to develop a first PBDE inventory in transport sector[6] comprised of a

[2] Agbo, C.O.A. (2011) A critical evaluation of motor vehicle manufacturing in Nigeria. Nigerian J of Technology 30 (1), 8-16.

[3] UNEP (2023) Sectoral guidance for inventories of POPs and other chemicals of concern in buildings/ construction, electrical and electronic equipment, and vehicles.

[4] UNEP (2021) Guidance on best available techniques and best environmental practices relevant to the polybrominated diphenyl ethers listed under the Stockholm Convention.

[5] UNEP (2021) Draft guidance on preparing inventories of polybrominated diphenyl ethers (PBDEs) listed under the Stockholm Convention on Persistent Organic Pollutants. Secretariat of the Basel, Rotterdam and Stockholm Conventions.

[6] Babayemi J.O, Osibanjo O, Sindiku O, Weber R (2018) Inventory and substance flow analysis of polybrominated diphenyl ethers in the Nigerian transport sector – contribution for end-of-life vehicles policy and management. Environ Sci Pollut Res Int. 25, 31793-31928.

[7] Liu H, Yano J, Kajiwara N, Sakai S. (2019) Dynamic stock, flow, and emissions of brominated flame retardants for vehicles in Japan. Journal of Cleaner Production 232, 910–924.

lead transport sector expert (Professor Cornelius Agbo) and members from ministries (environment and transport), waste management authorities, customs office, industrial sectors, the Basel Convention Regional Centre (Prof. Osibanjo), academic institutes (Dr. Joshua Babayemi; formerly Ibadan University). Since no inventory on the transport sector was available for Nigeria in 2012, the first PBDE inventory at the same time compiled the first inventory of the transport sector of Nigeria. With the support of the stakeholder group, Professor Agbo and Dr. Babayemi compiled the information in cooperation with the Ministry of Environment and approaching other stakeholders having information on the transport sector. Furthermore by cooperation with Technical University Vienna (Prof. Johann Fellner) the free software STAN[8] for the calculation of the material/substance flows in the first PBDE inventory of the transport sector[6] and also for this update of the inventory (see below). The team was also supported by an international consultant.

For the update of the inventory in 2022, the researcher which compiled the first inventory, Associate Professor Joshua Babayemi (now University of Medical Sciences (UNIMED), Ondo, Nigeria) was tasked for organising the update. By this the institutional knowledge developed in the first inventory to gather information and to establish a MFA/SFA was utilized for the update of the inventory. Also the Technical University of Vienna was involved again for capacity building in dynamic MFA/SFA which can be used to e.g. predict the amount of ELVs and related POPs or resources in future for Policy advice.

For the establishment of the POP inventory a work plan was developed in July 2022 with the aim of finishing the update by December 2022 including visit to Technical University in Vienna.

For the sectoral inventory it was decided to also focus on cars and other road vehicles (busses and trucks) since these are the major portion of the transport sector in Nigeria and this sector contains also the largest volume of POP of the transport sector. Other sectors (planes, trains and ships) were not considered for the inventory since all three categories are small and impact factors are not provided by guidance but it was concluded that in the literature search also initial information on these sectors would be gathered.

3 STEP 2: Choosing the inventory methodology

The POP inventory was developed following the 5 steps inventory approach provided by the *POP-PBDE Inventory Guidance*[5] (Chapters 3 and 7) and Figure 1 of this sectoral POP guidance[3].

In Tier 1 Phase (Section 4.1), an assessment of the availability of update data of the former used main database (Lagos State motor vehicle statistics) was conducted. One new stakeholder was discovered in this survey: the Nigeria National Automotive Design and Development Council (NADDC) which did not exist at the time of the first inventory.

For the main inventory Tier 2 assessment (establishing an inventory by gathering, screening and evaluating available data and compiling data) **(Section 4.2)** were carried out for this study.

Furthermore, as a part of Tier III, a dynamic MFA/SFA was developed (see below Section 4.3). With the available time and budget, no additional measurements of POPs in the transport sector were conducted but impact factors given by the sectoral guidance.

It was also concluded that data should be sourced in a similar manner as in the first inventory at Lagos state where the largest share of vehicles enter Nigeria, and which has robust data and information including the origin of the vehicle.

Since different POPs have been used in different period, it was key to get information of the age distribution of the vehicles imported, in current use and in end of life.

[8] http://iwr.tuwien.ac.at/resources/downloads/stan.html

In the planning of the inventory it was also concluded that the data should finally be subjected to a material flow and substance flow analysis to visualize the material/substance flows as a (discussion) base for policy making and (waste) management strategies.

A work plan was developed to compile data. The main responsibility for compiling the data and for the dynamic MFA/SCA was given to the Associate Professor Babayemi,

4 STEP 3: collecting and compiling the data

4.1 Tier 1 preliminary assessment

The initial assessment relies on collecting "low-hanging fruit", i.e. existing information, desk studies, literature searches, interviews etc. Priority is to get an overview of the present and historical use of the chemical and its life cycle in the country for refining the scope and planning the inventory process:

(a) Production; (b) Uses; (c) Waste management and potential recycling of materials containing the chemical; (d) Waste storages/disposal (end-of-life vehicle management; recycling/spare parts); (e) Understanding the life cycle of POP and the potential for emissions.

Most of these stages had been assessed for PBDEs in vehicles in Nigeria already in the development of the first inventory in 2012[6] and was only updated. However, one new discovery in the initial assessment was that in the end-of-life of vehicles many spare parts are removed from vehicle and that part of the polymer containing spare parts might contain POPs. Therefore, for this updated inventory also spare parts were considered but not assessed in depth due to the short time. It needs to be stressed that for PBDEs the use of spare parts are exempted.

Furthermore, this updated transport sector inventory aimed to consider multiple POPs in vehicles and not only the PBDEs. Therefore, the use and presence of other POPs in vehicles needed to be understood (HBCD, PFOS, PFOA, PFHxS SCCPs and the POPs candidates MCCP and dechlorane plus). For this task the new Sectoral guidance for inventory of POPs[3] and respected references in the guidance were assessed and if the suggested impact factors could be considered appropriate and could be applied to vehicles in Nigeria and in which time period the individual POPs have been used in vehicles and their likely presence in Nigeria.

4.2 Tier 2 inventory – inventory based on available and estimated data

4.2.1 Methodology for Data Collection

The evaluation of available and relevant national data of the transport sector was conducted by using the approach of the *PBDE Inventory Guidance*[5] covering PBDEs listed 2009 and decaBDE listed 2017 with the available data identified and by extrapolating some data to fill gaps.

The sectoral POP guidance[3] was studied for impact factors for selected other POPs (HBCD; PFOA, PFOS and SCCP) and POPs candidates (MCCP and Dechlorane Plus). Due to the high impact factor of organophosphorous flame retardants (OPFRs) in vehicles and their high release from African landfills (Sibiya et al. 2019)[9], it was decided that also a preliminary estimation of OPFRs in vehicles should be included. Basic information was compiled for the transport sector on the following (UNEP 2021a)[5]:

[9] Sibiya, I., Poma, G., Cuykx, M., Covaci, A., Adegbenro, P. D., Okonkwo, J. (2019). Targeted and non-target screening of persistent organic pollutants and organophosphorus flame retardants in leachate and sediment from landfill sites in Gauteng Province, South Africa. Science of the total environment, 653, 1231-1239

- Registered vehicles (cars, busses and trucks) between 1980-2020; in use and their age distribution to assess the production periods (e.g. for decaBDE use period 1975 to 2017).
- National statistics on number of imported vehicles in the past 19 years (1988-2020);
- Vehicles imported for the inventory year and for the years with relevant vehicle imports as a base for estimating total stocks including total amount of vehicles having entered end of life; national data and UN Comtrade Database
- The origin of imported vehicles and related age of vehicles (e.g. for c-PentaBDE vehicles produced before 2005 from US/North America);
- Production/assembly of vehicles in Nigeria
- End-of-life vehicles in the inventory year and those having already reached end-of-life;
- Treatment and management of end-of-life vehicles including management of plastic from end-of-life vehicles.
- Vehicle spare parts containing decaBDE (see Table 2 of sectoral POP inventory guidance[3]) – production, import, sales of exempted parts.
- data from Lagos State motor vehicle statistics 2009-2020
- International trade statistics (http://unstats.un.org/unsd/comtrade/)
- Available literature and peer reviewed paper on Nigerians transport (see in the respective sections below)

Total imported vehicles

The total number of motor vehicles (cars, buses and trucks) imported/put on market between 1980 and 2020 in Nigeria were 17,553,599 (Figure 1).

