Kiribati

National Implementation Plan for Persistent Organic Pollutants

March 2019

Foreword

The ratification by Kiribati of the Stockholm Convention in September 2004 reflects its global commitment towards the protection of human health and the environment from the adverse effects of persistent organic pollutants. As a Party, Kiribati is required to take appropriate measures to reduce and eliminate releases of POPs chemicals to the environment.

The National Implementation Plan on management of POPs fulfils this part of the commitment of Kiribati to the Convention. The NIP was prepared based on guidance documents provided by the Stockholm Convention Secretariat and is a document that provides a framework for the future management of POPs (and other) chemicals in Kiribati.

The success in preparation of the NIP document could not have been realised without the cooperation and support of all stakeholders including government agencies and utilities. We express our gratitude to the United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF) for the support and assistance provided towards the development of this document.

We consider the National Implementation Plan as a living document that will be updated on a regular basis based on changes to relevant national policies and strategies, taking into consideration any new POPs chemicals added to the Stockholm Convention in the future. The experience and lessons learnt in this process will be critical in future reviews of the National Implementation Plan.

In conclusion, I wish to record my appreciation of the lead role played by the Ministry of Environment, Lands & Agricultural Development (MELAD), key stakeholders and consultants Araspring Ltd in preparing the NIP. The endorsement of the NIP by my Ministry clearly paves a way forward for improved chemical and waste management in the country. The identification of the need for the Government to seek further funding and technical support to implement the NIP will be critical to ensure Kiribati meets its obligations under the Stockholm Convention.

Honorable Minister – Mr. Alexander Teabo
Minister for Environment, Lands and Agriculture Development

Date: 24th April 2019

Executive Summary

The Stockholm Convention on Persistent Organic Pollutants (the Stockholm Convention) is an international treaty that requires Parties to phase-out and eliminate the production and use of the most persistent and toxic chemicals that have adverse impacts on human health and the environment.

The Stockholm Convention was adopted on 22nd May 2001 and entered into force on 17th May 2004. On entry into force, the Stockholm Convention identified a list of 12 priority Persistent Organic Pollutants (POPs). This list was subsequently expanded to include 28 chemicals and groups of chemicals. Kiribati ratified the Stockholm Convention on 7 September 2004. Under Article 7 of the Stockholm Convention, Kiribati is required to develop, endeavour to implement, and update as appropriate, a National Implementation Plan (NIP), outlining how its obligations under the Convention will be met. This NIP covers the expanded list of 28 POPs chemicals and groups of chemicals listed under the Stockholm Convention to date (2018). The NIP has been developed and structured in accordance with guidelines provided by the United National Environment Programme.

POPs chemicals are toxic, persist in the environment, bio-accumulate in the food chain, and have trans-boundary transportation capabilities, often ending up in locations and being bio-accumulated and biomagnified in human (and animal) populations that are far-removed from the source of their generation. The 28 POPs chemicals and groups of chemicals managed under the Convention (Table A) include pesticides, industrial chemicals and unintentionally produced POPs (uPOPs), which are listed under three Annexes as follows:

- **Annex A**: these chemicals are mainly, but not exclusively, pesticides scheduled for elimination; Parties may register specific exemptions to continue the use of Annex A chemicals to allow for the time that may be needed to adapt and take necessary management measures required by the Convention.

- **Annex B:** Parties must take measures to restrict the production and use of these chemicals; Parties may register specific exemptions or restrict use of Annex B chemicals to an "acceptable purpose" listed under the Convention.

- **Annex C**: these chemicals are produced unintentionally due to incomplete combustion, and during the manufacture of pesticides and other chlorinated substances. They are emitted mostly as a by-product of the incineration of hospital waste, municipal and hazardous waste, and from automobile emissions, and the combustion of biomass including coal and wood. Parties must take measures to reduce the unintentional release of chemicals listed in this Annex, with the goal of continuous minimisation and, where feasible, ultimate elimination.

Table A: POPs chemicals and groups of chemicals listed in the Stockholm Convention

Stockholm Convention Chemical (listed alphabetically)	Annex	Date listed	Pesticide	Industrial chemical	By product
Aldrin	A	May 2004	●		
Chlordane	A	May 2004	●		
Chlordecone	A	May 2009	●		
Decabromodiphenyl ether (commercial mixture, c-decaBDE	A	May 2017		●	

Stockholm Convention Chemical (listed alphabetically)	Annex	Date listed	Pesticide	Industrial chemical	By product
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Hexabromobiphenyl	A	May 2009		●	
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Hexachlorobenzene	A & C	May 2004	●	●	●
Hexachlorobutadiene	A	May 2015		●	
Alpha-hexachlorocyclohexane	A	May 2009	●		
Beta-hexachlorocyclohexane	A	May 2009	●		
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Mirex	A	May 2004	●		
Pentachlorobenzene	A & C	May 2009	●	●	●
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Perfluorooctane sulfonic acids and salts and Perfluorooctane sulfonyl fluoride	B	May 2009	●	●	
Polychlorinated biphenyls	A & C	May 2004		●	●
Polychlorinated dibenzo-p-dioxins	C	May 2004			●
Polychlorinated di-benzofurans	C	May 2004			●
Polychlorinated naphthalenes	A & C	May 2015		●	●
Short-chain chlorinated paraffins	A	May 2017		●	
Technical endosulfan and its related isomers	A	May 2011	●		
Tetrabromodiphenyl ether and pentabroodiphenyl ether	A	May 2009		●	
Toxaphene	A	May 2004	●		

In addition to the obligation to develop and implement a NIP, Kiribati has several other obligations under the Stockholm Convention (Table B). This NIP outlines the actions that Kiribati intends to take to deliver on these obligations.

Table B: Summary of Kiribati's obligations as a Party to the Stockholm Convention

Stockholm Convention	Kiribati's obligations
Article 3	Eliminate the importation, production, use, and export of chemicals listed in Annex A except where authorised under the Convention, and restrict the production and use of chemicals listed in Annex B
Article 5	Reduce or eliminate unintentional production and release of Annex C chemicals
Article 6	Reduce or eliminate releases from stockpiles and wastes containing chemicals listed in Annexes A, B and C, including identification of products or articles in use and sites contaminated with these chemicals
Article 9	Establish mechanisms to exchange information on POPs between Parties and the Secretariat
Article 10	Promote awareness of POPs among policy and decision makers and educate the public on the

Stockholm Convention	Kiribati's obligations
	dangers of POPs to their health and the environment
Article 15	Participate in periodic reporting to the Conference of Parties (COP) Secretariat on the status and measures on POPs reduction undertaken nationally
Article 16	Participate in the Global Monitoring Plan on POPs for the national presence of chemicals listed in Annexes A, B and C, as well as their global and environmental transport

The Government of Kiribati contracted the development of the NIP update to an international consultant team in late 2018. This update was carried out in seven connected phases, which culminated in the drafting of the updated NIP document.

Kiribati (officially the Republic of Kiribati) is a sovereign state in Micronesia in the central Pacific Ocean (Figure 1). Kiribati consists of 32 atolls and one solitary island (Banaba), extending into the eastern and western hemispheres, as well as the northern and southern hemispheres. It is the only country situated within all four hemispheres. The groups of islands are:

- Banaba: an isolated island between Nauru and the Gilbert Islands;
- Gilbert Islands: 16 atolls located some 1,500 kilometres north of Fiji;
- Phoenix Islands: 8 atolls and coral islands located some 1,800 kilometres southeast of the Gilberts;
- Line Islands: 8 atolls and one reef, located about 3,300 kilometres east of the Gilberts.

Kiritimati (Christmas Island) in the Line Islands is the world's largest atoll. Collectively, they have a total land area of 800 square kilometres, dispersed over 3.5 million square kilometres. The islands range from 4.7 km^2 up to 388.4 km^2 in area and, scattered widely over a vast area of ocean. The permanent population is about 110,000 , more than half of whom live on Tarawa Atoll. With the exception of Banaba (or Ocean Island) which is a raised-coral island, the rest of the land in Kiribati consists of the sand and reef rock islets of atolls or coral islands, which rise only one or two metres above sea level.

Kiribati has highly diverse, rich and productive marine and coastal ecosystems that support hundreds of coral species, 500 species of fish, 20 marine mammal species and 2 IUCN Red-listed turtle species.

Terrestrial biodiversity in Kiribati, however, is neither rich nor endemic and it is threatened by human development and expansion activities across a limited land area. The nation's indigenous land-based flora and fauna are very limited. Much of this has to do with its soil quality, mainly of alkaline coral of high porosity. Agriculture is very difficult due to the poor soil quality and lack of space. Overpopulation is a problem in South Tarawa, and especially in Betio, which is one of Earth's most heavily populated locations.

In this project all POPs were carefully examined for their:

- Uses and former uses
- Threats to Health and the Environment
- Presence in Kiribati

The most common use of POPs has been for pesticides. Other pesticides in common use apart from non-POPs pesticides, were also considered, however, in this report. There are a few insecticides in use in the Kiribati and there is evidence that some pesticides are coming in to the country illegally.

Six other matters were also deemed appropriate to gain an overview on in the development of the NIP, as they were also relevant to a plan to manage POPs. These matters are:

- Laboratory Chemicals
- Used Oil
- The Future of Waste Management
- Recycling
- Renewable Energy and Energy Efficiency
- Contaminated Sites

Consideration was also given to the need to set up a system to manage hazardous substances in use and entering Kiribati. It was considered that adoption of a modified and simplified GHS classification system would be appropriate. It would need to be relevant to the needs of Kiribati. Once a suitable classification system was in place, an appropriate set of controls could be devised.

