KINGDOM OF CAMBODIA

NATION RELIGION KING

POPs Inventory Report 2020 in Cambodia

Hazardous Substance Management Office

Department of Hazardous Substance Management

General Directorate of Environmental Protection

Ministry of Environment

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Abbreviation Definition

◦C	Degree Celsius
APCS	Air pollution control system
CDC	Council Development for Cambodia
CMDGs	Cambodia millennium development goals
COMPED	Cambodian Education and Waste Management Organization
Dept.	Department
EDC	Eletricité du Cambodge
GWh	Giga watt per hour
MOC	Kingdom of Cambodia
l/year	liter/year
LAB	Laboratory
LOR	Lubricant oil residue
LPG	Liquefied petroleum gas
MAFF	Ministry of Agriculture, Forestry and Fishery
MIH	Ministry of Industry and Handicraft
MOE	Ministry of Environment
MOH	Ministry of Health
MOI	Ministry of Interior
MOP	Ministry of Planning
MOPWT	Ministry of Public Works and Transport
MWRAM	Ministry of Water Resources and Meteorology
MW/day	Megawatt/day
NA	Not available
ND	Not detected
NGGS	National Green Growth Secretariat
NGOs	Non-governmental organizations
NIS	National Institute of Statistics
NP-SNDD	National Programme for Sub-National Democratic Development
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzo-p-dioxins
PCDF	Polychlorinated dibenzofurans
POPs	Persistent Organic Pollutants
PPCH	Phnom Penh City Hall
Phnom Penh	Phnom Penh Municipality
Prov. Dept. of PWT	Provincial Department of Public Works and Transport
PVC	Polyvinyl Chloride
Ref. to	Refer to
RGC	Royal Government of Cambodia
SCARO	Sanitation Community and Recycling Organization
ST	Survey Team
t/a	ton per year
TEQ/a	Toxic equivalent *per* year
TV	Television
UNEP	United Nations for Environment Programme

This POPs update Inventory Report was prepared as part of the GEF/UNEP project Integrated SC toolkit to improve the transmission of information under Articles 07 and 15 in the Kingdom of Cambodia, Ministry of Environment. The project was financed by the Global Environmental Facility (GEF) with in-kind contributions from the Royal Government of Cambodia for conducting national activities e.g. POPs data collection etc.

This report was prepared based on the NIPs and National Reports of the Kingdom of Cambodia submitted to the Stockholm Convention which it was conducted on Persistent Organic Pollutants (POPs) inventory report from different sectors and undertaken by officers of Ministry of Agriculture, Forestry and Fishery; Ministry of Mines and Energy, Ministry of Industry Science Technology and Innovation, and Ministry of Public Works and Transport, and Ministry of Environment. The gap analysis was developed under the supervision provided by the NIP Updating Project's Coordination Unit. The report written by the technical team was training by UNEP and reviewed and commented by National Coordination Committee (NCC), Project Coordination Unit and UNEP through Ms. Mihaela Claudia Paun, international consultant.

This POPs update inventory report supports the testing of the SC integrated electronic toolkit (under development) and as well could contribute to the updating the NIP for the Stockholm Convention, highlighting the remaining legal, technical, economical and institutional challenges to achieve reduction and where possible the elimination of 12 initial POPs and 16 new listed POPs.

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I. BACKGROUND INFORMATION

In Cambodia and other developing countries, chemicals (including POP substances or products) play vital roles in socio-economic development (especially, in the agricultural, industrial and health sectors) and serve human daily living. Therefore, it has led to significant enlarges in production of chemicals used in main sectors and to growing numbers of industrial facilities which require chemicals and POP substances as raw materials. Chemicals can originally provide serious negative impacts to users, communities and the environment while its consumption and management is environmental unfriendly, unless the use and management of chemicals and POP containing in articles, including its waste disposal are operated on the right way.

The management of chemicals, waste and POPs containing in articles commonly is a global, regional and national issue requiring participations from all concerned parties in the sound management at all levels. The north-south and south-south cooperation should be improved and strengthened, otherwise, we will face many challenges on the way to achieve the goal No.7 of CMDG to minimize the negative impacts on the environment and human health, especially, women, children and old people whose spent more times with chemicals and/or whose live closed to chemicals operational areas.

Relevant data/information of importation and consumption of chemicals and POP containing in articles by sectors is still limited – that is a main challenge in doing a comprehensive assessment towards the consumption of chemicals, POP containing in articles and their wastes‟ release or disposal by sectors into the environment including its potential risks and hazards. The Chemical National Profile (2004) and the Situation Report on National Chemicals Management in Cambodia (2009) indicated clearly about the challenges of insufficient specific legislation, low awareness and implementing capacity to cope with the sound management of chemicals, POP related products and its wastes.

Cambodia ratified to become a Party to the Stockholm Convention (SC) on 25th of August 2006, and commits to fulfilling its obligations under this treaty by taking various measures in order to meet objectives of the Convention.

The Article 7 of the Convention requires Parties to update their National Implementation Plans (NIPs) to address old and new POPs as they are listed to the Convention annexes. While, Article 15 requires Parties to provide regular updates on progress in implementation of the SC through submission of National Reports every four years.

Inventory Approached

The compilation of an Updated National Inventory of POPs is a difficult task in the Cambodia. In view of the uncertainties generated by the different factors and in view of the need to complement the quantitative data with qualitative information, a conceptual approach was chosen for the compilation of the inventory based on three data collection methods:

- On site investigation of POPs management and management of other chemicals with interviewing the relevant persons and the members of the NCC which it established for chemical management (NCC-Steering Committee on Technical Working Group)
- Conduct training and seminars in POPs Inventory with representatives of the UNEP's.

- Collection of information by field survey.

This approach has allowed for the identification of some contamination sources not shown by the statistical and monitoring data. In addition, the significance of the human factor, that of the institutional capacities and that of the subjective of assessment, was revealed in POPs management.

In addressing the factual material, two national data sources were combined with local ones, such as: extracts form statistical materials, national reports, data of ministries, departments and agencies, along with local or 10 individual data in respect to an enterprise, entity for waste disposal or rural community.

The approaches used for data gathering:

While assessing the available methodologies of the necessary data gathering the following approaches were used:

- Collection of information and data on production of POPs
- Collection of information and data on import/export of POPs
- Collection of information and data on use of POPs
- Collection of information and data on wastes and contaminated sites

II. POPS DATA COLLECTION FINDINGS

A. Institutional, policy, and regulatory framework

a. The POPs in the International Context

Since Cambodia signed the Stockholm Convention in May 2001, Cambodia achieved several major outcomes, e.g. POPs inventory reports, NIP for the Stockholm Convention on POPs, National Profile on Chemicals Management in Cambodia, some POP related capacity building and awareness raising at both national and sub-national levels. Besides being a Party of the Stockholm Convention, Cambodia is also a Party of the Basel Convention, Montreal Protocol, Vienna Convention, Rotterdam Convention, etc., in according with the opened policy of the Royal Government of Cambodia (RGC) to integrate Cambodia into international communities (ref. to the 4nd Phase Rectangular Strategy of the Royal Government of Cambodia). It is clearly indicated in the chemicals management framework, Cambodia stands on the cooperation principle with countries in the region and the globe in order to mitigate and phase out negative effects to human health and the environment at national, regional and global scale.

As a Party to the Stockholm Convention on POPs, Cambodia took action to:

(i) develop list of pesticides banned for use in the Kingdom of Cambodia (KoC) to ban POP pesticides and other hazardous pesticides for importing, trading and using in Cambodia, including lists of pesticides restricted for use and list of pesticides permitted for registration in the KoC; and

(ii) (ii) develop and adopt the Sub-decree on Classification and Labeling of Chemicals recently.

Pertaining to above efforts, Cambodia faces many challenges under the legal and institutional framework, which is required to be improved in order to accomplish duties and/or obligations of the Convention signatory.

Furthermore, the management of former POPs and the new POPs – all are related to chemicals of which the RGC pays more attentions to carry out and accomplish the Johannesburg implementation plan by 2020, "Chemicals will be produced and used in ways that minimize significant adverse impacts on the environment and human health". Significantly, in according with the necessary requirement of capacity development, technological transfer and other supports, Cambodia still requires assistance from other donors, international organizations/communities in order to achieve the effective POP management in Cambodia, as well as to fully implement POP regional/global actions and programme.

b. The POPS in the national context

Cambodia has been taken action to deal with POP since 2001 after becoming a Party to the Stockholm Convention. The inventory on POP generating sources and its release, awareness raising and capacity building to stakeholders at national and sub-national levels were done afterward under the support of the Secretariat of Stockholm Convention. One of the core outcome is the first POP National Implementation Plan (NIP). It was formally submitted to the Stockholm Convention Secretariat in May 2007. The NIP addresses several key strategies to strengthen and improve the implementation of NIP including financial mechanism; and the implementation of the Stockholm Convention towards POPs identification, assessment, mitigation and its research. Significantly, the setting up of NIP also points out the need to either amend existing legal instruments or develop new ones if needed. Following that is the description of existing and pending legal instruments in relation to POPs management in Cambodia.

Table 1: Legislation linked to POPs Management in Cambodia

No.	Legislation's Title	Year of Approval	Responsible Institution	Direct/Indirect Involvement
Constitution				
1	The Constitution of the Kingdom of Cambodia	1993	All	It is indirect linked to POP and chemical management, but it aims to protect and conserve the environment and natural resources as a whole.
Relevant Laws				
2	The Law on Environmental Protection and Management	1996	MOE	A part of the Law aims to protect and maintain the environmental quality from any kind of pollution. It is indirectly impacting to POP and chemicals management, including its wastes.
3	Law on the Management of Quality and Safety	2000	MOC	Although the Law is not specifically addressing POPs products management, but it has

	of Products and Service			enough authority to control Quality and Safety of Products and Services in according with the existing national and international legislation.
4	The Law on Administration of Factory and Handicraft	2006	MIME	Some articles of the Law are directly linked to the management of POP products, although these are not specifically stipulated, such as POP products.
5	The Law on Water Resources Management in the Kingdom of Cambodia	2007	MoWRAM	Article 22 of the Law may indirectly impact on POP and chemicals management, including its wastes.
6	Law on Land Traffics	2007	PPWT	It may be indirectly linked to the transportation of POP products and related residues, as stipulated in Article 53.
7	The Law on The Management of Pesticides and Fertilizers	2012	MAFF	The Law is considered to directly impact on the management of POP pesticides and relevant chemicals, but its specific stipulation has not been highlighted.
Relevant Sub-Decrees				
8	Sub-Decree on Standards and Management of Agricultural Materials	1998	MAFF	Sub-Decree may be directly linked to management of POP pesticides, within which POPs pesticides have been banned.
9	Sub-Decree on Water Pollution Control	1999	MOE	The Sub-Decree may be directly linked to the environmental sound management of chemical wastes including POP wastes, as mentioned in its annexes.
10	Sub-Decree on Solid Waste Management	1999	MOE	The Sub-Decree may be directly linked to the environmental sound management of industrial and hazardous wastes including

				POP wastes, as mentioned in its annexes.
11	Sub-Decree on EIA Process	1999	MoE	The Sub-Decree may be indirectly linked to management of POPs chemicals and related residues due to its objectives aiming at protecting and conserving the environment and natural resources.
12	Sub-Decree on Industrial Standards of Cambodia	2001	MIME	As per stipulated by some articles, the Sub-Decree is indirectly linked in the management of POP containing products or substances.
13	Sub-Decree on the Implementation of the Amendment to the Law on Investment of the Kingdom of	2005	CDC	The Sub-Decree is evaluated to be indirectly linked to the management of POP containing products or POP containing articles.
14	Sub-Decree on the Establishment and Management of the Special Economic Zone	2005	CDC	It is indirectly linked to management of POP containing products or POP containing articles within various activities of trade and other developments.
15	Sub-decree 21 on the Facilitation of Trade Through Risk Management	2006	MoC	The Sub-Decree may indirectly linked to the control of POPs containing products, through control the import-export of chemicals, chemical substances at check-points.
16	Sub-Decree on Classification and Labelling Chemicals	2009	MoE and relevant ministries	The Sub-Decree commonly addresses the management of chemicals, hazardous substances including their wastes. It is recognized to directly impacting on POPs management.
17	Sub-Decree on E-waste Management	2013	MoE	It is considered directly linked to the management POP related wastes.

Relevant Regulations				
17	Guideline on Urging the Carrying out of Sub-Decree on Solid Waste	1999	MoE	It may be directly linked to the management of POP wastes through industrial and hazardous waste management.
18	Prakas on Industrial Waste Collection and Transportation in Phnom Penh	2002	MoE	It does not specify the POP waste, but its objective aim at managing industrial and hazardous waste as a whole.
19	Prakas on List of Pesticides in the Kingdom of Cambodia	2012	MAFF	It commonly involves the management of POP pesticides, these being banned nationally by this act.
20	Announcement on the Halting of Industrial Waste Selling, Providing and Burning	2003	MoE	It has not specification on POP wastes, but its objective aims at managing industrial and hazardous waste as a whole.
21	Prakas on Solid Waste Management in Factories,	2003	MoE	– Ditto –
22	The Joint Declaration Ministry of Interior and Ministry of Environment on "Solid Wastes and	2003	MoI and MoE	The management of POP wastes it is not clearly mentioned.
23	Prakas on Waste Management from Healthcare Services in the Kingdom of	2008	MoH & MoE	It is indirectly linked to POP wastes management, which might be generated by health sector.
24	Prakas on Procedure and Requirement for	2012	MAFF	It is not clearly linked to the management of POP.

25	Prakas on List of Pesticides in the Kingdom of Cambodia	2012	MAFF	It is directly linked to the management of POPs.
26	Prakas on Procedure of Management of Pesticides in Trade	2013	MAFF	-Ditto-
27	Joint Prakas on Guidance on safety of usage pesticide and fertilizer and waste management	2019	MAFF & MOE	The Joint Prakas may be directly linked to the environmental sound management of pesticide and fertilizer packaging wastes.
Relevant Draft Law/Sub-Decree				
28	Draft of Environmental code	Being submitted to the Council Ministers for approval	MOE	The code is linked to POPs management issue.
30	Draft Law on Chemicals Management	Under the drafting process in discussing with line ministries	MoISTI and relevant key ministries	The Law is considered to directly impacting to the management of POP products and relevant chemicals, including their wastes.
31	Draft of Sub-Decree on hazardous waste management	Under the drafting process in Ministry.	MOE	The Law is considered to be directly linked to the management of POP related wastes.
32	Sub-Decree on Water Pollution Control	Under the drafting process in Ministry.	MOE	The Sub-Decree may be directly linked to the environmental sound management of chemical wastes including POP wastes, as mentioned in its annexes.

33	Sub-Decree on Solid Waste Management	Under the drafting process in Ministry.	MOE	The Sub-Decree may be directly linked to the environmental sound management of industrial and hazardous wastes including POP wastes, as mentioned in its annexes.
34	Draft Sub-Decree on EIA Process	Under the drafting process in Ministry.	MoE	The Sub-Decree may be indirectly linked in managing POP chemicals and related residues due to its objectives aiming at protecting and conserving the environment and natural resources.

c. POPs management policy

As a Party of the Stockholm Convention, Cambodia is committed in managing POPs including to share information and exchange experience with the Secretariat and other Parties to the Convention. Approval of the POP National Implementation Plan (NIP) for Cambodia in June 2006 it is clearly indicating the profound efforts, willingness and supports of the Royal Government of Cambodia including line-ministries to implement the Convention.

POPs management in Cambodia is commonly a cross-sectoral issue requiring a close cooperation among government institutions and private sector and civil society, international organizations and/or communities. POPs management it is recognized as a complex issue due to the several shortcomings like lack of human expertise, lack of data/information and operational budget, lack of mainstreaming POPs into national sectoral development plans, lack of gender participation, etc..

A particular POPs management legislation does not exist, but several pieces of existing legislation and regulations in relation to chemical management are being operated by sectors in the country in different ways. Limited chemicals management related legislation was developed, and it is implemented widely throughout the country, especially the Law on The Management of Pesticides and Fertilizers, adopted by the National Assembly in 2012. These may contribute to halt the use of POPs including its waste management to comply with the Convention.

In the context of proper chemical wastes management including POPs residues, Cambodia has not had the environmental sound friendly disposal site yet and/or treatment process. Chemical wastes have not yet been identified as to be sent to a safety disposal site, except, of some industrial hazardous wastes whose management is stipulated in the legislation to be disposed at a suitable dumpsite identified by MoE. It is suggested to take action on the environmentally sound management of chemicals over its lifecycle including chemical wastes and POPs residues.

On the other hand, data and information related to the utilization and disposal of POPs and its residues is still insufficient to be used as a fundament of the country comprehensive assessment. In short, POPs related data/information is fragmented in various institutions/agencies – that is difficult for the users (e.g. planner, developer, surveyor, academic sector, decision maker etc).

Lacking of expertise and capacity to cope with POPs and related residues management is also recognized a key challenge in addition to above key constraints. Therefore the national chemicals and/or POPs management policy should be developed with a clear statement focusing on sustainable development to meet the Government green development agenda and strategies, in line with the Johannesburg implementation plan by 2020 of which “Chemicals will be produced and used in ways that minimize significant adverse impacts on the environment and human health”.

B. Assessment of the POPs issue in the country

In this assessment of the POPs issue in Cambodia, 9 of POPs substances/groups were considered as follows below:

Chapter 1: Assessment of POPs Pesticides

1. Introduction

As shown in Chapter 1, it is known that Cambodia is an agrarian country of which about 4million ha is covered by crops. The tropical monsoon climate of Cambodia, which is divided into two main seasons (dry and rainy) provide the country with relatively hot and humid agro-ecosystem. This condition is suitable for growing crops as well as for agricultural pests (eg. insect pests, diseases, and weeds). The damage from pests to rice and especially vegetable production is the main constraint for Cambodian farmers.

Figure 1: Task Team taking interview of farmers using pesticide at Kien Svay Village

To increase crop production yields, agricultural inputs including pesticides are regularly used by farmers and the owners of agricultural farmsteads. From year to year the demand for the use of pesticides increases dramatically. However, there is no report on sale and use of POPs Pesticides at all, according to the report of the teams on POPs pesticides inventory.

2. Production

Cambodia is currently an agricultural and not a chemical producing industrial country. That is why there is no local production and formulation of pesticides, including POPs pesticides.

3. Import

All pesticides which have been/are sold and used in Cambodia are imported from overseas, especially from China and neighboring countries such as Vietnam and Thailand.

In the inventory of POPs Pesticides in 2020 identified that the statistical data of pesticides imported into Cambodia is being fully recorded by Department of Agricultural Legislation (DAL), just after adopting the Law on the Management of Pesticides and Fertilizers in January 2012. It is noted, however, that pesticides imported increased in volume and in types from year to year, especially from 2011 until 2020, as shown below in Table 2.

*Table 2: **Pesticides imported into Cambodia (2007-2020)***

Year	No. Importing Companies	No of Pesticides trade names	Amt		
			Tonnes	***Litters (tonnes)***	***Total (T)***
2007	3	unknown	*174.00*	*Unknown*	***174.00***
2008	3	unknown	*328.00*	*Unknown*	***328.00***
2009	5	unknown	*793.00*	*Unknown*	***793.00***
2010	7	unknown	*2,365.00*	*Unknown*	***2,365.00***
2011	20	412	*18,775.00*	*Unknown*	***18,775.00***
2012	20	461	*10,503.00*	*Unknown*	***1,0503.00***
2013	27	552	*15,000.00*	*Unknown*	***15,000.00***
2014	30	602	*12,411.98*	*Unknown*	***12,411.98***
2015	33	656	*14,623.09*	*Unknown*	***14,623.09***
2016	55	827	*32,809.00*	*1,637.80**	***3,4443.80***
2017	85	1098	*51,833.00*	*1,300.00**	***53,133.00***
2018	87	2440	*61,500.00*	*1,465.15**	***62,965.15***
2019	92	2679	*77,117.00*	*2,291.70**	***79,408.70***
2020	110	2519	*NA*	*NA*	***103,005.86***
Grand Total			***298,232.07*****	***6,694,651*****	***407,929.58***

Source: Reports of Department of Agricultural Legislation (DAL), MAFF (* One metric tons of water converted into liter of water equals = 1,000.00L)

Cambodia imported in 1,509,781 tonnes of fertilizers and pesticides with 103,005.86 tonnes in 2020, with an annual increase of 13% between 2019 and 2020, according to a report of the Ministry of Agriculture, Forestry and Fisheries. However, the potential demand for fertilizer for agricultural crops does not seem to attract investments in fertilizer production for domestic supply, mentioning some challenges such as high cost of electricity and lack of some main raw materials for producing fertilizer which needs to be imported.

4. Export (previous, current, future)

As Cambodia does not produce any chemicals, there is no evidence of any legal export activities with regards to any kind of pesticides, including POPs pesticides.

5. Use (previous, current, future)

The robust growth in agricultural sector can be attributed to several factors, including but not limited to, the increased capacity and knowledge, introduced modern agricultural techniques, and agrochemical application supported or driven by mandated government agencies, NGOs, the

private sector and donors. Fertilizers and pesticides have become important agricultural inputs, which are believed to have led to sustained crop yields and avoidance of crop losses due to pests and diseases. In Cambodia pesticides are used to fight weeds, insects, diseases and rodents, of which insects and rats are common pest problem, especially in paddy fields.

During the period of 2007 to 2019, an amount of **407,929.59T** of pesticides (298,232.07 tonnes and 6,694,651liters=6,694.65tonnes) have been imported for use by private companies. This figure is far below actual amounts used. According to various estimates about 65-80% of the total pesticide amount entering the country are smuggled across the borders with Vietnam and Thailand (DAL/MAFF). Nevertheless, the use of pesticides is rapidly increased with the importing in number and volume as shown in Table 2.

The amount of pesticides used varies depending on season and type of crops and users financial potential. Based on the study by Cambodian Centre for Study and Development of Agriculture (CEDAC, 2007), the amount of pesticides used is greater on vegetables in rate 50 L/ ha/ year and 19 l/ ha/ year for mungbean. Pesticides are used in small volumes for rice crop: For wet-season rice dose rate is 0.8 l/ ha/year and 1.2 l/ ha/ year for dry season for rice. In another case study, the amount of pesticides used is reflected in Table 3 (Toshiharu Tanaka, 2016):

Table 3: Number of pesticide applications in each study area

Pesticide Category	**Takeo (34)**		**Prey Veng (33)**		**Siem Reap (62)**	
	Applications per study area (total)	Applications per field (mean)a	Applications per study area (total)	Applications per field (mean)a	Applications per study area (total)	Applications per field (mean)a
Herbicide	34	1.00a	17	0.52b	82	1.32
Insecticide	186	5.47a	173	5.24a	32	0.52b
Fungicide	55	1.62a	56	1.70a	2	0.03b
Growth activator	182	5.35a	176	5.24a	6	0.10b
Total	**457**	**13.44a**	**422**	**12.79**	**122**	**1.97**

Source: Number within parentheses represent the number of rice fields in each study area (3 regions)

(a) Values in the same row appended with the same letter are not significantly different according to the Kruskal-Wallis (Steel-Dwass) Test (P<0.05)

Cambodia has become self-sufficient in rice and has even become a net exporter of rice in recent years. In 2010, the Government of Cambodia put into force a policy on" the Promotion of Paddy Production and Rice Export". In order to achieve this policy goal and direction the "Enhancement of the Productivity", especially "Rice Intensification" and "Diversification" are the key successful approaches to be taken into account and these will be focused on the increase of effective supporting services and other necessary interventions to increase rice production. The Royal Government of Cambodia defined year 2015 as basis target year to achieve paddy surplus of more than 4 million tonnes and to achieve official rice export of at least 1 million tonnes. In this connection, pesticide demand is bigger and bigger from year to year.

Regarding POPs pesticides, the inventory results of the current survey conducted from April 2020 until February, 2021 showed that there is no indication of any kind of POPs Pesticides including old and new POPs being used because those pesticides have been banned for use since 2003 in Cambodia.

Chapter 2: Assessment of polychlorinated biphenyls (PCBs)

1 Introduction

The 2014 inventory was conducted to find out the old type of transformers installed at system medium voltage of 15kV network grid as currently they have been totally replaced from new 22kV network grid, since 2005. To date, there is no single PCB transformer available on public network grid, as reported by EDC. EDC also mentioned that about 30% of old transformers (used to install at 15kV network grid) were sold out for cost recovery.

The new transformers for 22kVnetwork grid that have been imported and installed on public network grid were gone through conformation without PCB dielectric fluid: (1.) by imported company with supporting documents (including SDS) and conformation certificate by origins, and (2.) proven certificates issued by the Ministry of Environment after laboratory analysis and results confirmed that such dielectric fluid are PCB free or less than 50ppm.

For private network investments, there is difficult to obtain information on number of transformers or its dielectric fluid because those private companies are under jurisdiction of NEAC. NEAC is generally given mandate to licensing for private electricity supply investment and deny controlling the 300 private companies which got licenses. Nevertheless, it was reported there is about 10 transformers per each private company installed on their network grids, but no confirmation of the actual number of transformers being installed or PCB free dielectric fluid being used.

2 Production

2.1. PCB Inventory findings in 2004

In 2004, the preliminary inventory team of the Ministry of Industry, Mines and Energy (MIME) had undertaken survey on all transformers operating in 17 provinces and municipalities in Cambodia. Based on this survey, it was projected that there are about 1600 transformers available in Cambodia, out of which 1343 transformers were recorded. Among the recorded transformers, there are only 988 units that have been inspected and recorded by the task team to identify the presence of PCB concentration in dielectric fluid.

The 2004 inventory shows that about 34% of total transformers are PCB-free, about 57% are PCB assumed, and the remaining 9% are in the PCB-contaminated category, throughout Cambodia. Among these figures, there are about 41% of pure PCB transformers being used in Phnom Penh, while the remaining 59% are being used in 16 provinces and municipalities. In Phnom Penh, there are only 15 pure PCB transformers currently being used at the distribution network, while most of PCB contaminated equipment remains mostly at warehouses (30 units).

The 2004 inventory also found that some new transformers contaminated with PCB substances even they were produced after 1983 and used cooling system as “ONAN” which was stated as non-PCB fluid (proved by test kits analysis). This finding is observed at Koh Kong province where transformers were ordered by private company. So, it is strongly recommended to check for PCB for all transformers throughout the country and then attached new label concerning PCB contamination status on each transformer. In addition, the control of importing transformers and electrical units should be considered.

2.2. PCB Inventory in 2014

According to the EDC commitment, it was understood that EDC has been successfully replacing new type of transformer with 22kV (without PCB dielectric fluid) and remove all legacy transformers (15KV) from public network grid since 2005. To date, old transformers with capacity of 15KV have been removed from services, some was sold out for cost recovery and some keep at warehouses. Currently, there are 3908 transformers are imported and most of them are put on network grids and those transformers are totally non PCB dielectric fluid. There are two confirmations of those transformers are non-PCB dielectric fluid: 1) by the imported company and 2) by the MOE laboratory analysis. In this regard, the imported companies (transformers suppliers) have to ensure that their supplied transformers are non PCB dielectric fluid by providing supporting documents (including SDS) and confirmation certificate by the origins. Fault to do so, such company will not allow to bidding/auction for supplying transformers.

The when the transformers are imported to country, their dielectric fluid is collected and sends to laboratory of the Ministry of Environment to analyze for PCB. If the analysis certificates issued by the Ministry of Environment confirmed that such dielectric fluid are PCB free or less than 50ppm, then such transformers are allowed to be put on service/network. However, if analysis confirmed that the dielectric fluid contains PCB, then the company must be ship out such dielectric fluid and supply the new one that has no PCB content.

Since such practice took place, it is noticed that to date, there is no any transformer being used at system medium voltage of 22 KV imported and put on service with PCB dielectric fluid. ***Therefore, Cambodia would like to declare that, PCB transformers have been phase out from Cambodia public network grids and the new importing ones are PCB free transformers.***

On the other hand, for private network grid, there is difficult to obtain information on number of transformers or its dielectric fluid because those private companies are under jurisdiction of NEAC, where to date there are about 300 private companies which got licenses to supply electricity mostly on rural electrification investment. *Nevertheless, it was reported there is about 10 transformers in maximum per each private company installed on their network grids, but no confirmation of the actual number of transformers being installed or PCB free dielectric fluid being used*.

Therefore, based on the above mentioned, it is can be calculated that there are about 3000 transformers being used by private companies to supply electricity for rural town and areas. Nevertheless, it is can be also assumed those transformers may not contain PCB as well due the fact the private companies have imported those transformers to be installed on new national 22kv network grid. So, it can have concluded that to date, Cambodia may have 6900 transformers, out of which about 3908 transformers are non PCB and they are belonging to EDC. The rest of transformers of about 3000 units may not contain PCB at all and are belonging to private companies' investment.

Table 4: ***Status of transformers owned by EDC in 2004, 2014***

No	Provinces	Number of transformer	Number of Transformers in 2014,	Amount of dielectric fluid, 2014, Kg (EDC)	Remark
1	Bantey MeanChey		90	11,235	
2	Battambang	73	240	14,589.75	
3	Kampong Cham	59	109	11,571	

4	Kampong Chhnang	24			**Not EDC**
5	Kampong Speu	6	81	4,685.625	
6	Kampong Thom	33			**Not EDC**
7	Kampot	21	149	12,240.375	
8	Kandal				**Not EDC**
9	Kep				**Not EDC**
10	Koh Kong	38			**Not EDC**
11	Kratie	16	77	6,343.05	
12	Mondulkiri		76	1,989.75	
13	OddorMeanche				**Not EDC**
14	Pailin	13			**Not EDC**
15	Phnom Penh	845	2385	699,326.25	
16	Posat	36			**Not EDC**
17	Preah Sihanouk	73	187	35,581.875	
18	PreahVihear				**Not EDC**
19	Prey Veg	14	21	20,26.5	
20	Ratanakiri	17	72	11,930.625	
21	Siem Reap	47	196	65,648.625	
22	Stung Treng		37	1,955.625	
23	SvayRieng	12	75	6,176.625	
24	Takeo	16	113	1,3408.5	
	Total	**1343**	**3908**	**898709.175**	

Note: EDC have invested electricity some province, most of them in capital and urban towns and economic strength activities

2.3. Inventory Report in 2020

Inventory was conducted to find out the old type transformers installed at system medium voltage of 15kV network grid which was totally replaced by the new 22kV network grid, since 2005. To date, there is no single PCB transformer available on public network grid, as reported by EDC. EDC also mentioned that less than 30% of old transformers (used to install at 15kV network grid) were sold out for cost recovery which it is our challenges in Cambodia. The new transformers for 22kVnetwork grid that have been imported and installed on public network grid were gone through conformation without PCB dielectric fluid: (1.) by imported company with supporting documents (including SDS) and conformation certificate by origins, and (2.) proven certificates issued by the Ministry of Environment after laboratory analysis and results confirmed that such dielectric fluid are PCB free or less than 50ppm.

The new transformer will be alternative use in the network grid as projects for a transmission line surrounding Tonle Sap Lake (connecting Battambang - Siem Reap -Kampong Thom - Kampong Cham), Phom Penh Loop Line Phase 2 (NPP - Chroy Changvar - EPP - SPP), and a transmission

line connecting Kampong Thom - Preah Vihear - Lao PDR Border are under study. These projects are funded by China Exim Bank.

