Thailand’s POPs Inventory Assessment Report

Executive Summary

March 2020

Prepared by:
National Metal and Materials Technology Center (MTEC)
National Science and Technology Development Agency (NSTDA)

Authors and Contributors

Part 1: Thailand's 2017 POPs Pesticides Inventory

Authors: Dr. Premrudee Kanchanapiya, Dr. Yot Boontongkong
Advisors: Dr. Nuansri Tayapat
Inventory Team:
MTEC: Dr. Premrudee Kanchanapiya, Dr. Pawadee Methacanon, Dr. Nudjarin Ramungul
PCD: Ms. Teeraporn Wiriwutikorn, Ms. Chalalai Rungruang
Reviewers: Dr. Roland Weber and Members of Working Groups 1 and 2
Editor: Dr. Apinya Panupat, Dr. Nudjarin Ramungul

Part 2: Thailand's 2019 POPs Industrial Chemicals Inventory

Authors: Dr. Nudjarin Ramungul, Dr. Samerkhae Jongthammanurak
Advisors: Associate Prof. Dr. Suwana Kitpadi Boontanon,
Assistant Prof. Dr. Dudsadee Muenhor,
Assistant Prof. Dr. Kulwadee Tongpubesra Eisingerich,
Dr. Asira Fuongfuchat, Dr. Chureerat Prahsarn, Dr.Wuttipong Rungseesantivanon,
Dr. Rittirong Pruthtikul, Dr. Ekkarut Viyanit
Inventory Team:
MTEC: Dr. Nudjarin Ramungul, Dr. Samerkhae Jongthammanurak,
Dr. Pawadee Methacanon, Dr. Supamas Danwittayakul,
Dr. Premrudee Kanchanapiya, Mr. Nuttakorn Keratipaiboon,
Ms. Saisamorn Khunhom, Mr. Supachai Songngam,
Mr. Pavares Viwatthanasittiphong, Ms. Paradee Boonrong,
Mr. Nuttawut Dokpikul
PCD: Ms. Teeraporn Wiriwutikorn, Ms. Chalalai Rungruang
Reviewers: Dr. Roland Weber, Members of Working Groups 1 and 3
Editors: Dr. Yot Boontongkong, Dr. Samerkhae Jongthammanurak, Dr. Pawadee Methacanon

Part 3: Thailand's 2017 Unintentional POPs Inventory

Authors: Dr. Nudjarin Ramungul, Dr. Yot Boontongkong
Advisors: Assistant Prof. Dr. Chalongkwan Tangbanluekal,
Assistant Prof. Dr. Ekbodin Winijkul
Inventory Team:
MTEC: Dr. Nudjarin Ramungul, Dr. Yot Boontongkong,
Dr. Samerkhae Jongthammanurak, Ms. Saisamorn Khunhom,
Ms. Paradee Boonrong
PCD: Ms. Teeraporn Wiriwutikorn, Ms. Chalalai Rungruang
Reviewers: Dr. Roland Weber, Members of Working Groups 1 and 4
Editors: Dr. Yot Boontongkong, Dr. Samerkhae Jongthammanurak

Acknowledgement

This Preliminary POPs Inventory Assessment Report was prepared for the United Nations Industrial Development Organization (UNIDO) by the National Metal and Materials Technology Center (MTEC), as part of the contract number 3000043597 between UNIDO and MTEC for the provision of services related to the enabling activities to review and update the national implementation plan for the Stockholm Convention on POPs.

This assessment benefited from available data at the national level from several relevant government agencies, as described in the Executive Summary and in the 3 respective inventory chapters; particularly DIW, PCD, DOA, NSO, DLT, and ONEP.

The following invited speakers at the project's Inception Workshop are gratefully acknowledged: Ms. Teeraporn Wiriwutikorn (PCD), Dr. Pattanan Tarin (DIW), Mr. Saran Watanatada (DOA), Dr. Pruetthichat Punyawattoe (DOA), Ms. Chaowanee Visaeso (DOA), Mr. Thongchai Suthhipongkeat (DOAE), Assoc. Prof. Dr. Nuchnart Jonglaekha (Royal Project Foundation), and Mr. Panyawat Aekitsawatwikul from Siam Makro PCL.

This study benefited from valuable inputs, comments, and feedback from key stakeholders who actively participated in various workshops/seminars organized throughout the course of the project. Insights obtained from respondents of our questionnaire surveys are also gratefully acknowledged. The inventory team would also like to sincerely thank relevant parties for the inputs and information gained from our site visits and interviews with them, as well as for the field samples that they provided. Non-exhaustive lists of stakeholders and relevant parties who contributed their feedback, comments, samples, and insights to this study can be found below.

Three respective inventory validation workshops were held in July and August 2019 at Thailand Science Park in Pathumthani Province to validate the inventory findings, wherein relevant stakeholders contributed valuable insights and feedback for this assessment report.

Several expert advisors outside the inventory team provided inputs, commented on the underlying analytical work, and reviewed our inventory report. Their comments and suggestions were of great value. The names of these individual appear in the preceding Authors and Contributors section and in Annex 2.

The report benefited from the peer review conducted by Dr. Roland Weber of POPs Environmental Consulting (assigned to the project by UNIDO), as well as the review by members of the respective national working groups (WG2 – WG5) and the Working Group on Project Supervision and Coordination (WG1).

A special acknowledgement to PCD's then-Deputy Director General Suwanna Tiansuwan for efficiently and effectively convening and presiding over this project's workshops, and for her thoughtful comments and guidance to the inventory team.

Finally, we wish to thank the Global Environment Facility (GEF) and the United Nations Industrial Development Organization (UNIDO) for funding this study. We also thank UNIDO Project Manager, Dr. Carmela Centeno, and UNIDO Regional Office in Thailand for their exceptional coordination and support.

Questionnaire respondents from February 20th, 2019 seminar (in alphabetical order)

3M Thailand
Apex circuit (Thailand)
Asahi Tsushin (Thailand)
Asian Inoac
Asian Stanley International
B.T.
Bara Scientific
Canon Prachinburi (Thailand)
CMK Corporation (Thailand)
Coattech
Cosmo group
Crestec (Thailand)
Delta Electronics (Thailand)
EPE (Thailand)
Eternal Resin
Feiti Precision (Thailand)
Focuz Manufacturing
FTE Precision (Thailand)
Fujikura Electronics (Thailand)
Furukawa Automotive Systems
Furukawa Fitel (Thailand)
Hana (AYT)
HET (Hayakawa Electronic Thailand)
High Grade
Hitachi Consumer Product (Thailand)
Inoac Industries
Inoue rubber (Thailand)
Intertek Testing Service
IPD Packaging
IRC (Asia) Research
K.M. Innovate (1996)
K.M.G.C. Group (Chemical, Innuvate, Oranoss)
Kaga Electronics (Thailand)
Kang Yong Electric
Kansai Felt (Thailand)
KCE Technology
Kem Kote
Kurashiki Siam Rubber
Kyoden (Thailand)
Kyosei Factory (Thailand)
Lite-On Electronics (Thailand)
Magnecomp Precision Technology
Misumi (Thailand)
Mititex
Mitsubishi Electric Consumers Products (Thailand)
Miyoshi-Hi-Tech
Musashi Paint Manufacturing (Thailand)
N.C.R. Rubber industry
Nagase (Thailand)
Nidec Copal (Thailand)
Nikon (Thailand)
Nippon Gasket (Thailand)
Nissei Trading (Thailand)
Nitta Chemical Products (Thailand)
O.T.J.
Ohta Precision (Thailand)
Oji Paper (Thailand)
Okayama (Thailand)
Okuno-Auromex (Thailand)
P T Engineering Parts
Panasonic Appliances Refrigeration Devices (Thailand)
Pata Chemical and Machinery
Patra porcelain
Poly HiTech
Poly Net
Prime Box Meg
Pro Nec
Property Perfect
Qual-Pro Corporation
Rohm Integrated systems (Thailand)
S.K. Polymer
Samil Foam (Thailand)
Seiko Precision (Thailand)
Senju (Thailand)
SGS (Thailand)
Sharp Appliances
Shin-Etsu Silicones (Thailand)
Siam Compressor Industry
Siam Fiber Optics
Siam Light
Sony Device Technology (Thailand)
Sony Technology (Thailand)
Sumida Electric (Thailand)
Sumitronics (Thailand)
T.S. Sanitary
Taisei Electronics (Thailand)
Taiyo Manufacturing (Thailand)
TDK (Thailand)
Techno Foam
Thai Brass Industry
Thai Daizo Nichi Moly
Thai Gci Resitop
Thai Nissin Mold
Thai NOK
Thai Polyaectal
Thai Summit Cable and Parts
TMSC
Todenko (Thailand)
Tokyo Byokane (Thailand)
Toshiba Carrier (Thailand)
Toyo Kogyo Toryo (Thailand)
Toyotsu Chemiplas (Thailand)
TPI Polene
UBE Chemical (Asia) PCL.
Union and Oji Interpack
Wing Fung Adhesive Manufacturing
Yano Electronics
Zeon Advanced Polymix

Questionnaire respondents from April 2019 survey (in alphabetical order)

BASF (Thailand)
Covestro (Thailand)
Farco International
HMC Polymers
IRPC PCL
Kang Yong Electric PCL
Luckystar Universal Co., Ltd.
Mitsubishi Electric Consumer Products (Thailand) Co., Ltd.
Salee Colour PCL
Siam Chemical Industry
UBE Chemical (Asia) PCL
Thai Plastic and Chemicals PCL
Thai Toshiba Electric Industries Co., Ltd.
TPBI PLC

Interview list: POPs Pesticides

F: face-to-face, P: telephone, T: teleconference, E: e-mail

Akkhie Prakarn Public Co.,Ltd (P,E)
Bayer Thai Co.,Ltd (F,P,E)
Department of Agricultural Extension (F,P,E)
Department of Agriculture (F,P,E)
Faculty of Forestry, Kasetsart University (P)
Food and Agriculture Organization of the United Nations (P,E)
Krung Thep Pharmacue Limited Partnership (P,E)
Metropolitan Waterworks Authority (F,P,E)
Pollution Control Department (F,P,E)
Provincial Waterworks Authority (F,P,E)
Royal Forest Department (P)
Royal Project Foundation (F)
Sherwood Corporation (Thailand) PCL (P)
State Railway of Thailand (P)
Thai Pesticide Alert Network (Thai-PAN) (F)
Food and Drug Administration (F,P,E)

Interview list: Industrial POPs

F: face-to-face, P: telephone, T: teleconference, E: e-mail

Airports of Thailand PCL (F)
Atotech (Thailand) Co., Ltd (F)
A.T.Con Insulation Co., Ltd (P)
Bang Khen Fire Station (F)
Bangkok Aviation Fuel Services PCL (P,E)
Delta Electronics (Thailand) PCL (P)
Department of Airports (F)
Ditto (Thailand) PCL (F)
Electricity Generating Authority of Thailand (P)
Fortune Foam Products Co. Ltd (P)
Global Plasts Center Co., Ltd (F)
KLJ Organic (Thailand) Co., Ltd (F)
Lenso Corporation PCL (P)
Nikon (Thailand) Co., Ltd (P)
Nippon Chemical Co., Ltd (P,E)
NPC Safety and Environmental Service Co., Ltd (F)
Okuno-Auromex (Thailand) Co., Ltd (P,E)
Optimal tech Co., Ltd (P)
Panasonic Appliances Refrigeration Devices Co., Ltd (P)
Plastic Industry Club, The Federation of Thai Industries (F)
Plastics Institute of Thailand (F)
PTT Exploration and Production PCL. (P,E)
Purchem Co., Ltd (P)
Salee Colour Public Co., Ltd (P)
Siam Chemical Industry Co., Ltd (P,E)
Suankaew Foundation (F)
Thai Auto-Parts Manufacturers Association (F)
Thai Insufoam Industries Co., Ltd (P)
Thai Parkerizing Co., Ltd (F)
Thailand Electroplating Professional Network (F)
Thailand Textile Institute (F)
Thaklong Fire Station (F)
The Electrical, Electronics and Telecommunication and Allied Industry Club, The Federation of Thai Industries (F)
Waste Management Siam Co., Ltd (F)
Zeon Advanced Polymix Co., Ltd (F)

Interview list: Industrial POPs and uPOPs

F: face-to-face, P: telephone, T: teleconference, E: e-mail

Amata Water Co., Ltd (F)
Bang Pu Industrial Estate Office (F)
Bangplee Industrial Estate Office (F)
Department of Energy Business (P)
Global Environmental Technology Co., Ltd (F)
Global Utilities Services Co., Ltd (F)
IRPC Public Co., Ltd (F, P, E)
Laem Chabang Industrial Estate Office (F)
Map Ta Phut Industrial Estate Office (F)
Petrochemical Industry Club, The Federation of Thai Industries (F)
PTT Global Chemical PCL (F)
PTT Oil and Retail Business PCL (F,P,E)
SCG Chemicals Co., Ltd (T)
Thai Oil PCL (P)

Interview list: uPOPs

F: face-to-face, P: telephone, T: teleconference, E: e-mail

Asean Vinyl Council (F)
Asian Institute of Technology (F)
Ban Kat SAO, Mae Hong Son (P)
Buatoom SAO, Bueng Kan (P)
Chotthakornpiboon Co., Ltd (P)
Department of Health (F)
Department of Primary Industries and Mines (F)
Don Kaew SAO, Chiang Mai (P)
Environment Department, Bangkok Metropolitan Administration (P)
Furukawa Metal (Thailand) PCL (P)
Iron and Steel Institute of Thailand (P)
King Mongkut's University of Technology Thonburi (P)
Khue Wiang SAO, Phayao (P)
Kornanun Electronic Co., Ltd (P)
Kudchumpattana SM, Yasothon (P)
Mae Kham SM, Chiang Rai (P)
Mae Khao Tom SAO, Chiang Rai (P)
Mae Sariang SM, Mae Hong Son (P)
Muang Yai SM, Chiang Rai (P)
Municipal Waste Management Center, Rayong Provincial Administrative Organization (F)
Nong Lad SM, Sakon Nakon (P)
Pa Sang SM, Chiang Rai (P)
Pa Tueng SAO, Chiang Rai (P)
SCG Cement – Building Materials Co., Ltd (F,P)
SCG Packging PCL (F)
Sri Kaew SM, Yasothon (P)
Ta Phraya SM, Sakaew (P)
Thai Plastic and Chemicals PCL (T, P, E, F)
Thaichanasuek SAO, Sukhothai (P)
Tham Charoen SAO, Bueng Kan (P)
Tobacco Control Research and Knowledge Management Center, Mahidol University (P)
United Nations Industrial Development Organization (F)
Vinythai PCL (T,P,F,E)
Wiang Lo SM, Phayao (P)
Wongpanit International Co., Ltd (P)