Annex C wastes are known as unintentional POPs (uPOPs). These are formed mainly as by-products of combustion processes. The United Nations Environment Programme has developed a comprehensive toolkit for estimating uPOPs emissions from countries. The results are presented as "Total Equivalent Dioxins per Annum" (TEQ/a). This is a methodology that relates all uPOPs to the most hazardous form of dioxin. The calculation for Kiribati has indicated that the current uPOPs emissions is 4.63 gTEQ/a. With improved management of uPOPs emissions it is expected that this figure should be much lower in five years. This will require a number of improvements including much improved waste incineration management, especially medical waste, much less open burning of waste, especially on the outer islands, and reduced biomass incineration for cooking, although it is acknowledged that this is a traditional cooking method.

Apart from uPOPs, the only POPs that have been identified in Kiribati are as follows:

- Polychlorinated Biphenyls (PCBs) in some small capacitors and some transformers, and possibly in soil on sites that have been contaminated with transformer oil.
- Polybromodiphenyl ethers (PBDEs), and other fire retardant POPs and related POPs that have ended up in the past on products that are being discarded in landfills and other disposal end-points. These products include various forms of e-waste, furniture, carpets, textiles and some chemicals such as glues and paints.
- "Perfluorooctane sulfonic acids and salts and Perfluorooctane sulfonyl fluoride" is one group of chemicals that is listed as one of the POPs. They are present mainly in fire-fighting foams, although advice has been received that they are not present in two of the fire-fighting foam used in Kiribati, as confirmed by Dafo Fomtec of Sweden and Chubb New Zealand. This fire-fighting foam may, however, have related compounds that are hazardous to the environment.

Given the presence of the above uPOPs and POPs in Kiribati, and also concerns about related issues such as waste management, laboratory chemicals, non-POPs pesticides, used oil, contaminated sites, and the lack of a proper system for managing hazardous substances in Kiribati, eight action plans have been developed as follows:

1. Institutional and Regulatory Strengthening Action Plan
2. PCB Management Plan
3. POP-PBDEs and Waste Management Action Plan (which will also address HBB, HBCD, PCNs and SCCPs)
4. Hazardous Substances Action Plan which will also cover PFOS/PFAS
5. uPOPs Action Plan
6. Contaminated Sites and Used Oil Action Plan

7. Public Awareness, Information and Training Action Plan
8. Monitoring, Evaluation and Reporting Action Plan

The action plans have been prepared on the following basis:

a) POPs are the focus but real achievements with POPs cannot be obtained without some progress on several other related areas.
b) The main related areas are waste management and hazardous substances management.
c) Other related areas are composting, used oil, renewable energy, recycling including e-waste, laboratory chemicals, hazardous waste, incineration, and the broader issues relating to contaminated site management and marine pollution.
d) There is an opportunity to achieve real progress in these related areas.
e) The overall cost of the action plans over 5 years is $US3.486M which is a substantial increase on the 2014 amount of $1.615M. It is expected, however, that many of these related issues may also be assisted with funding from other sources, rather than relying on funds arising entirely out of the Stockholm Convention Secretariat.
f) Management of the numerous strands of work will be a difficult and time-consuming exercise. If this management falters in any way the whole programme will be stalled. It is therefore considered necessary for MELAD to adopt a special focus for this project.
g) It is also thought necessary for an international project management company to be engaged from the outset and retained for the five-year duration, including regular interventions, reporting and audits, and ongoing availability for advice and support.
h) It should also be noted that as well as the Stockholm Convention, other international obligations can also be assisted by the action plans that have been set out below, including the Basel and Waigani Conventions, the Minamata Convention, the Montreal Protocol, MARPOL requirements, the London Convention and the Paris Agreement on Climate Change. It makes considerable sense to achieve some coordination of these various international requirements.

Table C below sets out the cost per year for each Action Plan, for the five year plan period for implementing these plans.

Table C – Total Action Plan Costed Over Five Years

Costs per Year (AUD)	2019	2020	2021	2022	2023	Total
Action Plan 1 - Institutional and Regulatory Strengthening Action Plan	201,000	330,000	195,000	185,000	165,000	**1,076,000**
Action Plan 2 – PCB Management	100,000	5,000	15,000	5,000	15,000	**140,000**
Action Plan 3 - POP-PBDEs and Waste Management	180,000	445,000	245,000	165,000	175,000	**1,210,000**
Action Plan 4 - Hazardous Substances	225,000	270,000	155,000	30,000	20,000	**700,000**
Action Plan 5 - uPOPs	195,000	260,000	130,000	130,000	120,000	**835,000**
Action Plan 6 - Contaminated Sites and Used Oil	50,000	210,000	50,000	65,000	50,000	**425,000**
Action Plan 7 - Public Awareness, Information and Training	5,000	40,000	30,000	30,000	30,000	**135,000**
Action Plan 8 - Implementation, Monitoring and Reporting	75,000	50,000	50,000	50,000	95,000	**320,000**
Total	1,031,000	1,610,000	870,000	660,000	670,000	**4,841,000**
Convert to USD at 0.72 AUD/USD	**742,320**	**1,159,200**	**626,400**	**475,200**	**482,400**	**3,485,520**

Contents

Abbreviations

ADB	Asian Development Bank
ADF	Advanced Disposal Fee
AFFF	Aqueous Film-Forming Foam
ASL	Above Sea Level
BAT	Best Available Techniques
BEP	Best Environmental Practice
BFR	Brominated Flame Retardants
BHC	Benzenehexachloride
BPC	British Phosphate Company
BTC	Betio Town Council
c-OctaBDE	Commercial octa bromodiphenyl ether
c-PentaBDE	Commercial penta bromodiphenyl ether
CCA	Copper, Chromium and Arsenic
CCID	Chemical Classification and Identification Database
CCK	Communication Commission of Kiribati
CDL	Container Deposit Legislation
CDS	Container Deposit Scheme
COP	Conference of Parties
CSO	Civil Society Organisation
DDT	Dichlorodiphenyltrichloroethane
EEE	Electrical and Electronic Equipment
EIA	Environment Impact Assessment
ECD	Environment and Conservation Division of MELAD
EOL	End of Life (Motor Vehicles)
ETC	Eutan Tarawa Council (North Tarawa)
e-Waste	Electronic and Electrical Waste
FTC	Fisheries Training Centre
GDP	Gross Domestic Product
GEF-PAS	Global Environment Facility Pacific Alliance for Sustainability
GHG	Greenhouse Gas
GHS	Globally Harmonised System
GMP	Global Monitoring Plan
HA	Highway Authority
HBB	Hexabromo-biphenyl
HBCD	Hexabromo-cyclododecane
HBDEs	Heptabromodiphenyls, Hexabromodiphenyls
HCB	Hexachlorobenzene
HCHs	Hexachlorocyclohexane
Hexa BDE	Hexabromo-diphenyl ether
Hepta BDE	Heptabromo-diphenyl ether
IBC	Intermediate Bulk Container (1000 L)
ICAA	International Civil Aviation Authority
ICT	Information, Communication and Technology
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
KANGO	Kiribati Association of Non-Governmental Organisations
KCCI	Kiribati Chamber of Commerce and Industry
KCDL	Kiribati Coconut Development Ltd
KCS	Kiribati Customs Service

KFHA	Kiribati Family Health Association
KFL	Kiribati Fish Ltd
KIEP	Kiribati Integrated Environment Policy
KIER	Kiribati Integrated Energy Roadmap
KIT	Kiribati Institute of Technology
KMS	Kiribati Meteorological Service
KOIL	Kiribati Oil Company Limited
KPS	Kiribati Police Service
KRCS	Kiribati Red Cross Society
KSEC	Kiribati Solar Energy Company
KUC	Kiritimati Urban Council
MARPOL	Convention for the Prevention of Pollution from Ships
MCIC	Ministry of Commerce, Industry and Cooperatives
MEHR	Ministry of Employment and Human Resource
MELAD	Ministry of Environment, Lands & Agricultural Development
MFAI	Ministry of Foreign Affairs and Immigration
MFAT	New Zealand Ministry of Foreign Affairs and Trade
MFED	Ministry of Finance and Economic Development
MHMS	Ministry of Health and Medical Services
MIA	Ministry of Internal Affairs
MICTTD	Ministry of Information, Communication and Tourism Development
MISE	Ministry of Infrastructure and Sustainable Energy
MLHRD	Ministry of Labour and Human Resources Development
MOE	Ministry of Education
MOJ	Ministry of Justice
MRF	Materials Recovery Facility
MTC	Marine Training Centre
MWYSSA	Ministry of Women, Youth, Sports and Social Affairs
NIP	National Implementation Plan
NGO	Non-Governmental Organisation
OAG	Office of the Attorney General
OB	Office of Te Beretitenti (President)
OSH	Occupational Safety and Health
OTEC	Ocean Thermal Energy Conversion
PIPA	Phoenix Islands Protected Area
PBDEs	Polybrominated diphenyl ethers
PCBs	Polychlorinated biphenyls
PCDDs	Polychlorinated dibenzo-p-dioxins
PCDFs	Polychlorinated dibenzofurans
PCN	Polychlorinated naphthalenes
PCP	Pentachloro-phenol
PeCB	Pentachloro-benzene
PET	Polyethylene terephthalate
PFAS	Perfluoroalkyl sulfonic acid
PFOS	Perfluorooctane sulfonic acid
POPs	Persistent Organic Pollutants
PPA	Pacific Power Association
PPE	Personal Protective Equipment
PVU	Plant and Vehicle Unit
SCCP	Short Chain Chlorinated Paraffins
SDS	Safety Data Sheet