Transmission line expansion project in Koh Kong, Kampong Cham and Kratie which funded by the Agence Francaise De Developmente (AFD) has been conducted the feasibility study and bidding preparation. The beginning of project study and negotiation 115kV transmission lines from GS Kampong Soeng to a new GS Svay Antor and from GS Preah Sihanouk to a new GS Ream with a total length of 62 km and a 230kV loop transmission line in Eastern Part of Cambodian National Grid part 1 which is going to construct from Stung Treng to Ratanakiri and from Kratie to Mondulkiri with a total length of 275 km.
In 2017, 230kV Transmission Line which connected from Lower Sesan II to Steung Treng substation and continued to Kratie substation and Kampong Cham substation have been operated for transmitting the power into the nation grid that allowed the consumer surround and under transmission line could absorb the maximum power directly, especially through the transmission line, it could sends a large amount of power to Phnom Penh where is a prime location in the industrial, commercial and development that is going to absorb huge amounts of electricity consumption in the future.

Table 5: Number of New PCB free Transformer in Cambodia (year?)

No.	Grid Substation Name	Rate Voltage (kV)	Number of Transformer	Total Capacity (MVA)	Operation Year
1	GS1	115/22	2 x 75	150	1999(Upgraded in 2013)
2	GS2	115/22	3 x 50	150	1999 (Added 1 unit in 2013)
3	GS3	115/22	2 x 50	10	1999
		115/22/15	1 x 50	50	2013
4	GS KPS	115/22	1 x 50	50	2002
5	GS BTB (CPTL)	115/22	1 x 25	25	2007
6	GS BTC	115/22	1 x 25	25	2007
7	GS SRP	115/22	2 x 50	100	2007(Added 1 unit in 2014)
8	GS4 (WPP)	230/115	2 x 200	400	2009
		115/22	2 x 50	100	
9	GS TKO	230/22	1 x 50	50	2009
10	GS KPT	230/22	1 x 50	50	2011
11	GS Kampong Chhnang	230/22	1 x 25	25	2012
12	GS Pursat	230/22	1 x 25	25	2012
13	GS BTB (CPG)	230/115/22	2 x 90	180	2012(Added 1 unit in 2015)

14	GS5	115/22	2 x 50	10	2013
15	GS STH	230/22	1 x 50	50	2013
16	GS6 (NPP)	115/22	1 x 50	50	2013
		230/115	2 x 200	40	
17	GS Osom	230/115/22	1 x 150	150	2013
18	GS KGC	115/22	2 x 50	10	2013 (Added 1 unit in
		230/115	1 x 200	20	(Added 1 unit in 2017)
19	GS Chhuk	230/115	1 x 100	10	2014
20	GS SHV	115/22	1 x 50	50	2014
21	GS Banteay Meas (SWS)	115	-	-	2014
22	GS7 (SPP)	230/115	1 x 200	200	2015
		115/22	1 x 50	50	
23	GS Tatay	230/35/22	1 x 60	60/60/40	2015
24	GS IE	115/22	1 x 50	50	2015
25	GS East Siem Reap	115/22	1 x 50	50	2016
26	GS Kampongsoeng	115/22	1 x 50	50	2017
27	GS 8 (Toul Pongror)	115/22	1 x 75	75	2017
28	GS Chrok Mates	115/22	1 x 50	50	2017
29	GS Kratie	115/230	1 x 50	50	2017
	TOTAL		3,315		

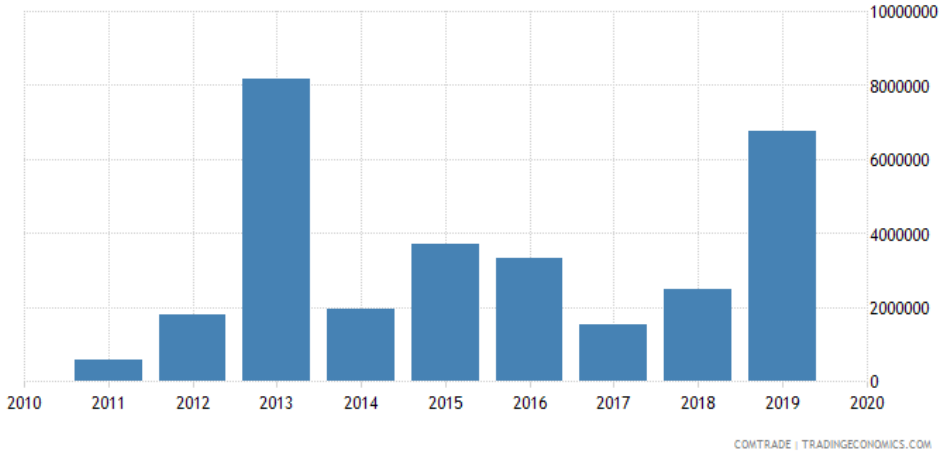
115kV Transmission line with the total length 145km, connecting from GS7 to GS Kampong Soeng and GS Chrok Mates has been commsioned in early of 2017 that allowed the people in Svay Rieng and Prey Veng province could get the power directly from the national grid and reduce the importing power from neighbor's country.

3. Import

So far since Cambodia became a Party to the Stockholm Convention, the imports of transformers were checked and validated as PCB free Transformers.

Cambodia's PCBs free imports of transformers from Vietnam of Electrical Transformers, Static Converters and Inductors were of US$6.77 Million during 2019, according to the United Nations COMTRADE database on international trade. Cambodia imports from Vietnam of Electrical Transformers, Static Converters and Inductors - data, historical chart and statistics - was last updated on March of 2021 (Economics, 2020).

Figure 2: Imports from Vietnam of Electrical Transformers (2010-2020)



4. Export

As Cambodia does not produce or export chemicals, there is no evidence of any legal export activities with regards to any kind of PCB or Transformer containing PCB. And as the waste of old transformer, we are storage at Sambour, Khan donkor for waiting to destroy and burn at Cement Kiln.

5 . Stockpiles and contaminated sites

5.1. Transformers stockpiles

The inventory report in 2004 stated that there were 274 units waiting for disposal are the only ones currently stored at the warehouses of Sambour and Toeuk Thla, belonging to EDC. The Sambour warehouse is currently storing all type of transformers ranking from brand new one to the repaired, standby for use and waiting for disposal transformers.

To date, it still observed that, transformers waiting for disposal have been sold by the owner for cost recovery and the scavengers can recycle the copper. The dielectric fluid generally has been sold to tailors for sewing machines as provides good lubricant oil, and to small handicrafts to be used as secondary fuel. However, there were no records, statistical data or information on the numbers of units that had been sold.

5.2. Contaminated Sites

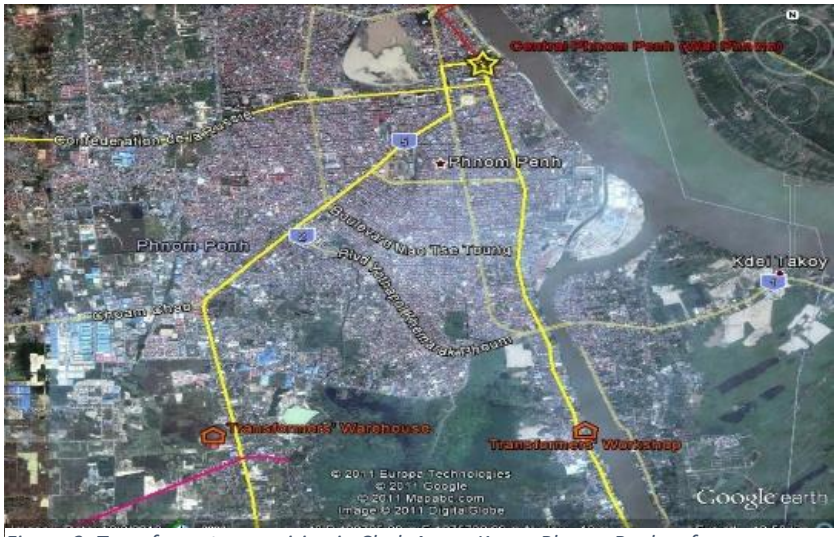
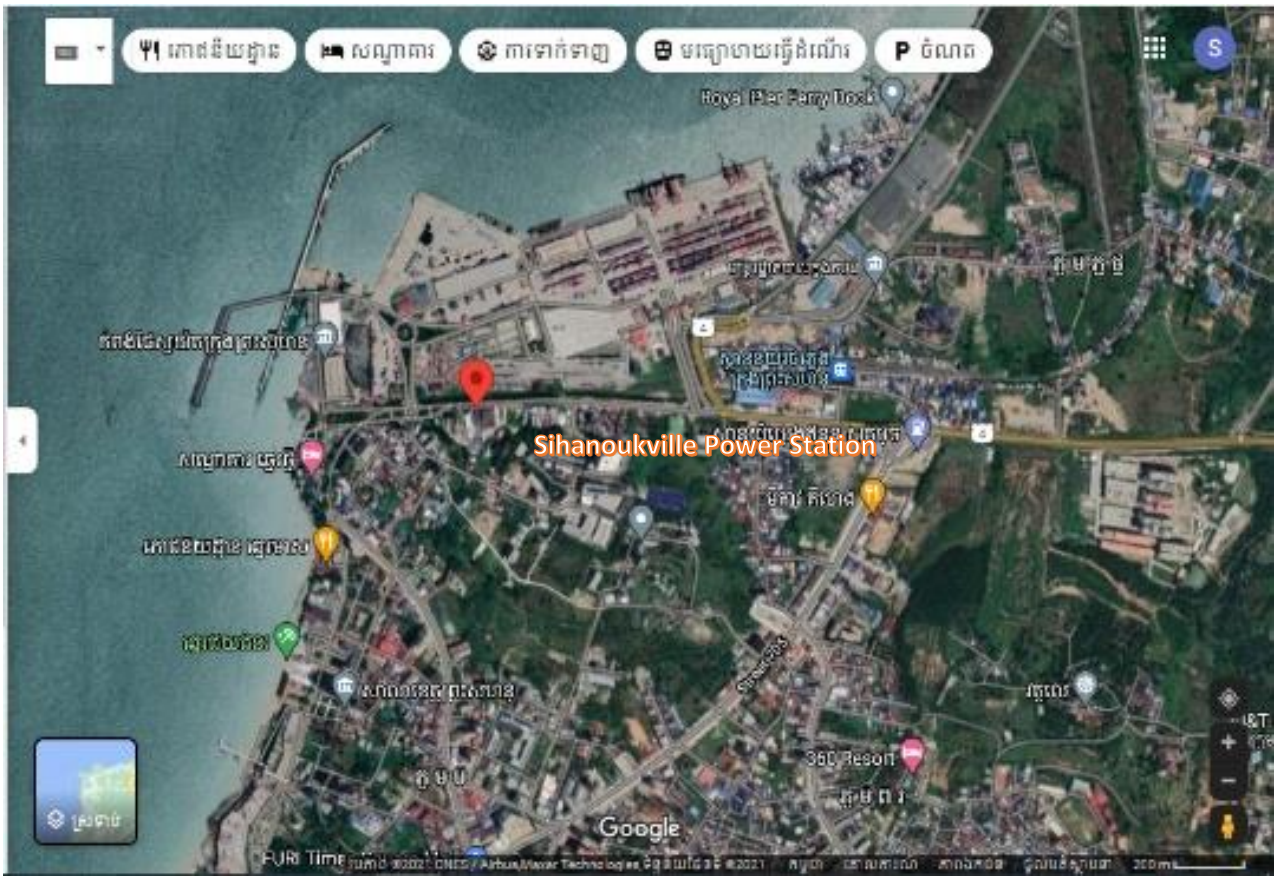


Figure 3: Transformater repairing in Chak Angre Krom, Phnom Penh sofa

There are four main areas that are considered to be contaminated sites by PCB including workshop, warehouses, substation (at network grid), and fired transformers. Transformer workshop and warehouses are reported the most contaminated sites, both located in Phnom Penh Municipality. The transformer workshop (Coordinate: X11.51261, Y104.93648) is locate at Sang Kat Chak Angre Krom, Khan Mean Chey, southern part Phnom Penh along national road No. 2, while the transformer warehouse (Coordinate: X11.51805, Y104.8889) is located at Sangkat Sambour, Khan Dangkor, southern part of Phnom Penh along road 303 (to Cheung Ek Memorial). However, the degree and risk of such contamination could not be evaluated until further studies are made.

Another place that can consider to be contaminated by PCB is Sihanoukville power station, where that area served as power plant, small repairing workshop, and warehouse for keeping new and old transformers. The ground of warehouse/repairing workshop (located in on building, which Coordinate, X:10.64262,Y:103.50562) is soaked by dielectric fluid, where that ear uses to have PCB dielectric fluid based on density test and test kit analysis conducted in 2004.

Figure 4: PCB contaminated sites located in Sihanoukville Power Station, 2021



Chapter 3: Assessment of POP-PBDEs in EEE/WEEE

This chapter will describe POP-PBDEs management in Cambodia including production, import-export, use, end life of equipment/articles containing POP-BDE, and stockpiles and contaminated sites of POP-BDE.

1. Country Status of Production, Import-Export and Use of POP-PBDEs

Cambodia industry consists mainly of small and medium enterprise (SME) where garment industry is a well-known sector followed by agro-industry and mineral products. There is no production of POP-PDBEs in Cambodia. Most of industrial products available in Cambodia are imported either as new and second hand materials.

Therefore, it can be assumed that there are no POP-PBDEs imported to or exported from or used in Cambodia, except POP-PBDEs contained in articles like CRT TVs and CRT monitors. Based on the technical report on a national inventory of use of EEE in Cambodia, (May 2007), it was noticed that thousands of TV set, computer and mobile phone were imported to Cambodia between 2000 to 2006 as show in Table 6 below.

Table 6: ***Statistics of imported EEE by types in the Kingdom of Cambodia, 2007***

No	EEE Categories	2000	2001	2002	2003	2004	2005	2006	Total
1	TV Color	66,127	52,642	44,463	29,257	29,868	24,711	25,709	272,777
2	TV B&W	90,969	109,915	119,200	85,133	96,887	70,558	60,729	633,391
3	Computer	26,342	1,863	1,990	1,852	1,467	9,232	3,101	45,847
4	Mobile Phones	1,486	1,407	7,356	12,222	142,990	113,605	86,438	365,504

Source: Technical report on national inventory of used of EEE in Cambodia, (MOE, May, 2007)

The sum of TVs between 2000 and 2006 in Table 1 indicated that the importation of black- white TVs in Cambodia is more common than color-TVs by The demand was 2.3 times higher as a result of people's demands throughout the country, especially of those who live in rural and remote areas and who use batteries as the energy supply. Color-TVs are being used mostly in cities and towns where there is an access to electricity supply. Therefore, during 2000-2006, 633,391 units of black-white TVs were imported in total compared to 272,777 units of color-TVs.

Like TVs, air-conditions, refrigerators, washing machines and computers are commonly used in cities and big towns, because such equipment requires electricity. Such equipment is little used in rural areas where there is no electricity and rural people cannot afford it.

Two types of computers are imported and being used in Cambodia, laptops and desktops. The statistics of the Department of CAMCONTROL indicated that the amount of imported desktop computers is larger than the amount of laptop computers. In the period of three years (2004-2006), the total amounts of imported desktop computers are 13,800 units, but laptop computers only 210 units.

Mobile phones are commonly used in both urban and rural areas. However, the number of mobile phone's imported tend to decrease from year to year. For instance, in 2004, imported mobile phones were 142,990 units; and this number decreased to 86,438 units in 2006. As a conclusion, local demand is gradually reduced because of most people who can afford it have already mobile phones. Therefore, further importation is for the domestic demand to change to new/modern mobile phones, or for replacing broken mobile phones.

Table 7: ***Imported EEE between 2000 – 2012 without separation of new and second- hand items***

No	Year	TV (CRT screen), unit	Computer (CRT Monitor), unit	Amount (Unit)
1	2000	157,096.00	26,342.00	**183,438.00**
2	2001	109,915.00	1,863.00	**111,778.00**
3	2002	163,663.00	1,990.00	**165,653.00**
4	2003	114,390.00	1,852.00	**116,242.00**
5	2004	126,755.00	1,467.00	**128,222.00**
6	2005	95,269.00	9,381.00	**104,650.00**
7	2006	86,438.00	3,115.00	**89,553.00**
8	2007	10,464.00	4,428.00	**14,892.00**
9	2008	48,373.00	4,709.00	**53,082.00**
10	2009	138,774.00	5,452.00	**144,226.00**
11	2010	12,965.00	867.00	**13,832.00**
12	2011	3,713.00	130.00	**3,843.00**
13	2012	10,495.00	2,153.00	**12,648.00**
	Total	**1,078,310.00**	**63,749.00**	**1,142,059.00**

Source: *Statistics of Imported EEE 2004-2006; General Dept. of CAMCONTROL, MOC*
Baseline Report: WEEE/E-waste in Phnom Penh Municipality and current management system, MOE /UNEP-DTIE, April 2009
Department of Statistics, Ministry of Commerce, 2013. This number is referring to the importation of branch new equipment only

It was recorded that the sum of TVs between 2000 and 2012 indicated that the importation of CRT TVs in Cambodia is about 1,078,310 units and CRT computer monitors is about 63,749 units, accounting for 1,142,059 units in total. This amount is including both branch new and second hand CRT TVs and CRT monitors. Remarkably, data from 2010 to 2012 are indicated mostly brand new equipment were imported for use in Cambodia, which accounts for about 30,323 units in total, of which CRT TVs is accounting for 27,173 units and CRT monitors is accounting for 3,150 units. Furthermore, there is no information regarding the importation of second hand equipment during period of 2010 and 2012.

2. PBDEs Inventory Findings

2.1. Input factors used for calculation of POP-PBDEs

To calculate the amount of POP-BDE in CRT TV casings and monitor casings in a country the Guidance for the inventory of polybrominateddiphenyl ethers (PBDEs) listed under the Stockholm Convention on Persistent Organic Pollutants provides the following numbers:

- Weight of the CRTs: **25 kg per device** (estimated average weight of a CRT monitor, either TV or PC monitor; (table 4-5 of the guidance document);
- Polymer content of CRT casings: 30% (estimated average, table 4-9 of the guidance document);
- A range of c-OctaBDE content, 0.47-1.37 kg/t, for these polymers used in CRT
- casings (estimated average; table 4-11 of the guidance document).

Table 8: ***Total polymer fractions in the relevant EEE/WEEE in Europe. Printed wiring boards and cables are not included (Waeger et al., 2008)***

Category/Article		Total polymer fraction Polymer [in % by weight]		
		Minimum	**Maximum**	**Mean**
3	ICT equipment without monitors	26%	58%	42%
4	Consumer equipment without monitors	21%	26%	24%
3	CRT monitors	13%	38%	30%
4	CRT-TVs*	15%	38%	30%

Source: Table 4-9 of the guidance document

Table 9: ***Total polymer fractions and c-OctaBDE concentrations in relevant EEE***

Relevant EEE	Total polymer fraction (mean)	c-OctaBDE content (mean) in plastics
	$f_{Polymer}$ [in % by weight]	$C_{OctaBDE;Polymer}$ in [kg/ metric ton]*]
WEEE category 3 (without CRTs)	42%	0.225
CRT computer monitors	30%	1.37
WEEE category 4 (without CRTs)	24%	0.15
CRT-TVs	30%	0.47

Note: ***** RoHS limit for c-OctaBDE is 1 kg/metric ton or 0.1 wt %.
Source: Table 4-11 of the guidance document/categories (data from Europe; Waeger et al., 2010)

2.2. Estimation of POP-PBDEs contained in EEE in Cambodia

3.3.2.1 Estimation of POP-PBDEs containing in EEE by Tier 1 methodology

The EEE/WEEE inventory is started by estimating the POP-PBDEs amount in CRT casings in the country. This requires estimating the country's penetration rate (number of appliances per capita from the number in countries with similar economic development and consumer behavior. Table 5shows the per capita data reported in the past.

Once the per capita data have been estimated, the POP-PBDEs content in CRT casings (TVs and computer monitors) can be calculated taking into consideration the following additional data:

- Population of the respective country;
- Weight of the CRTs: **25 kg per device** (estimated average weight of a CRT monitor, either TV or PC monitor);
- Polymer content of CRT casings: **30%**
- A range of c-OctaBDE content, **0.00047-0.00137 kg/tonne,** for these polymers used in CRT
- casings (estimated average; see also table 5).
- A range of c-OctaBDE in CRT devices can be calculated as follows:
  $M_{PBDE(i)}$ = [Number of CRTs/capita$_{Region}$] x population x 25 kg x 0.3 x [0.00047 to 0.00137] Where:
  $M_{PBDE(i)}$ is the amount of POP-PBDEs (i) in [kg]
  (in Polymer (k) of electrical and electronic equipment (EEE) (j))

The POP-PBDEs (heptaBDE and hexaBDE) in the c-OctaBDE can be calculated according to the homologue content shown in table 4-12 (of c-OctaBDE, the heptaBDE homologue is estimated as 43% and the hexaBDE as 11%).

*Table 10**: Total and per capita amounts of CRT (TVs and personal computer (PC) monitors) in different regions and countries. The average weight of a CRT device used in this table is 25 kg.***

Country/ Region	Total weight (10^3 tones)	Total number (million units)	Population (million)	CRT weight/ person (kg/capita)	No. of CRTs /person (units/ capita)	Source
Asian average (including	16’226	649	3’906	4.1	0.17	Gregory, 2009
North merican average	14’623	585	529	27.6	1.11	Gregory ,2009
LAC[5] average	5’189	207	572	9.1	0.36	Gregory, 2009
Benin	17.4	0.7	8.7	2.0	0.08	Basel Convention ,
Côte d’Ivoire	78.0	3.1	20.8	3.75	0.15	
Ghana, 2010	112	4.48	24.2	4.6	0.19	Green Advocacy &Empa, 2011
Nigeria, 2010	670	26.8	154.7	4.33	0.17	BCCC-Nigeria et al.,
Colombia, 2008/2009	343	13.7	46	7.46	0.3	León, 2010
Switzerland ,	54	2.2	7.7	7.05	0.28	BfS, 2011

Source: Guidance for the inventory of polybrominateddiphenyl ethers (PBDEs) listed under the Stockholm Convention on Persistent Organic Pollutants; UNEP-2012:

The Tier 1 calculation was done using a penetration rate of 0.10 (as estimated the average penetration rate per capita from the table above using a penetration rate between 0.17 like Nigeria and 0.08 like Benin). Furthermore, based on “technical report on national inventory of used of EEE in Cambodia” (MOE, 2007), indicated that the ownership ratio of PCs in surveyed households in urban areas is 0.12 unit/person, while average ownership ratio of TVs in the surveyed households in urban areas is 1.54 per household during the 2014. As the team survey reviewed as in 2020 resulting to 1,866,265.32 units of PCs and 5,471,652.34 units of TV, based on the above formula the amount of c-OctaBDE for the inventory year 2020 is ranged from 5,482.15 kg in minimum to 15,165.79 kg in maximum.

Table 11: ***Calculation of the amount of c-OctaBDE by Tier 1 method***

No	Description	Penetration	Population	CRT weight, Kg	Polymer in casing, %	c- OctaBDE content	Amount, Kg
1	Minimum	0.10	15,552,211	25.00	0.30	0.00047	5,482.15
2	Maximum	0.10	15,552,211	25.00	0.30	0.00137	15,165.82

The listed POPs contained in c-OctaBDE are 11% hexaBDE and 43% heptaBDE and that leads to an estimated range of 603.03 kg to 2,357.32 kg hexaBDE and a range of 1,757.79 kg to 6,871.36 kg heptaBDE in Cambodia.

Table 12: ***Amount of hexaBDE and heptaBDE based on c-OctaBDE calculated by Tier 1***

No	**Description**	**c-OctaBDE, kg**	**hexaBDE (11 %), kg**	**heptaBDE (43 %), kg**
1	Minimum	5,482.15	603.03	2,357.32
2	Maximum	15,165.82	1,757.79	6,871.36

3.3.2.2 Estimation of POP-PBDE containing in EEE by Tier 2 methodology

The POP-PBDEs content in CRT casings (TVs and computer monitors) can be calculated based on the number of relevant EEE, CRT TV and CRT monitor casings - in Cambodia as the data are available from the Ministry of Commerce (Table 2: Imported EEE between 2000 – 2012 without separation of -new and second-hand items). This tier 2 estimate is based on the assumption that all imported TVs and monitors are either still in use or in stockpiles in consumer households, government offices or company offices. Other – a small number – may have been recycled and other may have been dumped at city dump sites. In the tier 2 calculation the estimated penetration rate (for TVs and monitors) multiplied by the population number (see chapter 3.3.2.1 for tier 1) is replaced by the actually imported number of TVs and monitors (of imported computers). All computers are assumed to be desktop computers as the number of imported laptops is considered to be very small.

The estimated of POP-BDE containing in EEE by Tier 2 by year is based on the number of imported EEE (data taken from Table 7), which is assumed that those imported EEE (TV and computer) are some still in use as such, or even they are in use after repaired, and include some equipment that are un-repairable and have been sent to dumpsite (or waste stream) in the past. Thus this allows to calculate the amount of POP-BDE content of TV casings and monitors separately using the numbers of c-OctaBDE content in plastics from table 9-that is 1.37 [kg/ metric ton] for CRT computer monitors and 0.47[kg/ metric ton] for CRT TVs.

Therefore, the c-OctaBDE content in CRT casings– TVs and computer monitors - can be calculated with the formula below and the result of such calculation is shown in the Tables below.

For CRTs TV:

$M_{PBDE(i)}$ = [Number of imported CRT TVs and monitors] x 25 kg x 0.3 x [0.00047 to 0.00137]

Table 13: ***Amount of c-OctaBDE containing in CRT TVs and monitors imported during 2012 - 2020***

No	Year	CRT TV	Input weight per unit	Total Weight (Tons)	Polymer content of CRT casings: 30% , Kg	c-OctaBDE Content, (Kg)
1	2012	10,495.00	25	262,375.00	78,712.50	36.99
2	2013	8,116.80	25	202,920.00	60,876.00	28.61
3	2014	21,762.01	25	544,050.25	163,215.08	76.71
4	2015	35,407.21	25	885,180.25	265,554.08	124.81
5	2016	49,052.42	25	1,226,310.50	367,893.15	172.91
6	2017	62,697.64	25	1,567,441.00	470,232.30	221.01
7	2018	76,342.85	25	1,908,571.25	572,571.38	269.11
8	2019	89,988.05	25	2,249,701.25	674,910.38	317.21
9	2020	103,633.26	25	2,590,831.50	777,249.45	365.31
Total		**457,495.24**	**25**	**11,437,381.00**	**3,431,214.30**	**1,612.67**

Note: The amount of TV use in this calculation are all TV in per year

Based on number of EEE imported, it is understood that that equipment will be broken, where some equipment has been sent for repairing many times. However, due to local practices, the broken equipment will then have been recovered for usable parts to be using as spare part for further repairing other EEE, while recyclable material like cases will also collected for reproducing cases. Other economic recoverable parts, i.e. metal parts or circuit boards etc., also collected for exports. Only unrecoverable materials/parts (both none recoverable as recycling or economical recoverable material), will then be sent to dumpsite for final disposal.

Nevertheless, based on the above calculation, it is assumed all TV and Monitor cases including the one that can be used for recycling have been calculated for POP-BDE containing in those case based on their BDE properties: OctaBDE, ehxaBDE, and heptaBDE. Such results are shown in the table below as in TV set, in 1,612.67 Kg and computer set in 1,214.42 Kg.

Table 14: ***Amount of c-OctaBDE containing in both CRTs TV and CRT Monitor, 2020***

No	Des	c-OctaBDE, Kg	hex	hep
1	TV set	1,612.67		
2	Compu	1,214.42		**5**
Total		**2,827.09**		**1, 21**

Based on the import data of EEE and used EEE from 2012 to 2020 in Table 13, the amount of c-OctaBDE contained in imported CRT TV casings is calculated to be 1,612.67 Kg and the amount of c- OctaBDE contained in imported CRT Monitor casings is calculated to be 1,214.42Kg.

The total amount of c-OctaBDE in the country is estimated as the sum of both numbers, which is about 2,827.09 kg. This number replaces the crude estimate in Tier 1 above (Estimation of POP-PBDEs containing in EEE by Tier 1).

The listed POPs contained in c-OctaBDE are 11% hexaBDE and 43% heptaBDE and that leads to 277.98 kg hexaBDE and value of 1,215.64 kg heptaBDE in Cambodia.

Therefore, it is necessary to notify the Secretariat of the Convention that CRT casings of TVs and monitors contaminated with HexaBDE and HeptaBDE (c-OBDE) remain in use within the country.

3. WEEE

The discard of EEE in Cambodia is refers to that equipment that can be no longer repaired. Then such equipment will send to repairing shops or junk yards to take functional parts for further use as spare parts. The other remaining parts will then be segregated into two main streams: one for recyclable parts and other one for non-recyclable parts. The recyclable part refers to the scraps that have economic value (plastic or metals), which are then collected for selling out, while the non-economic value parts will be send to dumpsites for final disposal.

On the other hand, the estimation of discarded EEE/WEEE is based on imported quantity of EEE/WEEE comparing to average consuming lifetime, which is considering of about 4 or 5 years old equipment. Therefore, based on the outcomes of estimated of EEE/EEEE (TV and computer) that can be considered to be discarded can conclude as follows:

- Amount of TV waste was discarded in 2005 and 2006 for 162,557 sets and 163,557 sets respectively. These amounts are higher than other years between 2004 up to
- 2010. Remarkably, waste discards will reduce for the next four or five years. For instance, waste discard in 2009 will approximately 58.20% and in 2010 for 52.80% of the waste discard in 2006.
- Computer waste discard in 2004 was 26,342 sets, and will follow by 2009 (9,381 sets, equally 35.60% of 2004) which higher than other observed years (2004-2010), while
- 2005-2008 waste discard are estimated around 5.70 – 7.60% of the year 2004.

Figure 5: ***Discard of non-usable part from CRT TV and Monitor***

Disposed of CRT screen at Preah Sihanouk Province

Dumping of CRT screen at Kampong Cham province dumpsite

Dumping of scrap wastes from EEE in Battambang province

Discard of circuit board in Preah Sihanouk province

4. Status of POP-PBDEs in the Recycling Stream

There is no sound technology in Cambodia for dismantling and recycling of WEEE (e.g. TV, refrigerator, air-con, computer, and washing machine) even in the Phnom Penh Municipality.

The dismantling is usually applied to no longer functioning/broken EEE which needs serious repairs (with high expenditure but results in low economic value). Reusable parts recovered from dismantling process were kept separately (by types) for selling to repair shops based on their demand. Besides reusable parts, recyclable materials are bought by waste collecting buyers (for a lower price). As described above, waste collecting buyers sell these recyclable parts/wastes to scrap yard's owners for export. Anything else is disposed of together with municipal waste.

There are two types of recycling schemes that could be used for plastics containing POP-PBDEs: the external recycling[1] and domestic recycling. The external recycling generally gets recyclable e-waste by types from junkshops/scrap yards in Cambodia, and/or some time gets recyclable materials from domestic recycling owners too. Junkshop have been receiving

[1] *Recycler who his/her recycling business in other countries outside Cambodia*

recyclable e-waste from waste collectors then that wastes are sorted and stored by types separately, waiting for selling out to external recycling facilities.

Up to now, Cambodia does not have a big scale recycling facilities for recyclable wastes including e-waste. Few recycling places were found in Phnom Penh Municipality during the study, where is known as junkshops. As practice, such junkshops do not have capacity to recycle metals like copper, lead, goals, and other heavy metals, but instead, they collect all recoverable part such as circuit boards, integrated circuit (IC), wires, etc. and sell out to scavenger's groups for cost recovery. As known, such collected recoverable parts will send to neighboring countries for recycling.

In short, the recycling activity is focused more on plastic TV/monitors' casings. As there is at present some recycling of TV/monitor casings taking place in the country it is necessary to request an exemption from the Secretariat of the Convention for recycling articles containing POP-BDE.