Sample contributors

- An obsolete office equipment storage site in Pathum Thani Province
- E-waste dismantling shops in the Central Thailand: Bangkok, Chon Buri, Nakhon Pathom, and Nonthaburi Provinces
- E-waste dismantling shops in the Northeastern Thailand: Buri Ram, Kalasin, Maha Sarakham, and Nakhon Ratchasima Provinces
- Industrial estates in Samut Prakan and Chon Buri Provinces
- Municipal waste management sites and landfills in Rayong, Buri Ram, Maha Sarakham, and Nakhon Ratchasima Provinces
- Plastic recycling shops in the Central Thailand: Nakhon Pathom and Chon Buri Provinces
- Plastic recycling shops in the Northeastern Thailand: Buri Ram, Maha Sarakham, Kalasin, and Nakhon Ratchasima Provinces
- Materials from following private companies:
  A.T.Con Insulation Co. Ltd.
  Global Environmental Technology Co. Ltd.
  Global Utilities Services Co. Ltd.
  IRPC Public Co., Ltd
  Ming Dih Chemical Co. Ltd.
  PCBs Process & Service Engineering Co. Ltd.
  Polyfoam Group Co. Ltd.
  Thai Insufoam Industries Co. Ltd.
  Thai Plastic and Chemicals PCL
  Waste Management Siam Co. Ltd.

List of Abbreviations and Acronyms

AAC	Autoclaved aerated concrete
ABS	Acrylonitrile butadiene styrene
ACQ	Alkaline copper quaternary
ADt	Air-dry tonne (pulps and papers)
AFFF	Aqueous film forming foam
AL	Aerated lagoon
AOT	Airport authority of Thailand
APC(S)	Air pollution control (system)
AR-AFFF	Alcohol resistant-aqueous film forming foam
AS	Activated sludge
ATR	Attenuated total reflectance
BAT	Best available technology
BAT-AEPL	Average environmental performance level associated with BAT
BB	Brominatedbiphenyls
BDE	Brominated diphenylethers
BEL	Belgium
BEP	Best environmental practices
BF	Blast furnaces
BFR	Brominated flame retardants
BL	Biomass fuel load
BM	Biomass
BMA	Bangkok Metropolitan Administration
BOF	Basic oxygen furnaces
BREF	Best available techniques (BAT) reference documents
BTBPE	1,2-Bis(2,4,6-tribromophenoxy)ethane
C.I.	Color Index
CAK	Chlor-alkali
CAR	Corrective action request
CAS	Chemical Abstracts Service
CEM	Continuous emission monitoring
CF	Combustion factor
CHN	China
CHP	Combined heat-power power plant
CI	Confidence interval
CID	Chemical identification
CIF	Cost, insurance and freight
CiP	Chemical in product
CN	Chlorinated napthalenes
CNP	Chloronitrofen
CO	Carbon monoxide
COD	Chemical oxygen demand
COP	Conference of Parties

CPs	Chlorinated paraffins
CRM	Certified reference materials
CRT	Cathode ray tubes
CS	Capsule suspension
DBDPE	Decabromodiphenyl ethane
DCA	Dichloroethane
DCB	Dichlorobenzene
DDF	Deciduous dipterocarp forest
DDPM	Department of Disaster Prevention and Mitigation
DDS	The Department of Drainage and Sewerage of the Bangkok Metropolitan Administration (BMA)
DDT	1,1,1-Trichloro-2, 2-bis, 4-chlorophenyl ethane
DEDE	Department of Alternative Energy Development and Efficiency
DEF	Dry evergreen forest
DEHP	Bis(2-ethylhexyl) phthalate
DEQP	Department of Environmental Quality Promotion
DEU	Germany
DIW	Department of Industrial Works
DLT	Department of Land Transports
DMS	Department of Medical Sciences
DNP	Department of National Park, Wildlife and Plant
DOA	Department of Agriculture
DOAE	Department of Agricultural Extension
DOE	Department of Energy
DOEB	Department of Energy Business
DOH	Department of Health
DPIM	Department of Primary Industries and Mines
EAF	Electric arc furnace
EBTBP	Ethylene bis(Tetrabromophthalimide)
ECHA	European Chemical Agency
ECS	Environmental and chemical safety
ECU	Electrochemical unit
ECVM	European Council of Vinyl Manufacturer
EDB	Ethylene dibromide
EDC	Ethelene dichloride (also known as Dichloroethane)
EDC	Ethylene dichloride
EDXRF	Energy dispersive X-Ray fluorescent spectroscopy
EE	Electrical and electronics
EEE	Electrical and electronics equipment
EF	Emission factor
EGAT	Electricity Generating Authority of Thailand
EHA	Environmental health accreditation system
EHIA	Environmental health impact assessment
EIA	Environmental impact assessment
EMRL	Extraneous maximum residue limits

EOL	End-of-life
EPS	Expanded polystyrene
ERC	Energy Regulatory Commission
ERTC	Environmental Research and Training
ESP	Electrostatic precipitator
ETS	Emission trading scheme
EU	European Unions
e-waste	Electronic waste
FAO	Food and Agriculture Organization of the United Nations
FB	Fraction of residues subjected to burning
FDA	Food and Drug Administration
FF	Fabric filter
FFCD	Forest Fire Control Division
FMVSS	Federal Motor Vehicle Safety Standards
FOSA	Perfluorooctane sulphonamide
FPD	Flat panel displays
FR	Flame retarded, Flame retardant
FTI	The Federation of Thai Industry
G&C Hospital	GREEN & CLEAN Hospital Accreditation Initiative
GAP	Good agricultural practices
GCMS	Gas chromatograph-mass spectrometry
GDP	Gross domestic products
GGFR	Global Gas Flaring Reduction Partnership
GISTDA	Geo-Informatics and Space Technology Development Agency (Public Organization)
GMP	Global monitoring plan
GPPS	General purposes polystyrene
HA	Home Appliances
ha; Mha	Hectare; Million hectare
HBB	Hexabromobiphenyl
HBCD, HBCD	Hexabromocyclododecane
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HCH	Hexachlorocyclohexane
HDG	Hot-dip galvanization
HFC	Hydrofluorocarbons
HFO	Heavy fuel oil
HHW	Household or municipal hazardous waste
HIPS	High impact polystyrene
HS	Hazardous substances
HSA	Hazardous Substances Act
HS-code	Harmonized system (HS) of tariff nomenclature
HSDB	Hazardous Substances Data Bank
HW	Hazardous waste
ID	Identification

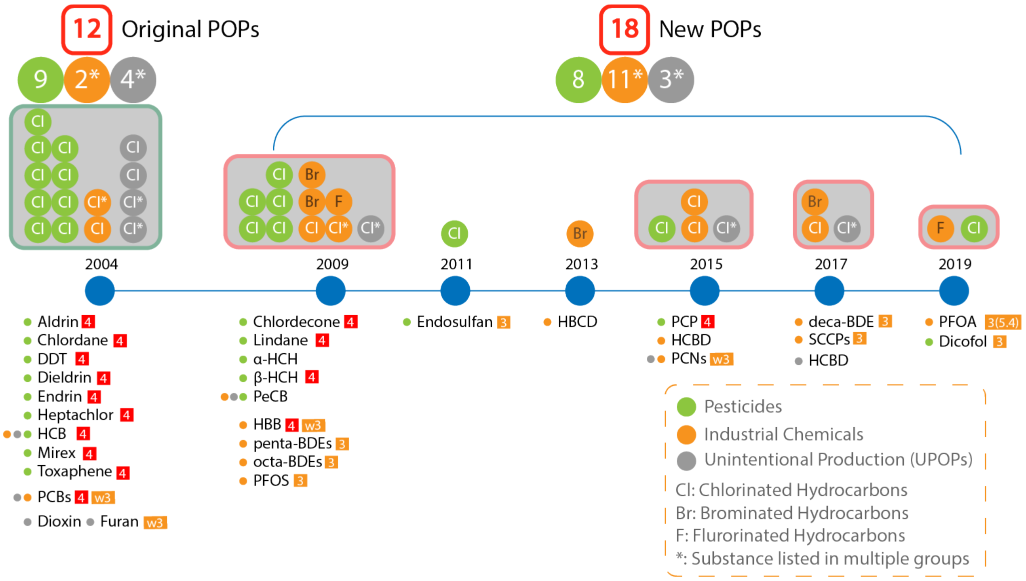
IEA	International Energy Agency
IEC	International Electrotechnical Committee
IEEE	Institute of Electrical and Electronics Engineers
IF	Induction furnace
IHW	Industrial hazardous waste
IMDS	International Material Data System
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated pesticide management
ISIC	International Standard Industrial Classification
ISIT	Iron and Steel Institute of Thailand
ISO	International Standards Organization
ISPM	International Standards for Phytosanitary Measures
IW	Industrial waste
JGPSSI	The Japan Green Procurement Survey Standardization Initiative
JPN	Japan
LCP	Liquid crystal polymer
LF	Landfill
LHV	Lower heating value
LOI	Limited oxygen index
LPG	Liquid petroleum gas
LTA	Land Transport Act
LTR	Liter
MAC	Maximum allowable concentrations
MB	Methyl bromides
MCCPs	Medium-chain chlorinated paraffins
MDF	Mixed deciduous forest
MoAC	Ministry of Agriculture and Cooperatives
MODIS	Moderate resolution imaging spectro-radiometer
MoEN	Ministry of Energy
M-Industry	Ministry of Industry
MNRE	Ministry of Natural Resources and Environment
MoPH	Ministry of Public Health
MRL	Maximum residue limits
MSW	Municipal solid waste
MT	Million tonnes
MTEC	National Metal and Materials Technology Center
MW	Municipal waste
MWA	Metropolitan Waterworks Authority
NA	Not Applicable
NBFR	Novel brominated flame retardants
ND	No data
NEB	National Environment Board
NGO	Non-government organizations
NIP	National implementation plan
NOX	Nitrogen oxides (NO, NO_2,N_2O, N_2O_2, N_2O_3, N_2O_4,N_2O_5)

NSO	National Statistical Office
NSTDA	National Science and Technology Development Agency
NSW	National single window
OAE	Office of Agricultural Economics
OCPs	Organochlorine pesticides
OCSB	Office of Cane and Sugar Board
OD	Oxidation ditch
OECD	The Organisation for Economic Co-operation and Development
OIE	Office of Industrial Economics
ONEB	Office of National Environment Board
ONEP	Office of Natural Resources and Environmental Policy and Planning
OSPAR	Convention for the protection of the marine environment of the north-east Atlantic
PA	polyamide
PAH	Polycyclic aromatic hydrocarbons
PBB	Polybrominated biphenyl
PBDE	Polybronated diphenylether
PBT	Polybutylene terephthalate
PC	Polycarbonate
Pc	Phthalocyanine
PCA	Principle component analysis
PCB	Polychlorinated biphenyls
PCD	Pollution Control Department
PCDD	Polychlorinated dibenzo-p-dioxins
PCDD/F	Polychlorinated dibenzo-p-dioxins and furans
PCN	Polychlorinated napthalenes
PCNB	Polychlorinated nitrobenzene (also known as Quintozene)
PCP	Pentachlorophenol
PeCB	Pentachlorobenzene
PFAS	Perfluoroalkyl substances
PFC	Perfluorocarbons
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
PFOSF	Perfluorooctane sulfonyl fluoride
PIC	Prior informed consent
PIR	Polyisocyanurate
POPs	Persistent organic pollutants
POPRC	Persistent Organic Pollutant Review Committee
PPS	Poly(p-phenylene) sulfide
PRTR	Pollutant release and transfer register
PS	Polystyrene
PTIT	Petroleum Institute of Thailand
PU, PUR	Polyurethane
PVC	Polyvinyl chloride
PWA	Provincial Waterworks Authority

RAPEX	EU Rapid Alert System for non-food products
RD	Residue density
RDF	Refuse derive fuel
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
RFD	Royal Forest Department
RON	Research octane number
RSS	Ribbed smoked sheet rubbers
SAO	Sub-district administrative organization
SC	Stockholm Convention
SCCPs	Short-chain chlorinated paraffins
SEC	Specific energy consumption
SK2	Call name (in Thai) of the DIW waste transfer request form
SM	Sub-district municipality
SME	Small and medium enterprise
SOX	Sulfur Oxides (SO, SO_2,SO_3, SO_4, …)
SP	Stabilization pond
SPP	Small power producer
SRT	State Railway of Thailand
SVHC	Substances of very high concerns
TACFS	Thai agricultural commodity and food standard
TAPMA	Thai Auto Parts Manufacturing Association
TAS	Thai agricultural standard
TBBPA	Tetrabromobisphenol-A
TCDD	Tetrachlorodibenzo-p-dioxin
TCE	Trichloroethylene
TCF	Totally chlorine free (bleaching)
TCMA	Thai Cement Manufacturers Association
TDS	Total dissolved solids
TEA-PFOS	Tetraethylammonium perfluorooctane sulphonate
TEI	Thailand Environment Institute
TEPNET	Thai Electroplating Professional Network
TEQ	Toxic Equivalent Note: For the purpose of this report, there is no difference if concentrations or emission factors are reported in TEQ or I-TEQ
TGO	Thailand Greenhouse Gas Management Organization (public organization)
THTI	Thailand Textile Institute
TIS	Thai Industrial Standard
TISI	Thai Industrial Standards Institute
TKN	Total Kjeldahl nitrogen
TMP	Thermo-mechanical pulp
toe, ktoe	Tonnes of oil equivalent, thousand tonnes of oil equivalent
TPD	Ton per day
TPPIA	Thai Pulp and Paper Industries Association
TRC	Tobacco Control Research and Knowledge Management Center

TSIC	Thai Standard Industrial Classification
TSP	Total suspended particles
TSR	Technically specified rubber
TSS	Total suspended solids
TTIA	Thai Tanning Industry Association
TV	Television
ULG	Unleaded gasoline
UN	United Nations
UNEP, UN Environment	The United Nations Environment Programme
UNIDO	The United Nations Industrial Development Organization
uPOPs	Unintentional POPs
US, USA	United States of America
VCM	Vinylchloride monomer
V-ETS	Thailand voluntary emission trading scheme
VOC	Volatile organic compound
VSPP	Very small power producer
VTM	Vertical thin material
WEEE	Waste of electrical and electronic equipment
WG	Working group
WHO	World Health Organization
WTE	Waste-to-energy
WW	Wastewater
WWTP	Wastewater treatment plant
XPS	Extruded polystyrene
α-HCH	Alpha hexachlorocyclohexane
β-HCH	Beta hexachlorocyclohexane
γ-HCH	Gamma hexachlorocyclohexane or lindane

Executive Summary



Numbers in square brackets indicate the substances are listed as hazardous substances in Thailand

Thailand ratified the Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) on 31 January 2005. The Convention initially included 12 chemical substances or groups of substances listed in 3 Annexes; Annex A for elimination, Annex B for restriction, and Annex C for the reduction of the unintentional production. Initially, there were 9 substances listed in Annex A, one substance (DDT) in Annex B, and 4 substances listed in Annex C. The Conference of Parties (COPs) of the SC has gradually added new POPs into the lists. As of 2019, the SC has 18 more POPs substances; 17 substances to Annex A, 1 substance to Annex B, and 3 substances to Annex C.