When assessing the import data an unusual high import was reported for 1999 (Figure 1). The reason for the large increase of registered vehicles in 1999 was due to the deadline set for registration of all vehicles in the country by the governmental registration. Therefore, the largest share of vehicles in 1999 were already in operation in Nigeria the years before but for the first time registered (as can be seen there were hardly any imports/new registrations in the1990s which was however caused by the lax import/registration practice). The second peak registration was observed in 2002 and was caused by the favourable government policies on importation of used vehicles at the inception of democratic rule in Nigeria. (Abam and Unachukwu, 2009)[10].

Table A-1: Total vehicles imported to Nigeria 1980 to 2020 (See also Figure A-1 for time trend)

Vehicle type	**Cars**	**Trucks**	**Buses**
Number	12,962,823	299,270	4,291,506

Distribution of the different vehicle types

The distribution of the different types of vehicles imported was established as follows: Of motor vehicles registered in Nigeria, 73.8% were cars and 24.4% buses and 1.7% trucks[11].

[10] Abam F.I. and Unachukwu G.O. (2009). Vehicular Emissions and Air Quality Standards in Nigeria. European Journal of Scientific Research, 34 (4): 550-560.

[11] Abam, F.I., Unachukwu, G.O. (2009). Vehicular emission and air quality standards in Nigeria. European Journal of Scientific Research, 34 (4): 550-560.

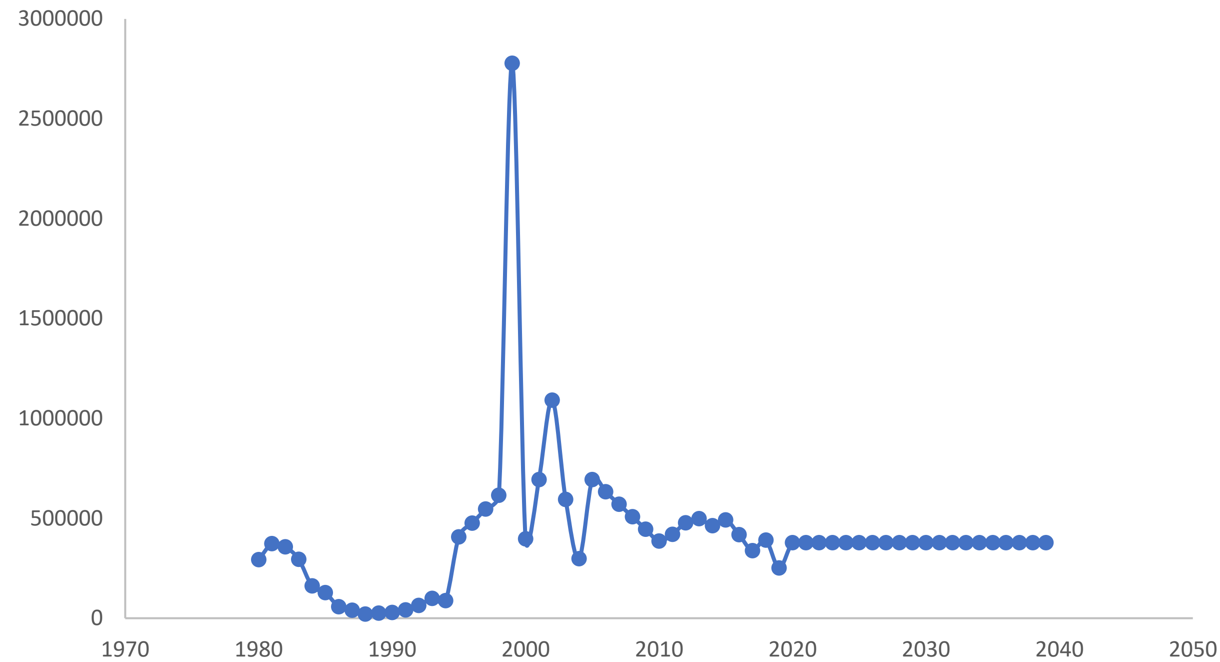

Figure A1. Total motor vehicles imported/put on market (1980-2020) and estimated future imported vehicles 2020 to 2040 for modelling of the dynamic material and substance flow analysis ().

Information on current transport fleet and total amount of vehicles having entered end-of-life
For this preliminary inventory relatively, good data were available from registration of vehicles and international statistics such as per capita use of vehicles[12]. **Based on these data in total 13 million vehicles were registered/in use in 2020.** This also correlated with the reported per capita use of vehicles in Nigeria. Since vehicles have not been exported from Nigeria

Table A-2. Total vehicles in current use in Nigeria (Inventory year 2020)

Vehicle type	Cars	Trucks	Buses	Total
Amount	9,620,000	260,000	3,120,000	13,000,000

Ratio of old and new vehicles in imports
From the available statistical data of imported cars to Lagos, the ratio of imported new cars to imported used cars was 40%:60% (ca. 60% used imported). This ratio was used to also estimate the distribution of busses/trucks. This information is needed for the age distribution of cars. Furthermore for it is considered that Nigeria does only allow the import of cars younger than 15 years.

Information on regional distribution
For some POP calculation in vehicles the origin of vehicles is relevant (in particular for c-PentaBDE; see below). The data from Lagos state motor vehicles statistics the origin of imported vehicles are registered including the origin of import. A large share of total vehicles in Nigeria are registered here and therefore this distribution was also used for the rest of vehicles in Nigeria: Based on this data vehicles have mainly

[12] https://en.wikipedia.org/wiki/List_of_countries_by_vehicles_per_capita and references there

been imported from Asia (69%), and Europe (12%) and to some extent from North America (7%) and remaining from other regions. This distribution was considered where regional distribution was needed for the calculation.

Service life of vehicles

In a developing country like Nigeria economy does not allow most car/vehicle owners to change their vehicles frequently but to keep and (let) repair the vehicles until it becomes non-functional. This is also driven by comparably low labour- and operational cost of car repair shops, cars in Nigeria are refurbished over and over again. In an expert consultation for the first inventory the service life of vehicles in use and stockpiled with reuse was estimated to 30 years for new cars and 25 years for imported second hand cars. This was confirmed with the dynamic substance flow analysis see TIER 3 assessment where a service life of 30 years fit with the total vehicle import between 1980 to 2020 of 17.5 million vehicles and the current use of 13 million vehicle.

The estimation of vehicles reaching end-of-life for the respective year is relevant for planning of waste/resource management of this material flow.

Please note for vehicle imports to Nigeria from 2012 on: The Nigerian legislation only allows the import of used cars which are less than 15 years old. Therefore from 2012 on the cars produced in and before 2004 are not allowed to be imported. This means while cars possibly impacted by PBDE use (assumed to be produced before 2005) will not be allowed to be imported. Therefore, the current legislation indirectly restricts the import of vehicles possibly containing POP-PBDEs.[13]

No export activities of used vehicles have been discovered in the development of the current inventory.

Exports of vehicles: The UN Comtrade data were also assessed for exports of vehicles. The information did not indicate a relevant export and the quantities was partly in “kg” and for most years “no quantity”. Therefore, it was concluded that no relevant export of vehicles take place from Nigeria.

Reuse and recycling of polymers from end-of-life vehicles

Data on reuse and recycling of polymers were highlighted as a gap in the 2012 inventory. Meanwhile it became clear that the spare part market including many spare parts containing polymers such as car seats are an important business in Nigeria and contribute to the extension of vehicle service life and the service life of individual spare parts. It was estimated that at least 20% of polymer parts of a vehicle is going to the second hand market.

4.2.2 Inventory of PBDEs listed 2009 and decaBDE in vehicles in Nigeria

PBDEs are the most relevant POPs in vehicles used as flame retardants in plastics, textiles and polyurethane foam mainly in the past.

Factors needed for PBDE calculation for vehicles were:

- the number of vehicles for the different sectors (cars, busses and trucks)
- the number of vehicles in the different life cycle stages (import, in use, end-of-life)
- the origins of manufacturers of vehicles
- age distribution of vehicles to consider the different impact factor

[13] However some vehicles are illegally imported in particular via neighbouring countries. These illegal imports might also contain POP-PBDEs. The share of these illegal imports needs further assessment.

- impact factors for the different vehicle types. The estimated contents of PBDEs in respective vehicle type are given by the *PBDE Inventory Guidance (UNEP 2021)*[5].