SOE	State Owned Enterprise
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TBDE	Tetrabromodiphenyl ether
TPD	Trade Promotion Division
TTM	Taiwan Technical Mission
TUC	Teinainino Urban Council (South Tarawa excluding Betio)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNRTDG	United Nations Regulations on the Transport of Dangerous Goods
uPOPs	Unintentionally Produced Persistent Organic Pollutants
USP	University of the South Pacific
WHO	World Health Organisation

Acknowledgements

NAMES	ORGANISATIONS/MINISTRIES
Otinteiti Taraitai	Airport Service
Berekita	MELAD/ALD
Karoti Toto	MELAD/ALD
Rui Tibau	MELAD/ALD
Kirata Iotam	ATHKL (cell company)
Kariawa Teuribba	Bikeniebu Landfill
Bwaaree Taorobwa	BTC
Iareta Borataake	BTC Landfill
Bishop Paul Mea	Catholic Church
Metioteraka Nita	Customs
Harry Langley	MELAD/ECD
Mwabeti Ereata	International Airport (tower)
Miriam Bataua	KCCI
Toani Benson	KCCI
Taboneao Kaireiti	KFHA
Teariki Utimawa	KGV & EBS (Ministry of Education, MoE)
Taebi Tekeea	Kiribati Coconut Development Ltd
Anre Anro	Kiribati Police Service
Katoaingina Tenten	Kiribati United Church HQ's (Mission)
Mwata Keariki	KMS
Tebatibunga Kaongotao	KMS
Maareke Timiti	KOIL
Maria Taua	KRCS
Rodney Taniera	KRCS (volunteer)
Tokitebwa Tawita	KSEC
Roiti Kirata	MEHR
Reea Binataake Aluta	MEHR (OHS)
Toreka Itaaka	MELAD/PPU
Roiti Kienene	MELAD/ALD
Susana Ratu	MELAD/ALD
Raitiata Cati	MELAD/ECD
Rubeaua Iannang	MELAD/ECD
Teburenga	MELAD/ECD
Teburenga Tabwebweiti	MELAD/ECD
Teema Biko	MELAD/ECD
Teniti Taam	MELAD/ECD
Terubeieta Tuntaake	MELAD/ECD
George Taoaba	MELAD/ECD
Robite Teaeta	MELAD/ECD

NAMES	ORGANISATIONS/MINISTRIES
Kathelyn Aneli	MELAD/ECD
Kirata Mwemwenikeaki	MELAD/ECD
Moataake Taakai	MEHR (OHS)
Mwata Keariki	MET
Kanikua Tekaoti	MFED (National Statistics Office)
Jonathan Taake	MHMS (X-Ray)
Semaia Tehumu	MHMS
Taata Tebikau	MHMS (Environmental Health)
Terikano Nakekea	MHMS (Environmental Health)
Aritu Iotia	MHMS (Environmental Health)
Touakai Kambati	MHMS (LABORATORY)
Kabeia Atanraoi	MICTTD (Marine)
Tienimatang Reue	MICTTD, Admin
Tibina David Yeeting	MICTTD
Boaa Fatali	MISE
Temanibwebwe Ruoikabuti	MOE
Bouri Tebao	Moroni High School
Ms Tetobi Mariko	Moroni High School
Rataro Burebo	Nanikaai Landfill
Monoo Mweretaka	OAG
Kanrooti Aukitino Tooa	OAG
Bureteiti Rui	MHMS (Pharmacy)
Toreka Itaaka	PPU/MELAD
Enoka Tauma	PUB
Teuatabo Teweiaba	Public Vehicle Utilities (PVU)
Katangaua Bwautira	Radio Station
Beetero Bwareta	Sacred Heart College
Tebwebwe Claude	Sacred Heart School
Nakoi Takaua	SLHS
Minoneti Kaufusi	St. Louis High School
Tokarake Terube	TPD-MCIC
Tiabere Itinibara	TUC
Bauro Tewareka	USP
Tebungata Tebenebene	William Goward Memorial College
Erirau Manikaoti	World Mosquito Program

Introduction

1.1 Stockholm Convention

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1.2 The 28 POPs

POPs chemicals are toxic, persist in the environment, bio-accumulate in the food chain, and have trans-boundary transportation capabilities, often ending up in remote locations and being bio-accumulated and biomagnified in human (and animal) populations that are far-removed from the source of their generation. The 28 POPs chemicals and groups of chemicals managed under the Convention (Table 1) include pesticides, industrial chemicals and unintentionally produced POPs (uPOPs), which are listed under three Annexes as follows:

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[1] UNEP (2017). *Guidance for Developing a National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants*. UNITAR. 71 pp.

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1.3 Stockholm Convention Obligations

In addition to the obligation to develop and implement a NIP, Kiribati has several other obligations under the Stockholm Convention (Table 2). This NIP outlines the actions that Kiribati intends to take to deliver on these obligations.

Table 2: Summary of Kiribati's obligations as a Party to the Stockholm Convention

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Article 16	Participate in the Global Monitoring Plan on POPs for the national presence of chemicals listed in Annexes A, B and C, as well as their global and environmental transport

1.4 NIP Development Process

The Government of Kiribati contracted the development of the NIP update to an international consultant team in late 2018. This update was carried out in seven connected phases:

i. A desktop review of available information and data relevant to contemporary chemical management in Kiribati;
ii. A review of progress achieved by the Government of Kiribati in completing actions identified in the original NIP for improved national management of chemicals listed under the Stockholm Convention;
iii. In-country training of national stakeholders on the national requirements of the Stockholm Convention, on improved national management of chemicals and the minimisation of the release of uPOPs. A report of this workshop Is presented in Annex 1;
iv. In country investigation of the status of management of Stockholm (and other) chemicals (two visits);
v. In country inventory of Stockholm Convention listed chemicals;
vi. Identification and costing of appropriate actions at the national level to implement the requirements of the Stockholm Convention at the national level; and
vii. Drafting of the updated NIP document.

1.5 Structure of the NIP

This NIP contains five chapters including this introductory chapter.

Chapter 2 of the NIP sets the country context with a country profile, including geography, climate, culture, and a political and economic summary. Environmental conditions are described including parts of the infrastructure that impinge on the environment. The institutional framework is described including relevant legislation, multilateral environmental agreements involving Kiribati, and stakeholder roles – both government and other stakeholders.

Once the scene is set with Chapter 2, Chapter 3 of the NIP discusses POPs and related issues in detail and presents the findings of the national inventory of POPs, which was conducted as part of the NIP update process. Where necessary, inventory findings have been supplemented with additional desktop research and analysis to fill national data gaps.

Chapter 4 then focuses on unintentionally-produced POPs (uPOPs) which represent the largest contribution from Kiribati to the national POPs inventory. There are numerous sources of uPOPs and these sources are described and estimated. Some issues related to POPs are also covered, including non-POPs pesticides, laboratory chemicals, used oil, the future of national waste management, recycling and renewable energy.

Chapter 5 explores a range of related POPs production issues, including national frameworks, the need for improved worker and public awareness, the current state of knowledge and any relevant existing programmes, any exemptions that may be needed, ongoing reporting and meeting requirements, technical infrastructure and procedures for approving currently-used and new chemicals. It then develops and concludes with proposed Strategy and Action Plan elements of the NIP. Each Action Plan is costed and identifies a lead implementing agency, who will be responsible for driving implementation of Action Plan activities.

The NIP also includes several Annexes containing relevant supporting information.

2.0 Country Background

2.1 Country Profile

2.1.1 Geography

Kiribati (officially the Republic of Kiribati) is a sovereign state in Micronesia in the central Pacific Ocean (Figure 1). Kiribati consists of 32 atolls and one solitary island (Banaba), extending into the eastern and western hemispheres, as well as the northern and southern hemispheres. It is the only country situated within all four hemispheres. The groups of islands are:

- Banaba: an isolated island between Nauru and the Gilbert Islands;
- Gilbert Islands: 16 atolls located some 1,500 kilometres north of Fiji;
- Phoenix Islands: 8 atolls and coral islands located some 1,800 kilometres southeast of the Gilberts;
- Line Islands: 8 atolls and one reef, located about 3,300 kilometres east of the Gilberts.

Kiritimati (Christmas Island) in the Line Islands is the world's largest atoll. Collectively, they have a total land area of 800 square kilometres, dispersed over 3.5 million square kilometres. The islands range from 4.7 km^2 up to 388.4 km^2 in area and, scattered widely over a vast area of ocean. The permanent population is just over 110,000 (2015), more than half of whom live on Tarawa Atoll. With the exception of Banaba (or Ocean Island) which is a raised-coral island, the rest of the land in Kiribati consists of the sand and reef rock islets of atolls or coral islands, which rise only one or two metres above sea level.