POPs substances under the SC can also be classified into 3 groups based on their intended purposes: POPs pesticides, POPs industrial chemicals, and unintentionally produced POPs or uPOPs. As of 2019, there are 17 POPs pesticides, 13 POPs industrial chemicals, and 7 uPOPs.

Thailand has compiled its first POPs inventory in 2006. Based on information gained from the first inventory report, the Thai government had developed and implemented its National Implementation Plan (NIP) to fulfill its obligations under the Convention. Since the last study was completed more than 10 years ago, an update of POPs inventory is required to better reflect current situations as well as new knowledge accumulated over the years.

This preliminary POPs inventory assessment study is Thailand's second POPs inventory assessment study. It aims to provide updated information on the 12 initial POPs and new information on the 15 new POPs listed in Annexes A, B and C of the Stockholm Convention during 2009 to 2017 (excluding SCCP). It forms a basis for the update of the National Implementation Plan (NIP), obligated under Article 7 of the Stockholm Convention.

Purposes of the study

A POPs inventory is a compilation of information regarding sources, consumptions, disposal and the fate of POPs of interest within the country. It aims to provide decision makers with reliable baseline information on current persistent organic pollutants (POPs) situation as well as key areas that need attention. It provides necessary information for relevant parties for their priority setting and choosing cost-effective risk reduction plans.

This preliminary POPs inventory assessment study is Thailand's second POPs inventory assessment study. It aims to provide updated information on the 12 initial POPs and new information on the 15 new POPs listed in Annexes A, B and C of the Stockholm Convention during 2009 to 2017[1]. It forms a basis for the update of the National Implementation Plan (NIP), obligated by Article 7 of the Stockholm Convention.

Stockholm Convention (SC) addresses POPs throughout their life-cycle. Applicable POPs inventory, therefore, cannot be limited to the release at the end-of-pipe. This preliminary inventory assessment endeavors to gather available information deemed necessary for the country's preliminary risk assessment and development of mitigation plans. Particularly, given the time and resource constraints, it tries to collect and analyze relevant national data to gain information on following issues:

- Past and current uses/production/emissions of each POP substance at the national level;
- Pattern of uses, flows, and amount of POPs historically or currently used to produce articles that were made available on consumer market;
- Presence of materials and articles containing relevant POPs in the recycling streams;
- Disposal practices for POPs substances and articles containing POPs when they become wastes;
- Amount of POPs substances in stockpiles;
- Potential contaminated sites.

Due to time and resource constraints, this study does not aim to provide precise figures for each POPs, but rather to provide a general idea on the current situation, identify areas that might be at risk, and areas where

[1] Excluding SCCPs

critical data might be lagging and, hence, need to be addressed in the upcoming NIP.

Methodology

The assessment procedures employed in this study closely followed the procedures given in relevant UNEP Guidances to ensure transparency and quality[2] of the inventory data. The National Metal and Materials Technology Center (MTEC) is assigned by the Pollution Control Department (PCD), with an endorsement of the Thai Stockholm Convention Subcommittee, to work as the inventory team, with technical support from 5 material specialists from MTEC, 6 national experts and an international expert assigned by the UNIDO.

Working group

The Thai Stockholm Convention Subcommittee has established five working groups (WGs) for this project as follows;

Working Group 1 (WG1): Working group on project supervision and coordination, consists of 14 members from 12 organizations with the PCD's Director General or representative as the chairman;

Working Group 2 (WG2): Working group on the review and update of the national implementation plan and POPs pesticides inventory, consists of 12 members from 9 organizations with the DOA's Director General or representative as the chairman;

Working Group 3 (WG3): Working group on the review and update of the national implementation plan and POPs industrial chemicals inventory, consists of 14 members from 11 organizations with the DIW's Director General or representative as the chairman;

Working Group 4 (WG4): Working group on the review and update of the national implementation plan and unintentional POPs inventory, consists of 13 members from 9 organizations with the PCD's Director General or representative as the chairman; and

Working Group 5 (WG5): Working group on socio-economic implications of POPs uses; consists of 12 members from 10 organizations with the Director of Office for the Promotion of Health Risks Controls, Thai Health Promotion Foundation or representative as the chairman.

Defining scope and choosing data collection method

The 3 inventory-related WGs (WG2 to WG4) were presented with relevant background information associated with each POPs group. Data collection methods were discussed along with associated constraints before each WG made decision on the scope and the depth of the assessment for each POPs group (see detail in Annex 1).

[2] Consistency, Comparability, Completeness (fit to purpose) and Accuracy

Collecting data from key stakeholders

The Inventory team was in charge of collecting and compiling data from identified key stakeholders using the agreed-upon methods, with supports from the WG members. The data collection was scheduled for 4 months and conducted during February to June, 2019.

Due to large number of POPs substances involved in this study, data collection campaign was preceded by a technical seminar entitled "the Stockholm Convention & REACH/RoHS" held on September 11th, 2018 (seminar presentation and supporting document are available online on MTEC run website www.ThaiRoHS.org) and accompanied by an explanatory document entitled "Thai POPs Inventory and the Stockholm Convention" that highlighted relevant provisions of the SC and summarized the new POPs with a focus on application areas that might have used certain POPs, business sectors/parties that might be involved and possible impact.

With limited time and resources available, the questionnaire survey was conducted through industrial organizations/professional associations. Each organization visited was presented with relevant background information to ensure their members' awareness about SC and POPs. The questionnaires were tailored for specific industry sectors to limit number of questions asked and to avoid overwhelming respondents with irrelevant chemical substances. Every set of questionnaire was accompanied by a 2-pages summary of relevant chemicals to assist respondents in assessing their involvement. The following is the list of industry-specific questionnaires that were distributed (see detail in the Annexes to Part 2 of this report):

- Chemical and Petrochemical Industry
- Plastics Parts Industry
- Automotive Industry
- Automotive Parts Industry [Thai and English]
- Electrical and Electronic Industry (with separate section only for Televisions and Monitors Manufacturers) [Thai and English]

The following is a non-exhaustive list of organizations visited and requested for information:

- Electrical, Electronic and Telecommunication Club of the Federation of Thai Industry (FTI)
- Thai Auto Parts Manufacturing Association (TAPMA)
- Petrochemical Industry Club of the FTI
- Thai Plastics Institute
- Thai Textile Institute (THTI)
- Thai Electroplating Professional Network (TEPNET)

To ensure adequate data coverage, another set of generic questionnaire entitled "Management practices for controlling Chemical Substances in Products" was formulated for the industry in general. The questionnaire dissemination was accomplished through a public seminar entitled

"Regulations on Chemicals Substances in Products" held on February 20th, 2019. The seminar was attended by 341 participants from 172 companies. Through this event, the inventory team received 223 questionnaires returned.

In terms of uPOPs inventory gathering, two aspects of data were considered: activity rates and attribute data for activity classification. For activity rates, the main sources were primarily national data/statistics from responsible governmental bodies, as well as relevant industrial and business associations. Examples of these include MNRE (PCD, ONEP, DEQP, DNP, Royal Forest Department), M-Industry (DIW, OIE, DPIM, OCSB), MoEN, MOAC (OAE, Department of Fisheries), Thai Customs Department, NSO, DLT, FTI, and ISIT. Data from these sources were obtained via formal data requests and/or from public domain when available (such as official publications/reports and official websites). For certain emission activities for which activity rates were not available at the national level, estimations were made based on other available circumstantial information.

Attribute data necessary for uPOPs class assignment were, in several cases, obtained directly from the main stakeholders involved with the respective activities (for examples, by interviewing/visiting manufacturers with significant shares of activity rates in their respective source categories). Certain classification attribute data were also inferred from applicable regulations that stipulate emission limits or actions for relevant pollutants.

Due to the difference in the nature of the controls, distributions, and uses of POPs pesticides, approaches taken for assessing POPs within this group were different. Open questionnaires were replaced by official requests for information from organizations in charge of the substances, and a number of stakeholders (DOA, DOAE, FDA, PCD, DIW, Royal Forest Department, and State Railway of Thailand, private agencies, non-government organizations (NGO), research institutes and laboratories, and universities) were interviewed face-to-face, by phone, and via email.

Collecting data from field survey

For some POPs Chemical in Products (CiP), such as PBDEs, the global phase-out has already begun for certain products and the risk phase may be shifted to the use phase and disposal phase. Most Thai producers produced compliant products to feed global markets. However, Thailand does not yet have legislation in place to deter contaminated products from entering its local market. In addition, Thailand also does not have requirements that demand rigorous uses of flame retardants. The extent to which POPs CiP has penetrated into daily-life products and appliances are, therefore, largely unknown. It is unlikely that the survey results from local producers alone can adequately fill this information gap.

Therefore, a brief preliminary survey for elemental bromine (Br) using handheld EDXRF was conducted to assess possible contamination in daily-life products and appliances, and to grasp some idea of the situation. Products included in this screening survey were those suggested by relevant UNEP guidances and those suggested by their needs to be flame-retarded. Examples of these products are ICT equipment, office appliances, office furniture, building materials, cars' interior parts, toys from flea markets, etc. (see detail in respective chapters).

For POPs in products that may already have reached end-of-life phase, 20 e-waste dismantling shops and plastic waste shredders/recyclers in 8 provinces were visited, 20 shop owners were interviewed, more than 2,000 target samples were collected back to MTEC for further analysis (see detail in respective chapters).
Finally for the disposal phase, 9 suspected dump sites/waste treatment plants were visited and 64 relevant samples (sludge, soil, leachate, waste water, etc.) were collected and submitted to laboratories for further analysis. (Analysis results are not available in time for this report.)

Managing and evaluating the data

Data and information received during the data collection period were compiled and analyzed by the inventory team. Apparent inconsistencies and/or ambiguous answers were resolved through follow-up phone call.

The results of the assessment study were summarized and presented to the respective WGs for their review/evaluation.

After passing the WG review process, the inventory results were then presented to the public (relevant stakeholders) via the Inventory Validation Workshops, held on July 31st, August 1st, and August 6th, 2019 for POPs Industrial Chemicals, POPs pesticides, and uPOPs, respectively. The workshops were attended by 232 participants from 52 organizations. Feedbacks received during the workshops and the one-week comment-gathering period were compiled and the inventory was revised as appropriate before being circulated to WG members for endorsement.

Preparing the inventory report

The inventory team was in charge of drafting the inventory assessment report. The final (draft) version of the inventory report was reviewed by WG1 responsible for project supervision and coordination before being submitted to the UNIDO for review by international expert(s).

Levels/depth of assessed data

This study adopted the tiered approach to collect data for the inventory. Due to the diverse nature of the substances under investigation, different levels of assessment were taken for different substances as detailed below (see summary in Annex 1):

Tier I: Initial (Indicative) assessment

Desk research was performed for every substance under investigation.

Example of information sources for these assessments are as follows:

- Import-export statistics from the Thai Customs
- Industrial products output statistics from the Office of Industrial Economics (OIE)
- Agricultural products output statistics from the Office of Agricultural Economics (OAE)
- Registered factory data from the Department of Industrial Works (DIW)
- Industrial waste transfer manifests from the DIW
- Municipal waste statistics and disposal sites statistics from the PCD
- Information technology and communication statistics from the National Statistics Office (NSO)
- Motor vehicles registration statistics from the Department of Land Transport (DLT)
- Relevant standards from the Thai Industrial Standards Institute (TISI)
- Relevant standards from the National Bureau of Agricultural Commodity and Food Standards (ACFS)
- Relevant products from UNEP Guidance document, EU ECHA substance information system, EU RAPEX[3] system,
- Relevant material (fire) standards and literatures in scientific community (ScienceDirect, IEEE, Springer, ACS, …)
- Relevant regulations in the global markets

Note that most available statistics data can only be traced back up to the Year 2000.