Based on global data from PBDEs in shredder residues and recalculated average of PBDEs content of individual cars (see PBDE inventory guidance), the POP-PBDE content is (UNEP 2021a)[5]

- 80 g decaBDE for vehicles produced until 2004 for all regions; except for the US with relevant use of c-PentaBDE an use of 40 g decaBDE and 40 g c-PentaBDE in average car[5,14] can be assumed
- 20 g decaBDE for vehicles produced 2005 to 2017
- 0 g decaBDE/PBDEs for vehicles produced 2017 onwards (if no exemption for decaBDE is made)

According to the Stockholm Convention PBDE inventory guidance Based on this practical approach the following formula can be used to estimate the PBDE amount in vehicles:

PBDEs in Vehicles = Vehicles (1970-2004) x 80 g decaBDE*/vehicle + Vehicles (2005-2017) x 20g/vehicle

*For the US it is assumed that the content is 40 g decaBDE and 40 g c-PentaBDE[14] were included in average vehicles before 2005

The estimate can be adjusted for larger or smaller cars or to buses as appropriate.[5] The inventory guidance stresses that if own robust PBDE data are available for a country/region then these data can be used instead of the suggested PBDE impact factors.[5]

Based on the assessment of total imports (Figure A-1; Table A-3) and the decaBDE impact factors the total amount of DecaBDE in the 17,553,599 vehicles imported 1980to 2020 was 1,484 tonnes. This calculation is based on the assessment of the age of vehicles having different impact factors[5] (See Table A-3 and Table A-4). Furthermore, it was considered that a share was new cars and another share were imported used cars with an age of up to 15years.

The current vehicle fleet of 13,000,000 vehicles in current use (in 2020) still contained 1,098 tonnes (74%) of the imported decaBDE in vehicles. In the last 40 years (1980-2020) 386 tonnes of decaBDE contained in vehicles entered end of life (see Table A-5).

Table A-3. Number of used and new vehicles imported to Nigeria from different regions since 1980 and PBDE impact factors selected for this study based on PBDE inventory guidance

Region of origin	Vehicles	Registration/ Put on market							
		2005-2020				1980-2004			
		Number of Vehicles	DecaBDE per vehicle	PentaBDE per vehicle	HBCD	Number of Vehicles	DecaBDE per vehicle	PentaBDE per vehicle	HBCD
Non-US	New Cars	2,276,829	20g		3	2,616,492	80g		2
	Used Cars	3,415,245	80g		3	3,924,739	80g		2
	New Trucks	74,874	20g		3	37,378	80g		2
	Used Trucks	112,311	80g		6	56,068	80g		2
	New Buses	486,596	40g		6	1,083,975	160g		4
	Used Buses	729,895	160g		6	1,625,963	160g		4
US	New Cars	94,867	20g		3	196,940	40g	40g	2
	Used Cars	142,301	40g	40g	3	295,410	40g	40g	2

[14] It is estimated that 85,000 tonnes of c-PentaBDE were used in the United States and with 36% in transport, 60% in furniture and a 4% residual in other articles (Alcock et al., 2003; UNEP, 2010b).

	New Trucks	4,642	20g		2	2,813	40g	40g	2
	Used Trucks	6,964	40g	40g	2	4,220	40g	40g	2
	New Buses	64,441	40g		4	81,589	80g	80g	4
	Used Buses	96,663	80g	80g	4	122,384	80g	80g	4
Total		7,505,628				10,047,971			

Total number of vehicles (1980-2020) is 17,553,599; of which approximately 13,000,000 (74 %) is in current use (in the year 2020).

Table A-4. Amount of DecaBDE in individual vehicle type and age in Nigeria imported 1980 to 2020

Region of origin	Vehicles	Registration/ Put on market					
		2005-2020			1980-2004		
		Number of Vehicles	DecaBDE per vehicle	Amount of DecaBDE (kg)	Number of Vehicles	DecaBDE per vehicle	Amount of DecaBDE (kg)
Non-US	New Cars	2,276,829	20g	45536	2,616,492	80g	209319
	Used Cars	3,415,245	80g	273219	3,924,739	80g	313979
	New Trucks	74,874	20g	1497	37,378	80g	2990
	Used Trucks	112,311	80g	8984	56,068	80g	4485
	New Buses	486,596	40g	19463	1,083,975	160g	173436
	Used Buses	729,895	160g	116783	1,625,963	160g	260154
US	New Cars	94,867	20g	1897	196,940	40g	7877
	Used Cars	142,301	40g	5692	295,410	40g	11816
	New Trucks	4,642	20g	93	2,813	40g	112
	Used Trucks	6,964	40g	279	4,220	40g	169
	New Buses	64,441	40g	2577640	81,589	80g	6527120
	Used Buses	96,663	80g	7733040	122,384	80g	9790720
Total		7,505,628		483,757	10,047,971		1,000,657

Table A-5. Amount of decaBDE (tonnes) in vehicles in current use and in vehicles having entered end of life (1980 to 2020) and the related share landfilled, openly burnt or reused in spare parts

Tonnes	DecaBDE in vehicles in current use (2020)	DecaBDE imported* in vehicles in the inventory year (2020)	DecaBDE in end-of-life vehicles (2020)	DecaBDE reused in spare parts (1980 - 2020) (20% of EoL)	DecaBDE in dump sites from transport sector (1980-2020) (64% of EoL)	DecaBDE in open burning from transport sector (1980-2020) (16% of EoL)
DecaBDE	1,098		386	77	247	62

4.2.2.1 Estimation of c-PentaBDE in vehicles considering import distribution for the different region

The production of c-PentaBDE (containing tetraBDE and pentaBDE) stopped in 2004 and therefore only cars produced before 2005 might contain c-PentaBDE. However, only a smaller part of the cars produced between 1975 to 2005 worldwide have been treated with c-PentaBDE. The use of c-PentaBDE depends on the national/regional legislations and production/use patterns. More than 90% of c-PentaBDE has been used in the US/North America (*PBDE Inventory Guidances*[5,]*;*Abbasi et al. 2019[15]). Only a share of the cars in the US have been treated with c-PentaBDE[16] and also decaBDE and organophosphorus flame retardants (OPFRs) were used in US/North America since 1980s. Therefore only 40 g c-PentaBDE (correspond to approx. 25% of US cars produced before 2005 were treated with c-PentaBDE) (*POP-PBDE Inventory Guidance*[5] Chapter 5).

The amount of c-PentaBDE (PBDEs listed 2009) contained in the 1,113,234 vehicles originating from the US (import 1980-2020) is calculated to 50 tonnes (Table A-6). In the inventory year 2020, out of the 13 million motor vehicles in current use, 520,000 (4%) originated from the US. This implies 593,234 motor vehicles (53%) originating from the US have reached EoL, and this contained 26.5 tonnes c-PentaBDE, while 23.5 tonnes (47%) are contained in motor vehicles in current use (Table A-7).

Table A-6. Amount of c-PentaBDE in individual vehicle type and age in Nigeria imported 1980 to 2020

Region of origin	Vehicles	Registration/ Put on market					
		2005-2020			1980-2004		
		Number of Vehicles	c-PentaBDE per vehicle	Amount of c-PentaBDE (kg)	Number of Vehicles	PentaBDE per vehicle	Amount of c-PentaBDE (kg)
Non-US	New Cars	2,276,829			2,616,492		
	Used Cars	3,415,245			3,924,739		
	New Trucks	74,874			37,378		
	Used Trucks	112,311			56,068		
	New Buses	486,596			1,083,975		
	Used Buses	729,895			1,625,963		
US	New Cars	94,867			196,940	40 g	7,878
	Used Cars	142,301	40 g	5,692	295,410	40 g	11,816
	New Trucks	4,642			2,813	40 g	113
	Used Trucks	6,964	40 g	279	4,220	40 g	169
	New Buses	64,441			81,589	80 g	6,527
	Used Buses	96,663	80 g	7,733	122,384	80 g	9,791
Total		7,505,628		**13,704**	10,047,971		**36,293**

Table A-7. Amount of c-PentaBDE (tonnes) in vehicles in current use and in vehicles having entered end of life (1980 to 2020) and the related share landfilled, openly burnt or reused in spare parts

(tonnes)	c-PentaBDE in vehicles currently in use (2020)	c-PentaBDE in end-of-life vehicles (1980 to 2020)	c-PentaBDE reused in spare parts (2020)	c-PentaBDE in dump sites from transport sector (1980-2020)	c-PentaBDE in thermally treated from transport sector (1980-2020)
c-PentaBDE	23.5	26.5	5.3	17	4.2

[15] UNEP (2015) Revised draft guidance for the inventory of polybrominated diphenyl ethers under the Stockholm Convention. UNEP/POPS/COP.7/INF/27

[16] According to the use pattern of c-PentaBDE, approx. 200 million cars produced in the US/North America from 1975 to 2004 could have been contaminated with c-PentaBDE.