*Figure 6**: Collection of usable parts from CRT TV and Monitors for cost recovery by recycling materials***

Collection of CRT Screen for reassembling new TV, Phnom Penh junkyard facilities

Collection of circuit boards for cost recovery to be recycling outside Cambodia, Bantey Meanchey junkyard facility 1

Collection of wire and other scrape plastic for recycling, Bantey Meanchey junkyard facility 2

Collection of CRT TV and Monitor cases for recycling, Bantey Meanchey junkyard facility 2

5. POP-PBDEs Waste Management and Contaminated Sites

There is no specific facility for POP-PBDEs containing waste. Most scrape wastes from WEEE that may contain POP-PBDEs have been collected together with municipality wastes and sent to city dumpsites.

In addition to this, there is no data on domestic E-waste recycling facilities neither by location and amount and type of e-wastes generated. Therefore, it is difficult to identify hot spots that are contaminated by POP-PBDEs. Nevertheless, e-waste recycling and dismantling facilities could be assumed to be POP-PBDEs contaminated sites, if they would have been operating for a long period.

Chapter 4: Assessment of POP-PBDEs in Transport Sector

1. Country Status of Production, Import-Export and Use of POP-PBDEs

Cambodia industry is mainly based on small and medium enterprise (SME) where garment industry is well known sector followed by agro-industry and mineral products. In this regards, there is no production of POPs-PDBEs in Cambodia. Most of industrial products available in Cambodia are imported either as new and second hand materials.

Therefore, it can be assumed that there is no POP-PBDEs are imported or exported or use in Cambodia in the transport sector, except POP-PBDEs contained in articles like car seats, head and arm rests in cars. The POPs containing elements are made of PUR foam that contain c- PentaBDE (listed as tetraBDE and pentaBDE in Annex A of the Stockholm Convention) as a flame retardant.

Based on a desk study and consultation with stakeholders, it was decided that only vehicles, mostly cars, trucks, vans, and buses are sources of POP-PBDEs in the country. Other mean of transportation vehicles like boats and airplane are not included in this inventory as their number is very limited in Cambodia. On the other hand, motorcycles are high in number in Cambodia but their seat life span is not long and generally they are replaced by homemade seats. The imported materials for homemade seats are quite new products; they are considered not to contain POP-PBDEs.

2. PBDEs Inventory Findings

2.1. Emission factors used for calculation of POP-PBDEs containing in article

Based on the SC Guideline, the c-PentaBDE in the major PUR foam fraction in transport (seats, head and arm rests) has been found to be 0.5 to 1% by weight (Ludeka, 2011). Considering an average use of 1% c-PentaBDE by weight in PUR foam in vehicles, the following estimates can be made:

- **Cars:** POP-PBDEs treated cars with approximately 16 kg (14 to 18 kg; Ludeka,2011) of PUR foam contain approximately 160 g c-PentaBDE[2]. This estimate is a bit low compared to another estimate for c-PentaBDE in treated cars of 250 g/car (ESWI, 2011);
- **Trucks**: The amount of PUR foam is estimated to be similar – 16 kg - as for a passenger car and therefore the POPs content is estimated to be 160 g c-PentaBDE per impacted truck;

[2] *C-PentaBDE was also used in back-coating in textiles in transport. Since the 160g c- PentaBDE is rather an upper conservative estimate, no additional POP-PBDEs are considered for this minor use for simplification purposes. That textiles from cars might be treated with c-PentaBDE can, however, be considered in the waste management of textiles from the transport sector (see chapters 5 and 6 of PBDE BAT/BEP Guidance). Also some cars might only have some PUR foam or only textiles treated and therefore contain less than 160 g POP-PBDEs.*

- Buses: An average PUR foam use is estimated at approximately 100 kg.12 With a similar average application rate of c-PentaBDE, an impacted "average" bus is estimated to contain 1 kg c-PentaBDE. For countries that mainly have mini-buses (often the case in developing countries), the content of PUR foam for mini-buses can be used. For mini-buses 32 kg of PUR-foam is considered, small buses (approx. 20 seats) 60 kg of PUR foam, and larger buses (approx. 80 seats) 240 kg PUR foam.

2.2. Vehicle Inventory Findings

The inventory approach recommended by the Stockholm Convention guidance was used to develop the POP-PBDEs inventory. Cars and other road vehicles (busses and trucks) are the major part of the transport sector and contain the majority of POP-PBDEs in this sector. The focus and methodology of the preliminary inventory therefore focused on these vehicles. POP-PBDEs were produced and used in PUR foam in the period from approximately 1975 to 2004. Therefore, following the SC guidance, vehicles produced within this period were considered for this POP-PBDEs inventory. The core team to establish the preliminary inventory included the Department of Vehicle Registration of the Ministry of Public and Transport together with a consultant on the transport sector and officers from the Pollution Control Department of the Ministry of Environment. At an inception workshop on POP- PBDEs held in early February 2014 a working group lead by a transport sector consultant and including relevant departments from concerned ministries, waste management officers, industrial sector, and consultants set the objectives and scope of the inventory.

The main responsibility was given to the Land Transport Department (Vehicle Registration Office) of the Ministry of Public and Transport to collect information on number of car registration including by type and region of importation. From the registration data for 2013, a record on the registration of vehicles was derived together with the country of origin of the individual vehicles. For the preliminary inventory it was assumed that the vehicle distribution for Cambodia is about 377,098 cars, of which about 328,526 were produced before 2005 and about 48,572 were produced since 2005. Nevertheless, the numbers of imported cars per year were not available for the inventory year 2013.

The fractions originating from the American (58%), Asian (39%), and European (3%) were calculated by registration. No cars or other vehicles are imported from African region. The regional origin is important for the assessment since the POP-PBDEs inventory guidance includes different impact factors for regions with high or low usage of POP-PBDEs in vehicles.

*Table 15: **Number of vehicles registered based on their imported origin, 2014***

No	Type of vehicle	Imported Source							Amount
		USA		Europe		Asia		Africa	
1	**Registered vehicles manufactured before 2005**								
1.1	Cars	190,096	90%	6,337	3%	14,785	7.%	0	211,218

12 *For mini-buses 32 kg of PUR-foam is considered, small buses (approx. 20 seats) 60 kg of PUR foam, and larger buses (approx. 80 seats) 240 kg PUR foam. An average of 100 kg PUR foam for the category "bus" was chosen for reasons of simplification. Countries can adjust this factor to their reality.*

No	Type of vehicle	Imported Source							Amount
		USA		Europe		Asia		Africa	
1.2	Trucks	5,155	6%	2,577	3%	78,174	91.%	0	85,906
1.3	Minibuses	1,668	6%	1,112	4%	25,024	90.%	0	27,804
1.4	Small buses (more than 15 seats)	36	1%	72	2%	3,490	97.%	0	3,598
	Total 1	**196,955**	**60%**	**10,098**	**3%**	**121,473**	**36.98%**	**0**	**328,526**
2	**Registered vehicles manufactured from 2005 onward**								
2.1	Cars	18,642	80%	1,165	5%	3,496	15.00%	0	23,303
2.2	Trucks	2,574	11%	468	2%	20,359	87.00%	0	23,401
2.3	Minibuses	150	9%	184	11%	1,335	79.99%	0	1,669
2.4	Small buses (more than 15 seats)	16	8%	26	13%	157	78.89%	0	199
	Total 2	**21,382**	**44%**	**1,843**	**4%**	**25,347**	**52.18%**	**0**	**48,572**
3	**All imported cars by regions**								
3.1	Cars	208,738	89%	7,502	3%	18,281	7.80%		234,521
3.2	Trucks	7,729	7%	3,045	3%	98,533	90.14%		109,307
3.3	Minibuses	1,818	6%	1,296	4%	26,359	89.43%		29,473
3.4	Small buses (more than 15 seats)	52	1%	98	3%	3,647	96.05%		3,797
	Total 3	**218,337**	**58%**	**11,941**	**3%**	**146,820**	**38.93%**	**0**	**377,098**

2.3. Estimation of POP-PBDEs containing in Cambodia vehicles

The SC inventory guidance also provides impact factors of c-PentaBDE depending on the vehicle size (e.g. car or busses). One modification to the proposed SC guidance approach has been made for this assessment to meet the Cambodia situation: The SC guidance suggests an average POP-PBDEs treated cars or truck with approximately 16 kg (14 to 18 kg; Ludeka, 2011) of PUR foam contain approximately 160 g c-PentaBDE. The average POP-PBDEs content for mini-busses of 32 kg of PUR-foam is considered, small buses (approx. 20 seats) 60 kg of PUR foam, and larger buses (approx. 80 seats) 240 kg PUR foam.

However, Cambodia is mainly using minibuses with approximately 10 seats and small buses with approximately 20 seats. Therefore, a factor of 320 g and 600g of POP-PBDEs were used for minibuses and small buses respectively.

The SC inventory guidance also provides the calculation of POP-PBDEs in vehicles in current use can be compiled according to table 13 below.

***Table 16**: Amount of POP-PBDEs in PUR foam of vehicles in current use in the inventory year*

Number of cars/trucks (manufactured in US before 2005)	Amount of c-PentaBDE per car/truck	Total amount POP-PBDEs in cars in use manufactured in US
5-1a)	160 g per car	No. of cars and trucks x 0.16 kg x 0.5*= _____kg
Number of cars/trucks in use (manufactured in other regions before 2005)	Amount of c-PentaBDE per car	Total amount POP-PBDEs in cars in use (manufactured in regions other than US)
5-1b)	160 g per car	No. of cars and trucks x 0.16 kg x 0.05*= _____kg
Number of buses in use (manufactured in US before 2005)	Amount of c-PentaBDE per bus	Total amount PBDE in buses in use (manufactured in US)
5-1c)	1000 g per bus	No. of buses x 1 kg x 0.5*= _____kg
Number of buses in use (manufactured in other regions before 2005)	Amount of c-PentaBDE per bus	Total amount POP-PBDEs in cars in use (manufactured in regions other than US)
5-1d)	1000 g per bus	No. of buses x 1 kg x 0.05*= _____kg
Total c-PentaBDE 5-1)	-	Sum of c-PentaBDE: _____kg

Factor estimating the share of impacted vehicles in the region of production (1975-2004)

Source: Table 15 (Amount of POP-PBDEs in PUR foam of vehicles in current use in the inventory year) of the Guidance for the inventory of polybrominated diphenyl ethers (PBDEs) listed under the Stockholm Convention on Persistent Organic Pollutants

2.4. Calculation of POP-PBDEs of vehicles in current use/sale

The following formula from the guidance is used to calculate the POP-PBDEs content of vehicles for the different categories (cars, trucks or buses):

Quantity of POP-PBDEs Vehicle category = Number of vehicles category **x** POP-PBDEs category **x** F regional

Where:

- ***Number of vehicles category*** is the number of vehicles (manufactured in 1975-2004) present in a category (car, bus or truck).
- ***POP-PBDEs category is the quantity of POP-PBDEs in an individual car, truck or bus treated with POP-PBDEs (0.16kg or 0.00016tons).***
- ***F regional The regional factor for vehicles which is 0,5 for cars coming from the US and 0,05 for cars coming from other regions***

So, based on calculation, there is found that the total amount of POP-PBDEs in vehicles registered in Cambodia is approximately 17.233 tonnes in **5,859.592** tonnes of PUR foam (c- PentaBDE).

*Table 17**: POP-PBDEs (in tonnes) in inventoried vehicles (cars, busses, trucks) in Cambodia, 2014***

No	Description of vehicle manufactured before 2005	Total number of Vehicle	Amount of PUR foam, tonnes	POP-PBDEs content, tonnes
1	Total cars imported from USA	190,096	3,041.54	15.28
2	Total cars imported from other regions	21,122	337.95	0.17
3	Total trucks imported from USA	5,155	82.48	0.41
4	Total trucks imported from other regions	80,751	1,292.02	0.65
5	Total minibuses imported from USA	1,668	53.38	0.133
6	Total minibuses imported from other regions	26,136	836.35	0.21
7	Total small buses imported from USA	36	2.16	0.0028
8	Total small buses imported from other regions	3,562	213.72	0.023
	All Total	**328,526**	**5,859.59**	**16.81**

2.5. Calculation of listed PBDEs in the transport sector

It is not the amount of c-PentaBDE or c-OctaBDE in the material flow that is reported for the Stockholm Convention but more specifically the relevant POP-PBDEs homologues:

TetraBDE, pentaBDE, hexaBDE and heptaBDE. These homologues can be calculated from the estimated amount of c-PentaBDE (or c-OctaBDE) by considering the percentages of homologues in the commercial mixtures, and result for each PBDE categories are shown in below table.

*Table 18**: Recalculation of POP-PBDEs present in the transport sector to the listed POP-PBDEs homologues (tetraBDE, pentaBDE, hexaBDE and heptaBDE)***

PBDE Categories	Distribution homologues c-PentaBDE	POP-PBDEs in vehicles currently in use in inventory year 2014, (in kg)
Inventoried POP-PBDE*		17.233
tetraBDE	33%	5.686
pentaBDE	58%	9.995
hexaBDE	8%	1.378
heptaBDE	0.5%	0.086

3. Status of POP-PBDEs Stockpiles

This first inventory of the Cambodian transport shows that a total amount of 377,098 vehicles (car/trucks/buses) have been imported and registered up to 2014, of which vehicles manufactured between 1975 and 2004 are account for 328,526 car/trucks/buses. These vehicles contain approx. 17.237 tonnes of POP-PBDEs in **5,859.592** tonnes of PUR foam. However, since the country has no practice in deregistration of cars and therefore we have no information on the number of cars entering the waste stream.

*Figure 7: **Repairing garage also serve as dismantling facilities to separate reusable parts and wastes materials from obsolete cars (Camry 2002)***

Based on Cambodia economic conditions, the old aged vehicles are not scrapped quickly but they are kept in use through many cycles of repairing. Then, at the end of life of the vehicle usable spare parts are used for other repairs and other parts with economic value have been sold as scraped materials. Thus, it is hardly to estimate the "life span" of those vehicles and the number of vehicles that have become waste.

During the inventory team, we did not check on the used car which it was imported from origin country or other country as series year 2004 and under 2004.

4. Status of POP-PBDEs in the Recycling Stream

Currently there are no recycling facilities in Cambodia. Nevertheless, some repairing garages are dismantling of end of life vehicles to take spare parts and scrap materials for sale, including car seats.

In practicing, poor condition car seats have been reused in local made trucks, known as “Handle Tractor?” and those vehicles play an import role in rural transportation of local commodities including rice. Thus it was considering that the largest share of POP-PBDEs is still in use in vehicles, this must be considered when reuse, recycling and recovery concepts are developed.

In conclusion, the recycling, reuse, and waste treatment of polyurethane foam and plastic from vehicles could not be assessed within the limited time scale of this preliminary inventory.

Figure 8: Car Sit was moved to replay of old of BPDE

Figure 9 ***: inventory Team Visit facilities using used cushioning car seats***

5. POP-PBDEs Waste Management and Hotspot Sites

There is no specific facility for POP-PBDEs containing waste. Most scrape wastes from care repairing garages or other car spare part facilities that may contain POP-PBDEs have been collected together with municipality wastes and send to city dumpsite.

In addition to this, there is no data on car repairing garages neither by location and amount and type of wastes generated. Therefore, it is difficult to identify hot spot sites that contaminated by POP-PBDEs. Nevertheless, car repairing garage and scrapping facilities can be assumed as POP-PBDEs contaminated sites.

Chapter 5: Assessment of PFOS, its salts and PFOSF

1. Overview on Firefighting Foam Use

The "Guidance for the inventory of perfluorooctane sulfonic acid (PFOS) and related chemicals listed under the Stockholm Convention on Persistent Organic Pollutants, July 2012, indicated that today most fire fighting foams are manufactured without PFOS, which has been replaced by fluorochemical/telomers based on a perfluorohexane (C6) chain up to 2003. In spite of a reduced production in many regions, there are still significant amounts of fire-fighting foams containing PFOS stored, and as fire-fighting foams have a long shelf life (10–20 years or longer), PFOS- containing firefighting foams may still be used for some time around the world in actual accidental fires. In addition, some regions have reported that firefighting foams with PFOS are still manufactured in high quantities by the companies below, and that they were phased in during the 1990s as an alternative to halones, an ozone depleting compound.

The PFOS guidance also mentioned that Ciba produced Lodyne™ grades with PFOS up to 2003 (Chemguard, accessed in 2012), but discontinued its manufacture of firefighting foams in 2003. The same products are now manufactured by Chemguard under new trade names (S grades). Newer brands manufactured by Chemguard do not contain PFOS or its related substances (Chemguard, accessed in 2012). 3M phased out its manufacture of fire fighting foams with PFOS (3M™ Light Water™ foam agents - AFFF or AFFF-ATC) in 2003. Tyco FS&BP also manufactured some fire fighting foam agents containing PFOS before 2000. Significant amounts of fire fighting foams containing PFOS, from Tyco FS&BP, Ciba, Chemguard and 3M, may still be stored at professional users because of the long shelf life

2. Country Status of Production, Import-Export and Use of PFOS

Cambodia is a country, where no chemical production facility exists, except small and medium enterprises (SMEs) where chemical formulation and manufacturing have been done with limited scope. Those formulations are related to small scale production of pharmaceutical and paint products. Garment industry is a well-known sector followed by agro-industry and mineral products, where some chemicals are used to increase the quality of products. Considering this it is concluded that there is no production of PFOS in Cambodia. Most of industrial products available in Cambodia are imported either as new and second hand materials.

Therefore, based on local industrial activities and in comparison with global production and application of PFOS in various sector, it is concluded that only the firefighting sector in the country might have PFOS in firefighting foam. The other applications of PFOS in other industrial sectors like electronic, semiconductor, photographic, chemically driven oil and gas production …etc. are not applicable in Cambodia. Table below can reflect the likely use of PFOS and PFOS related substances in Cambodia, from which it can be concluded that firefighting foams may contain PFOS or PFOS related chemicals.

Table 19: ***PFOS and PFOS-related substances that likely available by activities in Cambodia***

Categ	Proces	Import	Manufa	Export	Use
Photographic sector:	X	X		X	**X**

Electrostatic	X	X		X	**X**
Semiconductor sect	**X**	**X**	**X**	**X**	**X**
Electronics sector Etching agent	**X**	**X**	**X**	**X**	**X**
Avi	**X**	**X**	**X**	**X**	**L**
Firefig	**X**	**X**		**X**	**Y**
Metal plating	**X**	**X**		**X**	**X**
Certai	**X**	**X**		**X**	**X**
Ins	**X**	**X**		**X**	**X**
Coating and im	**X**	**X**		**X**	**X**
Avi	**X**	**X**		**X**	**X**
To	**X**	**X**		**X**	**L**
Cle	**X**	**X**		**X**	**X**

Note:

- X: PFOS and PFOS related substances activities that not available in Cambodia
- Y: PFOS and PFOS related substances activities that may likely be available in Cambodia
- L: PFOS and PFOS related substances activities that may likely be available but in very limited quantities and subject not to report

Regarding aviation hydraulic fluids, it is noticed that Cambodia does not have airline fleet yet, except joint venture with Vietnam airline. In addition to this, there is no repairing or maintenance facility for airplane even for civil ones. In general, all Cambodia owned airplanes are sent for maintenance overseas. In this regards, there is no need to do a national inventory for this sector.

Other sectors that are suspected to have PFOS or PFOS related substances are coating and impregnation products of synthetic carpets that is imported for use in the country. Regarding importation of cloth for garment industry, it is clear that those clothes are not containing PFOS or PFOS related substance because Cambodia garment products are targeted to export for USA and EU markets under quotation limited, where those countries have very strict regulation to ban PFOS or other hazardous chemical containing products and articles. Therefore, this sector is also excluded from the PFOS inventory.

3. PFOS Inventory activities and finding

3.1. PFOS Inventory activities

The field inventory survey was conducted in 10 out of the 24 provinces including the capital, considering high expected risk of fires due to the economy activities as well as the population density. Those provinces also have airport, in land water way ports, dry ports, oil terminals, storage facilities, and numbers of gas stations. For the inventory oil terminal, airports, ports, firefighting stations, and storage facilities were visited. Based on a questionnaire provided (See appendix 2: Self-Reporting form) and face to face interviews, it was recognized that some provinces have firefighting foams and some don't. 24 self-reporting forms were sent to police fire brigade offices of the 24 provinces and municipality (for a survey undertaken by provincial firefighting police brigades and salvage offices). In some provinces, numbers of self-reporting form were copied by provincial police fire brigade to send out to institution or private companies to fill in, where they knew that those entities have stockpiles of firefighting foams. After the forms were filled in and returned, the national firefighting police brigade (inventory team) have made fields visit to selected provinces, where foams are being stored or where suspected to store firefighting foams for use. Inventory activities in those provinces are shown in the table below.

Table 20: ***Status of self-reporting form filled in, foams use, and field visit by provinces, 2014 and 2020***

N	Province/Municipality	Forms filled in	Foams Status	Field Visited
1.	Phnom Penh	✓	Use	✓
2.	Kandal	✓	Use	✓
3.	Takeo	✓	x	
4.	Kampot	✓	x	✓
5.	Kep	✓	x	✓
6.	Preah Sihanouk	✓	Use	✓
7.	Koh Kong	✓	x	
8.	Kampong Speu	✓	x	
9.	Kampong Chhnang	✓	x	
10	Pousat	✓	x	
11	Battambang	✓	Use	✓
12	Pailin	✓	x	
13	BanteyMeanchey	✓	x	✓
14	OddorMeanchey	✓	x	
15	Siem Reap	✓	Use	✓
16	PreahVihear	✓	x	
17	Kampong Thom	✓	x	
18	Kampong Cham	✓	Use	✓
19	Kratie	✓	x	
20	Stung Treng	✓	x	
21	Ratanakiri	✓	Use	
22	Mondulkiri	✓	x	
23	Prey Veng	✓	Use	✓
24	**SvayRieng**	✓	**x**	

3.2. PFOS Inventory finding

Based on inventory, it was noticed that there are only 8 provinces including the municipality out of 24 provinces and municipality that have stored firefighting foams under the names of FP foam, AFFF foam and FFFP foam. Most foams were imported during the last 5 years, however, some foams are imported since in 1990s. Both recent and past imported foams remain of unknown manufacturing date, its origin, and chemical properties. Nevertheless, based on PFOS guidance document, it is assumed that those imported foams may contain PFOS[2], due to the fact some foams were produced and imported before the year 2000.

Table 21: ***Fire Fighting Foam finding in Battambang Province, 2014-2020***

No.	Description	Quantity	Foams type	Origin / producer	Imported date	Remark
1	SOKIMEX Oil storage facility,	400	FP 70	England	1998	**Likely to contain PFOS**
		200	FP 70	England	2000	**Likely to contain PFOS**
		200	Foam Fire Extinguish	Vietnam	1998	**Likely to contain PFOS**
2	Battabang Airport	624	Croda	England	UNTAC	**Likely to contain PFOS** **Imported during UNTAC, 1993**
		1750	Sabo	England	UNTAC	
		500	FP 70		UNTAC	
3	Firefighting brigade and Salvage Office	0	-			
	TOTAL	**3674**	-			

Table 22: ***Fire Fighting Foam finding in Siem Reap Province, 2014 between 2020***

No.	Description	Quantity	Foams	Origin/pro	Imported	Remark
1	Firefighting brigade and Salvage Unit of Siem Reap	8910	FFFP (6%)	Angus Fire (code: 1049/20/E	2008	**Unlikely to contain PFOS, Hexylene glycol (CAS: 107-41-5); 5); and Hydrolysed protein Flourosurfactants Bactericide Water**

		4095	FP (3%)	Angus Fire (code: 1038/13/w)	2000	**Likely to contain PFOS, Hexylene glycol (CAS: 107-41-5), Sodium chloride (CAS: 7647-14-5), Zine Oxide (CAS: 1314-13-2), and Bactericide Hydrolysed**
2	Sokimex gas station (Choeung Kun)	30	Unknown	England/ un known?	Unknown	**Assumed to contain PFOS**
3	Natural gas station (Soeun Thy)	30	Unknown	Unknown	Unknown	**Assumed to contain**
4	SOKIMEX Gas station (Chan	20	Unknown	Unknown	Unknown	**Assumed to contain**
5	Firefighting brigade and	-				
	TOTAL	1308	-			

Table 23: ***Fire Fighting Foam finding in Preah Sihanouk Province, 2014-2020***

No.	Description	Quantity (liter)	Foams type	Origin/ producer	Imported date	Remark
1	Sihanouk International Airport	3850	Film Foaming Fluoroprotein (FFFP)	England	2007	Unlikely to contain PFOS
2	Cheveron Oil storage terminal, Sihanoukville	4000	FP 70 (Fluoroproti en Foam)	Angus Fire Company	2011	Unlikely to contain PFOS
3	Sokimex oil terminal storage, Sihanoukville	2165	FP 70 (3%)	Angus Fire Com., England	2002, 2005, 2010	Likely to contain PFOS
4	LHR Oil storage terminal, SHV	2200	P 1	Thailand	2013	Unlikely to contain PFOS

No.	Description	Quantity (liter)	Foams type	Origin/ producer	Imported date	Remark
5	Tela Oil storage terminal, SHV	3830.6	K V Lite AFFFConcentrate I S 4989; Listed Foam Liquid Concentrate 4BA5;	Unknown	2007	Unlikely to contain PFOS
6	SHV Port Autonomous	300	PO_1	Vietnam		Unknown, assume to contain PFOS
7	Firefighting brigade and Salvage Office, SHV	-	-			
	Total	**16345.6**	**-**			

Table 24: ***Fire Fighting Foam finding in Prey Veng Province, 2014***

No.	Description	Quantity (liter)	Foams type	Origin/ producer	Imported date	Remark
1	Firefighting brigade and Salvage Office,					
2	LHR Company	100	AFFF 3%	Unknown	Unknown	Assumed to contain PFOS
	TOTAL	**100**	**-**			

Table 25: ***Fire Fighting Foam finding in Kampong Cham Province, 2014***

No.	Description	Quantity (liter)	Foams type	Origin/ producer	Imported date	Remark
1	Firefighting brigade and Salvage Office,	-	-			
2	Oil Storage Center of Tonle Bet, Kampong Cham	800	FIRE FOAM Concentrates-FP	Angus Fire Com. Singapore	2012	Unlikely to contain PFOS
	TOTAL	**800**	**-**			

Table 26: ***Fire Fighting Foam finding in Kandal Province, 2014***

No.	Description	Quantity (liter)	Foams type	Origin/ producer	Imported date	Remark
1	Oil Storage Terminal of PETRONAS Company	5220	FFFP (3%)	Unknown	Unknown	Assumed to contain PFOS
2	Oil Storage Terminal of Total Company	7000	FFFP (3%)	Unknown	Unknown	Assume to contain PFOS
	TOTAL	**12220**	**-**			

Table 27: ***Fire Fighting Foam finding in Phnom Penh Municipality, 2014***

No.	Description	Quantity (liter)	Foams type	Origin/ producer	Imported date	Remark
1	Firefighting brigade and Salvage Office, Phnom Penh Municipality	5800	AFFF (3%)	Unknown	Unknown	Assumed to contain PFOS
2	Firefighting brigade and Salvage Office Unit of Phnom Penh International Airpor t	14660	FFFP (6%)	Unknown	Unknown	Assumed to contain PFOS
3	Sokimex Oil terminal, Reusey Keo	3600	AFFF (5%)	Angus Fire Foam, England	31 Jan. 2012	Unlikely to contain PFOS,
	TOTAL	**24060**	**-**			

Through filling in a self-reporting form, it was reported that there are only 8 provinces including the municipality that have stored today fire-fighting foams with a total amount of 71,609.6 liters. The origin of these imported foams are from England, Singapore, Vietnam and Thailand. There are

mainly three types of foams stored in Cambodia: the Film Foaming Fluoroprotein (FFFP), Aqueous film forming foam (AFFF) and Fluoroprotein Foam (FP 70). Distributions of these foams by provinces are shown in below table.

Table 28: ***Summary of Firefighting foams distribution by provinces, 2014***

N	Province	(Foams liters)	Remark
1	Battambang	3,674	**FP 70, Corda, Sabo**
2	Siem Reap	13,085	**FFFP (3%), FFFP (6%)**
3	Preahsihanouk	16,345.6	**FP 70, FFFP, P1, PO1**
4	PreyVeng	100	**AFFF (3%)**
5	KampongCha	800	**FFFP**
6	Kandal	12,220	**FFFP (3%)**
7	Phnom Penh	24,060	**AFFF (3%) and (5%) and FFFP (6%)**
8	Ratanakiri	1,325	**This number was given by police fire brigade of Ratanakiri province, where name of foam, its origin, and imported date areunknown as nolabeling or documents**
	Total	**71,609.6**	**-**

4. Status of PFOS Containing in Firefighting Foam

It is understood that the total amount of PFOS containing fire-fighting foams is about 71,610 liters, distributed in the 7 provinces and municipality, where fire risks are of most concern due to many important infrastructures available such as airport, water ports, oil storage terminals and facilities, and high population density. Among the 71,610 liters, the inventory team had classified such foams into three main categories as the following:

- Likely to contain PFOS. This is referring to firefighting foams imported before 2003, when it was internationally recognized that most of such foams are containing PFOS,
- Unlikely to contain PFOS. This is referring to firefighting foams imported after 2003, when global firefighting foam production had been banned for use PFOS as fire extinguisher substances,
- Assumed to contain PFOS. This is referring to firefighting foams that remain unknown of it production year, or imported date or having missing information related to its composition, where it is hardly to classify it as non PFOS foam.

Based on these the categories for foam classification, it is understood there are about 44,419 liters of foam considered as PFOS contained foam, of which 9,934 liters are under category "Likely to contain PFOS" and about 34,485 liters are under category "Assumed to contain PFOS". The rest of the foam of

about 27,190.6 liters falls under the category “Unlikely to contain PFOS”. Distribution of firefighting foams by its categories, location and entities owners are shown in the below table.