Tier II: (Preliminary) Inventory

All POPs assessments under this study are classified as 'preliminary'. However, depending on the level of stakeholder involvement and perceived risk of the substance, the depth of data assessment varied as follows:

POPs pesticides

Substance	Depth of data assessment
Initial POPs pesticides Newly listed POPs pesticides	• Quantitative assessment based on national enforcement data • Indicative assessment of current contamination in environmental media from available data such as from product certification activities (GAP), market surveillance, etc.

[3] the rapid alert system for dangerous non-food products

POPs Industrial Chemicals

Substance	Depth of data assessment
PBBs, PBDEs	Qualitative assessment based on questionnaire survey and stakeholder interview Semi-quantitative assessment based on in-house predictive model accompanied by a limited number of quantitative analysis
HBCD	Qualitative assessment based on questionnaire survey and key producers interview Quantitative assessment based on EDXRF results and a limited number of screening and quantitative analysis
PFOS	Qualitative assessment based on questionnaire survey, stakeholder interview, and available monitoring results in literature
PCBs, PCNs	Qualitative assessment based on questionnaire survey and follow-up interview
HCB, PeCB, HCBD	Preliminary assessment based on questionnaire survey and available monitoring results on public domain.

UPOPs

Substance	Depth of data assessment
Dioxin/Furan, PCBs, HCB	Quantitative assessment based on national statistics data Semi-quantitative data gathering for class assignment

Note: excluding substances whose Emission Factors are not yet defined, namely PCNs, PeCB, and HCBD

Detailed methodology for each substance is presented in its respective part.

Organization of this report

This report is organized into three self-contained parts;

Part 1: Thailand’s POPs Pesticides Inventory

Part 2: Thailand’s POPs Industrial Chemicals Inventory

Part 3: Thailand’s Unintentional POPs Inventory

Each part provides summarized findings as well as detailed information related to data sources, limitations and assumptions made in order to estimate the amount of the substances of interest in Thailand.

Data gaps are described, typically in forms of qualitative uncertainty assessment, to indicate limitations of the study. Recommendation for filling these data gap and for the uses of these inventory findings are made for each POPs group.

Summaries of the findings for each POPs group are presented here with a set of recommendations.

Summary of assessment findings

POPs pesticides

Initial SC POPs pesticides

All 9 initial SC POPs pesticides have never been produced in Thailand, and over the 1981 to 2004 period all of these initial SC POPs pesticides became successively banned as Category 4 hazardous substances under the HSA. Based on this inventory team's 2018 data gathering, no registration or import/export data for initial SC POPs pesticides exist in the annual registration records and the annual import/export records of hazardous substances during the years following their effective bans, as reported by the relevant regulatory agencies -- the Department of Agriculture (DOA), the Food and Drug Administration (FDA), and the Department of Industrial Works (DIW).

Based on Thailand's first inventory, there were still about 220 kg of obsolete initial SC POPs pesticide stockpiles in the country in 2004. During 2010-2013, the PCD conducted a follow-up inventory of obsolete SC POPs pesticides. A combined 54 kg of chlordane were found in the chemical storage of the DOA and the Department of Agricultural Extension (DOAE), and 7 liters of dieldrin were held by the DOA. Subsequently, this study found that only about 31 kg of chlordane were still held by the DOAE as of year 2018. On the contrary, all obsolete SC POPs pesticides previously stocked by the DOA had already been collected and destroyed in an environmentally sound manner by industrial waste incineration because the DOA has a collection and disposal mechanism in place for obsolete pesticides.

Newly listed SC POPs pesticides

All 7 new SC POPs pesticides have never been produced domestically. Five of these (except chlordecone and PeCB) have been imported into the country in the past. During 1993-2012, 6 of these 7 new SC POPs pesticides -- α-HCH, β-HCH, γ-HCH (lindane), chlordecone, endosulfan, and pentachlorophenol (PCP) -- became successively banned under the HSA.

Technical endosulfan (with an exception for CS-type) has been banned since 2004 by the DOA and FDA. However, 2 specific forms of endosulfans – α-endosulfan and β-endosulfan– have been classified as Category 3 hazardous substances under DOA since 2002, which means that their production, import, export, or possession require prior authorization. According to DOA's annual import records of agricultural hazardous substances, approximately 8,700 tonnes of technical endosulfan were imported into Thailand during 1996-2003. No import figures for all endosulfan were present in the subsequent annual records following the 2004 general ban.

In terms of obsolete stockpiles, the previous Thai inventory reported a combined amount of 2.9 tonnes of endosulfan stocks in 2004. The following 2010-2013 PCD survey indicated a smaller amount (49 liters) of endosulfan being held by the DOA. No record of endosulfan stock was found for this study as all previous endosulfan stock belonging to DOA had already been collected and destroyed by industrial waste incineration.

α-HCH and β-HCH have been banned since 2001 by the DOA and since 2003 by the DIW and the FDA. Lindane (γ-HCH) has been banned by the DOA since 2001 and by the FDA since 2012 (with an exception for medical use as a second-line treatment for scabies and lice in humans). However, approximately 0.9 tonnes of lindane stock still remained in the warehouse of a private pharmaceutical company and PCD and FDA are planning to destroy them, pending disposal.

Pentachlorophenol (PCP) has been banned by the DOA since 1993 and has also been later banned by the FDA and the DIW since 2003. According to the DOA, PCP has never been approved for agricultural use in Thailand. The current study found no records on the registration, import, or export of PCP from the above regulatory agencies, and no PCP stock was found. No information on the domestic use of PCP in wood products such as utility poles, fences, railway sleepers, etc. was found from relevant documents or from the interviews with the Royal Forest Department (RFD) and the State Railway of Thailand (SRT).

Moreover, the DOA and the Rice Department have suggested alternative chemicals for technical endosulfan including CS formulation. The FDA recommended permethrin as a substitute for lindane as the second-line treatment for scabies and lice in humans.

Environmental monitoring

There are guidelines on the maximum allowable concentrations (MAC) for SC POPs pesticides in surface water, ground water, soil and MRL/EMRL for agricultural products, leading to the monitoring of SC POPs pesticide contamination in Thailand. Thai government agencies as well as academic institutions have monitored SC POPs pesticides in the environment and food, based on these guidelines. Most monitoring efforts conducted by DOA, PCD, Metropolitan Waterworks Authority (MWA), Provincial Waterworks Authority (PWA) and Department of Medical Sciences (DMS), showed that the residue levels of SC POPs pesticides were within the standard limits. Especially, in 2017 the DMS assessed the population’s exposure to toxic substances including 6 initial POPs and 4 new POPs in cooked food. The results showed that POPs pesticide residues in all of the sampled food groups were below the detection limits. However, four academic research works have shown that DDT and metabolites, HCHs, technical endosulfan and metabolite, aldrin, dieldrin, heptachlor, and lindane also exist above the applicable MAC and MRL/EMRL in specific agriculture areas.

POPs Industrial Chemicals

Hexabromobiphenyl (HBB)

Hexabromobiphenyl (HBB, CAS No 36355-01-8) can be considered a legacy chemical, with no new production for decades. Thailand never produced this substance and there is no data to suggest that HBB had ever been imported into or used in Thailand. HBB was totally banned as a Category 4 substance under the Thai Hazardous Substance Act (HSA) since 2013. No report of any detection of HBB in food chain or in any of Thailand's environmental media was found. HBB is, therefore, considered irrelevant for Thailand.

Tetrabromodiphenyl ether and pentabromodiphenyl ether (c-pentaBDE)

Tetrabromodiphenyl ether and pentabromodiphenyl ether (or commercial pentabromodiphenyl ether, c-pentaBDE) is also a historic substance with production ceased over 2 decades ago. Thailand never produced this substance. There is no record of c-pentaBDE ever been imported into or used in Thailand. C-pentaBDE was listed as Category 3 HS in 2017. At the time of this report, no firm filed any request to process or to handle this substance. Additionally, since worldwide production of c-pentaBDE was ceased more than 20 years ago, stockpile of c-pentaBDE in Thailand is believed to be zero.

Thailand's only involvement with c-pentaBDE is believed to be through imports of transport vehicles that may contain c-pentaBDE (produced before 2005), possibly in their seats and interior fabrics. The cumulative amount of c-pentaBDE imported into Thailand via these vehicles is estimated at **1.5 tonnes**. These contaminated materials are believed to have reached end-of-life and have been replaced with locally produced parts. The removed materials are believed to be discarded as municipal solid waste (MSW); which could be landfilled, incinerated or open-dumped depending on the MSW management system available to the relevant community.

Hexabromodiphenyl ether and heptabromodiphenyl ether (c-octaBDE)

Polybrominated diphenylethers (PBDEs) were imported into Thailand in the 90s to produce UL 94 V0 grade Acrylonitrile Butadiene Styrene (ABS) resins. However, due to the lack of supplier data disclosure in the past, the type of these PBDEs could not be confirmed. Since these ABS resins were produced 20-30 years ago (before the widespread uses of computers and database management system to store industrial transactions), information related to the type of the end-use product or the final market destinations were no longer traceable.

C-octaBDE was listed as Category 3 HS in 2017. At the time of this report, no firm filed any request to process or to handle this substance. Since worldwide production of c-octaBDE was ceased more than 20 years ago, stockpile of c-octaBDE in Thailand is believed to be zero.

Due to the lack of historic data, the inventory team developed a predictive model to estimate the levels of octaBDE based on results from a product survey for the type of BFR used in everyday products and the corresponding wastes found at waste management sites. From over 500 parts/devices found positive for brominated flame retardants (BFR), only two samples were found positive for octaBDE; one was ABS casing from a high-end computer monitor, another was polystyrene (PS) casing taken from a CRT TV imported from an Asian country. Both products were produced in the 90s.

Based on the developed model, the total amount of octaBDE in the affected ABS is estimated at 12 tonnes. Most of these products are believed to have reached end-of-life, leaving about 1,000 monitors, with **about 300 kg of octaBDE remained in hibernation**.

ABS resins extracted from end-of-life (EOL) monitors are shredded and sold as recycled ABS chips, with ABS-V0 grade commanding higher price than general grade. Most of the ABS-V0 chips found in Thailand were flame retarded with tetrabromo bisphenol-A (TBBPA), in-line with results for BFRs in house dusts and in ewaste dismantle sites published in the literatures. Nevertheless, ABS-V0 chips with octaBDE may still be found especially those from recycle shops located in the central part of the country.

Decabromodiphenyl ether (c-decaBDE)

Before listing in Annex A of the Stockholm convention, decaBDE used to be a popular flame retardant. Unlike other SC's industrial POPs, worldwide production and sale of decaBDE have not yet ceased. C-decaBDE may have been imported into Thailand in the past but due to the non-unique import classification code, the amount of decaBDE ever imported into the country was unknown. C-decaBDE was recently listed as Category 3 HS in 2019. Though, in 2018 DIW received (voluntary) notifications for the intentions to import about 70 tonnes of decaBDE. However, since decaBDE was not a controlled substance at the time, it was uncertain whether or not the notified activities were actually taken place.

Results from questionnaire survey indicated that producers along the electrical and electronic (EEE) supply-chain had phased-out the use of c-decaBDE since 2006, as a result of the enforcement of the EU RoHS directive. This result could imply historic uses. It was not clear whether or not the compounding of the affected resins took place in Thailand. Nevertheless, since the phase-out was commenced more than 10 years ago, stock of decaBDE for these historic uses (if exist) may already be exhausted.

Results from field survey suggested that decaBDE may find other uses in applications that faced lower restriction such as upholstery and drapery textiles, rubbers and silicone parts. Also, the survey found BFR in interior textiles and underhood parts in several passenger cars. It is not known whether these flame retarded materials were imported or locally produced. With limited responses from stakeholders and limited access to material samples, the type of the BFR cannot be confirmed at this time.

The uses of decaBDE were confirmed for polystyrene (PS) housings of CRT TVs produced before 2006. The number of the affected TVs is estimated at 5 million sets. The corresponding amount of PS resins that contained decaBDE is estimated at about 10,000 tonnes and the total amount of decaBDE is estimated at 920-1,500 tonnes. About half of this amount is believed to be already disposed of; leaving about **500-820 tonnes** remain 'in-stock' in the in-use and in-hibernation products.

The affected PS resins are recycled along with other plastic resins that can be extracted from ewaste. The concentrations of decaBDE in the shredded PS chips and, consequently, the recycled PS pellets depend on the feedstock that arrived at the recycle shops. While decaBDE concentrations in most batches tested were low, concentration in black PS-V0 chips can be high. Due to low demands from local compounders, these recycled materials are believed to be exported.

Apart from PS from CRT TVs, this assessment found traces of decaBDE in shredded PS chips from other applications. Unfortunately, the source of these chips cannot be confirmed at this time. This assessment also found TBBPA the most popular BFR for casings of computer's CRT monitors found in Thailand. As for decaBDE in other WEEE components, this study did not yet find decaBDE in other rigid polymeric resins other than PS.

For decaBDE uses in textile applications, the average amount of decaBDE in flame retarded fabrics is estimated at about **300 kg per year** and the cumulative amount of decaBDE in impregnated fabrics that are in use-phase is estimated at **about 3 tonnes**.

DecaBDE can be released from the affected products at any stage throughout products' life-cycle. Results from an emission model suggested the releases from EEE in form of dust are now shifting from the use-phase to the dismantling and recycling facilities. Moreover, the model indicates residues from EOL management will become important emission source of decaBDE in the next 10 years.

Plastic resins extracted from casings of ewaste are likely recycled. Due to the relatively high values of the affected resins, most of the decaBDE in polymeric resins are likely recirculated along with these engineering plastics. Half of the relevant amount was believed to be returned to material cycle while the fate of the remaining half is unclear.

Hexabromocyclo-dodecane (HBCD)

HBCD is not manufactured in Thailand but imported by expanded polystyrene foams (EPS) beads producers to be used as a flame retardant in self-extinguish grade EPS (SE-grade EPS) to produce EPS core sandwich panels in applications such as cold storage and cleanroom, etc.