4.2.3 Estimate of HBCD in vehicles in Nigeria

In the Japanese national inventory for PBDE and HBCD in vehicles, an impact factor for HBCD has been determined (3 g HBCD/car) (see Section 4.3.2 of sectoral POP inventory guidance[3]). There are no regional impact factors due to a lack of studies. Therefore the suggested impact factor was used for the estimate of HBCD in vehicles in Nigeria. It was also considered that the HBCD use in vehicles was stopped in 2013 (see Sectoral guidance Section 4.3.2[3]) and therefore vehicles produced from 2014 on do not contain HBCD. Total amount of HBCD in the 17,553,599 motor vehicles imported 1980-2020 was 61 tonnes. From these, the current registered 13,000,000 vehicles contain an estimated 45 tonnes (year 2020) and 16 tonnes HBCD were contained in vehicles in EoL from 1980 to 2020 (see Tables A-8 and A-9).

The sectoral POP inventory guidance[3] also informs that refrigerator trucks frequently contain XPS as insulation where HBCD have been used at least until 2013. However, there were no data/information on the amount of such trucks in Nigeria.

Table A-8. Amount of HBCD in individual vehicle type and age in Nigeria imported 1980 to 2020

Region of origin	Vehicles	Registration/ Put on market					
		Used vehicles in 2014-2020			New and used vehicles in 1980-2013		
		Number of Vehicles	HBCD (g/car)	Amount of HBCD (kg)	Number of Vehicles	HBCD (g/car)	Amount of HBCD (kg)
	Cars	1,425,996	3	4,278	10,586,166	3	31,758
	Trucks	49,501	3	149	212,964	3	639
	Buses	165,080	6	990	3,905,958	6	23,436
Total		1,640,577		5,417	14,705,088		55,833

Table A-9. Estimated amount of HBCD (tonnes) in vehicles in current use and in vehicles having entered end of life (1980 to 2020) and the related HBCD landfilled, openly burnt or reused in spare parts

(tonnes)	POP imported in vehicles (1980-2020)	HBCD in vehicles currently in use (2020) (74%)	HBCD in end-of-life vehicles (1980 to 2020)	HBCD reused in spare parts (1980-2020) (20% of EoL)	HBCD in dump sites from transport sector (1980-2020) (64% of EoL)	HBCD in open burning from transport sector (1980-2020) (16% of EoL)
HBCD	61	45	16	3	10	3

4.2.4 Estimate of SCCPs and MCCP in vehicles in Nigeria

Measurements of automotive shredder fraction (ASR) in Japan and Europe suggest an impact factor for SCCPs of 2.4 g/car (see Section 4.2.2 of sectoral POP inventory guidance[3]) and an impact factor for MCCP (MCCP is in POPRC evaluation) of 50 g/car (see Section 4.4.3 of sectoral POP inventory guidance[3]). These impact factors were used for a first estimate of CPs in the vehicles in Nigeria. SCCP and MCCP are still produced in high amount and SCCP has exemptions for uses in relevant application in vehicles (e.g. PVC, rubber, lubricants). Further, it was assumed that SCCP and MCCP were used mainly in vehicles from 2000 on where production has strongly increased in China and India with a large share of MCCPs/SCCPs used

as plasticizer in PVC (Chen et al. 2021[17]; Li et al. 2023[18]). More data of SCCPs/MCCPs in vehicles in respect to age is needed and when more robust data are available, the MFA/SFA can be easily updated.
The total number of vehicles produced 2000-2020 imported to Nigeria was 10,491,407. These are estimated to contain 30 tonnes SCCP and 633 tonnes of MCCP (Table A-10). Since the lifetime of motor vehicles in Nigeria ranges between 25-35 years, it is assumed that almost all of these vehicles are still in current use, and only a negligible amount of these cars ended in the EoL up to 2020.

Table A-10. Amount of SCCPs/MCCPs in the Nigerian transport sector in 2020 (in kg).

Vehicles	Registration/ Put on market (2000-2020)				
	SCCP			MCCP	
	Number of Vehicles	SCCP/vehicle (g)	Amount of SCCP (t)	MCCP/Vehicle (g)	Amount of MCCP (t)
Cars	8,099,244	2.4	19.4	50	405
Trucks	225,985	2.4	0.54	50	11,3
Buses	2,166,178	4.8	10.4	100	217
Total	**10,491,407**		**30.4**		**633**

4.2.5 PFOS, PFOA and PFHxS in vehicles in Nigeria

Measurements of automotive shredder fraction (ASR) in Europe suggest an impact factor of extractable PFOA of 15 mg/car (see Section 4.2.3 of sectoral POP inventory guidance[3]). Extractable PFOS and PFHxS in these ASR had an average concentration of 3 mg/car and 0.2 mg/car[3]. These impact factors were used for the estimate of the vehicles in Nigeria. Since PFOA is still produced and has an exemption for treating textiles and use in fluoropolymers, PFOA and related substances might still be present in new vehicles, it is considered for the current inventory and dynamic MFA/SFA that the use started 1980 and will further be used until 2025. For PFOS, the POPRC concluded 2012 that PFOS use is likely stopped and not needed in textiles, upholstery and carpets and can be removed as exemption. Therefore, it is considered that vehicles produced between 1980 to 2012 contain PFOS and PFHxS related substances (considered at the detected concentration an unintentional co-pollutant of PFOS) and that vehicles produced from 2013 on do not contain PFOS or PFHxS related substances.
Total amount of extractable POP-PFAS in motor vehicles in Nigeria (1980-2020) was estimated to 328 kg (PFOA), 66 kg (PFOS) and 4 kg (PFHxS).
The life cycle stage distribution of extractable PFOS, PFOA and PFHxS is given in the Table A-12 below. While 243 kg of extractable PFOA is still present in vehicles in use, 54 kg of PFOA has been dumped with end-of-life vehicles in recent years.
The guidance stressed that this amount is only the extractable PFOS/PFOA and that the amount of side chain fluoropolymer e.g. on seat textiles could be much higher but were not extracted in the study from which the impact factors have been developed[3].

[17] Chen C, Chen A, Li L, Peng W, Weber R, Liu J. (2021) Distribution and Emission Estimation of SCCP/MCCP in Chinese Products through Detection-Based Mass Balancing. Environ. Sci. Technol. 55, 7335–7343.
[18] Li et al. (2023). What do we know about the production and release of persistent organic pollutants in the global environment?. Environmental Science: Advances. DOI: 10.1039/d2va00145d

Table A-11. Amount of extractable PFOA, PFOS and PFHxS (kg) in the Nigerian transport sector in 2020.

Vehicles	Registration/ Put on market						
	1980-2020						
	Number of Vehicles	PFOA		PFOS		PFHxS	
		PFOA/ vehicle (mg)	Amount of PFOA (kg)	PFOS/ vehicle (mg)	Amount of PFOS (kg)	PFHxS/vehicle (mg)	Amount of PFHxS (kg)
Cars	12962823	15	194	3	39	0.2	3
Trucks	299270	15	45	3	1	0.2	0.2
Buses	4291506	30	129	6	26	0.4	1.7
	17,553,599		328		66		4

Table A-12. Estimated amount of POP-PFAS (kg) in vehicles in current use and in vehicles having entered end of life (1980 to 2020) and the related PFAS landfilled, openly burnt or reused in spare parts

(in kg)	Extractable POP-PFAS imported 1980-2020	Extractable POP-PFAS in vehicles in current use (2020) (74%)	Extractable POP-PFAS in end-of-life vehicles (2020) (26%)	Extractable POP-PFAS in reused parts (1980-2020)* (20% of EoL)	Extractable POP-PFAS in dump sites from transport sector (1980-2020) (64% of EoL)	Extractable POP-PFAS openly burnt transport sector (1980-2020) (16% of EoL)
PFOA	328	243	85	17	54	14
PFOS	66	49	17	3	11	3
PFHxS	4	3	1	0.2	0.64	0.16

4.2.6 Halogenated organophosphorus flame retardants

Halogenated organophosphorus flame retardants (OPFRs) are major flame retardants present in vehicles which are not POPs but have certain toxic properties and are found in high levels in African landfill leachate (Sibiya et al. 2019)[19]. There are only initial measurements of OPFRs in automotive shredder fraction (ASR) in Japan which suggest an impact factor for OPFRs of 10 to 100 g/car (see Section 4.2.3 of sectoral guidance[3]). As tentative impact factor 50 g of OPFR for cars and 150 g for (mini)buses were selected for this inventory of the Nigerian transport sector. Since chlorinated OPFRs are still produced and used in vehicles in textiles and PUR foam, they are still used in new vehicles. OPFRs have largely substituted BFRs in vehicles starting in 1990s. Therefore it is considered that 1166 tonnes of OPFRs were imported to Nigeria in 15,789,445 vehicles from 1990 to 2020 (Table A-13). In the inventory year 2020, the 13 million vehicles in current use contained 956 tonnes OPFRs is contained in vehicles in current use (2020), while 163 tonnes OPFR have entered EoL the past 30 year (Table A-14).