Table 29: ***Firefighting foams distributed by its categories, location and entities, 2014***

No	Description	Location	Quant. (liter)	Foams type	Origin / producer	Imported date	Remark
A	**Unlikely to contain PFOS**						
1	Cheveron Oil storage terminal, Sihanoukville	SHV Province	4000	FP 70	Angus Fire	2011	Unlikely to contain PFOS
	Firefighting brigade and Salvage Unit of Siem Reap Airport	Siem Reap Province	8910	FFFP (6%)	Angus Fire	2008	Unlikely to contain PFOS
2	LHR Oil storage terminal, SHV	SHV Province	2200	P 1	Thailand	2013	Unlikely to contain PFOS
3	Oil Storage Center of Tonle Bet, Kampong Cham	Kampong Cham Province	800	FP	Angus Fire, Singapore	2012	Unlikely to contain PFOS
4	Sihanouk International Airport	SHV Province	3850	FFFP	England	2007	Unlikely to contain PFOS
	Sokimex Oil terminal, Reusey Keo	PHN	3600	AFFF (5%)	England	31 Jan. 2012	Unlikely to contain PFOS
5	Tela Oil storage terminal, SHV	SHV Province	3830.6	AFFF	Unknown	2007	Unlikely to contain PFOS
	Subtotal A		**27190.6**				
B	**Assumed to contain PFOS**						
1	Firefighting brigade and Salvage Office Unit of Phnom Penh International Airport	PHN	14660	FFFP (6%)	Unknown	Unknown	Assumed to contain PFOS
2	Firefighting brigade and Salvage Office, Phnom Penh Municipality	PHN	5800	AFFF (3%)	Unknown	Unknown	Assumed to contain PFOS
3	LHR Company	Prey Veng Province	100	AFFF 3%	Unknown	Unknown	Assumed to contain PFOS
4	Natural gas station (Soeun Thy)	Siem Reap Province	30	Unknown	Unknown	Unknown	Assumed to contain PFOS

No	Description	Location	Quant. (liter)	Foams type	Origin / producer	Imported date	Remark
5	Oil Storage Terminal of PETRONAS Company	Kandal province	5220	FFFP (3%)	Unknown	Unknown	Assumed to contain PFOS
6	Oil Storage Terminal of Total Company	Kandal province	7000	FFFP (3%)	Unknown	Unknown	Assumed to contain PFOS
7	Ratanakiri airport	Ratanakiri	1325	Unkn own	Unknown	Unknown	Assumed to contain PFOS
8	SHV Port Autonomous	SHV Province	300	PO_1	Vietnam	Unknown	Assumed to contain PFOS
9	SOKIMEX Gas station (Chan Keo)	Siem Reap Province	20	Unkn own	Unknown	Unknown	Assumed to contain PFOS
10	Sokimex gas station (Choeung Kun)	Siem Reap Province	30	Unkn own	England /unknow n?	Unknown	Assumed to contain PFOS
	Subtotal B		**34485**				
C	**Likely to contain PFOS**						
1	SOKIMEX Oil storage facility,	BTB Province	400	FP 70	England	1998	Likely to contain PFOS
	SOKIMEX Oil storage facility,	BTB Province	200	FP 70	England	2000	Likely to contain PFOS
	SOKIMEX Oil storage facility,	BTB Province	200	Foam Fire Exting uish	Vietnam	1998	Likely to contain PFOS
	Sokimex oil terminal storage, Sihanoukville	SHV Province	2,165	FP 70 (3%)	Angus Fire, England	2002, 2005, 2010	Likely to contain PFOS
2	Battabang Airport	BTB Province	624	Croda	England	UNTAC, 1994	Likely to contain PFOS
	Battabang Airport	BTB Province	1,750	Sabo	England	UNTAC, 1994	Likely to contain PFOS
	Battabang Airport	BTB Province	500	FP 70		UNTAC, 1994	Likely to contain PFOS
	Firefighting brigade	Siem	4,095	FP	Angus	2000	Likely to

No	Description	Location	Quant. (liter)	Foams type	Origin / producer	Imported date	Remark
1	and Salvage Unit of Siem Reap Airport	Reap Province		(3%)	Fire		contain PFOS
2	**Subtotal C**		**9,934**				
	ALL TOTAL (A+B+C)		**71,609.6**				

Source: data collected by inventory task team, 2014

5. Status of Usage Firefighting foams and contaminated sites

All foams available in Cambodia are mostly stored at airports and oil terminals, where fire fighter trucks are on standby. Some private oil company have stockpiles of foams, but very limited amount, about 20 to 30 liters per oil storage terminals.

Concerning usage of this firefighting foam, it is noted that about 1220 liters of foam were used in Phnom Penh, to combat fire at a gas station, where about 500 liters were used for oil truck caught fire in 2009, about 600 liters were used to pull-out fire at a gas station in 2004, and about 120 liters were used for exercise at SOKIMEX oil terminal (no date confirmed). Other cases of fire, i.e. houses, markets, cars, etc. are not fought by foams, but instead, water has generally been used. Even in training, water is used to extinguish fire instead of foam.

Regarding contaminated sites related to PFOS, it is expected that those places that had used foams to extinguish fires were contaminated with PFOS. It can be assumed that there is no contaminated site related to PFOS or PFOS related substances storage. Based on field observation, it was noticed that foams are well stored in containers and kept in safe places.

1. Unintentionally-production

The updated inventory has done targeting ten source groups, but some source categories have changed in accordance with the progress of national economy, living style improvement and development policies/strategies of the government. Respective source groups and source categories are described accordingly below.

1.1. Group 1: Waste Incineration

In the context of waste incineration, the report focused on two main waste generation sectors, these include municipal waste and medical waste, and there is not hazardous waste incineration so far. Following description is focused on the municipal waste incineration and medical waste incineration. Beside these two main engaged sources in solid waste management, the Survey Team could not identified any kind of other sources which relates to the set criteria in the Toolkit.

A. Municipal Waste Incineration

In 2020 the total amount of waste incinerated is estimated at 38,486.10 tonnes (**Table 30**). In this regard, the estimated PCDD/PCDF release from municipal waste incineration to air are 13.470 g TEQ/a; fly ash of 19.243 g TEQ/a and bottom ash 0.577 TEQ/a (Table 31).

Figure 10: Waste Incinerator in Tboung Kmom

***Table 30**:* Municipal waste burnt from 31 Mach-31 December 2020

No	Areas/Place		No of incinerators	Period 2020		Days	Waste/ days	Total (tonnes)
1	Phnom Penh	Watphnom High School	1	01-01-20	31-12-20	365	1.5	1,149.00
		Sovieth Hospital	1	01-01-20	31-12-20	365	5.5	3,866.50
2	Kandal	Takmoa City	1	01-01-20	31-12-20	365	3	2,205.00
		Khan Ansnoul	1	01-01-20	31-12-20	365	5.5	3,503.50
		Koltateng Pagoda	1	08-04-20	31-12-20	267	5.5	1,468.50
		Oudongk	1	04-07-20	31-12-20	180	5.5	990.00
		Phnom Ba Seth	1	06-04-20	31-12-20	269	3	807.00
3	Siha-noukvill	Koh Rong	1	01-01-20	31-12-20	365	3	2,019.00
		Koh Rong Sanlem	1	01-01-20	31-12-20	365	3.94	2,245.80
		Steng Hav	1	21-04-20	31-12-20	254	5.5	1,397.00

No	Areas/Place		No of incinerators	Period 2020		Days	Waste/ days	Total (tonnes)
		Airport	1	13-08-20	31-12-20	140	3	420.00
4	Tboung Kmom	Ou Reang Ov	1	01-01-20	31-12-20	365	3	547.50
		Kroung Soung	1	01-01-2020	31-12-20	365	2	2,007.50
5	Prey Veng	Krong Prey Veng	1	01-01-20	31-12-20	365	3	1,095.00
		Kompong trobek	1	14-04-20	31-12-20	261	4.5	2,007.50
6	Mondol Kiri	Krong Monosen	1	01-01-20	31-12-20	365	0.4	1,468.50
7	Kompong-Thnom	Tangkok	1	01-01-20	31-12-20	365	4.5	990.00
		Baray	1	15-09-20	31-12-20	107	5.5	807.00
		Kompong Thmar	1	15-09-20	31-12-20	107	5.5	1,095.00
8	Siem Reap	Sout Nikom (Kompong Klang)	1	01-01-20	31-12-20	365	3	1,438.10
		Kolen District	1	01-01-20	31-12-20	365	9	1,397.00
		Banteay Srey District	1	14-09-20	31-12-20	108	9	420.00
9	Prehvihea	Krong Preh Vihea	1	01-01-20	31-12-20	365	5.5	1,095.00
10	Bonteay Meanchey	Banteay Chma(Thmar Pok)	1	01-01-20	31-12-20	365	1.5	730.00
		Krong Sereisophon	1	01-01-20	31-12-20	365	3	1,095.00
11	Battambang	Moung Resei	1	01-01-20	31-12-20	365	2	1,174.50
12	Pusat	Kandieng	1	01-01-20	31-12-20	365	5.5	146.00
		Kokor District	1	01-01-20	31-12-20	365	5.5	1,642.50
13	Oddar Meanchey	Samrong Distrit	1	15-02-20	31-12-20	320	5.5	588.50
14	Kratie	Sambo District	1	04-05-20	31-12-20	241	3	588.50
15	Takeo	Phnom Tamao	1	30-03-20	31-12-20	276	3	1,095.00
16	Kompong Speu	Oddong District	1	01-01-20	31-12-20	365	3	3,285.00

No	Areas/Place	No of incinerators	Period 2020		Days	Waste/ days	Total (tonnes)
Total		32			9,830	131.84	38,486.10

Source: Department of Solid waste management, EPA, MOE

Table 31: Summary of uPOPs releases from categories contributing to the source group 1a

Cat.	Class	Source categories	Production t/a	Annual release		
				g TEQ/a Air	g TEQ/a Fly ash	g TEQ/a Bottom Ash
		Waste incineration				
a		**Municipal solid waste incineration**	**38,486**	**13.470**	**19.243**	**0.577**
	1	Low technol. combustion, no APCS		**0.000**	**0.000**	**0.000**
	2	Controlled comb., minimal APCS	38,486	**13.470**	**19.243**	**0.577**
	3	Controlled comb., good APCS		**0.000**	**0.000**	**0.000**
	4	High tech. combustion, sophisticated APCS		**0.000**	**0.000**	**0.000**

B. Medical Waste Incineration

During the last decade, the development of health infrastructure has increased significantly. As of 2018, there are a total of 1,457 public health facilities, including 9 national hospitals in Phnom Penh, 25 provincial hospitals, 89 municipal referral hospitals, 1,205 health centers and 129 health posts. According to the latest data, by 2020, the number of public health facilities has changed, with the number of district referral hospitals (CPA1-CPA2) increasing by 92, health centers by 1221 and health centers by 127. The following is the basic public health data and some indicators of public hospital services according to the 2018 Health Achievement Report and 2019 Work Orientation of the Ministry of Health.

The collected waste is transported to the incinerator, which is usually located in a health care facility and incinerated. According to previous studies (Chin, 2015), three types of kilns are used, including: (1) Conventional kilns made of cement and brick, commonly used in health centers or district referral hospitals, there are about 739 kilns in Nationwide, there are 40 CSIM kilns nationwide and 36 modern furnaces nationwide. The latter two types of incinerators have been used in provincial referral hospitals and national hospitals.

Table 32: Hospital Waste incinerators 2004-2020

Incinerator type	Number of units according to inventory Year		
	2004	2013	2020*
Simple local medical waste incinerators (Class C1)	676	739	785
SCIM Incinerators (Class C2)	25	40	67
Modern 1 Chamber incinerator (Class C2)		10	10
Modern 2 Chamber incinerator (Class C2)	02	26	26

Total	**703**	**815**	**865**

Lack of record of medical waste established at special health care facilities in the provinces makes it difficult to determine the exact amount of medical waste according to the type of medical waste to facilitate management, as we are only record year 2006 the waste generate from health center, provincial hospital, clinic and polyclinic as below:

Table 33: Healthcare waste generate in medium from healthcare service

Facility	**Infectious Waste**		**Pathological Waste**		**Sharps Waste**	**Pharmaceutical Waste**	
	Kg/d	L/d	Kg/d	L/d	Box/d		
National Hospital	31.22	1.85	14.83	1.46	12.40	20.00	0.10
Provincial Hospital	18.8	1.66	15.08	10.24	3.60	3.20	0.87
Healthcare Centers	2.75	0.75	2.25	2.00	0.40	1.00	0.00
Clinic	0.10	0.26	1.21	0.73	0.80	0.57	0.00
Polyclinic	0.50	0.04	0.38	0.03	0.10	0.02	0.03

Note: Some waste from national hospital such as Genotoxic (6kg/d &11.5L/d), Chemical Waste (2.28/d&5.98), Pressure containers (2.5kg/d&0.50l/d) and Radioactive waste (10kg/d), MoE, 2019

So far, only data was obtained from the Medical Waste Management Unit of the Cambodian Red Cross Phnom Penh Branch, which estimated the total amount of medical waste generated from health care facilities in Phnom Penh, which is approximately 1.9 tonnes / day or about 40 tonnes / month.

According to a recent study by the team, in 2020, the amount of waste can increase by nearly 3 tonnes / day, in line with the increase in the number of health care facilities and the development of the health sector in Phnom Penh.

The proportion of this medical waste is estimated at 70% as infectious waste, 20% as organic waste and 10% as organic waste and other wastes (PPCA, IGES, Nexus, UN Environment, & CCCA, 2018).

According to a previous study by the World Health Organization, 85% of waste generated from health care facilities was normal or non-hazardous waste and 15% was hazardous waste or medical waste.

Hazardous waste or medical waste is also estimated at 0.5 kg / bed / day for developed countries and about 0.2 kg / bed / day or more for poor or developing countries.

There is generally no distinction between normal waste and medical waste. Therefore, in order to be able to estimate the amount of waste generated by public health care services, it was assumed that the amount of medical waste generated in Cambodia is about 0.5 kg / bed / day due to the situation of separation of medical waste and other waste.

Normal does not seem to be performing well yet. Based on the above coefficients and data on the number of beds, bed utilization rates and number of days of hospitalization, as shown in Table 3 above, it can be estimated the amount of medical waste generated from health care facilities in the provinces.

Nationwide, as shown in Table 8 below, according to the calculation, the amount of medical waste generated from public hospitals is about 5,479 kg / day or about 2,000 tonnes / year.

Figures from the company's study with 24 provincial health departments across the country (excluding Phnom Penh and nine public hospitals) in 2019, as shown in Table 9, found that the amount of waste generated from public health care services totals about 3,900 kg / day or about 1,400 tonnes / year. This size is similar to the above calculation based on the waste generation coefficient of 0.5 kg / bed / day, which is about 3,350 kg / day or about 1,700 tonnes / year.

Using the waste generation rate (0.5 kg / bed / day) and the rate, as well as the total number of hospital beds in the Kingdom of Cambodia, it can be estimated the amount of medical waste generated from public health care facilities throughout the Kingdom of Cambodia as shown in Figure 3 below.

As an assessment, it can be seen that the amount of medical waste increased by about 9% per year, from about 803 tonnes in 2003 to about 1,798 tonnes in 2013 and about 2,601 tonnes in 2018; in 2020 about total 71,08.56 tonnes are generated by separated in public and private hospitals which the public hospital was generated in 1,468.44 tonnes and private hospital was generated in 5,640.12 tons.

Table 34: Summary of uPOPs releases from categories contributing to the source group 1c

Group	Cat.	Class	Source categories	Production	Annual release		
				t/a	g TEQ/a	g TEQ/a	g TEQ/a
					Air	Fly ash	Bottom Ash
	c		**Medical waste incineration**	**7,109**	**75.658**	**0.000**	**0.406**
		1	Uncontrolled batch combustion, no APCS	1,468	**58.738**	**0.000**	**0.294**
		2	Controlled, batch, no or minimal APCS	5,640	**16.920**	**0.000**	**0.113**
		3	Controlled, batch comb., good APCS		**0.000**	**0.000**	
		4	High tech, continuous, sophisticated APCS		**0.000**	**0.000**	**0.000**

Following the 2020 survey, health care waste is estimated of around 5,640.12 t/a that are burnt in controlled incinerators, while the uncontrolled incinerators burnt about 1468.44 t/a. PCDD/PCDF emissions to air from the uncontrolled incinerators are 58.738g TEQ/a; and residues 0.294g TEQ/a as bottom ash. The more controlled medical waste incinerators release to air of 16.92g TEQ/a and to residues are of 0.113g TEQ/a as bottom ash.

Figure 11: Incinerator of healthcare Waste which they are Microwave, CSIM, TELA and Modern

1.2. Group 2: Ferrous and non-ferrous metal production

Generally, Cambodia imports ferrous and non-ferrous metal products and/or raw materials from other countries. There is limited information dealing with ferrous and non-ferrous metal production in Cambodia.

Figure 12 : Type of modern incinerator for healthcare waste in Phnom Penh

The survey team found small-scale handicrafts in different locations – these are being involved in the business of ferrous and non-ferrous metal production, of which one handicraft is located in Banteay Meanchey province, Prey Veny (Meun Chey as the new gate of border) and another in Phnom Penh.

A. Iron Melting Handicraft

Iron melting handicraft was located in Kongnoy, Dankor, Phnom Penh; the handicraft produces any types of steel with different shapes for transformer bobbin, Poly-machine, balance wheel/handle wheel for power machine, Semi for machine and others product which are requesting or order by domestic customer. Old irons, unused/recycle irons are core raw materials to produce such as construction-steels by types which it bought from construction sites, junkshops, wasted pickers, factory of machine waste…etc.

Figure 13: Iron scrap waste collected from Junkshop, factory and electronic kiln to use for melting of old irons

In the process of melting, as revealed by handicraft workers, the cleaning or treating old metal that is dirty or rusted, before re-melting, it is done by a blender using sand and then collected scrapped irons

clean are melted in the iron-kiln at a temperature of around 800-1300°C. That is a conventional and opened kiln with lower methodology used. Electricity power is being used commonly within the melting process, and fuel wood is sometime used instead when electricity supply is cut-off. These small processes do not have afterburners, they use scrap as received, do not pre-heat the scrap; therefore, these facilities are classified as class 2c1.

It is expected there are some iron melting handicrafts being operated in Phnom Penh and some provinces, referred to unofficial information such as Ti-Steel Corporation co,.Ltd, China Gang Tie Steel Co.,Ltd, other small handicrafts. Some of them do not h ave sufficient data/information in relation to the estimation of the generation and release of PCDD/PCDF. These handicrafts commonly use conventional kilns and technology including unsound management of residues, which may cause serious concerns to the environment and public health, especially the release of unintentionally produced POPs by various potential release routes.

There are consistently generating iron wastes and related residues within the production of construction-steels. Noticeably, iron waste around 25 – 30 tonnes are generated per month (360 tonness/year), and these can be sold to local buyers, while other related residues are improperly discarded away. The kilns operate with opened kiln without air pollution and temperature control system, and unsound discard of residues may cause serious concerns to the environment and human health, especially the release of PCDD and PCDF into the environment. But some waste was generated by production processing are dumping nearby to their located, it will cause to water contaminated by heavy metal. And in parallel with receiving the products of melting of scrapped iron, it is also expected to release 0.004 g TEQ/a to air and 0.005 g TEQ/a in residues as above amount output.

Figure 14: Productivities of Iron melting by local order

Figure 15: Zinc productivies in Teoung Meang Roth

B. Hot-dip Galvanizing

In Meunchey, Preyveng, it was found one hot-dip galvanizing handicraft which is in the process of producing steam-pot and needs raw materials of plate lead and aluminum. The articles/products of the galvanizing process (semi-product of steam-pot of lead and aluminum) are exported to Vietnam. The production is about 500 tonnes/month with dividing in 300 tonnes/year of lead which is corresponding to 10 months in a year (equal lead in 3000 tonnes/year and aluminum in 1000 tonnes/ year) which it is totally in 1,000 tons/year. As revealed by handicraft manager, such residues content lead is around 80%, aluminum 15%, and ash accounted for 5%. Currently, hazardous residues are kept at their location. Applying the emission factors for class 2c1 from the Toolkit, the survey team estimated the release of PCDD/PCDF into the environment to be in air 0.00006 g TEQ/a, and residue 0.000010g TEQ/a.

C. Copper production

Kinnrich Resources Co., Limited (Hong Kong) was established in 2018 and an office was skiet up in Shanghai in the same year. KINNRICH COPPER SMELTING CO., LTD.(Cambodia), located near Sihanouk Port in Cambodia, is a subsidiary wholly owned by Kinnrich Resources Co., Limited (Hong Kong). The company was purchasing copper raw material, other metal raw materials and their accessories and selling manufactured goods. Our company is committed to continuous exploration of the value of resources, abide by the commitment to sustainable development. Refer Mr. Wei Jie Liu, Director was reported that the production around 50tons/day equal: 18,250 tons/a. As Toolkit, the survey team estimated the release of PCDD/PCDF into the environment to be air in 14.60 g TEQ/a, to water in 0.009g TEQ/a and residue in 14.498g TEQ/a.

D. Aluminum

Tan Strang small-Scale handicrafts are located in Meun Chey, Prey Veng, and are generating 1660kg/day of melted aluminum which it was producing in 10 months/a equal: 1000tons/a, planning to stop using it at middle of 2021 above mention in hot-dip Galvanizing. The PCCD/PCDF release to environment to be air in 0.10g TEQ/a, and residue in 0.2g TEQ/a.

E. Lead

The SC WADO Component (Cambodia) Co.Ltd is located in Phum Phsar Kandal, Sankat Phsar Kandal, Poy Pet City, Banteay Meanchey province, produces computer hard-disk frame for supplying to computer factories in other countries.

So far Cambodia does not have a factory and/or an enterprise which uses raw material(s) of Aluminum scraps and its treatment. Keeping as baseline information of which the survey team found one factory that uses normal aluminum raw materials in its production process. That is the SC WADO Component (Cambodia) Co. Ltd - a local factory located in Poy Pet City, Banteay Meanchey province. The factory produces the ordered product of computer hard-disk frame for supplying to computer factories in other countries.

Figure 16: Protectivity of lead in Meungchey, Prey Veng provice

Raw aluminum and drillings are imported from abroad as raw materials for this factory. Several raw materials are used in the process of aluminum smelting and making hard-disk frame, these are solvent, lubricant oils and water. The product of hard-disk frame is approximately 210 tonnes being produced monthly by the factory, with 2,555 tons per year. Wastes also found to be generated during the production process. As revealed by the company respondent, solid waste generated annually is of 2,847 tonnes. According to the information available – including world aluminum producers and smelters, this facility only melts aluminum and forms/casts into specific shapes. This factory does not undertake aluminum smelting as described in the Toolkit and therefore, this activity is included in the national release inventory;

And the processing by waste of battery recycling at Meanchey Distict, Prey Veng Province, the main processing of 500 tons of battery waste it smelt of lead in 300tons/months in approximate 10 months per year equal in 3000 tons/a. it will release of PCDD/PCDF air 0.240g TEQ/a.

Table 35: Capacity of SC –Wado's Hardish's production in 2019-2020

Model	**Machine**	**Product Capacity (PCs/)**		**Waste Generate (t/a)**
		Monthly (PCs/)	Product (T/a)	
2.5" Base	10	2,200,000.00	1250.00	
3.5" Base	21	2,860,000.00	7350.00	
3.5" Vacuum Casting	10	500,000.00	3500.00	
	41	5,560,000.00	12,100.00	2,847.00

There is not available information in relation to the use of raw materials and its productions. Therefore, the survey team cannot estimate the amount of PCDD/PCDF generation and release into the environment.

F. Thermal Wire reclamation and e-waste recycling

In nearby the Dangkor Landfild, Phnom Penh, Junkshop was collected all waste from collector and buyer of waste in Phnom Penh, including of wire reclamation and e-waste.

Despite many efforts, it was not possible for the survey team to estimate the releases of PCDD/PCDF from open burning of cables and e-waste since the locations and the amounts are unknown.

Actions should be undertaken to enforce the prohibition of open burning of cables and e-waste in the future to avoid impact on human health.

Table 36: Summary of uPOPs releases from categories contributing to the source group 2

Group	Cat.	Class	Source categories	Production t/a	Annual release g TEQ/a Air	g TEQ/a Water	g TEQ/a Land	g TEQ/a Product	g TEQ/a Residue
2			**Ferrous and Non-Ferrous Metal Production**						
	c		**Iron and steel production plants and foundries**	**360**	**0**	**0**	**0**	**0**	**0**
			Iron and steel plants	*360*	*0*	*0*	*0*	*0*	*0.005*
		1	Dirty scrap, scrap preheating, limited controls	360	**0.004**				**0.005**
		2	Clean scrap/virgin iron or dirty scrap, afterburner, fabric filter		**0.000**				**0.000**
		3	Clean scrap/virgin iron or dirty scrap, EAF equipped with APC designed for low PCDD/PCDF emission, BOF furnaces		**0.000**				**0.000**
		4	Blast furnaces with APCS		**0.000**				
			Foundries	***0***	***0.000***	***0***	***0***	***0***	***0.0***
		1	Cold air cupola or hot air cupola or rotary drum, no APCS		**0.000**				
		2	Rotary drum - fabric filter or wet scribber		**0.000**				**0.000**
		3	Cold air cupola, fabric filter or wet scrubber		**0.000**				**0.000**
		4	Hot air cupola or induction furnace, fabric filter or wet scrubber		**0.000**				**0.000**
			Hot-dip galvanizing plants	**1,000**	**0.00006**	**0**	**0**	**0**	**0.00001**
		1	Facilities without APCS	1,000	**0.00006**				**0.00001**
		2	Facilties without degreasing step, good APCS		**0.000**				**0.000**

		3	Facilities with degreasing step, good APCS		**0.000**				**0.000**
	d		**Copper production**	**18,250**	**14.600**	**0**	**0**	**0**	**11.5**
		1	Sec. Cu - Basic technology	18,250	**14.600**	**0.009**			**11.498**
		2	Sec. Cu - Well controlled		**0.000**	**0.000**			**0.000**
		3	Sec. Cu - Optimized for PCDD/PCDF control		**0.000**	**0.000**			**0.000**
		4	Smelting and casting of Cu/Cu alloys		**0.000**	**0.000**			
		5	Prim. Cu, well-controlled, with some secondary feed materials		**0.000**	**0.000**			
		6	Pure prim. Cu smelters with no secondary feed			**0.000**			
	e		**Aluminum production**	**1,000**	**0.100**	**0**	**0**	**0**	**0.2**
		1	Processing scrap Al, minimal treatment of inputs, simple dust removal	1,000	**0.100**				**0.200**
		2	Scrap treatment, well-controlled, fabric filter, lime injection		**0.000**				**0.000**
		3	Optimized proces for PCDD/PPCDF abatement		**0.000**				**0.000**
		4	Shavings/turnings drying (simple plants)		**0.000**				
		5	Thermal de-oiling, rotary furnaces, afterburners, fabric filters		**0.000**				
		6	Primary Al plants						
	f		**Lead production**	**3,000**	**0.240**	**0**	**0**	**0**	**0.0**
		1	Lead production from scrap containing PVC	3,000	**0.240**				
		2	Lead production from PVC/Cl2 free scrap, some APCS		**0.000**				**0.000**
		3	Lead production from PVC/Cl2 free scrap in highly efficient furnaces, with APC		**0.000**				

			including scrubbers						
		4	Pure primary lead production		**0.000**				
2			**Ferrous and Non-Ferrous Metal Production**		**14.944**	**0.009**	**0.000**	**0.000**	**11.703**

1.3. Group 3: Power Generation and Heating

A. Fossil Fuel Power Plants

a. Coal Fired Power Boilers

Electricity sector is the priority sector among other key sectors for the national economic development. Electricity is required not only for daily living but also for sectoral developments, e.g. industry, handicraft, business, agriculture and so on. Therefore, the Royal Government of Cambodia (RGC) has set the target of rural electrification programme[3] as follows:

1) In 2020 all village in the Kingdom of Cambodia (MOC) will have electricity to use, which is generated from various sources.
2) In 2030, at least 70% of all families in the MOC will have qualified electricity to use as national electricity supply.

In this connection, the RGC tries to identify and develop electricity by doable ways with low a cost/price, for instances, heavy oil power plant, purchasing electricity from adjacent countries, hydropower, and coal power boiler plant. Pertaining on this matter, the RGC also urges to produce electricity from various potential sources including such as: biomass energy, solar energy, biogas energy, etc.

"The Cambodia Energy Limited"– it is a coal fired power boiler plant is located in Kampenh Commune, Stoung Hav, Sihanoukville Province. This coal power boiler plant has commenced since 2014. The coal power boiler plant runs for 24 hours with the produced capacity of electricity 240 MKW/day. According with the questionnaire respondent, it is known that coal is the main raw material to produce electricity. Approximately 1,300 – 1,500 tonnes of coal are used daily, with an average use per day of 1400 tonnes and 511,000 tonnes per year.

"Cambodia International Investment Development Group (CIIDG)"- it is a coal fired power plant located in nearby of CEL which it is established since 2012, which producing the capacity of electricity 843MKW/day with raw material of coals approximately 1,630,000 tons/year.

In total, the above two coal power plants need 2,141,000 tonnes of Charcoal per year.

Table 37: Unit's Conversion of tonnes of coal wood into TeraJoules (TJ)

Fuel type	Amount (t/a)	Heating value (MJ/kg)	Terajoules (TJ)
Charcoal	2,141,000	25-27 (average 26.50)	80,792.45

[3] Ref. to the Investment Project on the Construction of Coal Power Plant in Sihanouk ville, MIME 2010

These coal fired power boiler plants are equipped with the Electrostatic Precipitator (ESP) – an air emission control technology to minimize the atmospheric pollution including climate change and acid rain generation. Residues are mostly ashes generating from the power plant and collected and stored in a warehouse for a final disposal. To ensure un-releasing of atmospheric pollutants including PCDD/PCDF, better quality coals should be used and strictly and regularly control of ESP should take place.

Based on amount of coal (2,141,000 t/y) or 80,792.45TJ, the power boiler plants are assigned the category class 3a2 and the estimated annual releases are 0.808 g TEQ/a to air; and 1.131g TEQ/a in residues.

b. Heavy Metals

Major energy sources for domestic lighting in Cambodia include such as: public electric supply, battery and kerosene. People around 32% use public electric supply; 36% use battery; 29% use kerosene; and 3% other sources (NIS 2012 – Cambodia Socio- Economic Observation). Due to the economic development and people living style improvement, for example, there is an increase of the electricity demands in Cambodia so far, both urban and rural areas.

The "Report on National Strategy for Enhancing Conversion of waste Agricultural Biomass into Energy in Cambodia 2013" indicated that the production of electric power has increased from 1,105.50GWh to 1,378.10 GWh between 2006 and 2007 respectively (Eletricité du Cambodge – EDC), and up to 1,853.50GWh in 2009 (NIS, 2011). Electricity 1,378.10 GWh (for 80.5%) was generated in Phnom Penh (Year book 2008), and 268.60 GWh (equally 19.50%) is produced in provinces in 2007.

About 45.40% (842.40 GWh) of the total electricity used in Cambodia was imported from Thailand (38.49%) and Vietnam (61.51%) (NIS, 2011). Pertaining to self-generation and importation of electric powers from adjacent countries: Vietnam and Thailand, the RGC tries to encourage and boost other available ways of electric power generation, hydropower, biomass and its residues.

Figure 12: Advance oily water treatment unit being used in electric power generation in PPM

In the process of domestic electric power generation and supply, heavy oil is identified the main input, which is imported from countries in the region. There is no report identifying percentage of heavy oils used in power plants. But according to the "Inventory Report on Unintentionally Produced POPs in Cambodia", it is assumed 70 – 80% of heavy oils are used in power plants. In this regard it was assumed the percentage of used heavy oils in power plants being of 80%, while electric power demand is higher so far.

With the total amount of imported heavy oils in 2019 and 2020 respectively of 216,892.58 tonnes and 164,615.40 tonnes (General Department of CAMCONTROL), it was roughly estimated the amount of heavy oils used in the power plant sector (base on above percentage).

Table 38: ***Unit's Conversion of ton Heavy Oil into Terajoules***

Fuel type	Amount (t/a)	Heating value (MJ/kg)	Terajoules (TJ)
Heavy oil	164,615.40	40-43 (average 41.5)	3,966.636

Therefore, the unintentionally produced POPs release from heavy fuel power plants – using class 3a4 emission factor - is estimated to be 0.010 g TEQ/a to air.

B. Biomass Power Plants
    a. Clean Wood Fired Power Boilers

The clean wood fired power boiler is found to be popularly used in Cambodian industry. Steam for ironing – it is a main output of the clean wood fired power boiler in garment industry. In accordance with the questionnaire filling done by most provinces and cities (except Kampong Cham, Takeo and Kampot), there are 243 boilers being operated in the factories of which clean fuel wood is the key fuel combustion. There are approximately 295,920 m^3 of clean woods being used annually or equal 153,878.40 tonnes per year.

Figure 17: Overview of one of clean wood fired power boiler being used in Cambodia industry

An interesting case is the SL Garment Processing (Cambodia) Ltd. The factory is located in Sangkat Stoung Meanchey, Khan Mean Chey, Phnom Penh Capital. A part of its process, the factory uses wood fired power boilers with two functions of taking: (i) steams for ironing; and (ii) electric power with the capacity of 4.500 Kwh. Remarkably, the produced electric power can be for lighting factory areas and sell to EDC. The boiler processing requires clean fired wood 280 tonnes per day, or equal 102,200 tonnes per year.