There are two local EPS beads producers, producing about 12,000 tonnes of SE-grade EPS beads per year. Based on local EPS beads production capacity and EPS beads import/export statistic, the total amount of HBCD contaminated SE-grade EPS is estimated at about 175,000 tonnes, with the corresponding amount of HBCD of about **1,300 tonnes** [890-1,770 tonnes]. Most of the relevant amounts of HBCD are believed to remain within SE-grade EPS foams which are currently in the use phase.

There is no information related to HBCD uses for other purposes. Local industries have been unable to provide information on their involvement. Samples with HBCD were yet to be found. Furthermore, there is no report of detecting HBCD in environment media. Nevertheless, considering the large scale of the ‘likely’ relevant products, the number of samples explored was still too low to arrive at any conclusion.

HBCD was no longer imported into Thailand after global manufacturers terminated their productions. Local EPS bead producers have ceased to use HBCD and, instead used Polymeric FR (CAS No 1195978-93-8) – a novel substance offered by the same suppliers as a drop-in substitute for HBCD. Because EPS beads have a limited useful life of about 6 months, the affected EPS beads are expected to remain in the market only shortly after the phase-out of HBCD.

At the time of this report, HBCD is not yet a ‘classified’ substance under the HSA. Consequently the low POPs content for HBCD has not been established and, hence, waste containing HBCD is not yet classified as hazardous waste. Nevertheless, HBCD’s inherent hazards meet the requirements for voluntary declaration under DIW’s ‘list 5.6’. In 2018 a local distributor filed an intention to import about 8 tonnes of HBCD for EPS foam application. This is presumed to be the last import.

PS foams may be recycled and re-entered material cycle, possibly as general purpose polystyrene resins (GPPS). As the uses of SE-grade EPS foams are not yet widespread in Thailand and the installed panels are yet to reach end-of-life phase, the level of HBCD affected GPPS is presumed to be low. HBCD in articles made of GPPS was not yet found. Still, it is important to set a low POPs content for HBCD, in line with provisions developed by the Basel convention, to prevent HBCD from re-entering material cycle, as a substance or as a contaminant in PS resins/articles.

Because flame retarded and non-flame retarded EPS foams cannot be distinguished by physical appearance, it is imperative that the affected foams or panels be clearly marked to allow for easy identification, in line with the provisions of Part VII of Annex A of the SC. It is also necessary to identify appropriate disposal routes and develop guidance for the decommissioning and disposal of the affected panels to protect workers from the exposure to HBCD and to prevent further releases to the environment. As Thailand is making a transition toward a more circular economy, proper marking of BFR in products will remain an important measure to avoid unnecessary risk of cross-contamination of substances of potential concerns into sensitive products (such as food packaging, buoy, etc.) even after the phase-out of HBCD.

Except for the confirmed uses in EPS foams, information related to sources, releases and environmental fate of HBCD at the national level is lacking. Particularly, the levels of exposure of general population as well as workers to HBCD are currently unknown. It is therefore recommended that research studies should be conducted. Particular attentions should be paid to confirm levels of HBCD in following areas:

- Household dust (results from this study can help confirming the uses of HBCD in textiles and other household items)
- Dust and soil in and around ewaste dismantling sites and plastic shredding facilities (results from this study can help confirming the uses of HBCD in rigid polymeric resins, particularly HIPS)
- HBCD in other products/applications (In case the study of indoor dusts indicates possible uses or concerns)
- The releases of HBCD along pre- and post-consumer SE-grade EPS foams value chain (including sludge from wastewater treatment plants).
- Landfills and dump sites leachates and sediments[4]

Finally, once potential sources are confirmed, a full inventory should be conducted to provide an appropriate baseline data for HBCD for the country.

Perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOS-F)

PFOS is a surfactant that may be used in Thailand in textile (may be only for export oriented products), paper (food packaging), metal plating, and firefighting foams applications.

Information from stakeholder interviews indicated that most export oriented firms had phased-out PFOS since 2009 as a result of the publication of EU's PFOS directive [1]. Unfortunately, due to long delay time, the exact applications, amount used as well as the users cannot be traced. Information from local chemical distributors indicates that some small plating companies still prefer to use PFOS, but information related to the amount uses and the users is not disclosed to the inventory team.

Nine PFOS, its salts, and PFOS-F were recently listed as Category 3 HSs in 2013 and 2017. Based on import requests submitted to the DIW and import statistics, the remaining demand for PFOS for plating applications

[4] This study should apply for all POPs industrial chemicals, not limited to HBCDD.

is estimated at about **300-400 kg per year**.

PFOS was detected in several products including textiles, sun screen cream and bottled water. There were also reports of detecting PFOS in effluent of industrial wastewater treatment plants, groundwater, surface water and tap water, with the concentration level appeared to associate with the areas where PFOS may have been used.

Results from the survey of PFOS in firefighting foams found possible stockpile of PFOS containing foams in foams stored in petroleum refineries and oil depots that were imported before 2009. The amount of PFOS relevant foams are not available to the inventory team but, based on the amount firefighting stock required by the law, the amount of PFOS relevant firefighting foams is estimated at about **3,700 – 5,500 kg**

For firefighting training, which is considered the largest PFOS release source that lead to contamination to groundwater, the survey found most fire trainings in Thailand do not use actual foams, due to the high price of firefighting foams. However, expired foams may be used in firefighting trainings in certain high risk areas, such as petroleum complex and nearby industrial estates. Based on interview with industrial estate officers, effluent water both from firefighting trainings and real fire extinguishing within industrial estate are required to be collected and treated at the source before they are allowed to be released to the industrial estate's central wastewater treatment plant. However, in the absence of regulatory limit, no firm and/or industrial estate had ever conducted an analysis to confirm level of PFOS in their effluent water.

PFOS can contaminate surface water and groundwater. PFOS leached from sewage sludge can be accumulated in agricultural plants, where they can transfer to humans through the food chain. Existing treatment plants may not be able to handle (remove or destroy) PFOS contaminated inputs. It is not clear whether PFOS will pass through the WWTP or partitioned in to sewage sludge or both. Nevertheless, some of the WWTP sewage sludge is being used as soil conditioner.

Based on the assessments, the inventory team identified following areas that could have PFOS but has not been checked and/or controlled

- Wastewater treatment plants that receive wastewater from factory that uses or used PFOS and/or central WWTP that cannot separate incoming water
- WWTP effluent water, effluent from plating plants, sewage sludge and landfill leachate
- Areas that receive contaminated biosolids, particularly areas where these biosolids are used as soil conditioners
- Soil and groundwater in the affected areas

- Landfills, particularly industrial waste landfills

Responsible parties also need to develop a plan/measure to handle PFOS in firefighting foams that will be expired over the next 10 years or so.

Hexachloro-butadiene (HCBD)

There is no information related to production and uses of hexachlorobutadiene (HCBD) in Thailand. Since Thailand has no chlorinated solvent production plant, there is no major source for HCBD.

HCBD is not covered in the Pollutant Release and Transfer Registers (PRTR) pilot project, implemented in Rayong province in 2013. However, HCBD monitoring data appeared in the state of Thailand's pollution reports published between 2006 and 2009 by the PCD (during the survey of 44 volatile organic compounds (VOC)). The results for Bangkok and Rayong found annual average between $0.14 - 0.22\ \mu g/m^3$.

HCBD is listed in DIW's 2016 soil and groundwater standards. Relevant factories[5] are required by the Ministry of Industry's Ministerial Regulation on the control of contamination within factory into soil and groundwater B.E. 2559 (2016) to periodically monitor and report their soil and groundwater quality. At the time of this report, the inventory team received no data related to HCBD.

Finally, a search for information in international journals did not yet find a report on the detection of HCBD in environmental media in Thailand.

Polychlorinated biphenyls (PCBs) and Hexachlorobenzene (HCB)

PCBs and HCB are included in the initial list of POPs under the SC and, hence, had been addressed in Thailand's first NIP. The PCD had periodically submitted reports to the Secretariat in accordant to its obligation under Article 15 of the convention.

Thailand banned HCB and PCBs by listing them as Category 4 substances under the HSA in 2003 and 2004, respectively. The ban covers all activities, including the production, import, export or possess of HCB/PCB. The ban also covers devices that contain PCBs.

In 2004, the DIW designated end-of-life devices, transformers and power capacitors that contain PCBs a chemical waste, classified as Category 3 HS. Any production, import, export, or possess of these devices requires prior approval from DIW.

In 2008, the DIW announced a plan to totally phase-out PCBs by 2012. The announcement obligated device holders to prepare and implement a plan to phase-out and completely dispose of PCBs by 2012. Any movement of the affected devices also needed prior approval from the

[5] 12 Factory Types: 22, 38, 42, 45, 48, 49, 60, 74, 100, 101, 105 and 106

DIW.

Since PCBs oil was not one of the wastes or discarded materials that were allowed to be treated or disposed by waste management processors, industrial waste incinerators in Thailand were not allowed by law to incinerate PCBs oils. All PCBs oils, therefore, were collected and exported to the third countries (France, the Netherland, etc.) for final destruction.

PCBs has been monitored through several activities as follows:

(1) In 2006-2007, the Department of Environmental Quality Promotion (DEQP) studied PCBs in sediments in Chao Praya River, estuaries and upper gulf of Thailand. The study found highest accumulations in areas around Klong Tuy district (Bangkok) and Amphoe Prapradang (Samut Prakarn province). The level of PCB, though, was in pg/g (dw) range. This level of contamination was considered low in comparing to similar areas in other countries. The study found no PCBs accumulation in sediments in central areas from Nontaburi province upward.

(2) From 2004 to 2009, Ministry of education in collaboration with the Inter-University Program on Environmental Toxicology, Technology and Management of Chulabhorn Research Institute, Asian Institute of Technology and Mahidol University's Center for Environmental Health, Toxicology and Management of Chemical conducted research under the project "The evaluation of PCBs and dioxin -like PCBs contaminated coast of Thailand by using chemical and biological techniques" to assess the accumulation of PCBs in seafood from eastern coast of Thailand. The study found PCBs contaminations in mussels, oyster, and shrimps ranging between 19-1,100 ng/g (lipid adjusted weight), and the levels of PCBs in shrimp was higher than that in mussels and oysters.

Polychlorinated naphthalenes (PCNs)

In 2013, DIW designated wastes, substances and articles containing, consisting of or contaminated with polychlorinated biphenyl (PCB), polychlorinated terphynyl (PCT), polychlorinated naphthalene (PCN) or polybrominated biphenyl (PBB), or any other polybrominated analogues of these compounds, at a concentration level of 50 mg/kg or more as chemical wastes which are also classified as Category 3 that require prior approval from the DIW. A search in DIW database found no record that could be linked to PCN.

Apart from this filing, this assessment study did not find any other data related to PCNs in Thailand.

Pentachlorobenzene

This assessment study did not find any data/information related to PeCB

(PeCB)

in Thailand.

PeCB is not yet classified as a hazardous substance under HS Act. There is no record that PeCB was ever produced in Thailand. Except for small amounts imported for research/laboratory purposes, there is no information to whether PeCB ever been imported into Thailand[6]. A search for published articles also found no reports related to PeCB in Thailand.

Limitation of the study and recommendation

As mentioned earlier, with limitation in both time and resources, this study is classified as a preliminary inventory study. It has limitations in terms of data quality as well as data coverage to determine high risk areas which will be presented here along with recommendation to reduce risk from POPs on basis of the available data.

Data Gap

This study suffers from the lack of historic records/data, particularly data related to chemicals in products, and the amount and flow of these affected products. Since most relevant products were produced and put on market during the period when there was no system in place to control chemicals in products. Firms had no obligations to gain knowledge and, hence, unaware of chemicals incorporated in their products.

Consumption data for relevant products as well as markets shared by each player/brand were also lacking. Estimations made in this study were largely based on objective evidences gained from products survey and testing of EOL products that were arrived at waste management sites during the project's survey period.

This assessment only focused on large emission sources (eg., large part size) that are easily encountered in daily life.

- Apart from BFR in polymeric resins and EPS foams, this assessment determined and reported relevant products (such as textiles) but made no attempt to confirm the type nor did it quantify the relevant amount. There are also other important products that had not been covered under this study. This data gap should be addressed in the upcoming NIP.

Because there is no regulation in place to obligate relevant parties to monitor possible releases from their activities, this assessment lacks important data related to the emissions from factories and/or monitoring data for relevant POPs in important media such as wastewater, sludge, etc. Nevertheless, Thailand's existing framework can be updated to address this shortcomings as follows:

- Add new POPs to the existing laws and standards (soil,

[6] HS Code 29039300

groundwater, sludge, wastewater)

- Relevant agencies should have system in place to monitor upcoming (emerging) pollutant that may be included in the SC in the future
- Include monitoring of POPs industrial chemicals in environmental media and food and feed in line with the monitoring of POPs pesticides

Difficult to request data from producers after the product already put on market

Without legal obligation, not only that it is difficult to request data related to chemicals in products from producers, the chance of receiving reliable data is slim if the products were already put on market, especially if delayed for more than 5 years.

In case of export products, especially to the EU, producers must inform the next recipient of article of all Substances of Very High Concerns (SVHC) that are embedded in every part of the products. The concern substances do not need to be a restricted/forbidden substance. Furthermore, producers of EEE under EU RoHS directive are obligated to keep information related to CiP for at least 10 years to enable data/material flow tracing, when needed. Producers exporting products to the US (California) also need to inform intended customers of the embedded carcinogen and reproductive toxins in the products.

These material declaration systems will help in the tracing of hazardous substances that are embedding in products/articles and help reducing burdens to both public and private sectors from requesting CiP data along supply chain after product put on market.

Since CiP data declaration has become a new norm in the global market, firms who are producing products to serve global market are already required to have a system to collect and communicate CiP along their supply chain. These CiP data and declaration system are crucial elements for the management of chemical and environmental safety throughout product life-cycle. Therefore, relevant authorities should explore and take advantage from this globally established system.

Up-to-date materials (in/out) flow

Factories are required by law to report their materials input and product/waste output. This information is fundamentally important for chemical and environmental safety management. Materials and products flowing in and out from factories are valuable data for inventory assessment. It is unfortunate that this inventory assessment study could not benefit from this dataset. Except for the data from waste transfer manifests, the obtained data were fragmented, out-of-date and/or not reflecting the actual products.