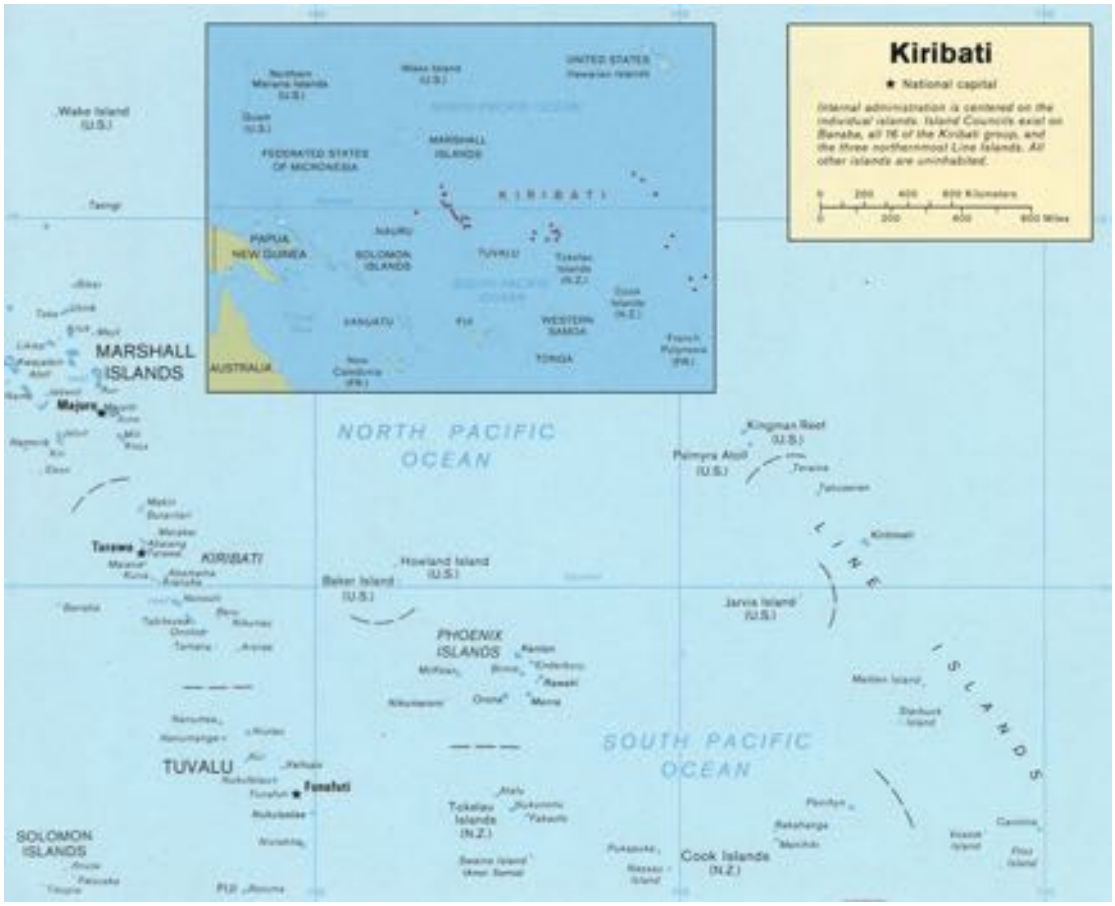

Figure 1. Map of The Republic of Kiribati Island (Source https://en.wikipedia.org/wiki/Kiribati)

2.1.2 Climate

Due to its location, Kiribati exhibits a maritime climate. Kiribati has a hot, humid tropical climate, with air temperatures very closely related to the temperature of the oceans surrounding the small islands and atolls. Across Kiribati the average temperature is relatively constant all year round. Changes in the temperature from season to season differ by little more than 1°C. The driest and wettest periods in the year vary from location to location.

At Tarawa, in the west, the driest six-month period begins in June, with the lowest mean rainfall in October. The wet season usually lasts from around November to April. At Kiritimati, 2000 km to the east, the wet season is from January to June and is much drier than Tarawa (Figure 1). Rainfall in Kiribati is affected by the movement of the South Pacific Convergence Zone and the Intertropical Convergence Zone. They extend across the South Pacific Ocean from the Solomon Islands to east of the Cook Islands, and across the Pacific just north of the equator, respectively. These bands of heavy rainfall are caused by air rising over warm water where winds converge, resulting in thunderstorms.

Kiribati's climate varies considerably from year to year due to the El Niño-Southern Oscillation. This is a natural climate pattern that occurs across the tropical Pacific Ocean and affects weather around the world. There are two extreme phases of the El Niño-Southern Oscillation: El Niño and La Niña. There is also a neutral phase. Across Kiribati, El Niño events tend to bring wetter, warmer conditions than normal. In the wettest years Tarawa receives more than 4000 mm, while in the driest years as little as 150 mm of rain has fallen. Droughts can be severe in Kiribati, usually associated with La Niña events. Average annual rainfall in Tarawa is approximately 2100 mm with just over 900 mm received between May and October. From July 1988 to December 1989 only 205 mm of rain fell, while from August 1998 to February 1999 total rainfall was 95 mm. A drought from late in 2008 to early 2009 severely affected water supplies in the southern Gilbert Islands and Banaba. Most of these islands are in the dry belt of the equatorial oceanic climatic zone and experience prolonged droughts. Projections from a decade ago of extreme weather, in the form of severe drought interrupted by frequent, more intense rainfall are, together with ocean acidification, now becoming evident in the data.

Historically Kiribati did not experience cyclones though effects have occasionally been experienced during cyclone seasons affecting nearby Pacific Island countries such as Fiji[2] . However, in 2015 and again in 2016 two cyclones, Pam and Pali, caused inundation, crop loss and damage to infrastructure as well as impacting shipping.[3]

The islands of the Republic of Kiribati are at grave risk from climate change[4]. Projections for all emissions scenarios indicate that the annual average air temperature and sea-surface temperature will increase in the future in Kiribati. By 2030, under a very high emissions scenario, this increase in temperature is projected to be in the range of 0.5–1.2°C. Most global climate models project an increase in average annual and seasonal rainfall over the course of the 21st century. This increase is projected to be greater in the Gilbert Islands and lower in the Line Islands. However, there is some uncertainty in the rainfall projections and not all models show consistent results. Droughts are projected to become less frequent throughout this century. Projections show extreme rainfall days are likely to occur more often and be more intense.

[2] Thomas, Frank R. (2003). Kiribati: Some aspects of human ecology, forty years later. *Atoll Research Bulletin*. 501: 1–40. doi:10.5479/si.00775630.501.1.

[3] https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/CDP-PL-2018-6b.pdf

[4] Pacific-Australia Climate Change Science and Adaptation Planning Program Partners (2015). *Current and future climate of Kiribati.* Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Sea level rise since 1998 is measured at from one to four mm a year. Wave height is projected to decrease December to March. Waves may be more directed from the south in October. However, wave height is projected to increase slightly in September in the Line Islands.

2.1.3 History

The islands have been inhabited by Micronesians for several millennia (at least 2-3,000 years). The I-Kiribati or Gilbertese people settled what would become known as the Gilbert Islands between 300-1300 AD[5]. Subsequent invasions by Samoans and Tongans introduced Polynesian elements to the already incumbent Micronesian culture and invasions by Fijians introduced Melanesian elements. Extensive intermarriage produced a population reasonably homogeneous in appearance, language and traditions.

During the 16th century, whalers, slave traders and merchant vessels visited the region. In 1820, the islands were named the Gilbert Islands after the British Captain Thomas Gilbert, who crossed the archipelago in 1788. In 1824, French captain Louis Duperrey was the first to map the entire Gilbert archipelago. Whalers, blackbirders, and merchant vessels made frequent visits for much of the 19th century. The resulting upheaval fomented local tribal conflicts and introduced damaging European diseases. In an effort to restore a measure of order, the Gilbert Islands and the neighbouring Ellice Islands (now Tuvalu) were declared a British Protectorate in 1892. The protectorate's headquarters were established on Tarawa Atoll in 1896. The headquarters were moved to Banaba (Ocean Island) in 1908, coinciding with the beginning of extensive operations by the Pacific Phosphate Company with its mining and shipping of phosphate. The islands became a Crown Colony in 1916 and Christmas Island became part of that colony in 1919. The Phoenix Islands followed in 1937 and the five islands of the Central and Southern Line Islands were added in 1972.

Banaba remained the headquarters of the colony until the British evacuation in 1942 when Japan occupied of some islands as bases during World War II. The Japanese entered the Pacific, invading the Gilbert Islands in December 1941, two days after they bombed Pearl Harbour. In August of 1942 US Marines fought three major operations in an attempt to remove the Japanese, including “The Battle of Tarawa”, reputedly one of the bloodiest battles ever fought in World War II. After World War II, the colony headquarters were re-established on Tarawa.

The shadow of war remained, however. In 1957, three hydrogen bombs were detonated in the vicinity of Kiritimati, as part of the UK’s hydrogen bomb atmospheric testing programme. In the 1950s and 1960s Kiritimati Island was used as a base for early nuclear testing.

Internal self-government was given to the renamed Kiribati on 1 January 1977. At a conference in 1978 it was agreed that Kiribati, with other islands appended to the territory by the colonial authorities, should become a fully independent republic. On Independence Day, 12 July 1979, Kiribati became the 41st member of the Commonwealth.

2.1.4 Population and Culture

The November 2015 census gave a population of 110,136. About 90% of that population live in the Gilbert Islands, with more than 50% of them on South Tarawa, including Betio, which is one of the most densely populated areas in the world. Until recently, the people of Kiribati mostly lived in villages with populations of between 50 and 3,000 on the outer islands.

The extended family plays a significant role in I-Kiribati life, assuming many social, economic and political functions. The extended family is the most important social unit within the community,

[5] Barrie Macdonald, (2001). *Cinderellas of the Empire*, IPS, University of the South Pacific

family members living in a cluster of houses on the same land or together under one roof. Households average 6 or 7 people, many are larger. Women are primarily responsible for cooking and housekeeping. Traditionally, I-Kiribati regard the welfare and maintenance of their old people as their social obligation. The old people are an important part of the extended family and are still regarded more as family assets than liabilities. Their presence in an extended family symbolises family cohesion and togetherness, a pride in traditional values and provides a sense of psychological security.