Table A-13. Amount of OPFR (t) in the Nigerian transport sector in 2020.

Vehicles	Registration/ Put on market (1990-2020)		
	Number of Vehicles	PFRs /vehicle (g)	Amount of PFRs (tonnes)
Cars	11,727,915	50	586
Trucks	281,628	50	14
Buses	3,779,902	150	566
Total	**15,789,445**		**1166**

[19] Sibiya, I., Poma, G., Cuykx, M., Covaci, A., Adegbenro, P. D., Okonkwo, J. (2019). Targeted and non-target screening of persistent organic pollutants and organophosphorus flame retardants in leachate and sediment from landfill sites in Gauteng Province, South Africa. Science of the total environment, 653, 1231-1239.

Table A-14. Amount of OPFR[20]* (t) in the Nigerian transport sector in 2020.

(in tonnes)	OPFR imported* in vehicles (1990-2020)	OPFR in vehicles in current use (2020)	OPFR in end-of-life vehicles (1990 to 2020)	POP in spare parts (2020)**	POP in dump sites and landfills (1980-2020)**
OPFRs	903	**740**	**163**	*25*	*104*

4.2.7 Inventory summary of POPs amount in the transport sector

The Table A-15 below summarise the amount of brominated POPs and SCCPs/MCCPs in vehicles in Nigeria in the life-cycle: total former imports, current use/stock and in end-of life including spare parts. This is complemented by Table A-12 for PFOS, PFOA and PFHxS (Table A-12) and OPFRs (Table A-14). The largest amount of POPs in vehicles stem from DecaBDE where approx. 1100 t are still in the vehicle fleet. High amount of MCCP (633 t) which is currently in the POPRC are also present in vehicles and are still increasing due to the continuous production.

A special concern are the large quantities of POPs from end-of-life vehicles in Nigerian dump sites (Table A-15) since it has been found that there is a PBDE contamination around Nigerian dumpsites (Oloruntoba et al. 2019)[21] and also high releases of chlorinated OPFRs were recently detected in leachates from African landfills with associated risk for the surrounding[19,22].

Table A-15 POPs in the Nigerian transport sector present in the life cycle stages in 2020* (in tonnes).

(in tonnes)	POP imported* in vehicles (1980-2020)	POPs in vehicles currently in use in inventory year (2020)	POP in end-of-life vehicles (1980 to 2020)	POP in spare parts (2020)**	POP in dump sites and landfills (1980-2020)**
c-PentaBDE	51	**23.5**	**26.5**	*1*	*17*
decaBDE	1,484	**1,098**	**386**	*19*	*247*
HBCD	44	**33**	**11**	*0.6*	*7*
SCCP***	30	**30**	**-**	-	-
MCCP***	633	**633**	**-**	-	-

* POPs in the imported vehicles are also included in the inventory of "current transport" and "end of life"
**Please note: POPs in spare parts and the POPs in landfills are part of POPs in end-of-life 1980 to 2020
*** Since the lifetime of vehicles in Nigeria are 25-35 years, it is assumed that vehicles produced since 2000 where major use of SCCPs/MCCPs in PVC started are in current use and none in the EoL.

4.2.8 Total polymer in the transport sector

Transport is a major use of plastic and other polymers. While approximately 7% of all plastic is used in transport sector, the long service life result that the share of the transport of total plastic increase to 15%[23].

[20] Halogenated OPFRs are not POPs but different OPFs have certain toxic properties ()

[21] Oloruntoba K, Sindiku O, Osibanjo O, Balan S, Weber R (2019) Polybrominated diphenyl ethers (PBDEs) in chicken eggs and cow milk around municipal dumpsites in Abuja, Nigeria. Ecotoxicol. Environ. Saf. 179, 282-289

[22] PBDEs and OPFRs are also included in plastic in electronics and polymers in buildings and related waste and have therefore several sources in landfills.

[23] Wang, C., Liu, Y., Chen, W. Q., Zhu, B., Qu, S., & Xu, M. (2021). Critical review of global plastics stock and flow data. Journal of Industrial Ecology, 25(5), 1300-1317.

And the plastic use is increasing in transport: While cars produced in the 1970s contained approx. 50 kg plastic/polymers, this increased to 160 kg by 2008 and meanwhile average cars contain approx. 200 kg plastic/polymers including approx. 25 kg of synthetic textiles (Szeteiova 2008[24]; American Chemical Council 2016[25]). While the PBDE inventory guidance suggest an average plastic content of 200 kg for cars, for the Nigerian inventory only 150 kg since many vehicles older than 2010 are still in operation. For the (mini)busses 400 kg polymers are considered and for trucks 200 kg. Based on this impact factors and the total import of vehicles, a total of 3.7 million t of plastic and other polymers have been imported to Nigeria. From these 2.7 million t of plastic is in current transport sector while 1 million tonnes entered end-of-life.

4.2.9 Other chemicals of concern in the transport sector

In this first sectoral inventory of POPs in transport in Nigeria, other chemicals of concern present in vehicles were not assessed such as heavy metals (e.g. lead, mercury), ODS/GHGs (CFCs, HFCs), PFRs or phthalates (see Section 4.5 of sectoral inventory guidance). However contacts were made to the Minamata, Basel and Rotterdam focal points to inform on the sectoral POP inventory and on interest to cooperate to a larger sectoral inventory with CoC in other MEAs. In the Minamata initial assessment mercury in the transport sector were not addressed. Considering the relevant amount in vehicles produced before 2004 (UNEP 2019) it was concluded that in the next assessment, cars and other vehicles should be included in the mercury inventory.

Furthermore, it was concluded that also lead and selected other metals of concern in the transport sector should be assessed also considering the option of better resource recovery of metals.

Also, a contact to the Montreal Protocol team was established to see if an inventory of F-gas as ODS or GHG stocks in the transport sector (air conditioner; refrigerator trucks and lorries) have been developed. Since this was not the case, it was concluded that in the refining of the POPs inventory in the transport sector a cooperation with the Montreal Protocol team should develop an F-gas inventory in EEE/WEEE.

4.2.10 Assessment of POPs in other transport sectors in Nigeria (planes and trains)

Within the information gathering phase preliminary information on other transport sectors were compiled. Currently Nigeria **does not have an operating airline**: Air Nigeria stopped operation 2012 with 11 airplanes. The Nigerian Airways stopped operation 2003 and is currently planning a potential relaunch. Therefore, there are is not a large air plane fleet in Nigeria but flights are operated by international airlines. **The Nigerian Railway Corporation** possesses 480 passenger coaches and less than 50% of the coaches and are in serviceable conditions[26]. These couches likely contain flame retarded seats and might contain also POPs. Further inventory assessment is needed for the coaches not operational anymore and their end-of-life management.

[24] Szeteiova. (2008). Automotive materials plastics in automotive markets today,

[25] American Chemistry Council. 2016. Plastics and Polymer Composites in Light Vehicles.

[26] https://en.wikipedia.org/wiki/Nigerian_Railway_Corporation

4.3 Tier III: Material and substance flow analysis of POPs and POP-containing materials from transport sector

For compiling the data in a visualized form and to gain an overview on the life cycle of materials containing POPs in the transport sector, a material flow analysis (MFA) of these materials and a substance flow analysis (SFA) of the relevant POPs (PBDEs, SCCP/MCCP, HBCD, PFOA/PFOS/PFHxS) have been performed.

4.3.1 Material and substance flow analysis

MFA systematically shows the bulk material flows through society in a comprehensive way. The underlying principle of MFA is to account for all materials entering and leaving a system (e.g. country or company), based on a mass-balancing approach. The flow of materials/substance starts at a source (e.g. production or import) and ends at a sink (e.g. export or landfill).

SFA is a specific type of MFA used for tracing the flow of a selected chemical (or group of substances) through a defined system[27,28].

A key aim of material flow analysis is to visualise the complex material/substance flow of a selected system (in this case the flow of POP-PBDEs in transport in Nigeria) in a simplified but correct manner to e.g. serve as a tool/support for decision making in waste management.