The total of used clean woods at major sources of above power boilers in industrial sector including the SL Garment Processing (Cambodia) Ltd., is 256,078.40 tonnes annually. Same as previous method, for estimating the release of unintentionally produced POPs from clean wood fires power boilers, it is suggested to convert unit of tonne/year to Terajoules. There are two potential release routes of PCDD/PCDF, through air and the estimated releases are 0.198 g TEQ/a.; and through residues and the estimated releases are 0.060 g TEQ/a.

Table 39: Unit's Conversion of tonnes of clean wood into Terajoules

Fuel type	Amount (t/a)	Heating value (MJ/kg)	Terajoules (TJ)
Clean wood	256,078.40	15-16 (average 15.5)	3,969.22

b. Boilers Fired with Straw and Rice Husk

These sources were not identified by the survey team.

C. Household Heating and Cooking-Biomass

a. Virgin Wood Fired Stove

In Phnom Penh Capital and other provinces/cities, wood, charcoal, and biomass residues are determined as major sources of fuel combustion in restaurants, bread production, rice wine production, palm sugar production, household cooking and the like. Significantly, these major sources are popularly use for household cooking in provinces and cities especially at rural areas, where these are easily purchased or cheap in consuming price, except for Phnom Penh where people are very keen to use LPG gas, electric power and charcoals.

Commonly, there is not a record of ash quantities generated from the combustion of fired woods, charcoal, and biomass or biomass residues from above mentioned sources. Generated ashes from these sources are commonly taken out and discarded at vacant area/space closed to these sources, or discard into dustbins without control.

In Phnom Penh, approximately 10% of fuel wood was used for cooking; while LPG – the most common energy source for cooking accounts for 70%, and followed by charcoal 20% (Statistical Yearbook of Cambodia 2011).

Biomass residues play important roles in household cooking, boiling pump juice, and other small industrial occupation, e.g. production of rice wine, noodle production, palm sugar, etc. It is not a report addressing how many households use biomass and how much quantity for household cooking purposes in Cambodia. Remarkably, as an observation in Phnom Penh and other urban areas, biomass residues, e.g. bagasse, corn stalk and corn cob, coconut husk and coconut shells – all are mostly not used, and such biomass residues are collected and disposed at dumpsite like other urban/household wastes. While the percentage of families in urban consuming LPG gas is around 56.5%, 31.0% families use woods, Charcoal 7.9%, Kerosene 0.4% and other 4.5% (General Population Census, NIS, MOP 2019).

But above solid biomass residues are popularly used at rural and remote areas with very simple stoves, but there is neither assessments nor surveys on the environmental and human health impacts which

resulted from the use of solid biomass. The survey team cannot estimate the generation and release of PCDD/PCDF from the source of biomass fire stoves.

Solid biomass (residue) is recognized to be additional source of available energy in Cambodia. Current biomass available in Cambodia includes: rice husk and rice straw, bagasse residue, corn stalk and corn cob, coconut husk and coconut shell, and rubber woody residue.

Same as the condition of Virgin wood fired stoves, the use biomass fired stoves also may generate and release of PCDD/PCDF resulting from incomplete combustion with limited or without control (ref. to the Toolkit). Potential release routes of PCDD/PCDF are to air, land and residue.

b. Rice Husk Fired Stoves

Simple wood fired stoves are found to be used in Cambodia but mostly are in use in other urban and rural areas beside Phnom Penh. According with NIS/MOP through the "Cambodia Socio-Economy Observation, 2012", 91% of families in other rural areas and 43% of families in other urban areas are using fuel wood for household cooking. There is no available reports or surveys on wood quantity used and its projection of future consumption, including its negative impacts to the environment and human health.

The survey team could not estimate the release of unintentionally produced POPs into the environment via the sub-criteria of virgin wood fired stoves because of the lack of wood consumption statistics.

c. Straw Fired Stoves

A report describing the use of biomass for power boiler to generate large scale community electricity is not existent. Based on informal consultations by phone with the private sector who gets involved on developing project to produce electricity from biomass residue: rice husk, Mr. Ngin Hong16 – Business Development Advisor, Waste to Energy for the Rice Milling Sector in Cambodia and after conducting the field research in the nine targeted provinces such as: Kandal, Battambang, Siem Reap, Banteay Meanchey, Kampong Speu, Pursat, Kampong Thom, Kampong Cham and Prey Veng, it was estimated that rice husks about 50,000 – 60,000 tonnes per year are used to convert powers to self-use in rice-mills only. Therefore, it's assumed the average amount of rice husks (55,000 tonnes per year) are being used in this sector. Therefore, the use of rice husk for power boilers above may release PCDD/PCDF through two identified routes, through air and the estimated release are 0.396 g TEQ/a; and through residues, but the releases in residues could not be estimated since the amount of ash generated, could not be identified.

Table 40: Unit's Conversion of tons rice husk into Terajoules

Fuel type	Amount (t/a)	Heating value (MJ/kg)	Terajoules (TJ)
Rice husk	55,000	13-19 (average 16)	880

The use of biomass including rice husk in domestic stoves saves fossil fuels and is available locally for energy conversion.

d. Charcoal Fired Stoves

Figure 18:rice husk in village

Straw from rice field is used at very small amount in fire stoves in Cambodia rural areas fire stove seems to be less popular consuming at Cambodian rural areas comparing to other biomass residues. This is because at rural areas there are plenty of biomass residues including enable seeking small three-branch/stem, where they can collect at areas closed to their dwelling.

However, rice straws burning is used in some areas especially in rural areas for different purposes, for example, cooking fishes, potatoes, getting heat (to keep warm surrounding) during the cold weather (between December to January). There is no data/statistics toward the quantity of rice straw burning for household cooking. Therefore, the survey team could not estimate the generation and release of PCDD/PCDF coming from rice straw burning.

Figure 19: wood fire by Local family

Charcoal is among core combustion fuels in Cambodian urban and rural areas so far. By observing rural areas, remarkably, people use fire-woods and biomass residues more than charcoals because these are available sources close to the dwelling areas or available to be bought with a lower cost. Vice versa, dwellers have to buy charcoals at charcoal depot or shelling shop by a particular cost.

Table 41: Type of fuel used

Type of fuel used	Total	Urban	Rural
Firewood	60.9	31.0	78.8
Charcoal	7.8	7.9	7.7
Kerosene	0.3	0.4	0.3
Liquefied petroleum gas (LPG)	27.7	56.2	10.7
Electricity	3.0	4.2	2.3
None	0.1	0.2	0.1
Others	0.1	0.1	0.1

Table 42: Amount of firewood, Charcaol, Kerosene and LPG

Area	Year	Number of Households	Type of Fuel							
			Total	Firewood	Charcoal	Kerosene	Liquefied Petroleum Gas (LPG)	Electricity	None	Others
Total	2019	**3,553,021**	100	60.9	7.8	0.3	27.7	3	0.1	0.1
	2008	2,817,637	100	83.6	7.5	0.4	7.9	0.4	0.2	0.1
	1998	2,162,086	100	90.0	5.3	1.8	1.7			1.1
Urban	2019	**1,328,501**	100	31.0	7.8	0.4	56.2	4.2	0.2	0.2

	2008	506,579	100	34.7	25.6	0.4	37.3	1.5	0.4	0.1
	1998	364,581	100	62.9	24.6	2.8	8.8			0.9
Rural	2019	**2,224,520**	100	78.8	7.7	0.3	10.7	2.3	0.1	0.1
	2008	2,311,058	100	94.3	3.5	0.3	1.5	0.1	0.2	0.1
	1998	1,797,505	100	95.6	1.3	1.6	0.3			1.2

The Statistical Yearbook of Cambodia 2011 indicated that around 20% of households in Phnom Penh use charcoals for household cooking, but it is not estimated the amount of charcoal used in a more recent year. One research did by a trainee, namely, "Aurélien HERAILom Paul Sabatier University in French", indicated that charcoal is an important source for household cooking than fire-wood – all of these fuel combustion are transported from various provinces closed to Phnom Penh. The research made an estimation that in 2004 the quantity of charcoal used was about 26,000 tonnes/year, and did a projection until 2009 which indicates a slight decrease to 21,000 tonnes/year, and this quantity may continue decrease due to some reasons of: law enforcement towards forest logging, charcoal price is kept on to increase from time to time, available use of biogas and LPG, etc. However, there is not available data toward the current use of charcoals in the context of domestic cooking, and also it is not possible to estimate the release of PCDD/PCDF by this sector, but the concern of PCDD/PCDF release from charcoal fired stoves are considered (ref. to the Toolkit).

D. Domestic Heating-Fossil Fuels

a. Natural Gas or LPG Fired Stoves

Figure 20: Gas usage for cooking at Phnom Penh city

Natural gas or LPG so far plays important role in energy sector of Cambodia, for instance, domestic cooking, and vehicle fuel combustion instead of using fuel oils. Because of a high expenditure for vehicles in using petroleum/gasoline, fuel oil, etc., and for economic saving, some of people tried to either change or add energy converting system in their vehicle from using petroleum/gasoline/fuel oil to LPG.

There is no reports addressing the consuming of LPG by sectors – a base for calculating the generation and releases of unintentionally produced POPs by consuming sectors. In this regard, the survey team tried to estimate the used LPG amount for domestic cooking in accordance with to the assumption that 97% of LPG were used for domestic cooking in the 2004 (ref. to Inventory Report on Unintentionally Produced POPs in Cambodia). It means that for estimating the LPG use in domestic cooking in 2019-2020, the survey team still kept the same percentage as in 2019 (56.2%) in urban areas, 10.7% in the rural areas and 14.89% in other areas.

Statistics of the General Department of Customs and Excise of MOC indicated that the imported quantity of LPG differs from year to year in accordance with domestic demands, for instance, LPG import in 2011 was 50,241,459 kg; in 2012 it was 45,171,242 kg; and 56,477,122 kg in 2013. In currently data

from Ministry of Mine and Energy (MME) of LPG importation in 2018 in 1,359,000 tonnes; 1,381,560 tons in 2019 and 2,763,130 tonnes in 2020.

Therefore, LPGs use in domestic cooking is estimated to be 2,763,130 tonnes in 2020. Therefore, the release of PCDD/PCDF to air are 0.199 g TEQ/a.

Table 43: ***Unit's Conversion of ton LPG into Terajoules***

Fuel type	Amount (t/a)	Heating value (MJ/kg)	Terajoules (TJ)
LPG	2,763,130	48	132,630.24

To respond to the environmental and health risk mentioned above, MME has continued the implementation of Energy Sector Development Plan, 2005-2024. It envisages diversifying energy supply sources (green energy options) in order to mitigate reliance on fossil fuels through developing renewable energy and promoting the exploration of energy sources such as hydropower, natural gas, and coal. It also plans to increase electricity supply capacity and reduce tariff, encourage the efficient use of energy and mitigate the adverse effects on environment. MME encourages private sector to invest in energy, including generation, transmission, and distribution. As a result, the RGC will be able to effectively implement the planned electrification strategy - "by 2020, all villages in the Kingdom of Cambodia will have access to electricity supplied by the national grid and other sources."

Table 44: Summary of uPOPs releases from categories contributing to the source group 3

Group	Cat.	Class	Source categories	Production	Annual release				
				TJ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
3			**Heat and Power Generation**		Air	Water	Land	Product	Residue
	a		**Fossil fuel power plants**	**84,759.09**	**0.818**	**0**	**0**	**0**	**1.1**
		1	Fossil fuel/waste co-fired power boilers		**0.000**				
		2	Coal fired power boilers	80,792.45	**0.808**				**1.131**
		3	Peat fired power boilers		**0.000**				
		4	Heavy fuel fired power boilers	3,966.64	**0.010**				
		5	Oil shale fired power plants		**0.000**				
		6	Light fuel oil/natural gas fired power boilers		**0.000**				
	b		**Biomass power plants**	**3,969**	**0.198**	**0**	**0**	**0**	**0.1**
		1	Mixed biomass fired power boilers		**0.000**				
		2	Clean wood fired power boilers	3,969	**0.198**				**0.060**
		3	Straw fired boilers		**0.000**				**0.000**
		4	Boilers fired with bagasse, rice husk etc.		**0.000**				**0.000**
	c		**Landfill biogas combustion**	**0**	**0.000**	**0**	**0**	**0**	**0.0**
		1	Biogas-/landfill gas fired boilers, motors/turbines and flaring		**0.000**				
	d		**Household heating and cooking - Biomass**	**888**	**0.400**	**0**	**0**	**0**	**0.0**
		1	Contaminated wood/biomass fired stoves		**0.000**				**0.000**
		2	Virgin wood/biomass fired stoves		**0.000**				**0.000**
		3	Straw fired stoves	888	**0.400**				**0.000**
		4	Charcoal fired stoves		**0.000**				**0.000**
		5	Open-fire (3-stone) stoves (virgin wood)		**0.000**				**0.000**
		6	Simple stoves (virgin wood)		**0.000**				**0.000**

Group	Cat.	Class	Source categories	Production TJ/a	Annual release g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
	e		**Domesting heating - Fossil fuels**	**132,630.24**	**01989**	**0**	**0**	**0**	**0.0**
		1	High chlorine coal/waste/biomass co-fired stoves		**0.000**				**0.000**
		2	Coal/waste/biomass co-fired stoves		**0.000**				
		3	Coal fired stoves		**0.000**				**0.000**
		4	Peat fired stoves		**0.000**				
		5	Oil fired stoves		**0.000**				
		6	Natural gas or LPG fired stoves	132,630.24	**0.199**				
3			**Heat and Power Generation**		**1.615**	**0**	**0**	**0**	**1.2**

1.4. Group 4: Production of Mineral Product

A. Cements Kilns

Currently cement plant are established 5 official factories in 2020 which it is target from 1,000,000 to 2,000,000 tonnes/y which it was increase 4 cement factory found during the field survey in 2013 are only one factory. There are in 2020 as bellowed in Table 45 which it is total amount in 7,790,500 tonnes

Table 45: Cement production in Cambodia (year?)

No	Facility and Address		Raw Material	Secondary/ Alternative Fuel	Process	Type of APCS	Cement Production (Mt/Yr)
	Facility Name	*Address*					
1	K-cement	Kompot	Lime, Clay, and gymsum	Diesel and Coal	Dry	Electrostatic Precipitator, Bag Filter	0.9125
2	Chip Mong INsee	Kompot	Limestone Clay Laterite Bauxite Coal	Rice Husk, Wood Chip, Industrial Waste (Plastic Paper, garment, Vehicle tire etc.)	Dry	Electrostatic Precipitator, Cyclone, Bag filer	2.07
3	Cakrey Ting	Kompot	Limestone, Clay, Coal Gypsum	Rice Husk, general waste	Dry	Electrostatic Precipitator, Cyclone,	1.168
4	Thai Bunrong	Kompot	Limestone, Coal, Clay,	Rice Husk and other waste	Dry	Bag filer	2.00

			Gymsum and Gravel				
5	CONCH	Battombong	Lime, Clay, gypsum, Coal	Rice Husk	Dry	Electrostatic Precipitator, Cyclone,	1.64
						Grand Total	**7.7905**

B. Lime and Brick

According to the survey team with questionnaire filled in by local brick kilns in Cambodia are 4644 facilities, which construction are increase, the minimum of brick are in operational kilns, located predominantly along Cambodia's major waterways, in particular the Mekong and the Tonle Sap river and an overall current population as brick is of minimum 13,154.40 tonnes/a ; clay is the raw material to produce brick, meanwhile fuel woods, scrap cloths and rice husks are main combustion in the heating process (for 15-20 days) with estimated product equal 6,103,641.60 tonnes in 2020 with releases of PCDD/PCDF through potential release routes in total amount of 1.79 g TEQ/a, of which to air: 1.221 g TEQ/a; as products: 0.366 g TEQ/a; and residue: 0.122 g TEQ/a respectively.

Figure 22: Tomrei Brick Kilns in Phnom Penh Tmey, Phnom Penh Capital

Figure 22: Touk Brick kilns in Preveng Province

C. Asphalt Mixing

As the transportation is highly increasing, Government of Cambodia, the Ministry of Public Works and Transport and the Ministry of Rural Development, are the two implementing agencies, with critical institutional development responsibilities. This includes developing a resilient rural road financing strategy, supporting road safety improvements, supporting two ministries with implementation of their gender mainstreaming action plans, and managing performance-based contracts for road maintenance to improve infrastructure sustainability. In the result street are used by AC and DBTS with total square length 496,624.30 tons of asphalt mixing. By this consumption, it is assumed to release unintentionally producted POPs only by the route to air: 0.035g TEQ/a.

Table 46: Road construction by Ministry of Public Work and Transport and Ministry of Rural Development-2020-2021

No	Type of Construct Street	Length (Km)	Width (m)	Asphalt Mix need tons/Km2	Total Asphalt Mix used (tons)
1	Rural Streat by MoRD	108.99	7	25	19,073.25
2	Repaired of Streat by MoVT	178.16	7	25	31,178
3	National Road No.3 -Bekos-KP	64.896	12	25	19,468.8
	National Road No.3 -Chaom Chaov-BEKOS	69.9	24.5	25	42,813.75
4	National Raod No.5	366	23	25	210,450
5	Road Project to Boost Siem Reap Development	82.15	12	25	24,643.5

[4] Source: https://www.projectbloodbricks.org/blog/2020/5/26/tdc34d18vw1fzarb3m80fcwu20r0oi

6	Road Project to Boost Siem Reap Development	108.74	12	25	32,622
7	Phnom Penh-Sihanouk Expressways	190.00	24.5	25	116,375
Total					496,624.30

Table 47: Summary of uPOPs releases from categories contributing to the source group 4

Group	Cat.	Class	Source categories	Production t/a	Annual release g TEQ/a Air	g TEQ/a Water	g TEQ/a Land	g TEQ/a Product	g TEQ/a Residue
4			**Production of Mineral Products**						
	a		**Cement kilns**	**7,790,500**	**0.390**	**0**	**0**	**0**	**0**
		1	Shaft kilns		**0.000**				
		2	Old wet kilns, ESP temperature >300 °C		**0.000**				
		3	Wet kilns, ESP/FF temperature 200 to 300 °C		**0.000**				
		4	Wet kilns, ESP/FF temperature <200 °C and all types of dry kilns with preheater/precalciner, T<200 °C	7,790,500	**0.390**				
	c		**Brick**	**6,103,642**	**1.221**	**0**	**0**	**0.366**	**0.122**
		1	No emission abatement in place and using contaminated fuels	6,103,642	**1.221**			**0.366**	**0.122**
		2	No emission abatement in place and using non-contaminated fuels; Emssion abatement in place and using any kind of fuel; No emission abatement in place but state of the art process control		**0.000**			**0.000**	**0.000**
	f		**Asphalt mixing**	**496,624**	**0.035**	**0**	**0**	**0**	**0.000**
		1	Mixing plant with no gas cleaning	496,624	**0.035**				
		2	Mixing plant with fabric filter, wet scrubber		**0.000**				**0.000**
	g		**Oil shale processing**	**0**	**0.000**	**0**	**0**	**0**	**0.000**
		1	Thermal fractionation						
		2	Oil shale pyrolysis		**0.000**			**0.000**	**0.000**
4			**Production of Mineral Products**		**1.645**	**0**	**0**	**0**	**0.122**

1.5. Group 5: Transport

A. 4-Stroke Engines

Same as in the previous survey in 2003, there is no report mentioning about the vehicle classification of 2-stroke and 4 stroke engines including its number importation and use. Respondents from concerned officials (MPWT and Prov. Dept. of PWT) could not give data/information in relation to 2-stroke and 4-stroke engines' vehicle, except explained the definition of: (i) 2-stroke engines' vehicle – those using mix fuel oil for combustion; and (ii) 4-stroke engines' vehicle – those using plain gasoline or diesel.

In the case of 4-stroke engines, it was assumed that these are the most used vehicle types in Cambodia – all are unleaded gasoline/diesel with catalyst. But this report focuses on unleaded gasoline with catalyst only.

The survey team identified the specific used amounts of gasoline and diesel from 2000 up to 2007 in the transport sector. Therefore, the average used percentage for both gasoline and diesel use could be identifyied from 2000 to 2007 (please see table below), and these are: (i) gasoline: 32%; and diesel: 68%.

Table: Estimation of fuel oil consumption by the transport sectors 200-2007

Year	Gasoline (m^3)	Diesel (m^3)	Total (m^3)	Total Gasoline % by year	Total Diesel % by year
2000	285	799	1084	26%	74%
2001	292	890	1182	25%	75%
2002	300	767	1067	28%	72%
2003	307	790	1097	28%	72%
2004	315	841	1156	27%	73%
2005	326	922	1248	26%	74%
2006	385	925	1310	42%	58%
2007	592	1,048	1640	56%	54%
GRAND TOTAL (%)				258%	542%
Overage % for gasoline				258% / 8=	32%
Overage % for diesel				542% / 8=	68%

Source: Mr. Cheam Sovanny, The 4th Experts Group Meeting on ASEAN- Japan Action Plan on Environment Improvement in the Transport Sector, 26-27 September 2012 Bangkok, Thailand

On the other hand, it was assumed that the gasoline and diesel consumption in transport sector is 65% (Cheam Sovanny, MPWT, 2012). As survey team could calculate Gasoline and Diesel being used in the transport sector based on the total import of fuel oil in Cambodia in 2018- 2020 (MIME-Table 48). According to the assumption 1381.56Ktoe (1,381,560 ton) in 2019 and 2763.13 Ktoe (2,763,130 ton) in 2020. As said above, the 65% of total imported gasoline and diesel being used in transport sector, these estimated to be 898,014 tons in 2019, and 1,796,034.5 tons in 2020. But according with the above table gasoline gasoline about 32% equand diesel about 68%, as below:

- Gasoline 287,364.48 tonnes (2019) and 574,731.04 tonnes (2020)
- Diesel 610,649.52 tonnes (2019) and 1,221,303.46 tonnes (2020)

Table 48: Energy demand imported to use from 2015 to 2020

Import (Unit in Ktoe=1000 tonnes)

Year	Petroleum	Motor Gasoline	Jet Fuel	Gas/Disel Oil	Fuel Oil	LPG	Other Petroleum	Electricity	Total
2015	1,932.00	502	97	1,086	36	192	20	133	3,845
2016	2,265.00	513	106	1,256	140	228	24	136	4,508
2017	2,355.00	585	153	1,262	78	265	12	124	4,698
2018	2,609.00	633	202	1,359	85	319	11	135	5,207
2019	2669.79	645.66	214.1	1381.56	96.9	334.95	10.56	132.3	5,343
2020	2731.996	658.57	224.8	2763.13	98.84	348.348	10.45	134.95	6,826
	14,562.79	**3,537.23**	**996.95**	**9,107.69**	**534.74**	**1,687.30**	**88.01**	**795.25**	**30,426.69**

Source: Ministry of Mine and Energy (energy demand and supply of Cambodia 2010-2020)

***Table 49**: Vehicle register from 2015 to 2020 at MoPWT*

Year Register	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Tourist Car	57,013.00	64,425.00	72,800.00	82,264.00	92,958.00	32,535.30

Heavy Vehicle/Truck	9,792.00	11,065.00	12,503.00	14,128.00	15,965.00	5,587.75
Motorbike	325,837.00	368,195.00	416,062.00	470,150.00	531,269.00	185,944.15

Source: MoPWT's Vehicle register

As demand above, the survey team estimated that the gasoline amount to be used in the 04-stroke enines in 2019 and 2020 are 287,364.48 tonnes and 574,731.04 tons respectively. This equal 574,731.04 tonnes in year 2020. Therefore Therefore, the release of unintentionally produced PCDD/PCDF resulting from the use of gasoline to air is 0.00057 g TEQ/a.

B. Diesel engines

As above brief description and estimation based on the data of imported diesels of data from Ministry Mine and Energy in 2015 – 2020, the amount of diesels using in the transport sector are estimated to be 610,649.52 tonnes in 2019 and 1,221,303.46 tonnes in 2020. Air is the potential release route is expected to be occurred through using diesels in the transport sector. This equal 1,221,303.46 ton of diesel in the year 2020. Therefore, the release of unintentionally produced PCDD/PCDF resulting from the use of diesel to air is 0.122 g TEQ/a.

The survey team did not find information in relation to 2-stroke engine, ship/ boats or LPG.

Table 50: Summary of uPOPs releases from categories contributing to the source group 5

Group	Cat.	Class	Source categories	Consumption t/a *	Annual release g TEQ/a Air	g TEQ/a Water	g TEQ/a Land	g TEQ/a Product	g TEQ/a Residue
5			**Transport**						
	a		**4-Stroke engines**	**574,731.04**	**0.00057**	**0.000**	**0.000**	**0.000**	**0.000**
		1	Leaded fuel		**0.00000**				
		2	Unleaded gasoline without catalyst		**0.00000**				
		3	Unleaded gasoline with catalyst	574,731.04	**0.00057**				
		4	Ethanol with catalyst		**0.00000**				
	b		**2-Stroke engines**	**0**	**0.000**		**0**	**0**	**0**
		1	Leaded fuel		**0.000**				
		2	Unleaded fuel		**0.000**				
	c		**Diesel engines**	1,221,303.46	**0.122**	**0.000**	**0.000**	**0.000**	**0.000**
		1	Regular Diesel	1,221,303.46	**0.122**				
		2	Biodiesel		**0.000**				
	d		**Heavy oil fired engines**	**0**	**0.000**	**0**	**0**	**0**	**0**
		1	All types		**0.000**				
5			**Transport**		**0.123**	**0**	**0**	**0**	**0**

1.6. Group 6: Open burning Processing

There is no national report available in relation to the open burning and self-firing of forests, agricultural biomass residues, grasses. In this regard, the estimation of potential release of unintentionally produced POPs is based on the outcome of fulfilling questionnaires. In the Source Group 6: Opened Burning Process, the two major category sources – these include such biomass burning (from agricultural sector), forest and grass fires and waste burning and accidental fires. Within the process of estimation of potential release of PCDD/PCDF, the survey team used the conversion factor of hectare (area) to tonne (weight), based on experience from the 1st survey in 2004 (made with the 2003 Toolkit).

Table 51: Conversion of unit of hectares into tonnes (ref. to the Toolkit Table II.6.40)

Type	Activity (Ha)	Conversion factor (ton/ha)	Total (tonnes)
Forest fire	2,932	32	93,824
Grass (Tropical, early dry season)	100	1.6	160
Rice	48,500	4.4	213,400

A. Biomass Burning
   a. Agriculture Residues Burning

In this context, the data collection focused on agricultural biomass residues. The survey team got insufficient data/information sent by some provinces and cities. The main respondents are representatives of Provincial Dept. of Agriculture, Forest and Fishery; and Provincial Dept. of Environment. As revealed by competent authorities of these representatives, it was found that paddy fields after harvesting confronted the burning practices (another kind of rice straw) in total areas of 48,500 ha. According to the Table 12, amount of materials burnt in such agricultural areas is 213,400 tonne per year. Therefore, using class 6a1 the potential release of PCDD/PCDF in total 8.54 g TEQ/a, of which release to air are 6.40 g TEQ/a, and to land are 2.13 g TEQ/a.

   b. Forest Fires

As per above respondents in the Agricultural Residues Burning (representatives of Provincial Dept. of Agriculture, Forest and Fishery; and Provincial Dept. of Environment), forest fires occurred about 2,932 ha. According to Table 39 (above), the forest areas converted to amount of fires/burnings equally 93,824 tonne per year. In this regard, the potential release of PCDD/PCDF in total 0.108gTEQ/a, of which release to air are 0.094 g TEQ/a, and to land are 0.014 g TEQ/a.

   c. Grassland and Savannah Fires

Following the input of the respondents from representatives of Provincial Dept. of Agriculture, Forest and Fishery; and Provincial Dept. of Environment, grassland was fired in 2020 on approximately 100 ha. According to the Table 39 above, the survey team estimated the potential release route of PCDD/PCDF are to air for 0.00008 g TEQ/a. and to land 0.00002 g TEQ/a. are total of 0.0001 g TEQ/a.

B. Waste Burning and Accident Fires
   a. Fires at Waste Dumps

So far some relevant regulations toward the prohibition of burning solid wastes at generating sources including dumpsite, were developed and implemented, for example, the "Guideline on Boosting the Carrying out of SSWM, 1999", the "Joint Prakas of MOE and the Ministry of Interior (MOI) on Solid Waste Management in Cities and Provinces, 2003", but open waste burning and/or self-fire at waste piles still happen. According to the outcome of filled questionnaires, the survey team estimated that in 2020 the quantity of waste at dumpsite is about 1,961,931 tonnes to 106 landfills and uncollected waste is about in 1,128,557 tonnes and recyclable waste is about in 159,972 tonnes. Out of the total amount of dumped waste of 1,961,931 tonnes/year, 60% or approximately 1,177,158 tonnes were burnt or gone on a self-fire. For further understanding please see the brief description in **Source Group 9: Disposal and Landfill, in the Criteria: Dumpsite for urban and domestic waste management**. There are two major potential environment media, including air and land, expected to be impacted by the releases of unintentionally produced PCDD/PCDF of 353.147 g TEQ/a to air, and 11.772 g TEQ/a to land, respectively.

b. Accidental Fires in House, Factories

In Cambodia, accidental fires often occur in urban and rural areas especially during the dry season. To minimize this serious concern, local authority often informs and reminds dwellers and other stakeholders to pay attention in preventing and intercepting any cases of accidental fire. Generally, accidental fires may occur to houses, building, factories, markets, etc., because the carelessness in: burning incenses for praying, lighting by candles or crude-oil, electricity sparks (in electricity cable), bursting/leaking gas during cooking and so on.

Table 52: Accident fires in house, building and forest in 2016-2020

Year	***Occurrence (time)***	***Damage (set)***			***Human Accident***	
		House	*Market (shop)*	*Building/Factory*	*Die*	*Injury*
2016	*612*	*760*	*1341*	*3*	*14*	*54*
2017	*514*	*480*	*220*	*6*	*22*	*128*
2018	*534*	*553*	*396*	*2*	*17*	*52*
2019	*717*	*576*	*372*	*1*	*17*	*97*
2020	*937*	*703*	*594*	*3*	*24*	*36*

Total	*3314*	*3072*	*2923*	*15*	*94*	*367*

Source: Department of Fire and Rescue Police, Ministry of Interior, year 2020

These accidental fires sometime cannot be cannot be extinguished in time because such their locations either are far away from urban areas or fire fighter vehicles cannot access for intervention of fire extinguishing. The loss of human life and injury, properties and others – all are consequences resulting from accidental fires, however, they never do an assessment of these impacts to the surrounding environment and public health (resulting from the release of PCDD/PCDF and other pollutions) which result from accidental fires.

The record of fire disasters by the Dept. of Weapons and Fires Management, MOI, is done from 2016-2020 (see a Table 52) to house/building and factory fires. Based on the record, it is known that fires in 2020 occurred in 1300 cases, but the loss (properties, human life, etc.) is minor than these former three years.

c. Open burning of Domestic Waste

Solid waste management in Cambodia is a simple practice or technology – that is an improper management of solid wastes in general. Two aspects of waste management in urban areas were found, these are: (i) improper discard solid waste from various generation sources; and (ii) waste management service which done by private company merely at urban areas where waste collecting vehicles can access and dwellers willing to pay for the waste collection fee. For areas where collecting vehicles cannot access and most dwellers are disagreed to pay for waste collection service, and less cooperation, waste management is recognized to be poor, of which requires to solve properly from responsible institutions, otherwise, this poor practice will harm to the environment and human health by different routes of pollution.