2.1.5 Political System

Under the independence constitution of 1979, Kiribati became a sovereign and democratic republic with a unicameral legislature, the *Maneaba ni Maungatabu*. The President (*Beretitenti*) is both head of state and head of government elected nationally from nominations by the *Maneaba ni Maungatabu*, the House of Assembly. The cabinet consists of the President, the Vice-President (*Kauoman-ni-Maungatabu*), and up to eight other ministers. These ministers are appointed by the President from the *Maneaba ni Maungatabu*.

The legislature has 44 members elected for four years by universal adult suffrage, and one nominated member from the Banaban community in Rabi, Fiji, who have a right to enter and live on Banaba and have their own Banaba Island Council. Individual rights and freedoms are guaranteed under the constitution. In the event of dissolution of the legislature on a vote of no confidence, the constitution provides for an interim Council of State, composed of the Chief Justice, the Speaker and the chairman of the Public Service Commission. The judicial system consists of the High Court, a court of appeal, and magistrates' courts. All judicial appointments are made by the *Beretitenti*. The Ministry of Internal Affairs controls local government services on outer islands (rural areas) and in urban centres through local urban councils.

Traditionally, the social and political system revolved around a village *maneaba* system. This was similar to a village 'parliament' where the traditional leaders in the community, known as the *unimane*, met to consider village matters. Under the traditional political structure, democratic rights of an individual to freedom of speech, for example, and equality between the sexes were unknown. Not every *unimane* in a *maneaba* setting would have the privilege of freedom of speech. In a traditional setting, women and the young have no freedom of speech. Their roles were to ensure that the decisions of the *unimane* were carried out. Now, the church *maneaba* is becoming more the centre of local politics than the village maneaba. The principle of egalitarianism is paramount in a church *maneaba*. All members enjoy freedom of speech, including women and young people. The chairperson usually controls these proceedings. Church members elect this chairperson and his/her committee members during the annual general meeting of the Parish, and they constitute the executive body managing the affairs of the Parish.

2.1.6 Economic Profile

2.1.6.1 General Economic Considerations

The Kiribati economy relies on foreign assistance, emigrants' remittances, sales of fishing licences, fish and coconut exports, and tourism. Contributors to Kiribati's Gross Domestic Product include the services and agriculture sectors, with value-added manufacturing responsible for about five percent of the economy. GDP stands currently at around US$196.2 million and is growing at about 2.3 percent per annum. Per capita GDP is projected at US$1800 for 2020. Contributors to Kiribati's GDP include the services and agriculture sectors, with value-added manufacturing responsible for over five percent of the economy. A report by IMF for the World Bank suggests that while the government's fiscal position has strengthened since 2014, long term share of development spending

financed by concessional loans will increase from 10 to 30 percent and "are assumed to be exclusively on credit terms"[6]

Primary export market destinations in 2015 were Australia, American Samoa, Colombia, New Zealand and the United States. Imports were predominantly from Australia, the People's Republic of China, Fiji, Japan and the Republic of Korea. Contributors to Kiribati's GDP include the services and agriculture sectors, with value-added manufacturing responsible for about five percent of the economy.

Kiribati faces long-standing development challenges due to its extreme remoteness and large dispersion. With over thirty remote islands spread over 3.5 million square kilometres of ocean, the cost of infrastructure and public service delivery is high. A narrow production and export base (mainly limited to fisheries and copra) makes the country highly dependent on income from fishing licencing to foreign nationals. Weaknesses in business climate and financial intermediation also limit economic and job opportunities. With the lowest per capita GDP in the region, about a fifth of the population lives below the basic-needs poverty line. The country's long-term prospects are further clouded by climate change with the low elevation of the atolls (1.8 meters on average) making them extremely vulnerable to sea level rise.

A shortage of skilled workers, weak infrastructure, and remoteness from international markets also constrain development in Kiribati. The public sector dominates economic activity with ongoing infrastructure projects and inefficient state-owned enterprises. The public sector accounts for as much as 50% of GDP and nearly 80% of jobs in the formal sector. Economic growth is undermined by regulations that hinder private-sector development. Government efforts to decentralize economic activity from the main islands have yielded only limited results. The financial sector remains underdeveloped, leaving much of the population without formal access to banking services. Maintaining fiscal sustainability, improving the business climate, and dealing with the effects of climate change are Kiribati's main development challenges. The economy is highly vulnerable to shocks and heavily dependent on external sources of revenue and imported food and fuel. Imported food is also impacting the general health of I-Kiribati. The private sector remains small and has struggled to grow because of high business and investment costs due to the problems outlined above, including remoteness, dispersion of population across many islands and an underdeveloped infrastructure. This has led to frequent shortages of power, water, food and fuel supplies. More recently, however, installation of small solar-power units is proving transformative both on remote islands as well as in Tarawa.

The private sector is very small and is made up mostly of passenger buses, small retail stores, fish and vegetable marketing and food stalls, second-hand clothing shops, travel agencies, hardware stores and exporters of tropical aquarium fish and other marine products[7].

Land sales are allowed only between I-Kiribati, and then only with the consent of the Land Court, which imposes the following strict conditions:

a. the land to be sold must be surplus to the needs of the seller and the seller's family,
b. the buyer must have a genuine need, and
c. there must be no other suitable land on the island.

In 2015 the UN Committee for Development Policy reviewed the status of Kiribati as a Least Developed Country (LDC) and decided not to recommend graduation at this time but to review the situation in 2018, for possible graduation in 2021. The main reason for the decision was the

[6] IMF Country Report No 17/386 (December 2017)
[7] https://www.adb.org/sites/default/files/publication/29734/kiribati-economic-development.pdf

economic vulnerability of Kiribati[8]. After a period of earlier volatility, Kiribati had its fifth year of consecutive growth in 2015. Growth has been driven in large part by construction associated with large donor-financed investments. An increase in fishing licence fees has also underpinned greater public spending and a rebuilding of the Revenue Equalization Reserve Fund and fiscal buffers (the latter now equivalent to about 6 months of public spending). The government elected in March 2016 has placed particularly strong emphasis on using its strong revenue base to improve both services to the poorest (including the introduction of free education and child support) and outer island development (including the expansion of the copra subsidy). In 2018 the same UN committee again reviewed Kiribati's status, noting its growing per capita "relative prosperity" in recent years. Its report suggests that with continued impetus on the same path that the nation's development status will be in 2021.[9]

2.1.6.2 Phosphate mining

Kiribati's economic activity once centred on the mining of phosphate but deposits were exhausted in 1979. The British Phosphate Commission settlement on Banaba was abandoned at this time, just before Kiribati was granted independence in 1979. Phosphate mining has made Banaba almost uninhabitable. Its inhabitants were moved to the Fijian island of Rabi in the mid-1940s; in 1970 they became citizens of Fiji, but kept the ownership of land on Banaba. In 1981, after ten years of discussion and litigation over phosphate royalties and environmental damage caused by open-cast mining, they accepted A$14.58 million compensation from the British government. As discussed, the Banabans have special rights of residence and representation in Kiribati. A $500 million fund created with mining revenues continues to provide significant national budget support.

2.1.6.3 Tourism

Tourism currently (2017) generates 21% of the country's GDP, with greatest economic benefit in Kiritimati Island and Tarawa which both derive significant tourism returns. Although the contribution of travel and tourism to Kiribati GDP has fluctuated substantially in recent years, it has tended to increase through the 1998 - 2017 period[10]. The Kiribati Development Plan 2008-11[11] is the key planning tool used to shape and form the future of the Republic.

The plan identifies tourism development is one of the key priorities for the government. Included as priorities are:

- Development of the Line and Phoenix Groups as tourism growth centres;
- The stimulation and enhancement of the private sector and public enterprises;
- Improving infrastructure – especially roads, airports and terminals;
- Improving the quality of local products and promoting them to tourists and overseas markets;
- Development and promotion of eco-tourism opportunities; and
- Strengthening wildlife conservation.

2.1.6.3 Fishing[12]

Fishery resources are essential to Kiribati for revenue, food security, employment and income. The combined value of all Kiribati lagoon, coastal and oceanic fisheries is estimated to exceed AU $110 million per annum. Given their significance, it is fundamentally important that these resources are managed well and sustained for present and future generations. However, the management and

[8] http://www.mfed.gov.ki/sites/default/files/Kiribati%20Development%20Plan%202016%20-%2019.pdf
[9] https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/CDP-PL-2018-6b.pdf
[10] https://knoema.com/atlas/Kiribati/topics/Tourism#Travel-and-Tourism-Total-Contribution-to-GDP
[11] Republic of Kiribati (2008). *Kiribati National Tourism Action Plan 2009-2014*.
[12] Republic of Kiribati (2012). *Kiribati National Fisheries Policy 2013-2025.* Ministry of Fisheries and Marine Resources Development Government of Kiribati. 36pp

development of these resources is increasingly being challenged by a combination of domestic and external factors.

While lagoon and coastal fisheries currently provide sufficient protein for most I-Kiribati, there is a real challenge to long-term food security from population pressures, overfishing (if not managed at sustainable levels), the impacts of climate change and increases in global food prices. The challenge has also been exacerbated by regional and global developments, especially in tuna fisheries as PNA (Parties to the Nauru Agreement) countries are moving to domesticate their own fishing and processing industry.