In the current study the system boundary is the country of Nigeria. The goods included in this study are main vehicle categories (cars, busses, and trucks). The substances considered in the substance flow are the POPs considered. The system therefore comprises the materials in transport in Nigeria and focus on the listed POP in transport. The stocks and flows in the system include importation, use/reuse, end-of-life (recycling, thermal treatment, landfill/dump) and export.

4.3.2 Overview of flows and stocks of POPs in the transport sector Nigeria

The strength of the material/substance flow analysis is the visualization of complex material and substance flows. University Vienna provides a material flow software (STAN) as open source[29] which was already used for the first PBDE inventory in Nigeria[6]. However, for the current MFA/SFA it was decided to use a dynamic MFA/SFA to develop predictions of the POPs in vehicle flows in Nigeria for providing information also for the coming years on POPs in ELVs in Nigeria which can be used for planning of the management of ELVs and in particular the plastic/polymer fraction in ELVs.
In a dynamic material flow also the future flow of vehicles can be modelled based on the current vehicle fleet where the total amount of vehicles (for Nigeria 13,000,000 registered vehicles) and the age distribution is known. The average service life for new cars was assumed to be 35 years. The average age of newly registered/imported used cars was assumed to be 10 years. Therefore, the average service life of registered used cars was assumed to be 25 years from the time of registration. The stock and the amount of the investigated substances in end-of-life vehicles were determined by applying a Weibull lifetime-functions (form factor 5 for new cars, 3 for used cars) to the input of the according substance.

[27] Baccini P, Brunner PH (2012) Metabolism of the Anthroposphere: Analysis, evaluation, design. 2nd edition, MIT Press, Cambridge US.
[28] Brunner PH, Rechberger H (2003) Practical Handbook of Material Flow Analysis. Lewis Publishers.
[29] http://iwr.tuwien.ac.at/resources/downloads/stan.html

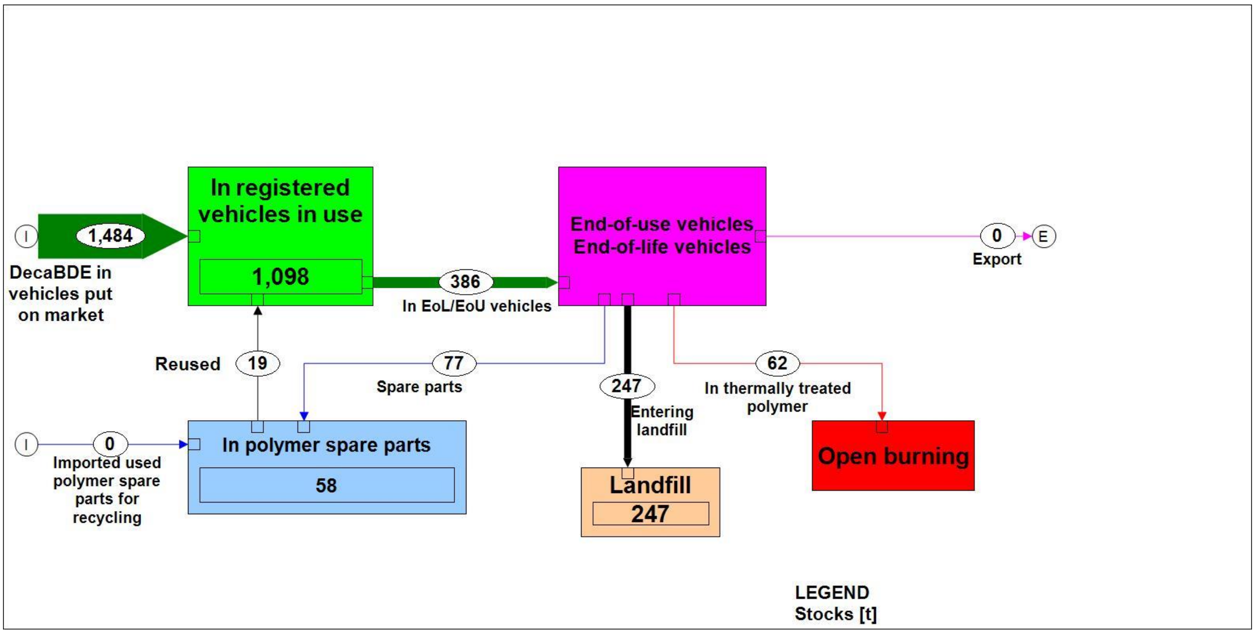

Figure A-2: Substance flow and stocks of DecaBDE in transport sector in Nigeria (1980-2020). The stocks are for the inventory year 2020. The flows are the total volume from 1980-2020.

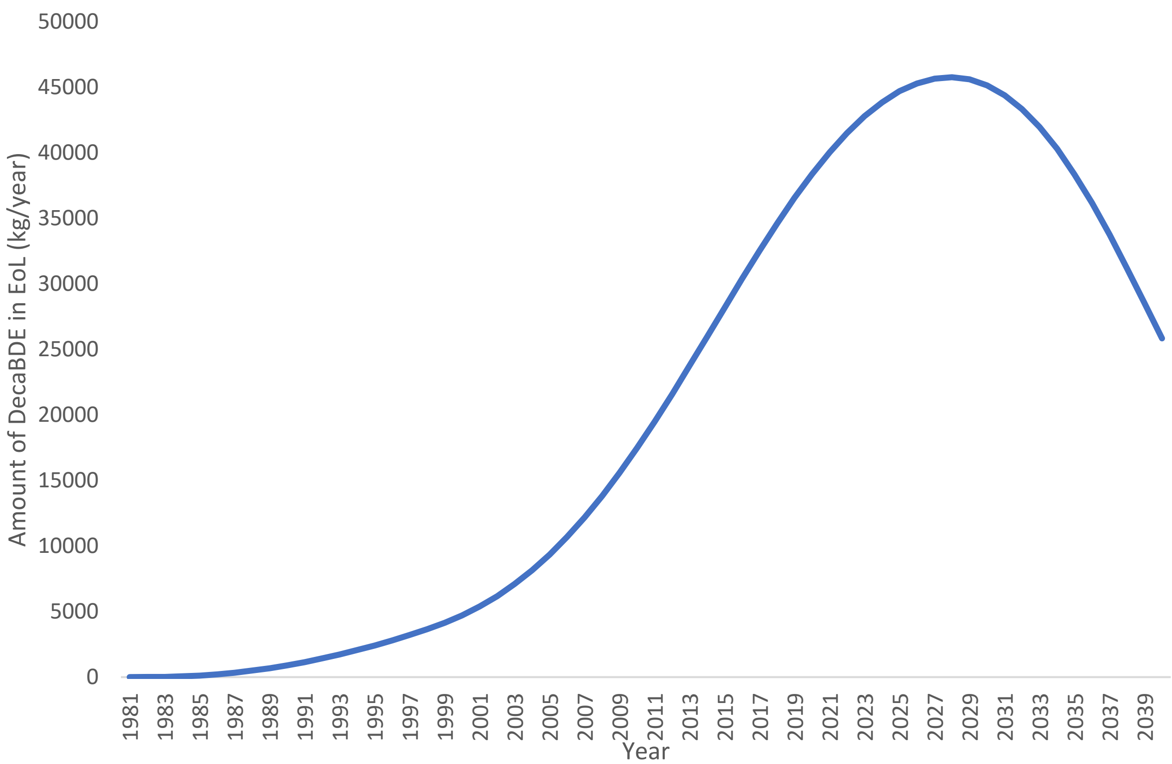

Figure A-3. Estimated amount of decaBDE in end-of-life vehicles in Nigeria for respective years (1981-2040) based on dynamic material and substance flow analysis of registered vehicles in Nigeria.