Table 53: overview of urban dumping waste burnt nearby Phnom Penh City

Because of there is no waste collection service, generating wastes are either disposed at vacant or low lands closed to residential areas, or buried or done opened burning. As said above, opened domestic waste management is recognized to cause serious impacts comparing to other poor managerial practices, especially the release of unintentionally produced POPs into the environment.

The outcomes of questionnaire filling indicated that opened burning of domestic wastes is taken around 60 – 80%, therefore, for estimating the quantity of domestic wastes are being openly burnt the average value of 80% it was taken. In short, out of the amount of generate waste of around 1,128,557 tonnes 80% of it was opened burning waste, around 902,845.60 tonnes from total generated waste in 2020, other than collected wastes to dispose at dumpsite and collected recyclable wastes for 20% or equal to

225,711 t/year. For further understanding about the total urban/domestic generation and remaining waste above, please read the **Source Group 9: Disposal and landfill, Criteria: Landfill/Dumpsite, and Sub-Criteria: Dumpsite for urban and domestic waste management**.

Same as the source of Fires at Waste Dumpsite, two potential release routes of air and land also take into account to be occurred in opened burning of domestic wastes. The amount of releasing unintentionally produced POPs to air is 36.114 g TEQ/a, and 0.903 g TEQ/a to land.

d. Accidental Fires in Vehicles (per Vehicles)

The record of accidental car fire is not available. However, this serious event is recognized to be rarely and unintentionally happened in some provinces and cities. As the conclusion of local competence authority, the cause of accidental car fires may from several reasons of: miss-connection of vehicle electric cables, crashing accident, improper function of cooling water tank and compressor, etc.

Phnom Penh Municipal Fire Department reported 27 car was fired in 2020 , the PCDD/PCDF releases where estimated to 0.003 g TEQ/a to air and 0.001 g TEQ/a to land.

Table 54: Summary of uPOPs releases from categories contributing to source group 6

Group	Cat.	Class	Source categories	Production t/a	Annual release g TEQ/a Air	g TEQ/a Water	g TEQ/a Land	g TEQ/a Product	g TEQ/a Residue
6			**Open Burning Processes**						
	a		**Biomass burning**	**307,384**	**6.496**	**0**	**2.148**	**0**	**0**
		1	Agricultural residue burning in the field of cereal and other crops stubble, impacted, poor burning conditions	213,400	**6.402**		**2.134**		
		2	Agricultural residue burning in the field of cereal and other crops stubble, not impacted		**0.000**		**0.000**		
		3	Sugarcane burning		**0.000**		**0.000**		
		4	Forest fires	93,824	**0.094**		**0.014**		
		5	Grassland and savannah fires	160	**0.000**		**0.000**		
	b		**Waste burning and accidental fires**	**2,081,430**	**389.793**	**0**	**13.197**	**0**	**0**
		1	Fires at waste dumps (compacted, wet, high Corg content)	1,177,156	**353.147**		**11.772**		
		2	Accidental fires in houses, factories	1,300	**0.520**		**0.520**		
		3	Open burning of domestic waste	902,846	**36.114**		**0.903**		
		4	Accidental fires in vehicles (per vehicle)	27	**0.003**		**0.002**		
		5	Open burning of wood (construction/demolition)		**0.000**		**0.000**		
6			**Open Burning Processes**		**396.279**	**0**	**15.345**	**0**	**0.000**

1.7. Group 7: Production and use of Chemicals and Consumer Goods

A. Textile and Leader Plants

Table 55: Concentrations of PCDD/PCDF in biocides and dye pigments/dyestuffs

Chemical	Country or use	Concentration (ng I-TEQ/kg)	Remark

Biocides			
PCP Pentachlorophenol	China, Europe, USA	800,000– 4,445,000	Different production processes
PCP-Na Sodium salt of pentachlorophenol	China, Europe, USA	500–3,374,000	Different production processes
CNP Chloronitrofen	Japan	400/300,000	Old/new technology
Dye pigments/starting materials/dye			
Chloranil	Starting material for production of dioxazine dyes	100–3,065,000	Different production processes
Carbazole violet	Dye pigment	211,000	
Blue 106	Dioxazine dye	19,502–56,428	

(Source: UNEP-POPs BAT/BEP guideline 08-2015)

In the MOC as well as other third world countries, conditions and influences causing less and/or severe risks or hazards to the environment and human health were many and varied. Some were constantly within a given locality whereas others were changing or may be unpredictable. In some cases, risks and hazards caused by the activities of living things[5], but in other cases, natural phenomena were responsible.

These can be of natural origin but the ones that because environmental damage are usually man-made. Persistent Organic Pollutants (POP), especially industrial chemical substances/compounds, can be concentrated in the food chain with serious consequences for the predators at the top of the chain. Impractical storage or consumption of hazardous/toxic chemicals in industrial processes including wastewater treatment, for example, the untidy storages of hazardous/toxic chemicals in closed rooms25or opened areas of factories, without labeling and/or precaution sign for a safety reason, or the utilization of such harmful substances without using mass/gloves cause high risks to particular workers and surrounding environment.

[5] Mostly it cover on human activities

B. Textile and leather plant

As explained and guided by the Toolkit, dyeing and washing in textile and leather factories can contribute to releases of PCDD/PCDF to, water and sludge from wastewater treatment system about 10 dyeing and washing factories are located in Phnom Penh, Sihanouk ville, Kampong Chhnang and Svay Rieng provinces. The textile industry in Cambodia does not manufacture textile from raw fibers, therefore there are no textile mills. The survey team did not find any records that dioxin dyestuffs are used in these factories. In Cambodia the main activities are cutting the tissue, sewing and printing on the finished shirt. These activities do not generate or release PCDD/PCDF.

1.8. Group 8: Miscellaneous

A. Crematoria

Figure 24: Crematorium in Pagoda at Battambang Province

Figure 23: Crematorium movable for locating in death's family

In **Cambodia**, when a person dies, the care of the body is undertaken by family. The body would be brought home, washed, dressed, and placed into a coffin. The body is not to be dissected and organs are not to be removed because it is believed that would affect one's rebirth and the body is not embalmed. The traditional funeral is using the 2 ways in Cambodia which is moved to the crematorium or burial site; it is according to their religions. The estimated number of deaths per year in 2020 as 21,928 dead bodies; All of dead funeral were fired of which 97.2% (Buddhism) equal 21,315 dead bodies and 2.8% (others region) equal 614 dead bodies are bury. The crematoria are common using way including which it will be release route of air and residue were found in crematory sector. Notable, there are two different values of releasing unintentionally produced POPs to air due the use of cremation process:

(i.) The most cremating are located in Pagoda which it is built by bricks and cement; (Table 56) and other mobile crematoria or are rental for those are living at remote area or the poor (Table 56). By open cremation class 8b2, 4,077 bodies of which

PCDD/PCDF is estimated to release to air 0.041 g TEQ/a, and 0.010 g TEQ/a to residue.

(ii.) By crematorium, class 8b1, 17,237 bodies cremated released 1.55g TEQ/a to air.

B. Tobacco Smoking

The 2014 and 2020 survey at the tobacco products and consumption companies in Cambodia survey in 2014 as same in 2020, shown: 35,545,628,000 pieces are brand name cigarettes such as Fine, Mild Seven, Dunhill, 555, Marlboro, Winstone, FSSE, Mevius, lapin Camboetc. According to increase of number of smokers, especially Chinese, 25% or 44,432,035,000 pieces (equal 44,432 tonnes) which our team survey can be estimation of PCDD/PCDF value from imported cigarettes by two identified release routes, to air is 0.0044 g TEQ/a, and to residues is 0.0044 g TEQ/a.

However, the release of unintentionally produced POPs from tobacco sector is expected to be decrease due to some key reasons:

– The awareness of health problems and health diseases in relation to smoking of cigarettes is being widely promoted and improved throughout the country in association with obvious evident of people die, serious sick/diseases resulting smoking.
– Legal regulation to ban the smoking has recently approved by the Council of Ministers. This case is clearly emphasized that the RGC's policy to abate health risk and hazard which caused from smoking

Table 56: Summary of uPOPs releases from categories contributing to the source group 8

Group	Cat.	Class	Source categories	Production	Annual release				
				t/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
8			**Miscellaneous**		**Air**	**Water**	**Land**	**Product**	**Residue**
	b		**Crematoria**	**21,314**	**1.592**	**0**	**0**	**0**	**0.010**
		1	No control (per cremation)	17,237	**1.551**				
		2	Medium control or open air cremations (per cremation)	4,077	**0.041**				**0.010**
		3	Optimal control (per cremation)		**0.000**				**0.000**
	e		**Tobacco smoking**	**44,432**	**0.0044**	**0**	**0**	**0**	**0.0044**
		1	Cigar (per million items)		**0.0000**				**0.000**
		2	Cigarette (per million items)	44,432	**0.0044**				**0.0044**
8			**Miscellaneous**		**1.597**	**0**	**0**	**0.000**	**0.015**

1.9. Group 9: Disposal and Landfill

A. Landfill/Dumpsite

General waste and waste disposal at landfill as final treatment is common practice. However, this is still a problem, because most of provincial authorities do not have enough ability and budget for landfill infrastructures, operation and management to properly meet the technical standards. As

the results, operation of landfill turns to open landfill with neither control nor good management (MoE, 2015). In currently, Ministry of Environment has provided the solid waste incinerator to all the provinces and cities for burning the municipal waste but it was only 32 facilities which it was able to burned only 131.84 tons/day, recyclable in 889.07 tons/day and uncollected in 4,588 tons which total generate in 11,206 tons/day.

Figure 25: Industrial landfill at Kombol district from garment factories in PHNOM PENH and others province

Is was estimated that 5597.09 tonnes/day (equal 2,042,937 tonnes/year) were disposed at dumpsite in 2020. According to the Toolkit, there are two potential release routes of PCDD/PCDF identified, to water and uPOPs releases are of 1.021 g TEQ/a, and as residues and uPOPs emissions are of 102.147 g TEQ/a.

B. Sewage and Sewage Treatment

Figure 26: Night soil waste treatment plant in sihanoukville

Cities and provinces of Cambodia, commonly, have neither had a central wastewater treatment plant, nor enough treatment system, including Phnom Penh. Most sewerage systems in these provinces and cities have common function of collecting together rain-waters, treated industrial effluents, sewage including black-water (night soil) from toilet as well. Currently of JICA supported research of the waste treatment plant was permitted of discharge of waste water treatment around 153 factories with amount of 2,125,317.10 m^3/year, it will be gather sludge in 174,637.31 tonnes/year[6]. This waste water discharge is

[6] Waste water of 1000m^3/d will be in 82.17kg VSS/d https://www.lenntech.com/wwtp/calculate-daily-sludge-production.htm

classified 9b2, the releases are PCDD/PCDF in 2020 were 0.028 g TEQ/a to water and 2.813 g TEQ/a in residue

The three main provinces, namely, Battambang, Siem Reap and Sihanouk ville, have the partial central domestic wastewater treatment plant, and these are being operated. A central domestic wastewater treatment plant, however, is being taken into consideration, and studied in some major provinces and cities.

Because of the insufficiency of relevant data/information, e.g. domestic sewage discharge volume, types of wastewater, its quality, condition use and maintenance of sewerage system in most provinces and cities, etc., except Phnom Penh, Battambang, Siem Reap and Sihanouk ville provinces which they reconstruction especial Sihanoukville (Figure 26), the survey team cannot do an assessment of PCDD/PCDF from sewage and/or sewage treatment during this survey 2019-2020.

C. Composting

Compost production process of APSARA Authority, CSARO, COMPED and other informal facilities has many benefits that can be used in agriculture to reduce the use of chemical fertilizers, improve soil quality and collect organic waste to be processed into natural fertilizers, especially as part of the understanding of Clean the environment through the production of compost as well. Not only that, it is also easy to produce without having to spend money to buy raw materials and does not use long and can be used safely. Disintegrate organic matter such as manure and plant waste, and make good compost, depending on the raw material, fresh leaves, kale, grass, cauliflower, vegetables, fruits, kitchen waste, etc. There are four main types of production processes: 1) raw materials, 2) moisture, 3) oxygen, and 4) bacteria.

Figure 27: Sewage run off to receiving sources with city sewage system

Figure 28:Organic waste collectio for composting, COMPED

Based on available data and information and questionnaire filling, the survey team did a conclusion of total compost products per year such as COMPED (production in 60 tonnes/year for compost fertilizer and 1200 tonnes/year for bio-fertilizer), APSARA (production in 40 tons/year) and CSARO (55.30 tonnes/year) approximately total amount 1,355.3 tonnes/year. Two main local NGOs (COMPED and CSARO) and local communities in Kampong Speu province (ref. to official of Provincial Dept. of Agriculture, Fishery and Forestry of Kampong Speu response) got involved on this matter.

Table 57: Organic waste collected in Angkor city by APSARA Authority

Accounting for the two local NGOs only, COMPED can produce organic compost about 70 tonnes/year, CSARO of 55.30 tonnes/year and Apsara authority about 40 as totally in 155.3 tonnes/a. Since there were no sources identified that would result in contaminated compost, class 9d2, clean compost, is applied.
The potential release source of PCDD/PCDF in sector through products equals 0.003 g TEQ/a.

D. Waste Oil Disposal

There is not enough data/information in relation to waste oil generation and disposal for the whole country. In Cambodian context, waste oil commonly is not an object to be disposed – it still has a lesser value through its recycle and/or reuse. Such waste oil commonly from vehicle workshops, for example, is selling to collector for refinery by their third party afterward.

Figure 29: Oil Waste refine in Kampong Speu

According to our team 2020 survey by interview to identify amount of lubricant oil residues (LOR) was done merely at car and moto bicycle garages/workshops, car and moto bicycle washing & lubricant services, and refinery handicrafts which our team found the ZHONGTIAN ZAISHENG ENEGEY

(CAMBODIA) INDUSTRIAL INVESTMENT CO., LTD is located in Village 1, Treng Trayeung Commune, Phnom Sruoch District, Kampong Speu Province.

In short, the collecting LOR amount from car garages/workshops, car and moto bicycle washing and lubricant services (at selected 04 survey areas above) is 100000 L/month (equal 1200 tonnes/year), which is refinery handicrafts, where refinery handicrafts got LOR in amount of 14,000 l of oil residue takes 4 days by 200 degrees Celsius to process into red oil, where 14,000 liters of black oil waste can be processed into 8,400 liters of red oil. - Power for cooking, black oil, drag and oil Red oil products are supplied to local steel, rubber and cigarette factories. - The storage of ash and oil is not technically correct.

On the other hand, waste oils refine of above company in 1200 tons/ year being generated and used by purposes. However, the toolkit does not result emission factor, therefore no release are estimated.

***Table 58**: Summary of uPOPs releases from categories contributing to the sources group 9*

Group	Cat.	Class	Source categories	Production	Annual release				
					g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
9			**Disposal**		**Air**	**Water**	**Land**	**Product**	**Residue**
	a		**Landfills, Waste Dumps and Landfill Mining**	**2,042,937**	**0.000**	**1.021**	**0.000**	**0.000**	**102.147**
		1	Hazardous wastes			**0.000**			
		2	Mixed wastes	2,042,937		**1.021**			**102.147**
		3	Domestic wastes			**0.000**			**0.000**
	b		**Sewage/sewage treatment**	**2,125,491,730**	**0.000**	**0.000**	**0.000**	**0.000**	**34.926**
		1	Mixed domestic and industrial inputs	*2,125,491,730*		*0.000*	*0*	*0*	*34.926*
			No sludge removal	2,125,317,100		**0.000**			
			With sludge removal	174,630.00		**0.000**			**34.926**
		2	Urban and industrial inputs	*0*		*0.000*	*0*	*0*	*0.000*
			No sludge removal			**0.000**			
			With sludge removal			**0.000**			**0.000**
		3	Domestic inputs	*1,460,000,000*		*0.000*	*0*	*0*	*0.000*
			No sludge removal	1,460,000,000		**0.000**			
			With sludge removal			**0.000**			**0.000**
	c		**Open water dumping**	**93,879,148**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
		1	Mixed domestic and industrial wastewater			**0.000**			
		2	Urban and peri-urban wastewater	93,879,148		**0.000**			
		3	Remote environments			**0.000**			
	d		**Composting**	**1,355.3**	**0.000**	**0.000**	**0.000**	**0.061**	**0.000**
		1	Organic wastes separated from mixed wastes	1,200				**0.060**	
		2	Clean compost	155.30				**0.003**	

	e		**Waste oil disposal**	**1,200**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
		1	All fractions	1,200					
9			**Disposal/Landfill**		**0.000**	**1.021**	**0**	**0.061**	**137.07285**

The summary of all group can be release PCDD/PCDF are detailed of amount totally in 696.33g TEQ/a such as to air 504.6 g TEQ/a, Water 1.0 g TEQ/a, Land 15.3 g TEQ/a, Product 0.4 and Residue 174.9 g TEQ/a (Table 59).

Table 59: Summary of total category of all group can be release to air, water, land...etc.

Group	Source Groups	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	89.13	0.0	0.0	0.0	20.23
2	Ferrous and Non-Ferrous Metal Production	14.94	0.1	0.0	0.0	11.70
3	Heat and Power Generation	1.61	0.0	0.0	0.0	1.19
4	Production of Mineral Products	1.65	0.0	0.0	0.37	0.12
5	Transportation	0.12	0.0	0.0	0.0	0.0
6	Open Burning Processes	396.28	0.0	15.34	0.0	0.0
7	Production of Chemicals and Consumer Goods	0.0	0.0	0.0	0.0	0.0
8	Miscellaneous	1.6	0.0	0.0	0.0	0.01
9	Disposal	0.0	1.02	0.0	0.6	137.07
10	Identification of Potential Hot-Spots				0.0	0.0
1-10	**Total**	**504.3**	**1.0**	**15.3**	**0.4**	**170.3**
	Grand Total			**692.46**		

It's suggested to reassessing the release of PCDD/PCDF in 2003 and 2013 and now we are conduct by using the 2020 emission factors as guided by the late version Toolkit for Identify and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs in January 2020. The reassessment is so-called the key inputs comparing with the PCDD/PCDF release in 2013. Both summarized outcomes of the generation and release of PCDD/PCDF in 2003 and 2013 are given in table below.

Table 60: Comparing the PCDD/PCDF release between 2003, 2013 and 2020 by Category Sources

Source Category	2003 Annual releases (g TEQ/a)						2013 Annual Releases (g TEQ/a)						2020 Annual Releases (g TEG/a)					
	Air	Water	Land	Product	Residues	Total	Air	Water	Land	Product	Residues	Total	Air	Water	Land	Product	Residues	**Ttoal**
Waste incineration	41.53	0	0	0	0.41	41.9	60.66	0	0	0	0.31	60.97	89.13	0	0	0	20.23	**109.36**
Ferrous and non-ferrous metal production	0.3	0	0	0	0.56	0.87	0.1	0	0	0	0.159	0.26	14.94	0.01	0	0	11.7	**26.65**
Power generation and heating	8.44	0	0	0	0	8.44	0.747	0	0	0	0.249	0.99	1.61	0	0	0	1.19	**2.8**
Production of mineral products	0.1	0	0	0	0.014	0.14	0.132	0	0	0.021	0.007	0.16	1.65	0	0	0.37	0.12	**2.14**
Transport	0.12	0	0	0	0	0.12	0.048	0	0	0	0	0.048	0.12	0	0	0	0	**0.12**
Open burning processes	24.95	0	3.95	0	0	28.9	214.26	0	9.04	0	0	223.3	396.28	0	0	0	0	**396.28**
Production of chemicals and consumer goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.34	0	0	**15.34**
Miscellaneous	3.77	0	0	0	0.12	3.89	1.5	0	0	0	0.013	1.51	1.6	0	0	0	0.01	**1.61**
Disposal/Landfill	0	0.2	0	0	17.38	17.58		0.028	0	0.003	2.81	2.84	0	1.02	0	0.06	137.07	**138.15**
Potential hot-spots	0	0	0	0	0	0	0	0	0	0	0	0				0	0	**0**
Total	**79.21**	**0.2**	**3.95**	**0**	**18.484**	**101.84**	**277.447**	**0.028**	**9.04**	**0.024**	**3.548**	**290.078**	**505.33**	**1.03**	**15.34**	**0.43**	**170.32**	**692.45**

III. EXISTING PROGRAMMERS FOR MONITORING RELEASES AND ENVIRONMENTAL AND HUMAN HEALTH IMPACTS

Lacking of expertise capacity to cope with POPs and related residues management is also recognized a key challenge in addition to above key constraints. Therefore, the national chemicals and/or POPs management policy should be developed with a clear statement focusing on sustainable development to meet the Government green development agenda and strategies, in line with the Johannesburg implementation plan by 2020 of which *"Chemicals will be produced and used in ways that minimize significant adverse impacts on the environment and human health".*

In recent decades the use of chemical substances and the significance of the chemical industry have significantly increased on a global scale. As a result, more and more toxic substances, including the so-called Persistent Organic Pollutants (POPs), are released into the environment causing adverse effects on human health and the environment. POPs pose a potential threat to human health and the environment across the globe and the exposure to the impact of POPs may lead to serious health problems. Therefore, taking actions at international level is necessary for reduction and elimination of the production, use and release of these dangerous chemicals into the environment. This assessment was conducted mainly based on Cambodian legislation related to POPs management and POPs inventory updated in 2014 conducted throughout the Kingdom of Cambodia. This assessment was supplemented by findings of the inventories of both initial and new POPs substances.

IV. OVERVIEW OF TECHNICAL INFRASTRUCTURE FOR POPS ASSESSMENT, MEASUREMENT, ANALYSIS, ALTERNATIVES AND PREVENTION MEASURES, MANAGEMENT, RESEARCH AND DEVELOPMENT

The MoE, based on its mandate, is responsible for protecting and conserving the environment and related natural resources against any harmful effects from various sources/activities, including the use of agro-chemicals including POP pesticides and relevant residue disposal. Protection and conservation of the environment and related natural resources – that is the cross-cutting issue requiring the coordinating and cooperating from concerned ministries and institutions. Within the implementation of national chemical management programmes, the MoE cooperates with other governmental institutions at both national and sub-national levels, international organizations, non-governmental organizations and private sector, to provided information for farmers, workers, and civil society regarding the implementation of legal instruments of environmental pollution, prevention programme of environmental pollution, public health protection, and minimizing toxic pesticides through doable means.

MAFF promotes public/community awareness and knowledge towards the safe use of agricultural materials, including doable alternative option instead of the use of agro-chemicals, in order to improve agricultural productivity, food safety and food security (ref. to Prakas on control/inspection of food safety of agricultural products, 2007), and public welfare. On the other hand, toward the target of proper use of pesticides, MAFF taken some measurements through provided education, IPM programme, capacity building and awareness raising to those involved (authority, seller, trader, farmers, pesticide use base communities, etc) since 2006.

Besides above activities, NGOs provided relevant comments/suggestions to responsible ministries and/or institutions to develop policy, strategy or action plans through either meeting or workshop. In the context of agro-chemical management, some NGOs actively did some activities such as: assessing the need and use of agro-chemicals and its negative impacts; disseminating and testing on the alternative use of botanic pesticide instead of chemical pesticide (alternative option) and IPM, consuming organic composts, farmer field school, campaigns, media and so on. CEDAC, NGO Forum, Sre Khmer, Cambodia-Australia Agricultural Extension Project, Resource Development International (RDI), Community Sanitation and Recycling Program (CSARO) and Cambodian Education and Waste Management Organization (COMPED), are NGOs actively working on agrochemical and waste management issues. Understanding and recognizing the important roles of NGOs, the Royal Government has encouraged the establishment and operation of civil organizations (especially NGOs) in terms of chemicals management and development in the country.

V. OVERVIEW OF TECHNICAL INFRASTRUCTURE FOR POPS DESTRUCTION

Cambodia is a developing country with inadequate infrastructure for the management and monitoring of POPs as in waste too. In general conclusion, the overall assessment revealed that the main factors contributing to the POPs contamination, POPs waste and pollution in Cambodia are as follows:

- Lack of umbrella law on general chemicals as well as POPs,
- Provisions of such laws or/and Governmental Ordinances does not have clear stipulations on POPs management
- Enforcement of existing laws is still limited because of unclear provision; limited capacity of governmental staff and poor monitoring facility and equipment,
- Capacity of all governmental institutions involved in POPs management as well as in implementation of international treaties is poor (human resource; technical guidelines, and monitoring lab…),
- Human resources are poor. All level start from employees and workers at the field; technical staff; experts to the top level is decision makers are inadequate capacity and have no technical skill in POPs management,
- Lack of technical guidelines related with POPs management,
- Insufficiency of relevant data at all sectors in relation POPs impact on the environment and human health,
- Lack of analytical capacity, poor monitoring programme and very limited capacity of laboratory related with POPs monitoring and management,
- Lack of POPs information exchange mechanism in both national and international levels and lack of database management system in place,
- Lack of allocation budget from government regarding POPs monitoring and implementing POPs management, and
- Awareness on general POPs and POPs hazard is almost zero point at all level of society due to both initial POPs and new POPs is a new concept and issues for Cambodia and it is shortcoming to implement new POPs regulations under obligation of the Stockholm Convention.

In general recommendation, the overall assessment recommended that the main factors contributing to improve POPs management and future elimination of POPs in Cambodia are as follows:

- Amend the existing laws and some Governmental Ordinances and ministerial ordinances and related regulation on POPs management,
- Develop the specific act and regulations on POPs,

- Develop a new technical guideline for POPs management,
- Strengthen law enforcement and continue monitoring activity and inspection of POPs in all sectors and compliance on POPs,
- Develop and implement POPs monitoring programme for all sectors related issues and much focus on conducting health impact and environmental impact assessment caused by POPs,
- Upgrade the monitoring laboratory in monitoring and analysing POPs,
- Clear mentioning of roles and responsibilities of inter-ministries, line agencies, local government and the stakeholders toward the POPs management should be identified and avoiding overlapping tasks or confusing,
- Increasing the cooperation and coordination among inter-ministries and line agencies in managing POPs, and especially in data and information sharing and technical exchange,
- Promote public awareness through mass media about hazards of POPs use as well the dangers of acute or chronic over exposure to stakeholders,
- Conduct training for and promote awareness and knowledge on perception of POPs and hazard, safe handling and correct use of POPs among decision makers, experts, and management of the concerned enterprises, technical staffs, employees and workers, local authorities, and last target in the general public, and
- Promote public awareness as a key factor to promote the public participation in reducing the emission/generation of POPs into the environment.

VI. IDENTIFICATION OF IMPACTED POPULATIONS OR ENVIRONMENTS, ESTIMATED SCALE AND MAGNITUDE OF THREATS TO PUBLIC HEALTH AND ENVIRONMENTAL QUALITY, AND SOCIAL IMPLICATIONS FOR WORKERS AND LOCAL COMMUNITIES

- POP Pesticides

In Cambodia, there are no amount of chlorinated pesticides, including DDT/DDE, HCB, lindane and chlordane, included in the ongoing monitoring of pollutants in the environment and in emissions from point sources. In general, there is decreasing or no concentrations of POP pesticides. Assessment Report on Impact of All POPs to Human Health and the Environment Page –22–

The concentration of POPs pesticides substances in mussels and fish in marine fishery products has been detected in 2004 (based on inventory report 2004), and up to now there has not beenany testing for POPs pesticides contaminated(based on updating POPs inventory report 2014) Also, according to the program on Drinking Water Quality Assessment in Cambodia, 2001, a survey on pesticide residues contaminated ground water(well water) was conducted by WHO in cooperation with the Ministry of Rural Development which showed that there were no pesticides (including POPs pesticides) detected in any of the samples collected. Other potential environmental impacts may include excess volume of pesticides applied, a large portion of which are WHO class I chemicals is a major concern associated with Cambodian agriculture, particularly because it produces contaminated runoff which adversely impacts recipient water resources; Sprays and vapor containing chemicals drift into ambient air during pesticide application, and can be transported long distances depending on persistence of chemicals and weather conditions, and deposited onto soil when it rains; excess chemical residue gets deposited on soil, and subsequently washed away with surface runoff into a water body affecting aquatic organisms and water quality, inappropriate use of pesticides kills natural pest predators and promotes pest resistance; and excess pesticides deposited on soil can infiltrate and contaminate soil when it rains, and potentially contaminate the ground water aquifer that is often a source of drinking water. As the current survey result, it showed that no POPs Pesticides used for agricultural purposes and no

organization has the ability to conduct a monitoring survey or program on pesticides contamination on crops, soil, water and air as well, in Cambodia. Therefore, there is no evidence of POPs Pesticides contamination in the environment.

Cambodia task team members, assisted by the national consultant, completed the updating POPs pesticides inventory during 3 months from January to April 2014. This updating inventory was conducted throughout the 9 provinces of Prey Veng, Kampong Cham, Takeo, Kandal, Kampong Thom, Kampong Speu, Kampong Chhnang, Pusat, Battambang and Phnom Penh municipality. The result has shown that the POPs pesticides were not available in the local markets and farm warehouses. Also, the contaminated sites and obsolete of POPs pesticides were found and reported during inventory 2004; those areas were strictly rechecked for update inventory record in 2014 and none were found. A few reasons are good awareness among Cambodian people, good law enforcement, land use changes, infrastructure development and housing development.

Based on the updating POPs Pesticides inventory report, only one monitoring program for pesticide is Integrated Pest Management (IPM) is currently running in Cambodia. The overall goal of the Cambodian National IPM Program is to improve Food Security and Safety in Cambodia by enhancing the sustainability and economic efficiency of intensified crop production systems through the promotion of Integrated Pest Management skills at the farm level. This program did not focus on POPs pesticides contaminated in food. No basis of the measurements that estimated of the substances including POPs in the food (fruit and vegetables) and human health to be conducted under this monitoring program. In general observation without testing evidence or results, daily intake has decreased significantly or no content for all the substances over the past 5 years in Cambodia (2008-2013). Although, the MAFF not concludes on the basis of the estimated intake compared with the ADI (acceptable daily intake) or TDI (tolerable daily intake), the content of POP pesticides in food does not give grounds for health concerns.

Related to the impact on human health, the MAFF has evaluated that pesticides pose a hazard to human health, animal, wildlife and pose environmental contamination. Although this has not been verified by laboratory tests, villagers in Cambodia have reported livestock deaths that they attributed to pesticide contamination and humans are part of food chain after livestock deaths. One study reported 56 such deaths in 2007 among 25 villages surveyed across 7 provinces. In Cambodia there is very limited information on pesticides-related health incidents and associated costs for treatment and income lost since no systematic data collection on these issues has taken place. However, there are a few study reports produced by the National IPM program (MAFF 2000) and by some NGOs and donors (CEDAC, Pesticide Forum, DANIDA and FAO). The findings of these reports can serve to illustrate the current magnitude of health impacts of pesticide use in Cambodia. There is still not enough data for the identification of pesticides (POPs pesticides) impacts on human health and the environment, but some priority concerns or risks have been observed by governmental institutions. No reports about POP pesticides contaminated have been detected in fruit, vegetables, fish, sea food and food of animal origin to be indicated in this updating POPs pesticides inventory.

- **PCBs**

Based on the updating POPs PCB inventory report 2014, we do not have any new data regarding the PCB impact on human health. Old information and data extracted from inventory report 2004 were used in this assessment of POPs PCB impact on human health.

In 2008, the MOE/Hatfield Consultants' Final Risk Assessment Report for Sambour EDC Warehouse**2**describes the analysis of the blood of warehouse workers and other EDC Training Centre employees. There are 14 blood samples which were analyzed by AXYS using US EPA Method 1668A. Results were reported for all 209 congeners, including total PCBs, PCB homologues, and PCB TEQ (based on the WHO 2006 criteria). Lipids were analyzed and reported for all blood samples.