In addition, there is a growing challenge to the traditional processing plants in Asia from the Latin Americas, and a shift to the lucrative markets in Europe. These changes highlight the need for Kiribati to implement rigid and complex management measures and to participate effectively in treaties and related fisheries arrangements to maximise economic returns, as well as to ensure the sustainable use and conservation of tuna resources.

2.1.6.4 Agriculture

Agriculture, along with forestry and fishing, contributes 26% to the GDP of Kiribati. Most of the working population is involved in subsistence agriculture. The soil in Kiribati is considered amongst the most infertile in the world, being young, shallow and alkaline, limiting conventional agricultural methods. However, the country has developed a sustainable farming system based on the traditional method of *te bwabwai* pits, which involves an extensive composting technique using pits dug to a depth of between one and eight metres and then filled with compost. Some traditional foods have been produced in these gardens.

The dominant species in the vegetation of Kiribati is the coconut palm (*Cocos nucifera*). It has been estimated that coconut occupies 80% of the land area of Kiribati. The main goods produced by the agricultural sector include coconuts (and copra), taro, pandanus, sweet potatoes and vegetables. Other food crops include bananas, breadfruit and papaya. Seaweed continues to provide another element of domestic export earnings. Aquaculture, of sea cucumbers in particular, is also in early development.

The limited land mass of Kiribati does not allow for any large-scale ruminant livestock production and the few livestock kept are largely under the subsistence production system. A limited number of small-scale pig and poultry farms are free-range or small production units. Local market places display only minute volumes of local produce; virtually all fruit and vegetables available in retail centres are imported from abroad.

Most of the land is farmed and agriculture accounts for 51 percent of land-usage. The state-owned Kiribati Copra Milling Company is the largest agricultural enterprise in the country, producing copra, until recently the sole agricultural export, generating two-thirds of overall export revenue. Copra production has declined somewhat in export value between 2010-18 from (US)1.5 million to $1.15 million. It is largely exported to Bangladesh for processing. Kiribati now exports organic coconut nut oil within the region, currently at about 20 container loads a month into a growing market. [13]

2.2 Environmental Conditions

[13] Alain Peyre, Strengthening the national food control system in Kiribati, with particular attention to the fish processing sector" Standards and Trade development Facility, 2018, PDF

2.2.1 Biodiversity[14]

Kiribati has highly diverse, rich and productive marine and coastal ecosystems that support hundreds of coral species, 500 species of fish, 20 marine mammal species and 2 IUCN Red-listed turtle species.

Terrestrial biodiversity in Kiribati, however, is neither rich nor endemic and it is threatened by human development and expansion activities across a limited land area. The nation's indigenous land-based flora and fauna are limited and among the poorest on earth. Much of this has to do with its soil quality, mainly of alkaline coral of high porosity. Biodiversity loss is mainly caused by human-induced factors, namely: climate change, overexploitation, pollution, land use change and invasive alien species. Indirect drivers also contribute significantly to human-related biodiversity loss. These include population growth, change of economic activities and lifestyle, limited awareness of biodiversity's significance, inadequate public commitment towards conservation initiatives and lack of strong law enforcement.

There has been a decline in traditional staple food crop species including the Pandanus (*Pandanus tectorius*), breadfruit (*Artocarpus mariennesis, A. altilis, A. mariennesis*), giant swamp taro (*Cyrtosperma merkusii*), native fig (*Ficus tinctoria*) and coconut (*Coco nucifera*). Other important plants in decline are *Te Kiaiai* (beach hibiscus), *te ukin* (beach almond), *te uri* (Guettarda), *te ren* (tree and beach heliotrope) and *Te mao*.

Most conspicuous of terrestrial fauna are the seabirds, comprising at least 21 breeding species. These include petrels (6 species), frigatebirds, boobies and tropicbirds (7 species), and terns and noddies (8 species). The petrels are best represented in the PIPA (Phoenix Islands Protected Area) and Kiritimati with 6 and 5 species respectively. These include most of the world's largest populations of the *Te Ruru* or Phoenix petrel and *Te Bwebwe Ni Marawa*, the White-throated storm-petrel, both classified by IUCN as Endangered.

The frigate-birds, boobies and tropic-birds are represented throughout the islands but globally important populations of all these birds occur in the PIPA and Line Islands. The terns are all common beyond Kiribati except for the *Te Raurau* or blue noddy, confined to the central Pacific where the PIPA and Kiritimati host globally important populations. Shorebirds include a few migrant species from their breeding grounds in Alaska, notably the vulnerable *Te Kewe* or bristle-thighed curlew, while *Te Kun*, Pacific golden plover, *Te Kirikiri* (wandering tattler) and Te Kitibwa (ruddy turnstone) make up the balance. The sea coasts of the Gilberts also support a breeding population of *Te Kaai* (Pacific reef heron).

Land birds are now relatively few in Kiribati. The only common native species are *Te Bitin* (Pacific pigeon) of the Gilbert Islands, long-tailed koel (a migrant from New Zealand to the Gilberts and southern PIPA) and the only endemic bird, *Te Bokikokiko* or Christmas Island reed-warbler, confined to Kiritimati and Washington Islands. Introduced species include an officially Vulnerable species, *Te Kura* (Rimatara Lorikeet) present on Kiritimati, common on Washington Island plus rock pigeon at Kiritimati and Tarawa. Many vagrants are detected from time to time, including waterfowl, gulls, waders and incursions of two invasive myna species in the Gilbert Islands.

2.2.2 Policy Alignment

Since 2015 the Parliament of Kiribati has run a whole-of-government approach to the existential threats to these low-lying islands. The Kiribati Development Plan 2015-19 addresses a range of interlinking goals and plans with the intention of retaining a healthy and prosperous life on the islands whilst taking all measures to improve resilience, be it geo-physical, human or natural.

[14] Republic of Kiribati (2015). *National biodiversity strategies and action plan 2016-2020*. 77pp.

This strategy incorporates not simply plans for survival, but an integrated plan for sustainability in the face of climate change. Inundation, salinization of soil and freshwater, drought and destruction of coral and the other attendant threats to life, both human and non-human. These are already underway for the inhabitants of some islands, especially Tarawa.

The plan also includes population measures, given the 4.4 percent growth rate of South Tarawa and 2.2 percent elsewhere. Other measures include solar power generation, fishing-free zones, solid waste management – sometimes in relation to seawall construction -- and beach enhancement. Further, the government has overseen and an impressive replanting of about one million mangroves.[15]

2.2.3 Waste Management[16]

In South Tarawa there are three landfills at Betio, Nanikai and Bikenibeu. These landfills are probably better termed “Controlled Dump Sites" (see Photos 1 and 2). These are run by the local councils, BTC and TUC.

There are difficulties in operating a controlled waste management facility in South Tarawa, including an inability to bury the waste below ground, and a lack of proper cover material. Useful techniques have been developed to overcome these difficulties, including containment and good compaction.

Concrete-covered sand-berm containment walls have been constructed to enable the landfills to be built into the lagoon tidal flats. Waste is retained behind these walls and compacted in place with a large excavator. It is planned to purchase a proper large compaction vehicle.

The walls and floor of the landfill are deliberately designed to be permeable so that water can pass through both the walls and the floor. The design allows for water to be passed through slowly so that excess rainfall does not migrate out into the sea.

The coral sand used to constructed the walls, and line the floor, is mainly calcium carbonate, which assists in the neutralisation of the acid leachate generated from the landfill. This coral sand also acts as a physical filter system, which greatly assists in the reduction of polluting materials (both liquid and solid) passing into the lagoon.

Photos 1 and 2 – Bikenibeu Landfill Operation

The landfills are kept locked when they are not open to the public, and when they are open to the public there is generally a landfill supervisor stationed at each landfill. The supervisor ensures that

[15] Kiribati Development Plan 2016-19 Government of Kiribati, PDF

[16] PRIF (2018). *Kiribati: Pacific Region Solid Waste Management and Recycling*. Pacific Region Infrastructure Facility (PRIF). Pp 35-40.

waste delivered to the landfills are carefully placed to ensure regular compaction, and the incoming waste is also carefully screened to make sure that unacceptable materials are not placed in the landfill.

Household waste is collected through the "Green Bag" system, or by the local councils BTC and TUC. The Green Bag system covers all of South Tarawa, and is available to anyone who buys a green bag and puts it out for collection by the Green Bag Compactor Truck. A significant part of the waste stream is delivered to the landfills by businesses and private citizens.

The Green Bag Programme is a user-pays system whereby special green garbage bags are purchased at A$0.20 per bag.

Landfill fires have occurred occasionally at the three landfills on South Tarawa, although last year they occurred only at the Betio Landfill and the Nanikai Landfill. It was reported that two uncontrolled fires occurred, last year, at each of these landfills. These fires tend to destroy a large part of the waste that sits on top of the landfill, but not the waste below ground level. It has been estimated that the fires would probably destroy approximately 50% of the waste coming into the Betio Landfill, per year, and approximately 30% of waste coming into the Nanikai Landfill per year. These fires are a significant source of uPOPs.

On Kiritimati Island, the KUC operate three dumping areas for domestic waste, and they also operate a remote dumping area for more hazardous waste. The three dumping areas are not controlled and fires occur there frequently. Quantities of waste dumped there are not known, but can be roughly estimated from the Kiritimati population of 6456 in 2015.[17]

The burning of waste on Kiritimati has been an active KUC policy in the past, in an effort to reduce waste quantities, and this also represents a significant source of uPOPs in Kiribati.

Waste management on all the outer islands is not carried out in a formal way, and usually the waste materials that cannot be reused on the islands are simply burnt, with the non-combustible materials accumulated at dump sites.