As worldwide industry is entering the ‘Industry 4.0’ era, automated data collection and update of factories’ materials input, products and residues output data are becoming feasible and, hence, should be explored. If properly designed and implemented (such as the PRTR system), this industry data should prove to be an invaluable asset not only for fulfilling obligation toward the SC but also for the effective chemical and environmental safety management at the national level.

POPs substances in import products/articles

This study relies on evidence obtained from testing EOL products. It does not cover newer imported products that did not yet show up at waste management sites. When other countries deploy measures to prohibit put-on-market of contaminated products, these products may be diverted to countries without such measures, like Thailand.

All SC POPs industrial chemicals are prohibited substances for export products. REACH and RoHS are becoming new norm for global supply chain. As an important producer for many of the relevant products, Thailand export products always satisfy customers’ requirements; including fire safety, environment and chemical safety (ECS) regulations in most stringent markets and/or sectors.

It is unfortunate that Thailand does not yet introduce such measures. Although most local producers tend to place similar RoHS/REACH compliance products on domestic market, this study found products with decaBDE begining to emerge in newer EEE products, believed to targeting only for Thai market. Due to limited number of samples and lack of market share data, this assessment study does not include the estimation of the amount of SC POPs in these newer products.

Contaminated products not only pose risks to consumers but also put burdens to public for their disposal. Materials contaminated with POPs are difficult to recycle without releasing harmful substances to the environment. Since recycled materials contaminated with prohibited substances are not accepted by mainstream producers, they are diverted to low cost products, undercutting the viability of the recycling industry.

It is, therefore, proposed that Thailand impose measures to prohibit the use of hazardous substances in domestic products, in-line with ECS measures imposed elsewhere around the world.

Plan for proper management of stockpile in in-use articles

POPs industrial chemicals differ from POPs pesticides by the fact that they are embedded in products with much longer life-cycle/value chain and they can be recycled into new products. While users of pesticides mostly know/are aware of their actions, except for the actor who actually add the substance in to target material, users of POPs industrial chemicals contaminated materials do not yet have a viable mean to know/aware of substances embedded within their products.

It is, therefore, important that contaminated products/materials are clearly identified and separately collected for proper disposal/management before they are mingled with other materials, causing wider spread and, consequently, posing higher risks.

For HBCD in SE-grade EPS Foams

- Since they are used in recently built constructions where information/materials specifications are still relatively fresh, it may still be feasible to conduct nationwide survey to allocate and provide proper markings for these foams/constructions.
- It is recommended that appropriate disposal routes be identified and guidances for the decommissioning and disposal of the affected panels be developed to protect workers from the exposure to HBCD and to prevent further releases to the environment.

For brominated flame retardants in polymeric resins

- Identifications of relevant BFR based on testing are costly. The practices in developed countries that rely on XRF and IR technologies to automatically separate contaminated materials (chips) at shredder facilities are considered too costly and, thus, may not be appropriate to Thai recyclers. It will be simpler and cheaper to separate out contaminated parts before mingling. However, to do so dismantlers need 'intelligence' information to help identify contaminated parts. It is, therefore, essential to conduct researches to gather such intelligence information to enable accurate prediction for all relevant products.
- It is also imperative to lay down measures to prohibit mixing (or dilution) of contaminated material with other cleaner material to prevent further spread out of POPs.

For other POPs and upcoming POPs industrial chemicals

- This assessment demonstrated the benefit of the new screening test methods. These test methods should be developed further to support the assessment of other SC POPs industrial chemicals that suffered from limited evidence/data (SCCPs and

PFOS/PFOA) as well as the upcoming POPs.

Unintentional Production POPs (UPOPs)

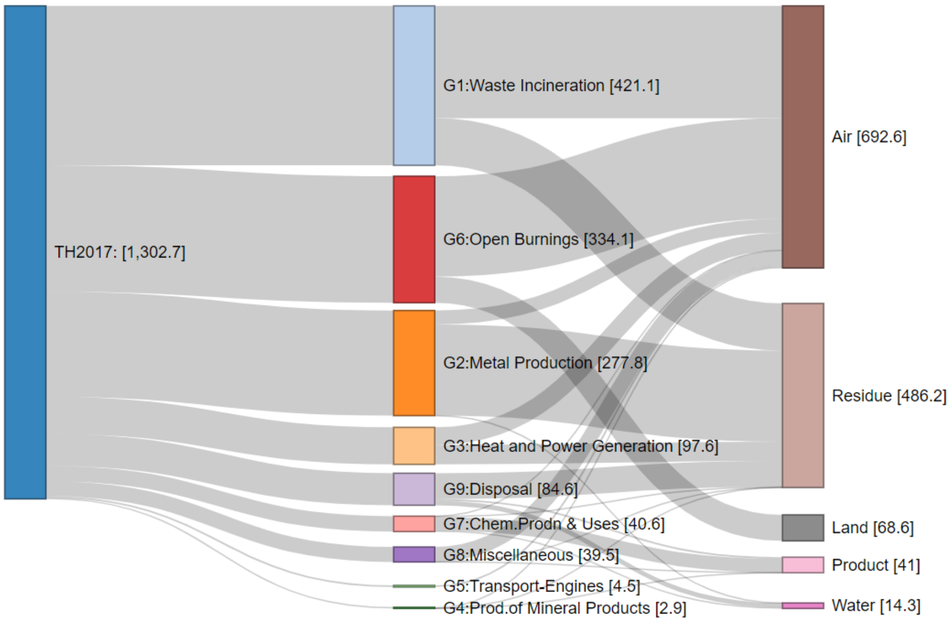
This study is intended to be a preliminary unintentional POPS inventory study, covering relevant activities that took place in Thailand in 2017. It covers the assessment of all of the 9 UNEP identified potential source-groups which are further divided into 74 source categories and 237 technology/activity classes.

An overview of the estimated PCDD/Fs emissions in Thailand for the baseline year 2017 is shown numerically in Table 1 and visually in Figure 1, where emissions into air, water, land, products and residues are 692.6, 14.3, 68.6, 41, and 486.2 g TEQ/a, respectively – totaling to an overall emission of 1,303 gTEQ/a.

The top 3 highest emission source groups are G1: Waste incineration (421.1 gTEQ/a)), G6: Open Burning Processes (334.1 gTEQ/a) and G2: Ferrous and Non-Ferrous Metal Production (277.2 gTEQ/a). These source groups contribute to 32%, 26% and 21% of Thailand's total PCDD/Fs emission in 2017, respectively.

Table 1: Overview of the estimated PCDD/Fs emissions in Thailand in 2017

	Source Groups	Annual Releases (g TEQ/a)						Destruction (g TEQ/a)
		Air	**Water**	**Land**	**Product**	**Residue**	**Subtotal**	
G1	Waste Incineration	296.8	0.0	0.0	0.0	124.3	**421.1**	-
G2	Ferrous and Non-Ferrous Metal Production	37.0	0.2	0.0	0.0	240.7	**277.8**	**-21.59**
G3	Heat and Power Generation	46.4	0.0	0.0	0.0	51.2	**97.6**	-
G4	Production of Mineral Products	2.9	0.0	0.0	0.1	0.0	**2.9**	-
G5	Transportation	4.5	0.0	0.0	0.0	0.0	**4.5**	-
G6	Open Burning Processes	265.5	0.0	68.6	0.0	0.0	**334.1**	-
G7	Production of Chemicals and Consumer Goods	0.2	2.2	0.0	36.4	1.8	**40.6**	-
G8	Miscellaneous	39.3	0.0	0.0	0.0	0.2	**39.5**	-
G9	Disposal	0.0	11.9	0.0	4.6	68.0	**84.6**	-
	Total	**692.6**	**14.3**	**68.6**	**41.0**	**486.2**	**1302.7**	**-21.59**
	Grand Total			**1,303**			**1,281**	



unit: g TEQ/a

Figure 1: Profile of the estimated PCDD/Fs emissions in Thailand in 2017

G1: Waste Incineration

Waste incineration in this report covers 7 source categories that contributed to the release of about 421 g TEQ/a in 2017, with municipal solid waste (MSW) incineration and medical waste (MW) incineration contributing to 83% and 16% of the emission from this source group, respectively. The high releases from MSW incinerators were mostly (75%) contributed by 57 small and inefficient incinerators. While these incinerators helped dispose of about 0.3% of Thailand's MSW in 2017, they were responsible for over 20% of the country's total PCDD/Fs release.

Emissions from MW incinerators (66.3 gTEQ/a), though only contributing at 5% of the country's total PCDD/Fs emission, were concentrated in about 10 locations, with one site accounting for more than 50% of total MW incineration. Because MW management sites play vital roles in the country's waste management and health development plans, these plants, therefore, deserve close attentions to ensure their prudent operations.

G6: Open Burning Processes

Open burning processes contributed about 334 g TEQ/a. The burning of agricultural residues in paddy and maize fields is the main contributor for this source group, responsible for about 20% of country's total PCDD/Fs release. The high level of PCDD/Fs released resulted from the combination of the high activity rates, the relatively poor combustion efficiency, and the involvement of chlorinated herbicides.

A relatively large portion (67 gTEQ/a, or 23%) of PCDD/Fs generated in agricultural field burnings was released to land, which poses long-term risks to the community that rely on food and feed produced from these land areas. Emissions from biomass open burning are, therefore, identified as a major source of PCDD/F emission that needs to be addressed in the upcoming NIP.

PCDD/Fs generated from fires at waste dumps is estimated at 37.2 gTEQ/a, or 11% of PCDD/Fs generated from open burning processes. Although the contribution from this source appears moderate, it illustrates a potentially risk of PCDD/F generations and releases from landfill fires, especially for large landfill sites.

G2: Ferrous and Non-Ferrous Metal Production

PCDD/Fs emission from metal production ranked first in the 2004 inventory and, hence is identified as a major source for actions at the national level. As a result, several air emission standards have been published and the releases from large factories have been monitored. Unfortunately, actions that were put in places were mainly toward reduction of the emission into air, while the main vector for this source group is the release into residues, which account for about 87% of the total release from this source group in 2017.

Emission from metal production ranks third in this 2017 inventory, with about 240 gTEQ/a released into residue; the transfer of which was controlled by Thai law. With an improved waste transfer reporting system, a large portion of residues from metal production plants could be traced. Some (21.6 gTEQ/a) of the PCDD/Fs embedded in these residues were destroyed via incineration in cement kilns.

G3: Heat and Power Generation

Heat and power generation contributed 98 gTEQ/a (7.7%) to Thailand's 2017 total PCDD/Fs emission, with about 48% and 52% released into air and residues, respectively.

Biomass power plants were the key contributor for this source group; responsible for about 48% of the emission, followed by fossil fuel power plants and household cooking with biomass, each contributing to about the same amount of PCDD/Fs but released into different vectors.

Although ranked 4^{th} for PCDD/F emission, this source group is of high importance due to its close tie to the country's Climate Change Master Plan and Sustainable Development Goals. While biomass has been widely regarded as a green energy source with low carbon footprint, relatively high PCDD/F emission contribution from biomass (73% of this source group total) deserves national attention. Biomass is a major part of Thailand's renewable energy portfolio. Diverting unused biomass residues from agricultural fields to power plants also help curb biomass open burning problems. However, attention should also be paid to ensure that the risks from unintended PCDD/Fs generations/emissions are under control. Particularly, research and development into new power plant/combustion technology with low PCDD/Fs generation should be promoted. Moreover, due to high PCDD/F emissions into residues couple with potentially high amount of residue generation from biomass power plants, technology for the ultimate destruction of PCDD/Fs will be needed.

The high emission from the use of biomass for household cooking is also important from the risk proximity and gender points of view. Again, measures should be put in place to ensure public awareness and the availability and accessibility of efficient, low PCDD/Fs stoves.

G9: Disposal

PCDD/Fs emission from disposal and landfill activities during the year 2017 was 95 g TEQ/a; with the release to residue, water, and products accounting for 80.5%, 14% and 5.5% of total emission, respectively.

The main contributor (93%) for this source group is from activities related to landfills and waste dumps, particularly landfilling or open dumping of wastes contaminated with hazardous components or mixed wastes, with residue being the main pathway. The emission into residues in engineered or secured landfills does not constitute a release per se, but rather the storage of PCDD/Fs that accumulates and gradually releases into water overtime, and will become important when excavated.

The value reported here for landfill residues appears low because it excludes the portions that are already counted in the respective waste-generating source groups (G1 to G8) to avoid double counting. Thus, the amount of PCDD/Fs stored in landfills are actually higher than reported in this source group (by about 400 g TEQ/a) and will further accumulate every year unless care is taken to remove contaminated items from waste streams prior to landfilling.

The emission into water, on the other hand, can be released to nearby receptors. The reported value for the release into leachate water from landfills shall not be misinterpret as emission from the entire landfills, but rather only from the portions that were deposited during the 2017 baseline year. The total amount of PCDD/Fs anticipated to have been released is thus higher, depending on the accumulated amount of waste landfilled over all years.

At the time of this report, there is no requirement to monitor PCDD/Fs released from landfills and landfill excavations; thus, no preventive action is yet in place to assure public and environmental safety. This gap, particularly for landfills near urban and industrial areas, should be addressed in the upcoming action plans.

G7: Production of Chemicals and Consumer Goods

The total PCDD/Fs emission from Source Group 7 during the year 2017 is about 41 g TEQ/a, with the emissions to product, water, and residues accounting for 90%, 5.6% and 4.4% of the emission from this source group, respectively.

The main source for PCDD/Fs in products were dioxin contamination in chlorinated chemicals, particularly, chlorinated paraffins and dioxazine pigments, and residuals in paper recovered from contaminated paper waste.

Due to the absence of representative EFs into water and residues, relatively low values for PCDD/Fs emission into these vectors should be interpreted with caution. The reported emission values do not yet include releases from potential sources, such as textile and leather plants. Therefore, releases from these potential sources should be confirmed via measurement data. Particularly, data related to quantities, method of treatment, fate of wastewater, wastewater sludge and other solid wastes should be recorded and analyzed.