Results from blood analysis expressed the presence of PCB substances in human blood; even some samples indicated little variation on concentration. Some samples showed higher concentrations than other samples, up to 10 times higher than other blood samples. Information on this individual indicates that the expert, he used to train other employees on how to re-condition old transformers; and he also regularly brought transformer oils home for burning or to be used to lubricate a sewing marching. The other two samples exhibited total PCB concentration 1.8 and three times greater than the next highest concentration, respectively. These two samples corresponded to the senior warehouse managers and a janitor at the warehouse.

In general, concerning PCB impact on the environment and on the human health, Cambodia conducted a health risk assessment project in 2008, in which environmental and blood samples were collected and analyzed find PCB substances in soil, sediment, biota (snail, crabs, and fishes) and human blood. Samples analysis in Canada and Japan confirmed the escape of PCBs substance from broken transformers to and polluting nearby environment. Through food chain aspect, PCBs finally have been entered into animals and humans via intake.

- **POP-PBDEs containing E-waste**

The Ministry of Environment has never investigated levels of PBDEs in E-Waste impact on the environment including in water, soil, marine environment, and air because of no legal enforcement and no law addressing for POP-PBDE management exists in the country and it is the new coming issues in the country. On the other hand, Cambodia also lacks awareness among our lawmakers, technical officers, and people on the sound use or handling of PBDE chemicals including agricultural pesticides, household insect control chemicals, industrial chemicals, etc. causing a significant institutional weakness to manage entirely or partially POP-PBDE either in products or waste forms. The inventory report 2014 on POP PBDE in E-Waste impact on the environment does not provide any results of their survey data. Only one interested recommendation raised by consultant on Monitoring on EEE repairing or dismantling facilities or scrap yards shall be regularly undertaken to ensure that existing legislations are in compliance. Impossible to find levels POPs PBDE in E-Waste impact on the environment. In general assumption, based on new inventory conducted by the inventory team in 2014 is also no monitoring programme has been conducting for assessment of the POPs PBDE in E-Waste impact on the environment and it may not be a big concern for the environment that impact by POP PBDE in E-Wastes.

To some extent, PBDEs evaporates indoors, and people using rooms in which these substances are present, will be exposed to the substances. Cambodia does not have an overall health assessment of chemical substances from selected consumer products in indoor climate, carried out as part of the inventory's survey of chemical substances in consumer products because of limited funds. We are poor also in PBDE exposure study of pregnant women and their unborn children, which included measurement of PBDEs in house dust as well as in maternal and umbilical cord plasma, placental tissue, and breast milk that is much different from other countries that they can be found and showed the total internal exposure to PBDEs. Currently, analyses of PBDE in health are not part of the Cambodia monitoring programme for organic pollutants in industrial processes, recycling stream, waste management and hotspot sites. Unfortunately, based on the inventory of POPs PBDE inventory report 2014 Cambodia has no monitoring programme in place and no available data regarding the impact on human health. The inventory report shows very clearly that, up to now, Cambodia does not have large scale recycling facilities for recyclable wastes including e-waste. Few recycling places were scarcely found in PPM during the study. In short, the recycling activity is focused more on plastic TV/monitors' cases, but toward the producing metal or copper recycling products (recycle products or semi-recycle product)s by using e-waste is not done in Cambodia. The recycling methodology and its

practice is simple, in accompany with improper management or e-waste related toxic residues release and pollution – that is noted as a pollution source to the environment and public health. In conclusion, we must know that, POPs PBDE are discharged into the environment during their production and use in consumer goods during their lifecycle. The path of their intake in the human body is through emissions during the production or processing of these compounds to products and finished articles.

- **POP-PBDEs in Transport**

In Cambodia, the most commonly used PBDEs have been found in car seats, head and arm rests but not in sediments, mussels, and fish. A full study does not exist to show levels of POP PBDE in car seats, head, arm and waste disposal sites. The environmental criteria for PBDEs have not yet been established within the context of environmental protection as well as the human health risk prevention. PBDEs have never been included in any another study or monitoring program yet.

Referring to the historical of import, production, export and use of POP PBDE in Cambodia and based the inventory report 2014, we assume that, currently there are no recycling facilities are in place Cambodia. Nevertheless, some repair garages play a role in dismantling of end of life vehicles to take spare parts and scrap materials for sale, including car seats. In conclusion, the recycling, reuse, and waste of polyurethane foam and plastic from vehicles could not be assessed within the limited time scale and budget of this preliminary inventory.

Human exposure to POPs can be through air, water, soil, food, dermal contact and occupational exposure. There is no specific facility working on POP-PBDEs waste related activities. Most scrap wastes from car repair garages or other car spare parts facilities that may contain POP-PBDEs have been collected together with municipality wastes and sent to city dumpsite as mentioned above. In addition to this, there is no data on car repair garages neither by location and amount and type of wastes generated. Therefore, it is hard to identify hot spot sites with contaminated by POP-PBDEs. Nevertheless, car repair garages and scrap facilities can be assumed as POP-PBDE contaminated sites. There are no results from inventory available in 2014. PBDEs in transportation impact on human health will also be included in a new investigation led by The Ministry of Public Works and Transport in cooperation with the Ministry of Environment and the Ministry of Health in 2016.

- **PFOS in Firefighting Foams**

Cambodia not yet conducted any survey for PFOS and related compounds in or in the environment. Only the first inventory on PFOS in firefighting was conducted by the national inventory team from April to July 2014. Due to the lack of technical survey data for analysis of PFOS, there is no idea to determine the levels of PFOS contaminated in both environment and in the human health. The inventory report assumed that levels of PFOS even maybe low and no concerns were raised about human health. The Ministry of Environment as well as the line Ministries have never undertaken monitoring for PFOS in the environment. A range of organic contaminants have not been determined in environment alongside without support. Future monitoring programme should include the flame retardants PBDEs as well as PFOS. Without the Environment Monitoring Programme, Cambodia will not be able to undertake contaminant analyses (PCBs, PBDEs, PFOS…) in Cambodia's environment. As mentioned in the inventory report 2014, it is clear that only firefighting foam that is likely to be containing PFOS or PFOS related substances, and they are subject for this inventory. The inventory report also assumed that there is neither contaminate site nor hot spot sites related to PFOS or PFOS related substances, even at foam storage facilities. Based on field observations, it was noticed that foams are well stored in containers and kept in a safe place.

- **Unintentionally produced POPs**

There is uncertainty with some of the inventory information particularly in relation to releases to the environment such as land, air and water and impact on human health. There is limited information in relation to dioxin and furan levels found in the Cambodia environment such as water and soil however

the low levels being found as table above is an indicator of low level contamination in the environment. Based on the Inventory Report on Unintentionally Produced POPs in Cambodia 2014 did not indicate figure or scope of negative impacts to human health and the environment, because there was not enough data/information including less capability to identify such negative impacts from unintentionally produced POPs, while Cambodia does not have LAB for monitoring and analysing POPs. The Comparison of Total Release on Unintentionally Produced POPs between 2003 and 2013, among the potential routes of unintentionally produced POPs, air is the route getting most PCDD/PCDF for 277.71g TEQ/a (or equal 95.46%). The release by land is taken about 9.043g TEQ/a (or 3.25%) and it is ranked at second level after the potential route's air. The residues released is taken about 4.02g TEQ/a (or 1.44%) andit is ranked at third level after the potential route's land. On the other hand, the two lowest receiving routes are products and water – these got around 0.058 g TEQ/a, and 0.024 g TEQ/a respectively.

Same as the 1st inventory report 2004, the report commonly assessed vulnerable people and/or areas engaging the sources of generating unintentionally produced POPs based on visible cases and its estimation in accordance with the UNEP Toolkit. For instance, the most potential vulnerable people (direct impact) to unintentionally produced POPs would be waste pickers, workers who work at dumping sites and dwellers living in surrounding areas, or those who lived closed to or on land-fills mixed with PCDD/PCDF, or those who worked in area or engaged activities of unintentionally produced POPs. For those were exposed to less potential impacts – those consumed foods (e.g. vegetable, fish…etc.) taken from urban sewage or wastewater canal, pound/wetland which comprised PCDD/PCDF substances. In Cambodia the potential exposed population based on the second inventory reported in 2014, people mostly faced serious health impacts through directly and/or indirectly contacted/absorbed are as follows:

- Waste pickers at waste generating sources and dumpsites, as well as those dwellers who are living in, surrounding and/or beneath these sources, including domestic animals.
- Workers who are working at occupation areas which generated unintentionally produced POPs (for example, industrial and handicraft sector, composting centre, etc.) without thinking about health safety precaution, e.g. using health safety facilities; surrounding dwellers.
- People who are living at or close to dredging drainages/channels of urban sewers, and those who are living on land filled by sludge or sediment taken from these dredging processes.
- People who work at or live close to power generating and heating plants including crematorium areas.
- It is considered people and workers who live or work at transformer warehouses, where it is concerned on the leakage of PCB oil and other lubricants.

Cambodia has no monitoring programme on controlling dioxins in food and non-available estimated of human exposure to dioxins can result from the consumption of dioxin-contaminated food. Dioxins can occur mainly in foodstuffs of animal origin with a high fat content as they can accumulate in fatty tissues including meat, fish, eggs and milk. The Ministry of Environment should do in conjunction with Ministry of Commerce, local authorities and civil society to undertake regular monitoring of dioxins and furans in various food groups. Through monitoring, Cambodia could indicate levels of dioxin contamination and at concentrations below limits for set out in the future food legislation Dioxins, furans are currently being proposed for inclusion in the list of priority hazardous substances that are subject to environmental quality standards under the development of Cambodia Environmental Pollution Control Law.

VII. DETAILS OF ANY RELEVANT SYSTEM FOR THE ASSESSMENT AND LISTING OF NEW CHEMICALS

As such, Cambodia does not have a well working system for assessment and classification of chemicals regarding their characteristics including hazard, bio-accumulation, and impact on the environment and food chain and more importantly human health, etc. In addition, no criteria is in place for listing new chemicals to be classified into potential risk levels and no system exists for assessment of POPs used in Cambodia due to a number of constrains.

On 23rd May 2001, Cambodia signed the Stockholm Convention and officially became the signatory of the Convention. In May 2006, Cambodia's National Assembly ratified to enforce the Stockholm Convention's regulation. In June 2006, the POP National Implementation Plan (NIP) was officially formulated for reduction and elimination of 12 initial POPs. The first NIP's timeframe covered from 2006-2010. Assessment Report on Impact of All POPs to Human Health and the Environment Page –10– Cambodia as well as other countries adopted the amendments listing the addition of the nine POPs in 2011. The new POPs now listed under the annexes to the Convention include pesticides, industrial chemicals (including flame retardants) and unintentionally produced chemicals. Most of the new POPs were listed in Annex A of the Convention, meaning that Parties were required to eliminate all production and use of that substance (except in areas where specific exemptions have been claimed). One new substance was listed in Annex B, whereby its production and use were allowed only for certain "acceptable purposes" in accordance with specific exemptions. Another new POP was listed in Annex C and Parties were therefore required to reduce unintentional releases through implementation of best available techniques (BAT) and to promote best environmental practices (BEP).

VIII. DETAILS OF ANY RELEVANT SYSTEM FOR THE ASSESSMENT AND REGULATION OF CHEMICALS ALREADY IN THE MARKET

Up to now, Cambodia has neither a specific law nor regulation to properly manage POPs and related substances. Indeed, the several inventory reports of unintentionally produced POPs, DDT for disease vector control, PCBs dielectric fluid for transformers, and the National Profile on Chemicals Management in Cambodia. All identified the need to amend several existing legal instruments by sectors, as well as to develop a particular law/regulation which aims at managing POPs in an environmental sound manner.

Following is the explanation of figure of legislation system in Cambodia, while the Constitution is the supreme law accompanied by relevant laws and sub-decrees as needed. *(Please see the flowchart below).*

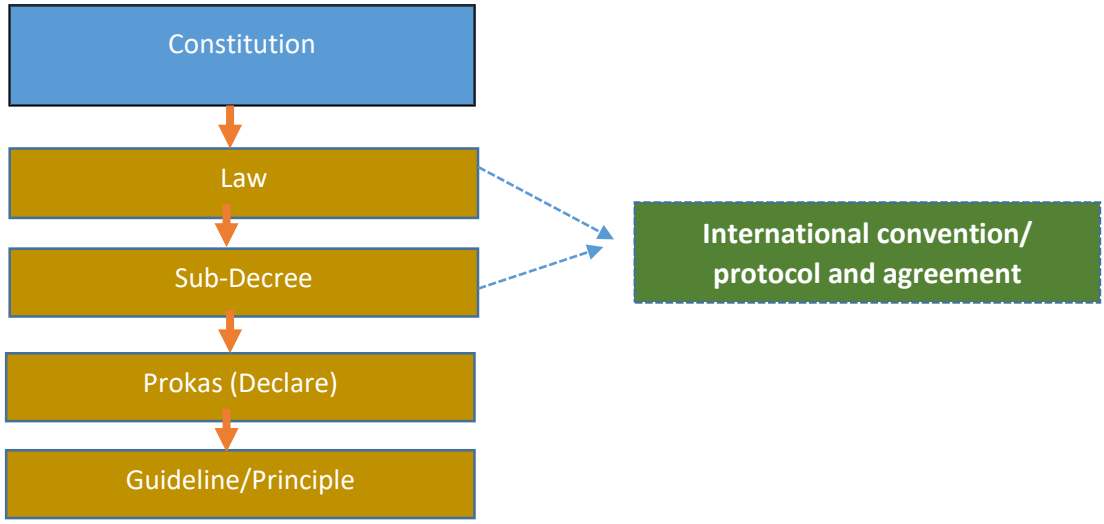


Figure 30: Flowchart of law processing related to chemical and POPs

As said above, the Constitution is the State supreme law, which is the umbrella to develop relevant sectoral laws and regulations. The establishment of various laws is commonly based on the stipulation of the Constitution, for instance, the development of the Law on Environmental Protection and Natural Resources Management is based on the Article 59 of the Constitution.

At the different level, the development of sub-decrees is significantly in accordance with the stipulation of specific law, for example, the development of Sub-decree on Solid Waste Management in 1999 was referred to in Article 13 of the Law on Environmental Protection and Natural Resources Management. Noticeably, the contents of laws and sub-decrees shall integrate to regional and global contexts (ref. to above figure). For the purpose of effective implementing, the Sub-decree usually indicates and identifies responsible institution to develop Prakas or Guidance/Principle upon the obvious requirement. Existing and draft legislations and regulations toward chemicals and POP management in Cambodia.

ANNEX: QUESTIONNAIRE OF POPS COLLECTION DATA

Annex 1: Questionnaire for POPs Pesticide

POPs PESTICIDES FORM

(including contaminated soil, empty packaging material and old contaminated equipment)

Inventory form for recording POPs pesticides

(to be completed for each product or empty contaminated packaging material – if one product is kept in different types of containers, one sheet should be completed for each type of container)

POP Pesticide form number: …… **Site form number:** ……..….. **Date of visit:** ……..……

(copy from site form)

Owner of POP product: …….

(name of person or company)

Labels on containers:

complete info / incomplete info / label missing / not readable / foreign language :
…….

[ ] [ ] [ ] [ ] [ ] …..……..

Trade name: ……..……..……..

Active ingredient(s): ……...…….

Formulation type: liquid / powder / granulate / other: ……..……...

[ ] [ ] [ ] [ ]

Concentration: …… % **/g/liter / g/kg** (info from label) **Batch number:** ……

Manufacturer: ……../…..……..
name company / country

Manufacture date: ……. **Arrival date:** …….

Container type: ……..…….. **Unit size:** ……..…….

Number of containers:…….....……. **Total quantity:** ……

Status of containers: good / minor damage / serious damage / transportable / not transportable

[ ] [ ] [ ] [ ] [ ]

description of container: ……..…….

Origin: purchased / donated (name donor) ……

imported by private company (name company) ……

Status of POP pesticide: waiting to be used / waiting for disposal / already disposed of

[ ] [ ] [ ]

Reason for disposal (if applicable):

Deteriorated / banned / no demand / stock too large / no longer recommended / other

[ ] [ ] [ ] [ ] [ ] [ ]

Remarks:

……
……
……
……

Recording team: ……

Recording Team leader: ……

Photographs (store / site, label, total package, total quantity, contamination / spillage):

Annex 2: Questionnaire for PCB

For: Self reporting form on transformers management status

1	Inventory code for province and municipality	
2	Name of Entity	
3	Entity's address	
4	Report's filling date	
5	Name of reporter	
6	Please descript challenges in the management of old transformers, basically produced prior 1993	
7	Please describe level of PCB understanding of officers working with transformer regarding health and the environmental issues	

8	Please describe measure to address leakage transformers (including environmental management)	
9	Please describe measure to repair all type of transformers both old and new one (particularly focusing on purification machine and retro filling oil)	
10	Please describe the trend use of new transformers in the future (Example, ONAN type)	
11	Please describe measures for the management of out off used transformers particularly the one containing or contaminated with PCB (including old aged or broken transformer found in 2004)	
12	Other comments, if any	

Note: Please handed over this report to inventory team

Date: ..... / ..... / .....
Signature
Name:

For: Self reporting form on PCB Status

No.	Status of transformers	Number of transformers by year				Total numbers (unit)	Total weight (kg)	Dielectric fluid		Leaking	Status of PCB			Other
		Before 1970	1970-1983	After 1983	Un-known			Weight (Kg)	%		Non PCB	PCB Assum	ONAN	
I	**Number of transformers (2014)**													
1.1	*In use*					**0**								
1.2	*Standby for use*					**0**								
1.3	*Standby for repair*					**0**								
1.4	*Waiting for disposal*					**0**								
	Total I	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
II	**Status of repairing new transformers**													
2.1	*Never repaired*					**0**								
2.2	*Used to repair*					**0**								
2.3	*Type of retro-filled dielectric fluid*													
	Total I	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
III	**Status of old transformers aged more than 20 year old (2004-2014)**													
3.1	*Never repaired*													
3.2	*Used to repair*													
3.3	*No used/ disposal*													
	Total III	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
IV	**Balancing transformers**													

Note: Please handed over this report to inventory team

Date: ..... / ..... / .....

Signature

Name:

Annex 3: Questionnaire for POPs PBDEs in E-waste and transport

For Questionnaire for EEE importers

Date:	Location:	Interviewer:

Interview introduction
I am …….. (name interviewer) coming from …. **We are collecting data on e-waste generation and management in order to ….** **Can we ask you some questions about e-waste? / Thank you for participating in our survey**

General information about company	
☐ **Import and/or** ☐ **Production of electrical and electronic equipment (EEE)**	
Name of company	
Address / City	
Number of employees	
Year of foundation	
Name and function of contact person	
Telephone	
E-mail	
Main activity	
To which economic se	☐ **Collection** ☐ **Dismantling/Recycling** ☐ **Refurbishment** ☐ **other:**
Is your institution ISO 14001 certified? *(ISO 14001 is an international certification for an environmental management system)*	☐ **YES** ☐ **NO**

Introducing question
(Introduction & introductory question, answers will not be evaluated. First question should ideally be answered with yes in order to set up a positive atmosphere for the interview to be held.) **Do you know what e-waste or waste of electrical and electronic equipment (EEE)/ waste of electrical and electronic equipment (WEEE) is?** *(describe to interviewed person what EEE)/WEEE is, if necessary….)*

1. Questions about awareness and behaviour			
	Question	*Answer*	*Enhance the replies with comments, suggestions, details, etc.*
1.1	**Are you aware about the environmental hazards caused by discarded EEE**	☐ **YES** ☐ **NO**	
1.2	**Are you aware that some EEE parts may be profitably recycled?**	☐ **YES** ☐ **NO**	
1.3	**Are you aware that some hazardous fractions in EEE need a special treatment in order to be safely disposed of?**	☐ **YES** ☐ **NO**	

2. Imported / produced electric and electronic equipment (EEE)
2.1 EEE-products
Which EEE-products does your company import / produce? **How many units per year of each product does your company sell?** **Which percentage of your imported products are second hand products? (please tick)** **What is the (estimated) national market share in % of your company for each product?** **According to your experience, what's the average life span of each product?** *(**from the purchase** by the consumer **to the disposal** by the consumer)*

a) *Product*	*b)* *units/year*	*c)* *% second hand*	*d)* *market share %*	*e)* *ø life span (years)*
*If PCs or TVs are imported/ produced, **ask for the LCD-CRT ratio** of the monitors!*				

2.2 Distribution of products / customers	
Product	**Who are the (main) customers for each product?**
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households)

	☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:
	☐Wholesaler ☐Retail ☐Direct sale to private users (households) ☐Direct sale to public institutions ☐ Direct sale to corporate users ☐others:

3. General questions			
	Question	*Answer*	*Enhance the replies with comments, suggestions, details, etc.*
3.1	**Is the principle "Extended Producer Responsibility" (EPR) known in your company?**	☐ **YES** ☐ **NO**	**if yes: could you describe it shortly?**
3.2	**Is your company working on a formal basis or is it an informal company?** ☐ **formal** ☐ **informal**		
3.3	**Is your company member of any association or body of importers and/or producers of electrical and electronic equipment (EEE)?**	☐ **YES** ☐ **NO**	**if yes: name of body/association?**
3.4	**Is your company member of any association or body which is in charge of a proper e-waste management (collection and recycling)?**	☐ **YES** ☐ **NO**	**if yes: name of body/association?**
3.5	**Please describe your company's strategy to collect and recycle the e-waste generated by its customers?**		
3.6	**From your point of view, what are the main obstacles for a proper e-waste treatment?**		
3.7	**What should be done to facilitate e-waste management (to your company)?**		
3.8	**Would you be willing to pay for a service/organisation which collects and treats the e-waste generated by your customers?** ☐**YES** ☐**NO**		

	If yes: at what conditions? *(e.g. pickup service, guarantuee of proper disposal, reliability, etc.)*

3.9	**General remarks**

For Questionnaire for households (EEE)

Date:	**Location:**	**Interviewer:**

Interview introduction
I am …….. (name of interviewer) coming from ….
We are collecting data on e-waste generation and management in order to ….
Can we ask you some questions about e-waste? / Thank you for participating in our survey

Interviewed person	
Name (female/male)	
Suburb	
City & State	☐ **rural area** ☐ **urban area**
Telephone	
E-mail	

0. Introducing question
(Introduction & introductory question, answers will not be evaluated. First question should ideally be answered with yes in order to set up a positive atmosphere for the interview to be held.)
Do you know what electrical and electronic equipment (EEE) or waste of electrical and electronic equipment (WEEE) is?
(describe to interviewed person what e-waste is, if necessary….)

1. Questions about awareness and behaviour		
1.1	**Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed of?**	☐ **YES** ☐ **NO**

1.2	**Do waste collectors come and pick up waste at your door?** **Do they pick up e-waste too?**	☐ **YES,everything** ☐ **YES, but no e-waste** ☐ **NO**

1.3	**a) Is the current e-waste collection convenient to you?** **b) What could be improved?**	a) ☐ **YES** ☐ **NO**	b)

2. Number (#) of electrical and electronic equipment in the household
How many appliances of each electric and electronic product do you have in your household (in use and stored)?

Large household appliances (category 1)	
Product	*#*
Fridges*	
Air conditioners*	
Washing machines*	
Freezers	
Clothes dryers	
Electric heaters	
Dish washers	
Grillers	
Electric/Gas stoves	
(Steam-)Ovens	
Electric hot plate	

Small household appliances (category 2)	
Product	*#*
Irons*	
Kettles*	
Blenders*	
Microwaves*	
Hair dryers	
Mixers	
Fans	
Vacuum cleaners	

Carpet sweepers	
Toasters	
Popcorn makers	
Rice cooker	
Water dispenser	
Cables	
Extension boxes (?)	
Soldering iron	
Electric lawn-mowers	
(Alarm) Clocks	

IT and telecommunications equipment (category 3)	
Product	*#*
PCs* (central unit)	
CRT monitors*	
LCD monitors*	
Laptops*	
Mobile phones*	
Phones	
Printers	
Copy machines	
Scanners	
Fax machines	
Modems	

Consumer equipment (category 4)	
Product	*#*
TVs (CRT)*	
TVs (flat panel)*	
Radios*	
Stereos*	
DVD players	
VCR players (video-cassette recorder)	
MP3-players	
Cameras	
Game consoles	

Other _____ _____ _	
Product	*#*

3. Tracer products
3.1Life span of the tracer product
a) From the <u>moment you buy</u> the product <u>until the moment you dispose it or give it away</u>: How many years do you have the product in your household, approximately?   ***b) For how many years do you use the product?***   ***c) After its usage, for how many years do you store the product in your household?***   *note: adding up answer b) and c) should equal answer a) → b) + c) = a)*

Cat.	*Product*	*a)*	*b)*	*c)*
		[in years]		
1	Fridge			
1	Air conditioner			
1	Washing machines			
1				
1				
2	Iron			
2	Kettle			
2	Blender			
2	Microwave			
2				
2				
3	PC (central unit)			
3	CRT monitor			
3	LCD monitor			

3	Laptop			
3	Mobile phone			
3				
3				

Cat.	*Product*	*a)*	*b)*	*c)*
		[in years]		
4	TV (CRT)			
4	TV (flat panel)			
4	Radio			
4	Stereo			
4				
4				
5	Light bulb			
5	Fluorescent tube			
	….			

For: Questionnaire for corporate and institutional consumers

Date:	Location:	Interviewer:

Interview introduction
I am …….. (name interviewer) coming from …. **We are collecting data on e-waste generation and management in order to ….** **Can we ask you some questions about e-waste? / Thank you for participating in our survey**

General information about organization	
Name of organization	
Type of organization	☐ **public authority** ☐ **educational organization** ☐ **private company** ☐ **NGO** ☐ **other:** **…….**
Address / City	
Number of employees	
Name and function of contact person	
Telephone	
E-mail	
Main activity	
For <u>private companies</u>: **Economic activity of the company**	☐ **MiningManufacture of industrial products** ☐ **Bank/Insurance** ☐**Sales** ☐**Telecommunication** ☐ **Tourism** ☐**Other services** ☐ **other:**
Is your organizationISO 14001 certified? *(ISO 14001 is an international environmental certification)*	☐ **YES** ☐ **NO**

Introducing question
(Introduction & introductory question, answers will not be evaluated. First question should ideally be answered with yes in order to set up a positive atmosphere for the interview to be held.) **Do you know what electrical and electronic equipment (EEE) or waste of electrical and electronic equipment (WEEE) is?** *(describe to interviewed person what e-waste is, if necessary….)*

1. Questions about awareness and behaviour			
	Question	*Answer*	*Enhance the replies with comments, suggestions, details, etc.*
1.1	**Are you aware about the environmental hazards caused by discarded electronic equipment?**	☐ YES ☐ NO	
1.2	**Are you aware that some electronic parts may be profitably recycled?**	☐ YES ☐ NO	
1.3	**Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed of?**	☐ YES ☐ NO	
1.4	**Does your organization have a policy or strategy for the management of e-waste?**	☐ YES ☐ NO	
1.5	**Does your organization keep inventories of the electric and electronic equipment discards / stores?**	☐ YES ☐ NO	

2. Number (#) of electrical and electronic equipment in the organization
a) How many appliances of each product do you totally have in your organization (in use and stored)? **b) How many of them are not in use (stored)?**

IT and telecommunications equipment (category 3)		
Product	*a) total*	*b) not in use*
PCs* (central unit)		
CRT monitors*		
LCD monitors*		
Laptops*		
Mobile phones*		
Landline phones*		
Printers*		
Copy machines*		
Scanners		
Fax machines		
Modems		

Large household appliances (category 1)		
Product	*a) total*	*b) not in use*
Fridges*		
Air conditioners*		

Small household appliances (category 2)		
Product	*a) total*	*b) not in use*
Kettles		
Microwaves		
Fans		
Water dispenser		

Consumer equipment (category 4)		
Product	*a) total*	*b) not in use*
TVs (CRT)*		
TVs (flat panel)*		
Radios*		
Video projector		
DVD players		
Cameras		

Lighting equipment (category 5)		
Product	*a) total*	*b) not in use*
Light bulbs		
Fluorescent tubes		
Long life light bulbs (energy saving)		
Rechargeable lamps		

Other _____ ***_____***		
Product	*a) total*	*b) not in use*

3. Tracer products
3.1 Life span of the tracer product
a) From the <u>moment the product is bought until the moment it is disposed of or given away</u>: ***How many years*** **does your organisation** ***have the product, approximately?***   ***b) For how many years is the product in use?***   ***c) After its usage, for how many years is the product usually stored in your organisation?***   *note: adding up answer b) and c) should equal answer a) → b) + c) = a)*

Cat.	*Product*	*a)*	*b)*	*c)*
		[in years]		
3	PC (central unit)			
3	CRT monitor			
3	LCD monitor			
3	Laptop			
3	Mobile phone			
3	Phone			
3	Printer			
3	Copy machine			
3				
Cat.	*Product*	*a)*	*b)*	*c)*
		[in years]		
1	Fridge			
1	Air conditioner			
4	TV (CRT)			
4	TV (flat panel)			
4	Radio			

3.2 Detailed information about tracer products				
Category	*Product*	**Where does your organization buy its products?** *(e.g. supermarket, second hand market, friends, etc.)*	**How many new appliances does your organization buy per year?**	**How many years does your organization store a product before its disposal?**
	In general			
3	PC (central unit)			
3	CRT monitor			
3	LCD monitor			
3	Laptop			
3	Mobile phone			
3	Phone			
3	Printer			
3	Copy machine			
1	Fridge			
1	Air conditioner			
4	TV (CRT)			
4	TV (flat panel)			
4	Radio			

3.3Disposal of tracer product (please tick)										
What does your company do with the electrical and electronic equipment which is not of use anymore?										
Category	*Product*	Sell to a second hand dealer	Give or sell to a scrap dealer	Dispose with general waste	Hand over to an e-waste collection	Sell via tender offer	Sell/hand over to employees	Sell to individuals	Donate	Other
	In general									

3	PC (central unit)									
3	CRT monitor									
3	LCD monitor									
3	Laptop									
3	Mobile phone									
3	Phone									
3	Printer									
3	Copy machine									
1	Fridge									
1	Air conditioner									
4	TV (CRT)									
4	TV (flat panel)									
4	Radio									

4. General questions			
	Question	*Answer*	*Enhance the replies with comments, suggestions, details, etc.*
4.1	**Are you aware of what happens to the equipment you have discarded?**	☐ **YES** ☐ **NO**	
4.2	**From your point of view, what are the main obstacles for a proper e-waste treatment?** *(e.g costs, lack of infrastructure and/or policy within your company, lack of legislation, absence of recycling solutions, absence of collection system, etc.)*		
4.3	**What should be done to facilitate e-waste management (to your organization)?**		
4.4	**Would you be willing to pay for your equipment to be collected and treated?**	☐ **YES** ☐ **NO**	**If yes: at what conditions?** *(e.g. pickup service, guarantuee of proper disposal, etc.)*
4.5	**Is your organisation working on a formal basis or is it an informal organisation?** ☐ **formal** ☐ **informal**		
4.6	**General remarks**		

Interview closure
Thank you for participating in this survey • *The interviewer could also provide information about <u>when & where</u> the results of the survey will be available (if this is the case)*

For: Questionnaire for WEEE recyclers

Date:	Location:	Interviewer:

Interview introduction
I am …….. (name interviewer) coming from …. **We are collecting data on e-waste generation and management in order to ….** **Can we ask you some questions about e-waste? / Thank you for participating in our survey**

General information about company		
Name of company		
Address / City		
Number of employees		
Year of foundation		
Name and function of contact person		
Telephone		
E-mail		
Main activity		
Which e-waste activities does the company carry out?	☐ **Collection** ☐ **Dismantling/Recycling** ☐ **Refurbishment** ☐ **other:**	
Is your companyISO 14001 certified? *(ISO 14001 is an international certification for an environmental management system)*	☐ **YES** ☐ **NO**	