2.2.3 Waste Incineration

A small quarantine incinerator operates at the agriculture site at the western end of South Tarawa. This incinerator is well located away from residences and staff at the Agricultural and Livestock Division of MELAD. The incinerator is a simple single-chamber unit, and combustion is manually initiated by simply igniting the waste. The incinerator has a stack, which helps direct smoke emitted. More efficient combustion could have been achieved by having the waste sit on a grill, with ventilation underneath for air to pass through.

The waste that is burned in this small incinerator is confined to small amounts of aircraft waste and waste that is impounded from flights by Custom's officials. The food waste from Fiji Air and Nauru Air flights are not left at Bonriki Airport (the Kiribati International Airport), but are returned to their points of origin. The only airline leaving food waste at Bonriki Airport is Solomon Airlines, which arrives once weekly, with the aircraft and crew staying overnight. Normally, there are only approximately 60 people on the aircraft, and the food waste represents the main waste being destroyed in the incinerator.

[17] 2015 Population and Housing Census, National Statistics Office, Ministry of Finance, Bairiki, Tarawa.

Various aid agencies have made several attempts to establish an effective clinical waste incinerator at Nawerewere Hospital, the main medical facility on South Tarawa, although these attempts have all failed, for a variety of reasons. The most recent incinerator was supplied under the SPREP PacWaste Programme, but it never operated successfully, and both burners and the control box are no longer operable. The incinerator's metal parts are also now quite corroded, as the location by the sea is a corrosive environment for metal. The location is also unsatisfactory from another point of view, namely, it is quite close to residential housing, and the prevailing wind blows in the direction of the residences.

Until an effective disposal method is found for clinical waste at Nawerewere Hospital, the waste is being burnt in steel drums at a remote location. These drums corrode regularly, and need to be replaced. The odour from the drums is strong and unpleasant.

It is estimated that 12 full bags per day of clinical waste is produced from Nawerewere Hospital and that these bags weigh an average of 13 kg. This is only clinical waste and does not include pharmaceutical waste, which is accumulating.

There is also a small quarantine incinerator on Kiritimati Island, which is infrequently used as Fiji Air take waste food from their weekly flight back to Fiji with them. It is understood that this incinerator is, again, a simple single-chamber unit, similar to that used on South Tarawa.

The SPREP PacWaste Project provided a small two-chamber incinerator to Kiritimati Island to be used for London Hospital's clinical waste. Unfortunately, it has never been commissioned, as the burners and control box went missing before they reached Kiritimati Island. There is potential for new components to be delivered, and for this incinerator to be commissioned, and this should be investigated. At present, the clinical waste is simply burnt at one of the landfills.

2.2.4 Energy Supply

The Ministry of Infrastructure and Sustainable Energy (MISE) is responsible for the planning, management and coordination of the energy sector. In addition, other specific energy sector responsibilities have been delegated to the respective entities, as follows:

- The Energy Planning Unit (EPU), responsible for coordinating the implementation of energy policies and providing necessary advice and assistance on all energy activities and energy-related matters.
- The Public Utilities Board (PUB), a statutory authority responsible for provision of power, water supply and sewerage services for South Tarawa and the provision, operation and management of all assets associated with service delivery.
- The Kiribati Solar Energy Company (KSEC), an incorporated company, majority owned by the Government, involved in renewable energy, particularly sale or lease of solar PV systems and relevant components.
- The Kiribati Oil Company (KOIL), an incorporated company involved in the distribution of petroleum products, with the Government having a majority shareholding.
- Ministry of Lines and Phoenix, responsible for all government services, including the development of power, electrification and transmission on Kiritimati Island, and other islands.

The traditional use of biomass for cooking and copra drying remains a major use of renewable energy, accounting for around 25% of gross national energy production. Cooking on the outer

islands is mostly undertaken using local wood, however on South Tarawa many people cook using kerosene or gas.

Kiribati is highly dependent on petroleum imports for electricity generation in the urban areas, as well as for land, sea and air transport. With the outer islands dependent on solar and biomass for energy, the growth of petroleum imports is almost entirely due to increased population and economic growth on Tarawa, and, to a much smaller extent, on Kiritimati Island.

Petroleum is supplied mainly from Fiji, with the Kiribati Oil Company (KOIL) responsible for local distribution and sales. Supply to the outer islands is by 200-litre drums, with inconsistent shipping supplies causing shortages.

Fuel use in the outer islands is mainly kerosene, which is used for lighting and cooking. Petrol is used for motorcycles, outboard motor-powered boats and a few private and communal stand-alone gen-sets. On outer islands, traditional sailing canoes are used extensively for subsistence fishing, keeping petrol use low.

Traditional uses of biomass no longer provide most of the overall energy used by the country, although it still dominates energy use on the outer islands. Coconut husks, shells and wood are used for cooking and crop drying. The other sources of renewable energy, such as livestock wastes and wind, continue to remain undeveloped.

The power system on South Tarawa was upgraded by the Government of Japan, via Japan International Cooperation Agency (JICA) funding, with current total installed capacity of 5.45 MW. South Tarawa electricity usage in 2007 was 34% by government, 48% domestic, 18% commercial and 0.1% other users, with a total demand of 16,734 MWh. Kiritimati Island had a total demand of 2,362 MWh in 2006.[18]

For the outer islands, during the period 1990-2004, Kiribati Solar Energy Company (KSEC) installed approximately 285.5 kW solar PV systems, with 67.6 kW for community buildings, 224 kW for residential households, 7.5 kW for street lighting and 6.4 kW for communication. By the end of 2005, with the completion of the European Union (EU) outer islands electrification project, more than 2000 solar home systems were installed.

While fuel supply stability is important for supporting all economic and social activities, KOIL has been facing increasing demand for fuel since 2014. A new fuel farm, which provides additional supply capacity of 3,170 tonnes, was completed in December 2016 and commissioned in April 2017. It assists in addressing challenges of fuel supply shortage due to increasing demand for fuel.

There has been an increasing trend in consumption of fuel by sector. In this context, transport sector consumption increased from 6,006,962 kilolitres in 2010, to 10,891,220 kilolitres in 2016, while fuel for electricity consumption increased from 6,025,310 kilolitres in 2010 to 6,222,000 kilolitres in 2016, and residential consumption increased from 2,136,205 kilolitres in 2010 to 2,446,556 kilolitres in 2016.

As the national income level is expected to rise, and urbanisation to intensify, household and commercial demand for energy will also increase. The Tourism and Fisheries sectors are expected to consume more energy as more tourist resorts, trans-shipment hubs and fish processing plants are established.

[18] Kiribati National Energy Policy April 2009, Ministry of Public Works and Utilities

Electricity, reticulated water and sewerage services are provided by PUB. Prior to 2016, the quality of PUB services was considered to be mediocre to average. Since that time, however, there has been a major improvement in PUB's services, following a reform programme funded by the World Bank, Asian Development Banks and New Zealand Government (through the Pacific Regional Infrastructure Initiative (PRIF). The reform contributed to a reduction of domestic tariff from 55 cents per unit of consumed electricity for the first 100 kilowatt hours (KWH) to 45 cents and enabled a decrease in connection fees from $389 per connection to $50.

Power generation continues to increase, at an annual rate of approximately 1.7%, to try and meet public demand, even though the number of PUB customers has been on a declining trend. The reduction in the number of PUB customers shows that an increasing number of people in South Tarawa have shifted from using PUB electricity services to solar-powered systems. This may be attributable both to an avoidance of electricity tariffs and the positive impacts of solar-powered systems.

In terms of power generation, compared to diesel use and energy efficiency, there has been a rapid reduction in diesel use for PUB generators during the period of 2014 and 2015. The reduction is attributed to the installation and use of Solar PV systems connected to the PUB grid in 2015.

From 2014 to 2017, PUB has benefitted from three renewable energy projects based on Solar Photovoltaic (PV), linked to the main grid, to supplement electricity supply from diesel generation and reduce fuel consumption.[19] The first project was commissioned in 2014, with Japanese funding, through the Pacific Environment Community (PEC) Fund. The second project was completed in 2015, with financial assistance from the United Arab Emirates (UAE). The third project was also completed in early 2016, with World Bank funding. The Solar PV system has contributed to a PUB saving on fuel cost of $A800,000 per annum**.**

The Kiribati Solar Energy Company (KSEC), a Government-owned company, also provides solar-powered products, and related services, to the public, with a focus on the outer islands. A rapid increase in the use of solar power (KWh) in 2015 and 2016 follows the full installation and use of Solar PV Systems connected to the PUB grid.

KSEC sells small solar-lighting systems suitable for households, and medium-sized ones for community use. Since 2014, all households in the outer islands have been donated a solar lighting kit through the Solar Lighting Kits Project funded by the Government of Taiwan. Efficient back-up service for solar lighting products is an emerging concern.

2.2.5 Water and Sanitation Management

2.2.5.1 Water Management

Water is a precious resource in South Tarawa and all the outer islands. It is, firstly, very important for human consumption and other human needs. In addition, is it very important for agriculture. Kiribati's soil composition is calcareous and sandy, and lacks essential nutrients for good plant growth.

The only sources of fresh water are underground water lenses and rainfall, which is often quite low, with long periods of drought. The underground water lenses are shallow and fragile, and are easily contaminated by salt water intrusion, due to overuse, drought and sea-level rise.

[19] Kiribati 20 Year Vision 2016-2036 (KV20) Consultation Draft

On Kiribati, water management is the responsibility of the Ministry of Infrastructure and Sustainable Energy (MISE). The PUB (mentioned in Section 2.2.6, above) also covers water and sewerage, as well as electricity generation, and is a section of the MISE.