G8: Miscellaneous

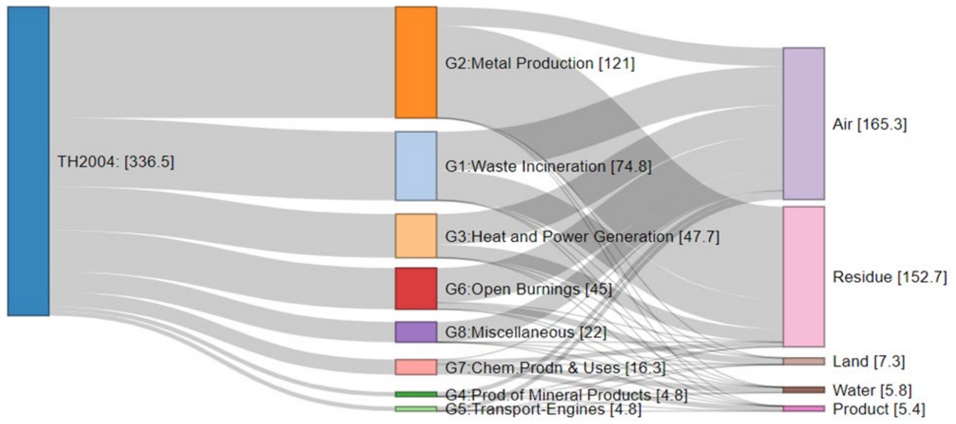
Miscellaneous sources contributed about 40 gTEQ/a (3%) to the total emission in 2017, with crematoria being responsible for almost all (98%) of the PCDD/Fs released from this source group.

Crematoria was identified in Thailand’s 2006 inventory report as a potential source and actions have been taken to reduce the emission. Consequently, through efforts laid down by the previous NIPs, the number of improved crematoria has increased and Thailand’s country-specific emission factors have been made available.

Nevertheless, the improvement appeared moderate because the derived country-specific EFs were still higher than those of UNEP’s Class 2 crematoria. This finding points toward the interaction of other important factors, particularly operation and maintenance. As Thailand is planning to upgrade all crematoria to meet PCD’s Type-3 specification, it is crucial that responsible agencies put in place measures to ensure that the performance of the upgraded crematoria also meet at least UNEP Class 2 performance.

Comparison to emissions in 2004

In 2006, Thailand reported total emission of 1,096.7 g TEQ/a for the 2004 reference year, using UNEP’s 2005 EFs. The same set of activities leads to a total emission of 336.5 g TEQ/a when revised using UNEP’s 2013 EFs. The profile of the recalculated emissions for activities reported for baseline year 2004 is illustrated in Figure 2.



unit: g TEQ/a

Note: Estimated with UNEP's 2013 EFs

Figure 2: Profile of the estimated PCDD/Fs emissions in Thailand's 2006 inventory report (baseline year 2004)

Because the 2006 report was Thailand's first attempt to assess PCDD/Fs, the report covered 8 source groups with 31 source categories and 53 unique activity entries. Since current study assesses PCDD/Fs from 9 source groups with 74 source categories and 237 technology/activity classes, the results from these two baseline years (2004 and 2017) cannot be directly compared.

However, when comparing similar sources per unit activity, the emissions per unit activity from several source categories are declining. Activities that were identified with high releases potential were improved and, hence, received better class allocations in this report. Unfortunately, new activities with poor technologies also have concurrently been taken place, leading to only a moderate improvement in the overall national performance.

It is, therefore, important that the upcoming action plans lay down measures to prevent installation of new plants/activities with inferior technology and, instead, to promote the adoption of BAT & BEP.

Comparison with emissions from other countries

Figure 3 compares Thailand's dioxin emission to air per unit $GDP with 40 other countries based on income level. Thailand's overall results compare well with those from other upper middle income countries.

Thailand's emissions from Source Groups 4, 6 and 7 were on the lower range among the upper-middle income group, while emissions from Source Groups 1 and 8 were on the high range. As previously stated, the main emission from Source Group 1 was from the improper waste incineration, while crematoria were responsible for the high emission from Source Group 8.

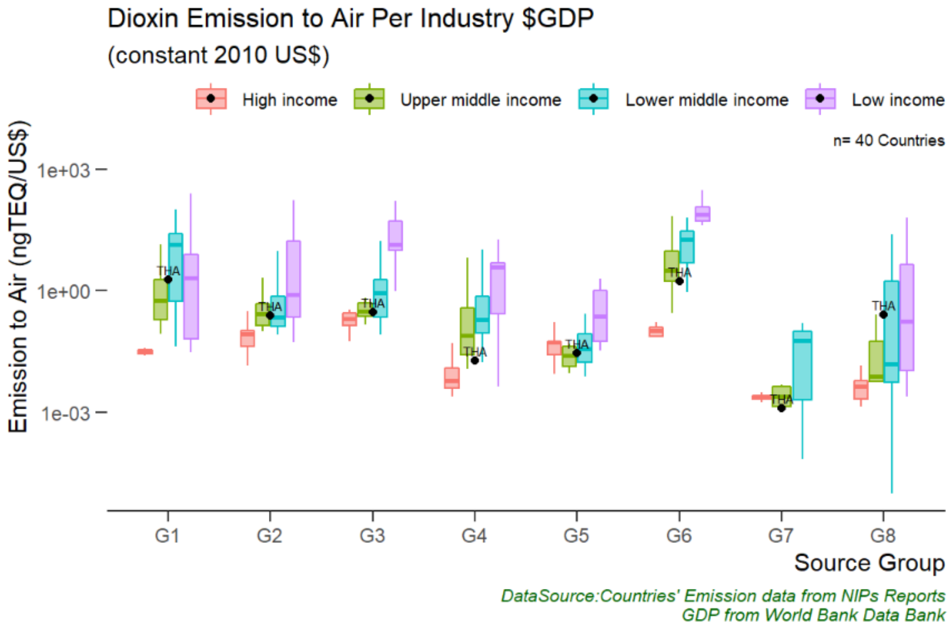


Figure 3: Thailand's PCDD/Fs emission into air per industry $GDP in comparison with other 40 countries based on income level

□□□

Annex 1. Work Plans

Table 2: Work plan for the inventory assessment of POPs pesticides

Group	Substances	Factors considered	Scope	Depth of data assessment
Old POPs pesticides	1. Aldrin 2. Chlordane 3. DDT 4. Dieldrin 5. Endrin 6. Heptachlor 7. HCB 8. Mirex 9. Toxaphene	Previous inventory assessment results and NIP	▪ Possible remaining obsolete stock ▪ Sites of historic uses, storage and repackaging ▪ Monitoring results from downstream areas ▪ Results from market survey of agricultural products	▪ Quantitative assessment based on National enforcement data ▪ Indicative assessment of current contamination in environmental media from available data such as from product certification activities (GAP), market surveillance, etc.
New POPs pesticides	1. Alpha-HCH 2. Beta-HCH 3. Gamma-HCH (Lindane) 4. Chlordecone 5. PeCB 6. Endosulfan 7. PCP	Historic uses and current control status Relevant stakeholders (from Registration record) Import-export and registered of domestic-used formulation	▪ Disposal of regulated substances and possible remaining obsolete stock ▪ Sites of historic uses, storage and repackaging ▪ Monitoring results from downstream areas ▪ Results from market survey of agricultural products	

Table 3: Work plan for the inventory assessment of industrial POPs

Group	Substances	Factors considered	Scope	Depth of data assessment
Br-Based Chemicals in Products	PBBs, PBDEs (penta-, octa-, decaBDE) HBCD	▪ Inter-relationship between consumers, domestic (fire) regulation and producers ▪ Influence from international regulation, such as RoHS, REACH, on Thai products ▪ Costs and compatibility of the substances and base polymers ▪ Results from preliminary survey	▪ Plastic parts in electrical and electronic (EEE) and automotive products ▪ Textiles in automotive, construction, and furniture applications EPS foam in construction application	Qualitative and semi-quantitative method, using in-house predictive model
Cl-Based Chemicals in Products	PCBs, PCNs (SCCPs)	▪ Physical properties of the substances ▪ Current and historic applications ▪ Potential users (and key stakeholders)	Cutting fluids Soft PVC and rubbers Hydraulic oil Paints, sealants and gaskets Fat liquor Recycled oils	Qualitative and semi-quantitative method, with primary focus on SCCPs
Cl-Based chemicals (chemical products)	HCB, PeCB, HCBD	▪ Physical properties of the substances ▪ By-products from production of chlorinated solvents	Chlorinated organic compounds value chain	Preliminary assessment
F-Based chemicals (chemical products)	PFOS, (PFOA)	▪ Physical properties of the substances ▪ Current and historic applications ▪ Potential users (and key stakeholders)	Fire-fighting foams Metal plating and lithography: chemicals suppliers Other surfactants	Preliminary assessment

Note: SCCPs and PFOA are beyond the scope of this study.

Table 4: Work plan for the inventory assessment of uPOPs

Group	Factors considered	Scope	Depth of data assessment
uPOPs Dioxin/Furan, PCB, HCB, PeCB, PCP Note: excluding substances whose Emission Factors are not yet defined, namely PCNs and HCBD	▪ UNEP Toolkit 2013 ▪ Existing regulations ▪ National Strategy ▪ National GHG inventory	▪ Recalculation of baseline data using previous activity rates ▪ Updating activity rates for the 10 source groups according to the new Toolkit ▪ Reviewing of existing source-specific emission	▪ Quantitative assessment based on national statistics data ▪ Semi-quantitative data gathering for class assignment

□□□

Annex 2. Project's advisors and their expertise

Name	Affiliation	Area of expertise
Dr. Nuansri Tayapat	Project Advisor	POPs pesticides
Asst. Prof. Dr. Chalongkwan Tangbanluekal	Project Advisor	UPOPs
Asso. Prof. Dr. Suwanna Boontanon	Mahidol University	PFOS
Asst. Prof. Dudsadee Muenhor	Prince of Songkla University	PBDE
Asst. Prof. Ekbodin Winijkul	Asian Institute of Technology	UPOPs
Asst. Prof. Dr. Kulwadee Tongpubesra Eisingerich	Project Advisor	Material/Substance Flow Analysis (MFA/SFA)
Dr. Roland Weber	UNIDO-designated consultant	SC POPs
Dr. Asira Fuongfuchat	Director of the Advanced Polymers Technology Research Group, MTEC	Polymer rheology, biopolymers and physical chemistry of polymers
Dr. Chureerat Prahsarn	Head of the Textiles Research Team, MTEC	Fiber design for functions, fabrication of biocomponent fibers and nonwovens fiber spinning
Dr.Wuttipong Rungseesantivanon	Head of the Plastics Technology Research Team, MTEC	Plastics technology including injection moulding and other techniques for shape processing
Dr. Rittirong Pruthtikul	Plastics Technology Research Team, MTEC	Polymer blends
Dr. Ekkarut Viyanit	Head of the Coating and Joining Technology Research Team, MTEC	Metal plating, metal etching and corrosion

Annex 3. Working Groups established for Thailand's NIP update

คำสั่งคณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนาน
ที่ ๑/๒๕๖๒
เรื่อง แต่งตั้งคณะทำงานโครงการ Enabling Activities to Review and Update the National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants

---

ด้วย คณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนาน ในคราวการประชุมครั้งที่ ๑/๒๕๖๒ เมื่อวันที่ ๑๗ มกราคม ๒๕๖๒ เห็นชอบให้มีการสรรหาประธานคณะทำงานวิเคราะห์ด้านสังคมและเศรษฐศาสตร์ เนื่องจากการใช้สารมลพิษที่ตกค้างยาวนาน ภายใต้คณะทำงานโครงการ Enabling Activities to Review and Update the National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants แทน เลขาธิการสภาพัฒนาการเศรษฐกิจและสังคมแห่งชาติหรือผู้แทน

อาศัยอำนาจหน้าที่ข้อ (๔) ของคณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนาน และมติคณะอนุกรรมการฯ ดังกล่าว จึงมีคำสั่ง ดังนี้

ข้อ ๑ ให้ยกเลิกคำสั่งคณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนาน ที่ ๒/๒๕๖๑ ลงวันที่ ๒๑ กันยายน ๒๕๖๑ เรื่อง แต่งตั้งคณะทำงานโครงการ Enabling Activities to Review and Update the National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants

ข้อ ๒ ให้แต่งตั้งคณะทำงานโครงการ Enabling Activities to Review and Update the National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants โดยมีองค์ประกอบ และอำนาจหน้าที่ ดังต่อไปนี้

๑. คณะทำงานกำกับดูแลและประสานดำเนินโครงการ Enabling Activities to Review and Update the National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants

๑.๑ องค์ประกอบ

๑)	อธิบดีกรมควบคุมมลพิษ หรือผู้แทน	ประธานคณะทำงาน
๒)	ผู้แทนกรมวิชาการเกษตร	คณะทำงาน
๓)	ผู้แทนกรมโรงงานอุตสาหกรรม	คณะทำงาน
๔)	ผู้แทนเลขาธิการสภาพัฒนาการเศรษฐกิจและสังคมแห่งชาติ	คณะทำงาน
๕)	ผู้แทนกรมส่งเสริมคุณภาพสิ่งแวดล้อม	คณะทำงาน

๖) ผู้แทนกรมศุลากร...