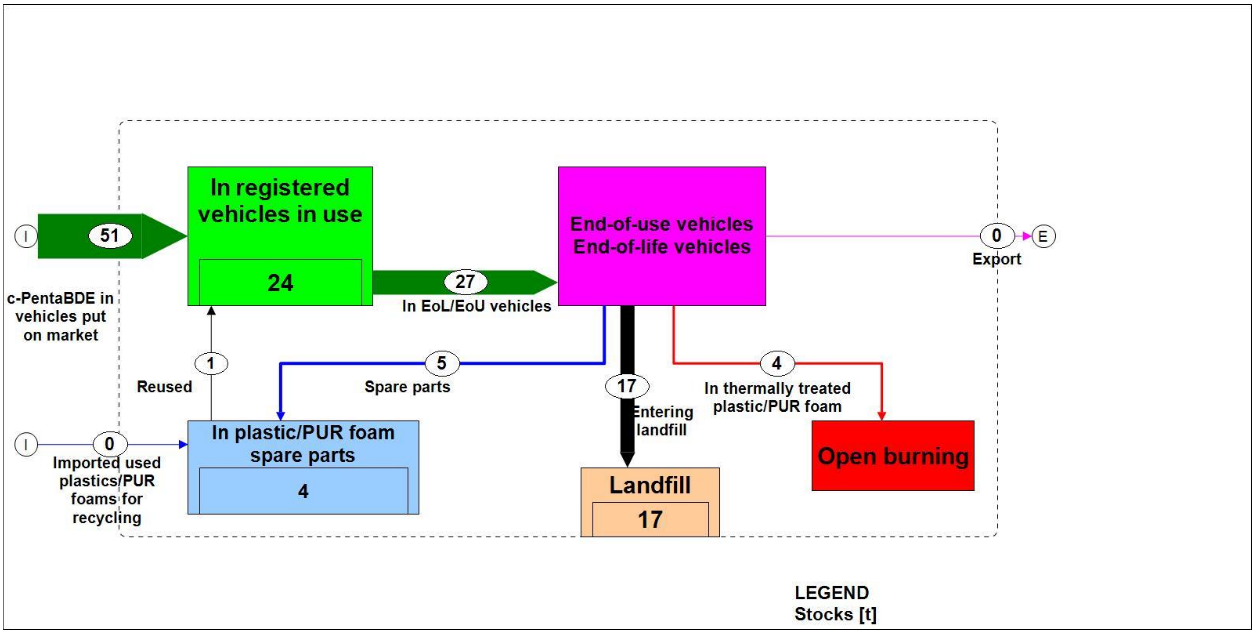

Figure A-4: Substance flow and stocks of c-PentaBDE (including tetraBDE, pentaBDE) in the transport sector in Nigeria (1980-2020). The stocks are for the inventory year 2020. The flows are the total volume from 1980-2020.

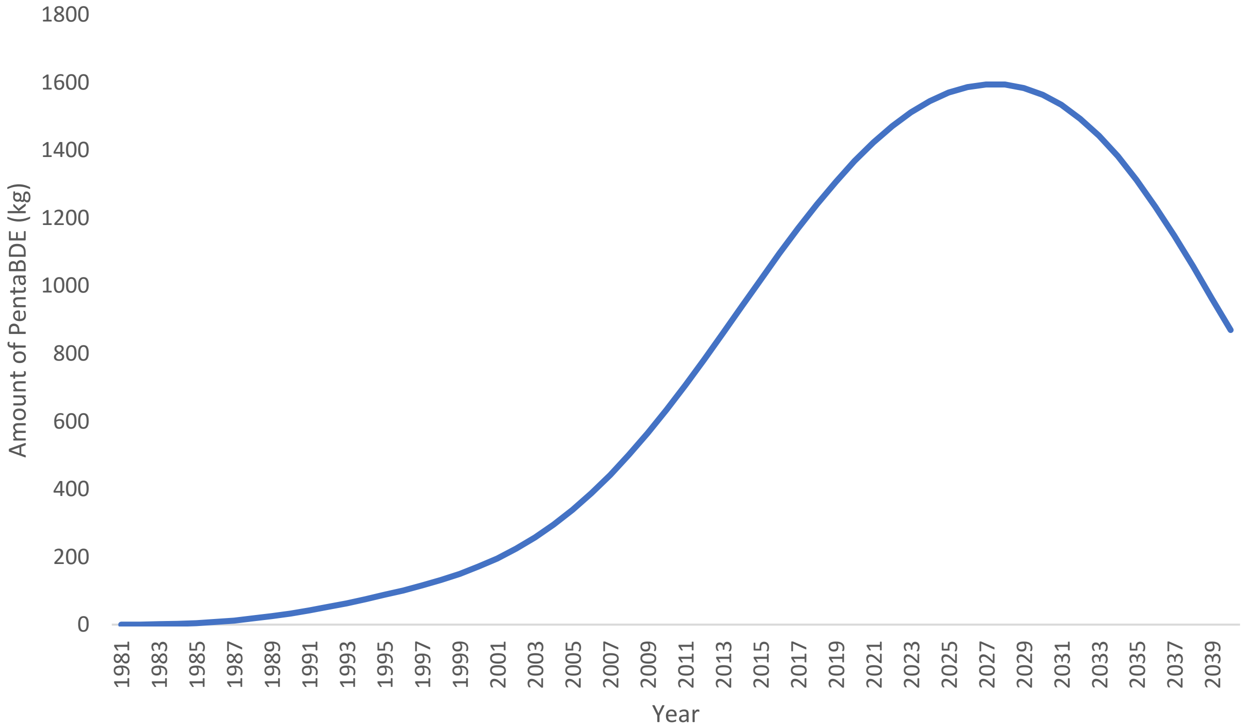

Figure A-5. Estimated amount of c-PentaBDE (tetraBDE/pentaBDE) in end-of-life vehicles in Nigeria for respective years (1981-2040) based on dynamic material and substance flow analysis of registered vehicles in Nigeria

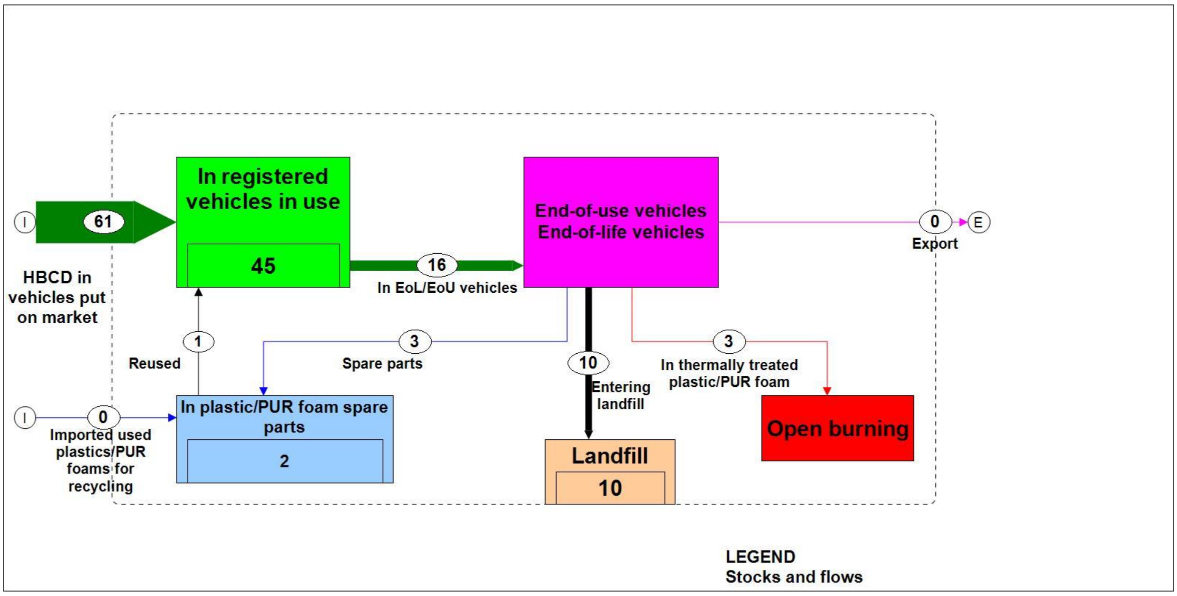

Figure A-6: Substance flow and stocks of HBCD in the transport sector in Nigeria (1980-2020). The stocks are for the inventory year 2020. The flows are the total volume from 1980-2020.