Introducing question
(Introduction & introductory question, answers will not be evaluated. First question should ideally be answered with yes in order to set up a positive atmosphere for the interview to be held.) **Do you know what e-waste or waste of electrical and electronic equipment is?** *(describe to interviewed person what e-waste is, if necessary….)*

1. Questions about awareness and behaviour			
	Question	*Answer*	*Enhance the replies with comments, suggestions, details, etc.*
1.1	**Are you aware about the environmental hazards caused by discarded electrical and electronic equipment?**	☐ **YES** ☐ **NO**	
1.2	**Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed of?**	☐ **YES** ☐ **NO**	**if yes: which ones?**

2. Collection of (waste) electrical and electronic equipment			
	Question	*Answer*	
2.1	**By which strategies and channel does your company collect e-waste?** *Which stakeholders are involved? Responsibilities? etc.*		
2.2	**In terms of amounts, which one is the most important strategy/channel?**		
2.3	**Do you cooperate with other companies/authorities for collection purposes?**	☐ **YES** ☐ **NO**	**if yes: which ones? can you provide any details?**

2.4	**Which company transports the materials during collection?**	

2.5	**What are the main obstacles for a proper e-waste collection?**	

3. Recycling / treatment of waste electric and electronic equipment (WEEE)
3.1WEEE products that are treated
Which electrical and electronic products does your company (collect and) treat? How many units or kg per month of each product does your company actually treat? (throughput) How many units or kg per month of each product could your company treat? (treatment capacity) Does your company pay or charge the treatment of the respective product? Or does it accept the product for free? If yes: how much does your company pay per unit or kg of each product? (price, on average)

a) Product	*b) actual throughput (indicate unit)*	*c) capacity (indicate unit)*	*d) pay / charge*	*e) price (indicate unit)*
*Note: don't forget to **write down the units** of the indicated numbers!*				
General (all products)			☐ pay☐ charge ☐ free	
			☐ pay☐ charge ☐ free	
			☐ pay☐ charge ☐ free	
			☐ pay☐ charge ☐ free	
			☐pay ☐ charge ☐ free	
			☐pay ☐ charge ☐free	
			☐ pay☐ charge ☐ fee	
			☐ pay☐ charge ☐ fee	
			☐pay ☐ charge ☐ free	
			☐pay ☐ charge ☐ free	
			☐ pay☐ charge ☐ free	
			☐pay ☐ charge ☐ free	

			☐pay ☐ charge ☐ free	
			☐pay ☐ charge ☐ free	

Annex 4: Questionnaire for POPs –PFOS, its salts and PFOSF

For: Questionnaire for (metal) plating industry

1. Name and address of plating industry:

Name of industry	Address

2. Type of plating process

(a) Chromium ☐ (b) Nickel ☐ (c) Plastics ☐Others (Please specify

_____

_____

_____

3. Chemicals used in the process (List of chemical mixtures/attach list of chemical mixtures used in the process which contain or might contain PFOS or related substances; if possible with safety data sheets)

Name of chemical or chemical mixture	CAS number	Time span of use	Quantity (Yearly amount)	Contain PFOS or PFOS related chemicals (yes or unknown)

4. If you are aware that any of the chemicals used contain PFOS, salt of PFOS or PFOS precursors, list the chemical mixtures and their contents in the table. Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixture	Name of PFOS or PFOS related chemical	CAS number	Function (foam suppressant, wetting agent etc.)	Content of PFOS or PFOS related chemical (%)	Quantity PFOS or PFOS related chemical used (Yearly amount)

5. Stockpiles of chemical mixtures

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or PFOS related substance	CAS number	Content of PFOS or PFOS related chemicals (%)	Location

6. How is the waste from the metal plating process managed? (Fill in according to the following choices: A. deposited on the factory area, B. destroyed in a waste treatment facility, C. Sent to a landfill, D. Use on agricultural area, E. Reuse of plating bath, F. please specify)

Type of waste	**Waste treatment**
Chemicals becoming waste	
Plating bath when becoming waste	
Waste sludge from the waste water treatment of the rinse water	

7. Are you aware of locations contaminated with PFOS or its related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and PFOS related substances (if available)**

8. Please name the suppliers/producers of the chemical mixtures used in the metal plating process

Name of company	Product	Contact information

9. Remarks

10. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	

Email Address	
Signature	
Date	

For: Questionnaire for textile manufacturers and retailers

1. Name and address of the textile producer or (major) retailer:

Name	Address

2. Select the type of activity of your textile business that apply

Impregnation or coating of textiles	☐	Bulk sale of clothing, apparel, upholstery, furniture made with impregnated textiles	☐
Import of impregnated or coated textiles	☐	Retail sale of clothing, apparel, upholstery, furniture made with impregnated textiles	☐
Manufacturing of clothing, apparel, upholstery, furniture made with impregnated textiles	☐	Cleaning or repair of clothing, apparel, upholstery, furniture made with impregnated textiles	☐
Import of clothing, apparel, upholstery, furniture made with impregnated textiles	☐	Recycling of clothing, apparel, upholstery, furniture made with impregnated textiles	☐
Disposal of clothing, apparel, upholstery, furniture made with impregnated textiles	☐	Others (Please specify):	☐

3. Indicate the type of textiles you deal with

Textiles for clothing	☐	Textiles for apparel	☐
Textiles for upholstery	☐	Textiles for furniture	☐

Textiles for cleaning or repair?	☐	Textiles for recycling to produce other products	☐
Textiles for disposal	☐	Others (Please specify):	☐

4. Indicate the properties of the textiles you deal with:

Water resistant/repellent	☐	Stain resistant	☐
Synthetic	☐	Dirt resistant/repellent	☐
Oil and grease resistant	☐		☐
Other	☐	Please specify	

5. Please specify the amounts of textiles you deal with. (Yearly amount manufactured/ imported /sold/treated/recycled)

Types of textiles identified in part 3 of this questionnaire	Estimated amount per year [kg]
	[kg]
	[kg]
	[kg]
	[kg]

If other consumer products have been produced by recycling textiles produced before 2003, please specify the product and its annual production amount. The year of 2003 has been recognized as the threshold year when use of PFOS has been discontinued in commercial repellent chemicals.

Types of consumer products produced from old textiles	Estimated amount per year [kg]
	[kg]
	[kg]
	[kg]

	[kg]

6. What chemicals have been used for impregnation or coating of textiles in the textiles/products you deal with or manufacture? You might fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Product code or number/ CAS number	Type of textile/product	Weight ratio applied	Contain PFOS or PFOS related chemicals (unknown, yes or no)
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	

7. If you are aware that any of the chemicals used contain PFOS, salt of PFOS or PFOS precursors, list the chemical mixtures and their contents in the table. Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Name of PFOS or PFOS related chemical	CAS number	Content of PFOS or PFOS related chemical (%)	Quantity PFOS or PFOS related chemical used (Yearly amount)

8. How are wastes managed in the facility (Fill in using the following categories: A. deposited on the factory area, B. destroyed in a waste treatment facility, C. Sent to a landfill, D. Use on agricultural area, E. please specify)

Type of waste	**Waste treatment**
Chemicals becoming waste	
Materials becoming waste	
Waste sludge from the waste water treatment of the rinsing water	

9. Stockpiles of PFOS containing chemicals or wastes

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or PFOS related substance	CAS number	Content of PFOS or PFOS related substances (%)	Location

10. Are you aware of locations contaminated with PFOS or PFOS related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and PFOS related substances (if available)**

11. If you are a supplier/producer or downstream user of textiles, upholstery, clothing or apparel please name the company you sell to or buy from:

Name of company	Product	Contact information

12. Please specify the suppliers/producers of the chemical mixtures/materials used in the manufacturing process

Name of company	Product	Contact information

13. Remarks

14. Respondent

Name	

Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

For: Questionnaire for synthetic carpets sector

1. Name and address of the carpet producer or retailer:

Name	Address

2. Select all types of activity of your business that apply

Production of synthetic carpets	☐	Retailers of synthetic carpets	☐
Import of synthetic carpets	☐	Export of synthetic carpets	☐
Cleaning and reimpregnation of synthetic carpets	☐	Waste disposal of synthetic carpets	☐
Recycling of synthetic carpets to produce materials for other consumer products	☐	Others (Please specify):	

3. Select the type of synthetic carpets do you deal with

Synthetic carpets for households	☐	Synthetic carpets for any other indoor use	☐
Synthetic carpets for hotels	☐	Synthetic carpets for outdoor use	☐
Synthetic carpets for cars	☐	Old synthetic carpets for reuse or recycling	☐
Synthetic carpets for trains	☐	Others (Please specify):	☐

4. Indicate the properties of the carpets you deal with:

Water resistant/repellent	☐	Stain resistant	☐
Synthetic	☐	Dirt resistant/repellent	☐
Oil and grease resistant	☐	Contain flame retardants	☐

Other	☐	Please specify

5. Please specify the amounts of synthetic carpets you deal with (amount manufactured/ imported /sold/treated/recycled)

Types of synthetic carpets identified above #3	3-year average amounts of synthetic carpets per year
	[kg]
	[kg]
	[kg]
	[kg]

If other consumer products have been produced by recycling synthetic carpets produced before 2003, please specify the product and its annual production amount. The year of 2003 has been recognized as the threshold year when use of PFOS has been discontinued in commercial repellent chemicals.

Types of consumer products produced from synthetic carpets produced before 2003	Average amounts of products per year
	[kg]
	[kg]
	[kg]
	[kg]

6. What chemicals have been used for impregnation or coating of carpets you deal with or manufacture? You might fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Product code or number/ CAS number	Type of carpet	Weight ratio applied	Contain PFOS or PFOS related substances (unknown, yes or no)
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	

7. If you are aware that any of the chemicals used contain PFOS, salt of PFOS or PFOS precursors, list the chemical mixtures and their contents in the table. Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Name of PFOS or PFOS related substances	CAS number	Content of PFOS or PFOS related substances (%)	Quantity PFOS or PFOS related substances used (Yearly amount)

8. How are wastes managed in the facility (Fill in according to the following options: A. deposited on the factory area, B. destroyed in a waste treatment facility, C. Sent to a landfill, D. Use on agricultural area, E. please specify)

Type of waste	**Waste treatment**
Chemicals becoming waste	
Materials becoming waste	
Waste sludge from the waste water treatment of the rinsing water	

9. Stockpiles of PFOS containing chemicals or wastes

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or related substance	CAS number	Content of PFOS or its related chemicals (%)	Location

10. Are you aware of locations contaminated with PFOS or its related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and its related substances (if available)**

11. If you are a supplier/producer or downstream user of synthetic carpets please name the company you sell to or buy from:

Name of company	Product	Contact information

12. Please specify the suppliers/producers of the chemical mixtures/materials used in the manufacturing process

Name of company	Product	Contact information

13. Remarks

14. Respondent

Name	
Department	
Position	
Telephone	

Mobile Phone	
Email Address	
Signature	
Date	

For: Questionnaire for pulp and paper

1. Name and address of the paper producer or retailer:

Name	Address

2. State the type of technology you use in your production

_____

_____

_____

_____

3. What type of papers do you produce?

(a) Uncoated wood free printing and writing papers ☐

(b) Tissue paper ☐

(c) Coated wood free printing and writing paper ☐

(d) Recycled paper ☐

(e) Coated papers for water and oil/grease repellence ☐

(f) Speciality paper ☐

(g) Other paper (please specify) _____ ☐

4. What chemicals have been used for impregnation or coating of paper or paperboard in the products you manufacture or recycle? Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Product code or number/ CAS number	Type of textile/product	Weight ratio applied	Contain PFOS or PFOS related substances (unknown, yes or no)

			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	

5. If you are aware that any of the chemicals used contain PFOS, salt of PFOS or PFOS precursors, list the chemical mixtures and their contents in the table. Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Name of PFOS or PFOS related substances	CAS number	Content of PFOS or PFOS related substances (%)	Quantity PFOS or PFOS related substances used (Yearly amount)

6. Does any of these chemicals contain other fluorinated carbons?

(a) Yes ☐ (b) No ☐ (c) Don't Know ☐

What chemicals and amount?

Name of chemical	Product code or number	Weight ratio applied per synthetic carpets
		[wt%]
		[wt%]
		[wt%]

7. How are wastes managed? (Fill in according to the following options: A. deposited on the factory area, B. destroyed in a waste treatment facility, C. Sent to a landfill, D. Use on agricultural area, E. please specify)

Type of waste	**Waste treatment**
Chemicals becoming waste	
Materials becoming waste	
Waste sludge from the waste water treatment of the rinsing water	

8. Stockpiles of PFOS containing chemicals or wastes

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or related substances	CAS number	Content of PFOS or PFOS related substances (%)	Location

9. Are you aware of locations contaminated with PFOS or PFOS related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS or PFOS related substances (if available)**

10. If you are a supplier or downstream user of paper or packaging please name the company you sell to or buy materials/chemicals from:

Name of company	Product	Contact information

11. Please specify the suppliers/producers of the chemical mixtures used in the manufacturing process

Name of company	Product	Contact information

12. Remarks

13. Respondent

Name	Position

Department	
Telephone	Mobile Phone
Email Address	
Signature	
Date	

For: Questionnaire for semi-conductor industry, electronic industry and photographic industry

1. Name and address of facility:

Name of facility	Address

2. Tick process stages that apply for your company

Photoresist and anti-reflective coating	☐	Photo-mask	☐
Etching agent for compound semi-conductors and ceramic filters	☐	Edge bead removers	☐
De-gluing agents	☐	Developing agent	☐
Metal plating in closed loop system	☐	Hard metal plating	☐
Decorative metal plating	☐	Desmear agent	☐
Dispersion	☐	Surface treatment	☐
Solder	☐	Paint	☐
Adhesive	☐	Photoimaging	☐
Others (Please specify):			

<u>Please complete the table below</u>

Type of sector	3-year average production of electronic devices per year
	[kg]
	[kg]
	[kg]
	[kg]

Please indicate if your process uses PFOS-contained chemicals? No ☐ Yes ☐

If the answer is yes, please specify the annual amount of PFOS used

Chemical's agent	Name of chemical mixture/agent	Name of PFOS or PFOS related substances	Content of PFOS or PFOS related substances [wt%]	The amount of chemical mixture/agent used in the past and planned to be used in the future [kg]					
				Year					
Etching agent									
Photoresist substance									
Photo-acid generator									
Surfactant									
Anti-reflective coating agent									
Solder									
Adhesive									
Paint									
Photoimaging									
Metal plating									

Photo-mask									
Edge bead removers									
Developing agent									
Hard metal plating									
Desmear agent									
Surface treatment									

3. Obsolete Stockpiles

Name of chemical agent	Product code or number/ CAS number	Storage conditions	Quantity [kg]	Name of PFOS or related substance	CAS number	Content of PFOS or related substance [wt%]	Location
Etching agent							
Photoresist substance							
Photo-acid generator							
Surfactant							
Anti-reflective coating agent							
Solder							
Adhesive							
Paint							
Photoimaging							
Metal plating							
Photo-mask							
Edge bead removers							
Developing agent							

Hard metal plating							
Desmear agent							
Surface treatment							
Mist supressant							
Galvanic bath							

4. How are the PFOS containing waste rejects from your sector processes managed?

(a) Deposited near the factory area ☐

(b) Destroyed in a waste treatment facility ☐

c) Sent to a landfill (name/address) ☐

(d) Other (please specify) _____ ☐

5. Are you aware of locations contaminated with PFOS or its related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and its related substances (if available)**

6. If you are a supplier or downstream user of manufactured or semi-manufactured goods please name the company you sell to or buy from:

Name of company	Product	Contact information

7. Please name the suppliers/producers of the chemical mixtures used in the manufacture processes

Name of company	Product	Contact information

8. Remarks

9. Respondent

Name	
Department	

Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

For: Questionnaire for chemical industries and product suppliers

1. Name and address of the chemical industry:

Name	Address

2. Are you a:

Producer of chemicals or products ☐

Supplier of chemicals or products ☐

Downstream user of chemicals or products ☐

Please specify type of chemicals or products you produce or supply:

PFOS or its related substances	☐	Impregnation/coating formulas for textiles	☐
Fire fighting foam	☐	Impregnation/coating formula for carpets	☐
Aviation hydraulic fluids	☐	Impregnation/coating formula for leather	☐
Insecticides	☐	Impregnation/coating formula for paper and packaging	☐
Drilling fluids			
Chemicals for use in the metal plating industry	☐	Chemicals for use in the electronic industry	☐
Chemiclas for use in the semi-conductor	☐	Chemicals for use in the photographic industry	

Chemical mixtures/agents, Please specify	☐	Products, such as waxes, shampoos, sealants, paint, coating, household and industrial surfactants etc. Please specify	☐
Others (Please specify):			

3. What kind of PFOS or PFOS related substances, chemicals or products containing those substances does your company produce, supply or use?

Name of chemical or product	Product code or number/ CAS number	Yearly amount produced, consumed or supplied (kg)	Name of PFOS or PFOS related substances	CAS number	Content of PFOS or PFOS related substances (%)

4. How are the PFOS containing waste rejects from your sector processes managed?

(a) Deposited near the factory area ☐

(b) Destroyed in a waste treatment facility ☐

c) Sent to a landfill (name/address) ☐

(d) Other (please specify) _____ ☐

5. Stockpiles of PFOS containing chemicals or wastes

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or related substance	CAS number	Content of PFOS or its related chemicals (%)	Location

6. Are you aware of locations contaminated with PFOS or its related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and its related substances (if available)**

7. Please name the company you sell chemicals or products to or buy from:

Name of company	Product	Contact information

8. Remarks

9. Respondent

Name	Position
Department	

Telephone	Mobile Phone
Email	
Signature	
Date	

For: Questionnaire for (major) retailers of commercial products possibly containing PFOS

1. Name and address of retailer:

Name	Address

2. Does your store sell any of the following products?

a) Stain resistant Furniture	Yes ☐	No ☐
b) Shoes	Yes ☐	No ☐
c) Leather	Yes ☐	No ☐
d) Textiles	Yes ☐	No ☐
e) Clothing and apparel	Yes ☐	No ☐
f) Synthetic carpets	Yes ☐	No ☐
g) Industrial and household cleaning products	Yes ☐	No ☐
h) Hygienic articles and cosmetics,	Yes ☐	No ☐
i) Other	Yes ☐	No ☐

3. Does the product(s)/article(s) you sell have or provide the following properties:

Water resistant/repellent	☐	Stain resistant	☐
Oil and grease resistant	☐	Dirt resistant/repellent	☐
Other	☐	Please specify	

4. To your knowledge do any of the products/articles you sell contain or has been surface treated with PFOS or its related substances?

Yes □ No □ Don't know □

If yes please specify:

Type of product	Name of chemical	CAS nr (if available)	Trade name	Content (wt %) (if available)	Sale per year

5. How do you manage wastes potentially containing PFOS? (deposited on a landfill/deposited in the company area/incinerated etc.)

Type of waste	**Waste treatment**

6. Do you have stockpiles of products/articles treated with or containing PFOS or its related substances?

Type of product/article	Storage conditions	Quantity	Name of chemical	CAS number (if available)	Content of PFOS or its related substances (wt %) (if available)	Location

7. Please name the supplier of the commercial products you sell potentially PFOS or other related substances containing articles or products

Name of company	Product	Contact information

8. Remarks

9. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

For: Questionnaire for firefighting foams

1. Name and address of fire fighting agency or factory/entity using or having used fire fighting foams with emphasize on fire fighting foam category:

Name of fire fighting agency/factory/facility/installation/organization	Address

2. Name and producer (seller) of currently used fire fighting foams (Please attach safety data sheet if available)

Name of currently used fire fighting foams	Producer of the fire fighting foams	Product code or number/CAS number	Amount in storage (wt)	Year of purchase

3. Content of chemicals (Check with the safety data sheet if available. Data on chemicals listed as fluorsurfactant, surfactant or surfactant agent, is especially of interest. Please indicate if data on those chemicals are not provided in the safety data sheet. If possible check with producer.)

Name of currently used fire fighting foams	Content of chemicals	CAS number	Content of PFOS or PFOS related substances (yes (wt%), unknown or no)

4. Usage frequency, location and amount of fire fighting foam use for training purpose

Number of times used/year	Total amount used/year	Training location (detail address)

5. Location and amount of fire fighting foam used in actual fire events (for the past 20 years)

S/N	Location of large fire event	Date	Type of fire fighting foam used	Rough amount used

(Use additional sheets, if necessary)

6. How do you manage waste generated from application of fire fighting foam in your organization?

(a) Deposited in the area ☐ (b) Destroyed in a waste treatment facility ☐

(c) Sent to a landfill (name/address) ☐ (d) Other paper (please specify) ☐

7. Stockpiles of PFOS containing chemicals or wastes

Name of fire fighting foam	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or related substance	CAS number	Content of PFOS or related chemical (%)	Location	Year of purchase

8. Have the training site/site of accident fires been investigated?

Yes ☐ No ☐ Don't know ☐

If Yes:

Location	**Fire fighting foam used at the location**	**Levels of PFOS and its related substances in the fire fighting foam used (if available)**	**Levels of PFOS or its related substances at the site (If available: levels in soil/water/sediments)**

9. Please name the supplier of the fire fighting foam you use

Name of company	Product	Contact information

10. Remarks

11. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	

Date	

For Questionnaire for waste treatment facilities

1. Name and address:

Name	Address

2. Please indicate the type of waste management facility you administer:

i. **a) Landfill** ☐
ii. **b) Incinerator** ☐
iii. **c) Waste water treatment facility** ☐

3a. If you administer a waste treatment plant, please indicate what type of waste water you receive:

i. **Industrial waste water** Yes ☐ No ☐
ii. **Waste water from households** Yes ☐ No ☐

3b. How do you manage the sewage sludge?

(a) Deposited on agriculture land ☐

(b) Destroyed in a waste treatment facility ☐

c) Sent to a landfill (name/address) ☐

(d) Other (please specify) _____ ☐

3 c. To your knowledge does the sewage sludge contain PFOS or PFOS related substances?

Yes ☐ No ☐ Don't know ☐

If yes, please specify if possible

Name of chemical	Content (wt %)

4 a. If you administer landfills or incinerators please indicate what kind of waste products you accept/receive:

a) Furniture Yes ☐ No ☐

b) Shoes Yes ☐ No ☐

c) Leather Yes ☐ No ☐

d) Textiles Yes ☐ No ☐

e) Clothing and apparel Yes☐ No ☐

f) Synthetic carpets Yes ☐ No ☐

g) Industrial and household cleaning products Yes ☐ No ☐

h) Hygienic articles and cosmetics, Yes ☐ No ☐

i) Chemical stockpiles Yes ☐ No ☐

J) Industrial waste Yes ☐ No ☐

i) Other Yes ☐ No ☐

4b. To your knowledge does any of the products you store or burn contain or has been surface treated with PFOS or PFOS related substances?

Yes ☐ No ☐ Don't know ☐

If yes please specify, if possible:

Type of product	Name of chemical	Content (wt %)	Yearly quantity (wt)

4c. Please name the supplier of the waste you deal with

Name of company	Waste	Contact information

5. Remarks

6. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

Annex 5: Questionnaire for Unintentional Produced POPs

For Waste Incineration

Name of Location (city, town or province)		
Address of incinerator		
Contact person / owner		
Type of Incinerator for Waste Burned	Municipal waste	[ ]
	Industrial waste	[ ]
	Hospital waste	[ ]
Type of Incinerator	**7 SIMPLE MADE BY BRICK**	[ ]
	8 CSIM	[ ]

	9 MODERN		[ ]
	10 OTHER(PLEASE SPECIFY)		
Number of furnace			
Temperature ^{0}C	1st chamber		
	2nd chamber(after burned)		
Time to Operation_ hour/day	8 h[ ]		
	12 h[ ]		
	24 h[ ]		
	Other		
Quantity of waste burned	Kg /day		Ton/year
Air Pollution Control System (APCS)	Yes	No	If yes, please indicate methodology to clean
			[ ] [ ]

Residues	Yes	No	Pleaseindicatedtheamount	
			kg/ton/day	kg/ton/year
Bottom Ashes	[ ]	[ ]		
Waste Water or Sludge or dried matter	[ ]	[ ]		
Please provide brief on how to dispose of ashes/ waste				

For: Ferrous and Non-Ferrous Metal Production

Name of Location (city, town or province)		
Address of incinerator		
Contact person / owner		
Type of Secondary Metal Production	**11 IRON FOUNDRY**	[ ]
	12 COPPER	[ ]
	13 ALUMINUM	[ ]
	14 LEAD	[ ]
	15 OTHER(PLEASE SPECIFY)	
Number of Facility		
Temperature ^{0}C	Main furnace T°C	
	Second chamber/afterburner T°C	
Type of Furnace	Simple made by brick	[ ]
	Concrete	[ ]
	Modern	[ ]
	16 OTHER(PLEASE SPECIFY)	
	8 h[ ]	

Type of Operation	12 h[ ]	
	24 h[ ]	
Total Annual Production of Metal	Kg /day	Ton/year

Quantity of Metal from wire burned, plastic (Kg, Ton, %,...)	Yes	No	If yes, please indicate and or assume the amount	
	[ ]	[ ]		
Residues from facility	Yes	No	Sludge or dried matter Kg/Ton/day	Bottom Ash Kg/Ton/year
	[ ]	[ ]		
Please provide brief on how to dispose of ashes/ waste				

For Power Generation

Name of Location (city, town or province)				
Address of incinerator				
Contact person / owner				
Type of Energy Source	**Type of Energy Used**			
	Heavy/Fuel Oil			[ ]
	Light Fuel/ Diesel			[ ]
	Coals			[ ]
	Other (please specify)			
17 Type of Operation	8 h			[ ]
	12 h			[ ]
	24h			[ ]
Quantity of Gasoline, Heavy oil, Diesel, or Other Used *(Littre/Ton/ m^3 / year)*	**Gasoline**(L/T// m/y)	**Heavy** (L/T//m/y)	**Diesel** (L/T/m/y)	**Coals** (L/T/m/y)
Type of Furnace/Combustion	**Annual Energy Production KVA/ Year**			
1_ Boiler	[ ]			
2_ Energy)	[ ]			
3_ Other	[ ]			

Air Pollution Control System (APCS)	Yes	No	If yes, please indicate methodology to clean
	[ ]	[ ]	
Fuel Oil Treatment and Waste Oil	Yes	No	If yes, please indicate and or assume the amount (L / Kg / T/y)
	[ ]	[ ]	
Please provide brief on how to dispose of ashes/ waste			

For Cement Plant

Name of Location (city, town or province)				
Address of incinerator				
Contact person / owner				
Type of Energy Source	**Type of Energy Used**			
	Heavy/Fuel Oil			[ ]
	Light Fuel/ Diesel			[ ]
	Coals			[ ]
	Other (please specify)			
18 **Type of Operation**	8 h			[ ]
	12 h			[ ]
	24h			[ ]
Quantity of Gasoline, Heavy oil, Diesel, or Other Used *(Littre/Ton/ m^3 / year)*	**Gasoline**(L/T// m/y)	**Heavy** (L/T//m/y)	**Diesel** (L/T/m/y)	**Coals** (L/T/m/y)
Annual Production of Cement	**Ton / Year**			
Air Pollution Control System (APCS)	Yes	No	If yes, please indicate methodology to clean	
	[ ]	[ ]		
Residues	Yes	No	If yes, please indicate and or assume the amount (L / Kg / T/y)	
	[ ]	[ ]		

Please provide brief on how to dispose of ashes/ waste	

For Mineral Production

Name of Location (city, town or province)		
Address of incinerator		
Contact person / owner		
Type of Facility	Cement	[ ]
	Lime	[ ]
	Brick	[ ]
	Glass	[ ]
	Asphalt	[ ]
19 Type of Operation	8 h	[ ]
	12 h	[ ]
	24h	[ ]
Total Annual Production	**Amount (kg/ton/piece/day/ month / year)**	
Type of Furnace	Simple made by brick	[ ]
	Concrete or Modern	[ ]
	Other different	[ ]
Source of Heat	Wood	[ ]
	Charcoal	[ ]
	Heavy oil fuel	[ ]
	Biomass, rice husk	[ ]
	Old automobile tired	[ ]
	Other	[ ]
Temperature T ^{0}C)		
Residues	Yes / No	
	[ ] / [ ]	

Please provide brief on how to dispose of ashes/ waste	

For Transportation

Name of Location (city, town or province)				
Address of incinerator				
Contact person / owner				
Type of Fuel (L/ T/a)	Lead Gasoline	Un-Lead Gasoline	Diesel	Heavy Oil
Annual Total (for only transport sector_ L/T/ year)				
4-strok engines without catalyst				
Fuel Used for 4-Strok engines without catalyst (total %)	Lead Gasoline	Un-Lead Gasoline	Diesel	Heavy Oil
4-strok engines with catalyst				
Fuel Used for 4-Strok engines equipped with catalyst(total %)	Lead Gasoline	Un-Lead Gasoline	Diesel	Heavy Oil
2-strok engines				
Fuel Used for 2-Strok engines (total %)	Lead Gasoline	Un-Lead Gasoline	Diesel	Heavy Oil
Ships				
Total Consumption of Fuel (total %)	Lead Gasoline	Un-Lead Gasoline	Diesel	Heavy Oil
Train				
Total Consumption of Fuel(total %)	Lead Gasoline	Un-Lead Gasoline	Diesel	Heavy Oil

For Open Burning Process

Name of Location (city, town or province)	
Address of incinerator	
Contact person / owner	

Biomass Burned[ ]	
19.1 Type of Biomass Burned	**Surface Burned**(in $m^2$and or m^2/ ha)
1_ Rice husk	
2_ Grass	
3_ Straw	
4_ Leaf-tree	
5_ Animal manual	

Waste Burned[ ]			
Total Amount of Waste Burned (Kg/ Ton/ day/ month/ year)	Kg/ Ton/ day	Kg/Ton/ Month	Kg/Ton/ Year

Percentage of Waste (Burned, Recycled,….)	
Total waste for recycled (%)	
Total waste disposed at dump site (%)	
Total waste burned at dump site (%)	
Uncontrolled waste burned at open area (%)	

Accidental Fire[ ]	
Total number houses fired / year	
Total number factories fired / year	
Total number vehicles/ ship/ train/ fired / year	
Other fired / year	

For Crematoria

Name of Location (city, town or province)				
Address of incinerator				
Contact person / owner				
Type of Crematoria	Simple made by brick [ ]			
	Modern) [ ]			
Number of Cops Burned in Crematoria (body or %)	Number of Cops/D	Number of Cops/M	Number of Cops/Y	
Number of Cops Burned in Open Area (body or %)	Number of Cops/D	Number of Cops/M	Number of Cops/Y	
Residues (after burned)		Yes	No	Kg/Tone/m/y
	Bottom ash	[ ]	[ ]	
	Waste water/ Sludge)	[ ]	[ ]	
Please provide brief on how to dispose of ashes/ waste				

For Composting

Name of Location (city, town or province)		
Address of incinerator		
Contact person / owner		
Method Used for Composting)	Aerobic conditions	[ ]
	Anaerobic conditions	[ ]
	Other	[ ]
Type of Waste for Composting s (wastes kitchen and garden waste, se wage sludge, agricultural crop, residue, some industrial wastes, anim al manures and human excreta)	**Amount(Kg/Ton/month/year)**	
	Wastes kitchen	
	Wastes market or Garden	
	Sewage sludge	

	Agricultural crop residues	
	Industrial waste	
	Animal waste	
	Other	
Total Amount of Composting	**Amount (Kg/ton/month/year)**	

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