๖)	ผู้แทนกรมศุลกากร	คณะทำงาน
๗)	ผู้แทนกรมอนามัย	คณะทำงาน
๘)	ผู้แทนสำนักงานมาตรฐานผลิตภัณฑ์อุตสาหกรรม	คณะทำงาน
๙)	ผู้แทนการนิคมอุตสาหกรรมแห่งประเทศไทย	คณะทำงาน
๑๐)	ผู้แทนสภาอุตสาหกรรมแห่งประเทศไทย	คณะทำงาน
๑๑)	ผู้แทนองค์การพัฒนาอุตสาหกรรมแห่งสหประชาชาติ สำนักงานประเทศไทย	คณะทำงาน
๑๒)	ผู้อำนวยการกองจัดการกากของเสียและสารอันตราย กรมควบคุมมลพิษ	คณะทำงานและเลขานุการร่วม
๑๓)	ผู้แทนศูนย์เทคโนโลยีโลหะและวัสดุแห่งชาติ สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ	คณะทำงานและเลขานุการร่วม
๑๔)	ผู้อำนวยการส่วนสารอันตราย กองจัดการกากของเสียและสารอันตราย	คณะทำงานและผู้ช่วยเลขานุการ

๑.๒ อำนาจหน้าที่

๑) กำกับดูแลการดำเนินงานในภาพรวมให้เป็นไปตามเป้าหมายและวัตถุประสงค์ของโครงการ Enabling Activities to Review and Update the National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants

๒) พิจารณาและให้ข้อเสนอแนะเกี่ยวกับการจัดทำทำเนียบสารมลพิษที่ตกค้างยาวนานและร่างแผนจัดการระดับชาติเพื่อการปฏิบัติตามอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานในภาพรวม

๓) ติดตาม ประเมินผล และรายงานผลการดำเนินโครงการ Enabling Activities to Review and Update the National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants ให้คณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานรับทราบ

๔) ปฏิบัติหน้าที่อื่น ๆ ตามที่คณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานมอบหมาย

๒. คณะทำงานทบทวนและปรับปรุงแผนจัดการระดับชาติและทำเนียบข้อมูลสารมลพิษที่ตกค้างยาวนานประเภทสารเคมีป้องกันกำจัดศัตรูพืชและสัตว์

๒.๑ องค์ประกอบ

๑)	อธิบดีกรมวิชาการเกษตร หรือผู้แทน	ประธานคณะทำงาน
๒)	ผู้แทนกรมส่งเสริมการเกษตร	คณะทำงาน
๓)	ผู้แทนกรมศุลกากร	คณะทำงาน
๔)	ผู้แทนสำนักงานคณะกรรมการอาหารและยา	คณะทำงาน
๕)	ผู้แทนกรมอนามัย	คณะทำงาน
๖)	ผู้แทนสภาเกษตรกรแห่งชาติ	คณะทำงาน
๗)	ผู้แทนองค์การพัฒนาอุตสาหกรรมแห่งสหประชาชาติ สำนักงานประเทศไทย	คณะทำงาน

๘) ดร. นวลศรี...

๘)	ดร.นวลศรี ทยาพัชร	คณะทำงาน
๙)	นายสกล มงคลธรรมากุล	คณะทำงาน
๑๐)	ผู้อำนวยการกองจัดการกากของเสียและสารอันตราย กรมควบคุมมลพิษ	คณะทำงานและเลขานุการร่วม
๑๑)	ผู้แทนศูนย์เทคโนโลยีโลหะและวัสดุแห่งชาติ สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ	คณะทำงานและเลขานุการร่วม
๑๒)	ผู้อำนวยการส่วนสารอันตราย กองจัดการกากของเสียและสารอันตราย	คณะทำงานและผู้ช่วยเลขานุการ

๒.๒ อำนาจหน้าที่

๑) พิจารณาและเสนอแนะแนวทางการทบทวนและปรับปรุงทำเนียบสารมลพิษที่ตกค้างยาวนานชนิดเดิม และจัดทำทำเนียบสารมลพิษที่ตกค้างยาวนานชนิดใหม่ ประเภทสารเคมีป้องกันกำจัดศัตรูพืชและสัตว์

๒) พิจารณาข้อมูลสถานการณ์ วิเคราะห์ช่องว่าง และความต้องการ กลไกที่เกี่ยวข้อง เพื่อกำหนดเป้าหมาย จัดลำดับความสำคัญของกิจกรรม/โครงการที่เกี่ยวข้องกับการจัดการสารมลพิษที่ตกค้างยาวนาน ประเภทสารเคมีป้องกันกำจัดศัตรูพืชและสัตว์

๓) พิจารณาและให้ข้อคิดเห็นต่อร่างแผนจัดการระดับชาติเพื่อการปฏิบัติตามอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานที่เกี่ยวข้องกับสารมลพิษที่ตกค้างยาวนาน ประเภทสารเคมีป้องกันกำจัดศัตรูพืชและสัตว์

๔) ปฏิบัติหน้าที่อื่น ๆ ตามที่คณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานมอบหมาย

๓. คณะทำงานทบทวนและปรับปรุงแผนจัดการระดับชาติและทำเนียบข้อมูลสารมลพิษที่ตกค้างยาวนานประเภทสารเคมีอุตสาหกรรม

๓.๑ องค์ประกอบ

๑)	อธิบดีกรมโรงงานอุตสาหกรรม หรือผู้แทน	ประธานคณะทำงาน
๒)	ผู้แทนกรมโรงงานอุตสาหกรรม	คณะทำงาน
๓)	ผู้แทนสำนักงานมาตรฐานผลิตภัณฑ์อุตสาหกรรม	คณะทำงาน
๔)	ผู้แทนกรมศุลกากร	คณะทำงาน
๕)	ผู้แทนการนิคมอุตสาหกรรมแห่งประเทศไทย	คณะทำงาน
๖)	ผู้แทนการไฟฟ้าฝ่ายผลิตแห่งประเทศไทย	คณะทำงาน
๗)	ผู้แทนสถาบันไฟฟ้าและอิเล็กทรอนิกส์	คณะทำงาน
๘)	ผู้แทนสภาอุตสาหกรรมแห่งประเทศไทย	คณะทำงาน
๙)	ผู้แทนสมาคมธุรกิจเคมี	คณะทำงาน
๑๐)	ผู้แทนองค์การพัฒนาอุตสาหกรรมแห่งสหประชาชาติ สำนักงานประเทศไทย	คณะทำงาน

๑๑) รศ.ดร สุวรรณา....

๑๑)	รศ.ดร. สุวรรณา บุญตานนท์ คณะวิศวกรรมศาสตร์ มหาวิทยาลัยมหิดล	คณะทำงาน
๑๒)	ผู้อำนวยการกองจัดการกากของเสียและสารอันตราย กรมควบคุมมลพิษ	คณะทำงานและ เลขานุการร่วม
๑๓)	ผู้แทนศูนย์เทคโนโลยีโลหะและวัสดุแห่งชาติ สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ	คณะทำงานและ เลขานุการร่วม
๑๔)	ผู้อำนวยการส่วนสารอันตราย กองจัดการกากของเสียและสารอันตราย	คณะทำงานและ ผู้ช่วยเลขานุการ

๓.๒ อำนาจหน้าที่

๑) พิจารณาและเสนอแนะแนวทางการทบทวนและปรับปรุงทำเนียบสารมลพิษที่ตกค้างยาวนานชนิดเดิม และจัดทำทำเนียบสารมลพิษที่ตกค้างยาวนานชนิดใหม่ประเภทสารเคมีอุตสาหกรรม

๒) พิจารณาข้อมูลสถานการณ์ วิเคราะห์ช่องว่างและความต้องการ กลไกที่เกี่ยวข้อง เพื่อกำหนดเป้าหมาย จัดลำดับความสำคัญของกิจกรรม/โครงการที่เกี่ยวข้องกับการจัดการสารมลพิษที่ตกค้างยาวนาน ประเภทสารเคมีอุตสาหกรรม

๓) พิจารณาและให้ข้อคิดเห็นต่อร่างแผนจัดการระดับชาติเพื่อการปฏิบัติตามอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานที่เกี่ยวข้องกับสารมลพิษที่ตกค้างยาวนาน ประเภทสารเคมีอุตสาหกรรม

๔) ปฏิบัติหน้าที่อื่น ๆ ตามที่คณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานมอบหมาย

๔. คณะทำงานทบทวนและปรับปรุงแผนจัดการระดับชาติและทำเนียบข้อมูลสารมลพิษที่ตกค้างยาวนานประเภทปลดปล่อยโดยไม่จงใจ

๔.๑ องค์ประกอบ

๑)	อธิบดีกรมควบคุมมลพิษ หรือผู้แทน	ประธานคณะทำงาน
๒)	ผู้แทนกรมโรงงานอุตสาหกรรม	คณะทำงาน
๓)	ผู้แทนกรมอนามัย	คณะทำงาน
๔)	ผู้แทนกรมส่งเสริมคุณภาพสิ่งแวดล้อม	คณะทำงาน
๕)	ผู้แทนกรมส่งเสริมอุตสาหกรรม	คณะทำงาน
๖)	ผู้แทนการนิคมอุตสาหกรรมแห่งประเทศไทย	คณะทำงาน
๗)	ผู้แทนสภาอุตสาหกรรมแห่งประเทศไทย	คณะทำงาน
๘)	ผู้แทนองค์การพัฒนาอุตสาหกรรมแห่งสหประชาชาติ สำนักงานประเทศไทย	คณะทำงาน
๙)	ดร. ฉลองขวัญ ตั้งบรรลือกาล	คณะทำงาน
๑๐)	ดร. เอกบดินทร์ วินิจกุล สถาบันเทคโนโลยีแห่งเอเชีย	คณะทำงาน

๑๑) ผู้อำนวยการ....

๑๑)	ผู้อำนวยการกองจัดการกากของเสียและสารอันตราย กรมควบคุมมลพิษ	คณะทำงานและ เลขานุการร่วม
๑๒)	ผู้แทนศูนย์เทคโนโลยีโลหะและวัสดุแห่งชาติ สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ	คณะทำงานและ เลขานุการร่วม
๑๓)	ผู้อำนวยการส่วนสารอันตราย กองจัดการกากของเสียและสารอันตราย	คณะทำงานและ ผู้ช่วยเลขานุการ

๔.๒ อำนาจหน้าที่

๑) พิจารณาและเสนอแนะแนวทางการทบทวนและปรับปรุงทำเนียบสารมลพิษที่ตกค้างยาวนานชนิดเดิม และจัดทำทำเนียบสารมลพิษที่ตกค้างยาวนานชนิดใหม่ ประเภทปลดปล่อยโดยไม่จงใจ

๒) พิจารณาข้อมูลสถานการณ์ วิเคราะห์ช่องว่างและความต้องการ กลไกที่เกี่ยวข้อง เพื่อกำหนดเป้าหมาย จัดลำดับความสำคัญของกิจกรรม/โครงการที่เกี่ยวข้องกับการจัดการสารมลพิษที่ตกค้างยาวนาน ประเภทปลดปล่อยโดยไม่จงใจ

๓) พิจารณาและให้ข้อคิดเห็นต่อร่างแผนจัดการระดับชาติเพื่อการปฏิบัติตามอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานที่เกี่ยวข้องกับสารมลพิษที่ตกค้างยาวนาน ประเภทปลดปล่อยโดยไม่จงใจ

๔) ปฏิบัติหน้าที่อื่น ๆ ตามที่คณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานมอบหมาย

๕. คณะทำงานวิเคราะห์ด้านสังคมและเศรษฐศาสตร์ เนื่องจากการใช้สารมลพิษที่ตกค้างยาวนาน

๕.๑ องค์ประกอบ

๑)	ผู้จัดการกองทุนสนับสนุนการสร้างเสริมสุขภาพ หรือผู้แทน	ประธานคณะทำงาน
๒)	ผู้แทนสำนักงานคณะกรรมการอาหารและยา	คณะทำงาน
๓)	ผู้แทนสำนักงบประมาณ	คณะทำงาน
๔)	ผู้แทนกรมการค้าต่างประเทศ	คณะทำงาน
๕)	ผู้แทนกรมสวัสดิการและคุ้มครองแรงงาน	คณะทำงาน
๖)	ผู้แทนสภาอุตสาหกรรมแห่งประเทศไทย	คณะทำงาน
๗)	ผู้แทนคณะสาธารณสุขศาสตร์ มหาวิทยาลัยมหิดล	คณะทำงาน
๘)	ผู้แทนศูนย์เทคโนโลยีโลหะและวัสดุแห่งชาติ สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ	คณะทำงาน
๙)	ผู้แทนองค์การพัฒนาอุตสาหกรรมแห่งสหประชาชาติ สำนักงานประเทศไทย	คณะทำงาน
๑๐)	ผู้อำนวยการกองจัดการกากของเสียและสารอันตราย กรมควบคุมมลพิษ	คณะทำงาน

๑๑) รศ.ดร.นิรมล....

๑๑)	รศ.ดร.นิรมล สุธรรมกิจ คณะเศรษฐศาสตร์ มหาวิทยาลัยธรรมศาสตร์	คณะทำงานและ เลขานุการร่วม
๑๒)	ผู้อำนวยการส่วนสารอันตราย กองจัดการกากของเสียและสารอันตราย	คณะทำงานและ เลขานุการร่วม

๕.๒ อำนาจหน้าที่

๑) วิเคราะห์ผลกระทบทางด้านสังคมและเศรษฐกิจจากการลดและเลิกการใช้สารมลพิษที่ตกค้างยาวนาน

๒) พิจารณาและเสนอแนะแนวทางการจัดการผลกระทบด้านสังคมและเศรษฐกิจ อันเนื่องจากการลดและเลิกการใช้สารมลพิษที่ตกค้างยาวนาน

๓) พิจารณาและให้ข้อคิดเห็นต่อร่างแผนจัดการระดับชาติเพื่อการปฏิบัติตามอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานที่เกี่ยวข้อง และเสนอต่อคณะทำงานกำกับดูแลและประสานการดำเนินโครงการฯ

๔) ปฏิบัติหน้าที่อื่น ๆ ตามที่คณะอนุกรรมการอนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนานมอบหมาย

ทั้งนี้ ตั้งแต่บัดนี้เป็นต้นไป

สั่ง ณ วันที่ ๑๕ มีนาคม พ.ศ. ๒๕๖๒

(นายวิเชียร กีรตินิจกาล)
ประธานคณะอนุกรรมการ
อนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษที่ตกค้างยาวนาน