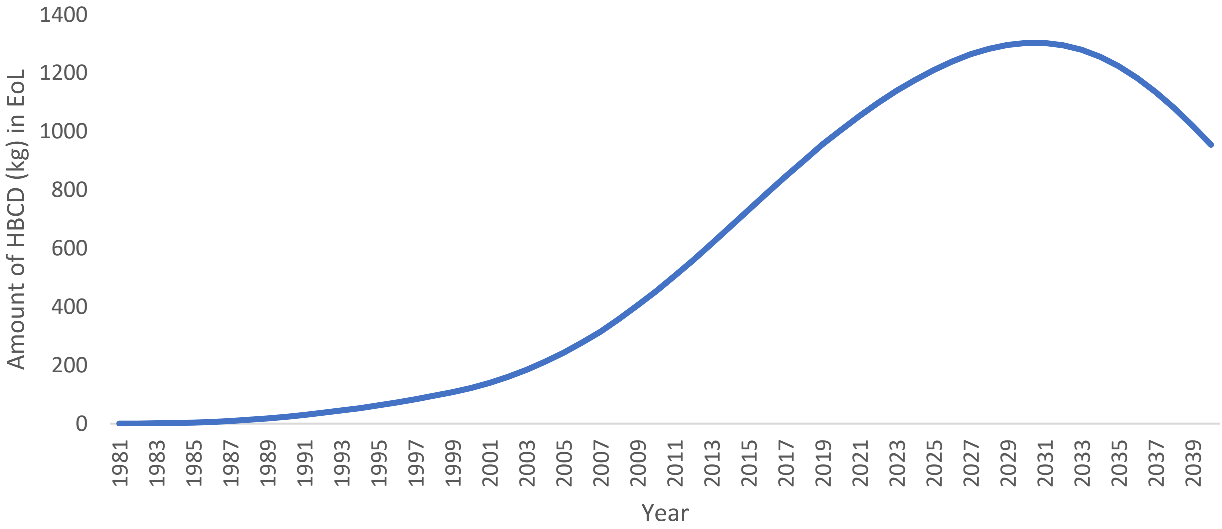

Figure A-7. Estimated amount of HBCD in end-of-life vehicles in Nigeria for respective years (1981-2040) based on dynamic material and substance flow analysis of registered vehicles in Nigeria

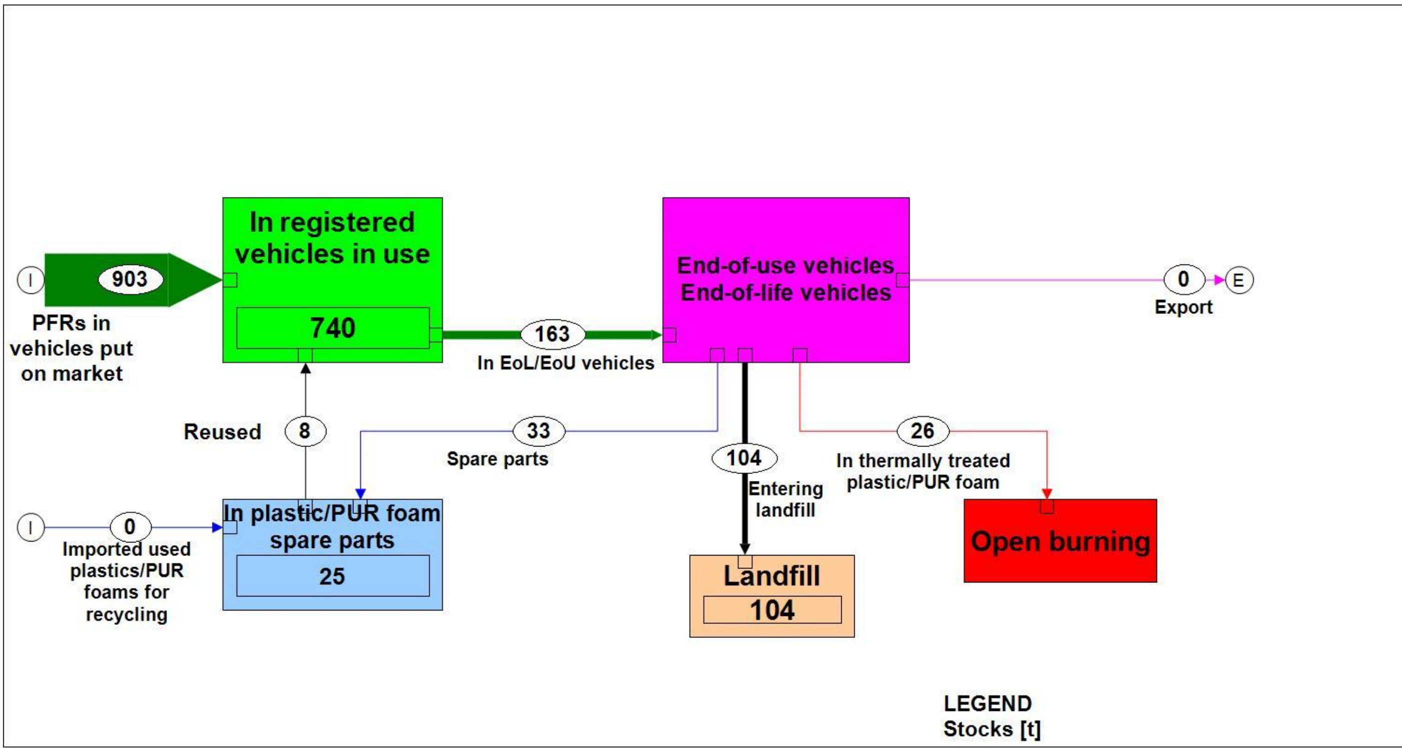

Figure A-8: Substance flow and stocks of OPFR in the transport sector in Nigeria (1980-2020). The stocks are for the inventory year 2020. The flows are the total volume from 1980-2020.

5 STEP 4: Managing and evaluating data

The current sectoral inventory of POPs in vehicles can be considered a preliminary inventory since it includes a range of uncertainties and assumptions (see below). The inventory considers the life cycle of the vehicles in Nigerian – import, current use/stock, end-of-life treatment and disposal.

5.1 Evaluation of data and further improvement of the data

In this inventory step the data are assessed for completeness and plausibility possibly including the comparison with data from other countries in the region (See Guidance on QA/QC[30]).

The information gathered was assessed by the transport expert and the director of the Basel Convention Regional Centre and approved for use in the preliminary inventory compilation (tier 2). Furthermore, the expert on Nigerian transport supplied data from his research results on Nigerian road safety.

Within the short time available for the current inventory this step has only be done to some extent.

Data gaps in this study have (partly) been filled by extrapolation of data. This was done e.g. for the import data from different world regions and for the amount of vehicles in end-of-life (see above).

5.2 Uncertainties and improvements for developing a more robust inventory

The current preliminary inventory contains a range of uncertainties and assumptions:

- In the current inventory ships, airplanes and trains were not included. However, the air fleet and trains in Nigeria is minor and therefore does not make a relevant contribution
- There is no official statistics of end-of-life vehicles. The amount of end-of-life vehicles in the current inventory was therefore estimated from the total amount of vehicles in use and an estimated life span of vehicles. The improvement of this situation will need to wait for the overall development of a vehicle de-registration system in Nigeria.
- A large uncertainty exists for the percent distribution of end-of-life treatments including the recycling rate based for this preliminary inventory on data for general waste. This will need further assessment efforts for an in-depth inventory considering that currently larger plans on polymer recycling exists in Nigeria.
- The distribution of originating regions of imported vehicles is currently based on data from Lagos vehicle statistics (covering more than 50% of total import) and is extrapolated to the other regions of the country.
- The POP impact factors are based on a few measurements and might be refined in future. Also, many of the data are from Japan and Europe. Impact factors from China or Korea Therefore an in-depth inventory could be improved by screening and analysis of POP-PBDEs in vehicles.

5.3 Managing the data

The gathered general inventory data for Nigeria's transport sector have been compiled

- vehicles in the different life cycle stages
- materials in the transport sector potentially contaminated by POP-PBDE (volume of PUR foam[31]).
- POP in the

and have been compiled as a material/substance flow with predictions of POPs in end-of-life vehicles until 2040. As can be seen by Figures A- the POP release in the transport sector will continue beyond 2040.

[30] UNEP (2023) Short Guidance on implementing Quality Assurance and Quality Control (QA/QC) for POPs Inventories Data Validation.

[31] In addition back-coated textile in the transport sector has been treated to some extent with POP-PBDE and other flame retardants. No monitoring study have been published on the extent.

Since the data are valuable for the (waste) management of end-of-life vehicles (and prediction of end-of-life vehicles) the data will also be made available to departments responsible for waste and resource management in Nigeria (Ministry of Environment and other responsible ministries). The data will then be fed into and further managed within a database of the governmental body responsible for waste and resource management.

5.4 Data gaps and need for improvements (preliminary action plan consideration)

This substance flow analysis of POP-PBDE in the transport sector describes the flow from import, use/stocks until the end-of-life including the recycling stage. There are currently considerable uncertainties in respect to the volumes of recycled polymers and to which products these polymers are recycled. Further due to the plan of the government to increase the recycling of polymers this issue needs to be better assessed and should become a priority within the action plan of NIP. Within this assessment the options and limitations of POP-PBDEs separation and management will be assessed.

Currently no assessment of the flows/releases of POP-PBDEs into the environment and towards human exposure in the different life cycle stages have been performed. This is a future task and might also be included in the action plan.

A detailed assessment of the different end-of-life and recycling options need to be carried out focusing on best practice approaches which can be implemented in Nigeria in future.

6 STEP 5: Inventory report

The current case study of the transport sector has been established for this sectoral guidance. The data can be included in the inventory reports for the individual POPs for the update of the Nigerian NIP.