On South Tarawa, underground water is available throughout all areas, including Betio, although most of this underground water tends to be brackish. It also suffers from faecal contamination and some industrial contamination, mainly numerous oil spills that have occurred. This contaminated water is still used, however, for lower grade uses, such as washing and flushing toilets.

There are two good quality water reserves at the eastern end of the island, past the airport, at Bonriki and Buota. These two reserves are protected and carefully nurtured, although people are living quite close to these reserves. A total of 28 pumps extract water from these two reserves and pump it along 30km of pipeline, including Betio. Numerous lines branch off to all the villages and the water is chlorinated with gas chlorine at the beginning of the pipeline, with re-chlorination in Betio. There are 17 pump stations along the way and air breaks provide some back-flow prevention.

The Ministry of Health and Medical Services (MHMS) carries out regular bacterial water testing of the water supply, and salinity levels are also monitored. If bacterial levels are high, the public are advised to boil drinking water.

In general, water is provided from this supply for only two hours every two days, during which time residents are required to collect and store water for use at other times. A trial is being conducted in three small pilot areas, with water being supplied to individual residences on a 24-hour, 7-day week basis. The supplies to individual residences are all metered and the water charged for, although there is significant resistance to these charges from the local people.

The reticulation network is quite old, with leaks, particularly in the branch lines to villages. The total amount of water delivered is typically around 1600 m3/d sustainable limit.

A new project is underway to construct a reverse osmosis desalination plant, which will be located at the western end of Betio. The seawater intakes will be bore wells, which will penetrate the water lens. A new water reticulation will be constructed throughout South Tarawa. The project is currently at the design stage, and a contract is expected to be awarded in 2020, with an 18-month construction phase. The first stage is expected to provide 4,000 m3/d of desalinated water, with capacity to increase to 6,000 m3/d. The focus will, initially, be on providing a 24-hour, 7-day supply to Betio, with the other two large centres of Bairiki and Bikenibeu following soon after. The salty water discharge from the desalination plant will be disposed of through the sewage outfall, which is near the location of the desalination plant.

The desalination plant will be powered by the PUB Power Station in Betio, while a compensating 2.5 MW solar array is planned at Bonriki.

The outer islands all rely for their water supplies on fragile water lenses and rainwater collection, although the KSEC is planning to install 10 small packaged desalination units for ten outer islands.

2.2.5.2 Sewage Management

The general method of sewage disposal is septic tanks. This does, however, result in contamination of the water lenses. There is some sewage reticulation at Betio, Bairiki and Bikenibeu and government buildings and houses are connected to this reticulation. Private dwellings can also be connected for a $50 connection fee.

Three outfalls are associated with these reticulation systems. The outfalls are all located on the ocean side of South Tarawa, and discharge the sewage at a 30m depth below mean sea level.

The Government provides a service to clean out septic tanks, for a charge. The septic-tank waste is discharged to the outfalls.

2.3 Institutional, Policy, and Regulatory Framework

2.3.1 Strategic framework

The Republic of Kiribati environmental management framework is derived from several relevant strategies. These include the Republic of Kiribati legislation relevant to the Stockholm Convention, and the effectiveness of regulatory and enforcement infrastructure and national capacity for managing POPs.

The main environmental agency is Ministry of Environment, Lands & Agricultural Development (MELAD), which is described in Section 2.4.1 below, and particularly the Environment and Conservation Division (ECD) of MELAD.

All other government agencies are expected, however, to cooperate in environmental protection, including initiatives to meet obligations under the Stockholm Convention.

2.3.2 Description of existing legislation, policy and regulations addressing POPs

2.3.2.1 Environment (Amendment) Act 2007

The enactment of this Act has been a major step in ensuring the protection of the sensitive environment in Kiribati. It would also provide a logical base for further measures proposed in this report, including the management of hazardous substances and POPs.

This Act amends the earlier Environment Act 1999. Among other things it sets out provisions to:

- manage littering,
- manage pig premises,
- prevent excessive emissions from vehicles,
- to prevent pollution of waters
- prevent dumping in the sea or the lagoon
- prevent pollution from private premises
- prevent pollution in a public place or in a public conveyance
- prevent any discharge or a substance or energy that harms the environment, other than in accordance with an environmental licence.

The penalties are potentially severe and include fines up to $A100,000 and imprisonment for 5 years.

The section relating to pollution of waters prohibits the discharge of any substance or energy into water (unless in accordance with an environmental licence) that:

- results in a change in the physical, chemical or biological condition of the water;
- causes a visible change to the water or the surface of the water;
- makes, or is likely to make, the water unclean, noxious or poisonous;
- makes, or is likely to make, the water detrimental to the health or safety of persons, property, animals or plants; or
- interferes with, or is likely to interfere with, the exercise or enjoyment of any person's right in relation to the water

The carrying out of "environmentally significant activities" must be done in accordance with an environmental licence. There is a formal process detailed for applying for an environmental licence including the need to carry out a detailed environmental assessment. This requirement is waived only if the activity is an unforeseen activity requiring immediate action in the public interest.

The Act also includes detailed conservation provisions to protect sensitive flora and fauna, and manage protected areas and "World Heritage" areas.

Other relevant legislation that may be relevant to this report is described below.

2.3.2.2 Local Government Act 1984

The Act sets up local councils that have various functions prescribed by the Minister. Local councils currently take on the responsibility of collecting solid waste.

2.3.2.3 Public Utilities Ordinance 1977

This Ordinance sets up the Public Utilities Board which has powers and functions:

- to generate and supply electricity
- to collect and supply water
- to establish sewerage works

2.3.2.4 Public Highways Protection Act 1989

The purpose of this Ordinance is to protect Public Highways. The Act establishes the Highways Authority which is generally responsible for highways. The Act contains offence of depositing litter or rubbish on a public highway.

2.3.2.5 Kiribati Ports Authority Act 1990

This Act establishes the Kiribati Port Authority and gives general powers to manage ports.

2.3.2.6 Special Fund (Waste Material Recovery) Act 2004

This Act sets up a system whereby prescribed materials are charged a deposit when they are imported into the country. A refund is then paid when the material is returned to depots for recycling. Currently the scheme covers aluminium cans, PET bottles and lead-acid batteries and has been effective in removing these items from the waste stream.

2.3.2.7 Public Health Ordinance Cap 80

The Public Health Ordinance is a framework law which allows the Minister to make regulations to protect and advance the public health of Kiribati. Regulations have been made relating to water, litter and garbage, and latrines. Notably, the regulations require that all garbage and rubbish which can readily be destroyed by fire shall be so destroyed.

2.3.2.8 Customs Act 2005

The Customs Act controls the movement of goods into and out of the country. It contains a list of restricted and prohibited imports and exports. This Act needs to be included in any considerations of managing the import and export of hazardous substances. There is a Customs Amendment Bill due to go to Parliament and it may be useful to include in this bill some of the Customs measures mentioned in this plan.

2.3.2.9 Carriage of Goods by Sea Ordinance Cap 7

This Ordinance requires every contract for the transport of goods by sea, to be subject to the rules set out in the Schedule to the Ordinance. It does not apply to transport of any goods contracted to be carried (and are carried) on the deck of the vessel. The schedule sets out various rights and

responsibilities that the carrier and the shipper have with respect to the goods, such as seaworthiness of the vessel, responsibilities for accidents, and handling of the goods.

2.3.2.10 Foreign Investment Act 2018

This Act regulates the conduct of foreign investment in Kiribati. Conditions can be placed on the business activities of foreign investors.

2.3.2.11 Consumer Protection Act 2001

This Act provides for the requirements of approved standards for products and for the power of the Minister to make an order for the recall of products which do not comply with such requirements.

2.3.2.12 Food Safety Act 2006

This Act aims to:

- promote public health and safety with regard to food,
- regulate the preparation, sale and use of food,
- assist consumers in making informed choices on food,
- promote fair trading practices in relation to food, and for related matters.

Any regular testing of food that is carried out for POPs or other food contaminants should be done under this Act or appropriate regulations pertaining to this Act.

2.3.2.13 Biosecurity Act 2011

This Act provides for the treatment of vessels, people and goods to prevent the entry of animal and plant pests into Kiribati and the spread of diseases in Kiribati. The Act describes the procedure for inspection, exclusion, detention, observation, segregation, isolation, protection, treatment, and disinfection of vessels, persons and goods.

2.3.2.14 Maritime Act 2017

This new Act covers, among other matters the responsibility to manage oil and other spills in Kiribati waters, and also meet the requirements of the MARPOL Convention.

2.3.2.15 Nuclear Installations (Gilbert and Ellice Islands) Order 1972

This order applies the Nuclear Installations Act 1965(UK) to Kiribati. This Act regulates the transport of nuclear material.

2.3.2.16 Petroleum Ordinance 1977

This ordinance regulates the storage, handling and transport of petroleum.

2.3.2.17 Pharmacy and Poisons Ordinance Cap 70

This Ordinance provides for the licensing of pharmacies and regulates their conduct. It also regulates the importation and use of poisons. Poisons are substances that are listed in a schedule to the Ordinance. This Ordinance was made in 1948 and has not been amended since 1977. The government is considering a revision of this Ordinance.

2.3.2.18 Occupational Health and Safety Act 2015

This new Act sets out comprehensive provisions for managing occupational health and safety (OSH) in Kiribati. The general provision is to require employers to "…. maintain, as far as practicable, a working environment for employees and site visitors that is safe and without risk to health." More detailed provisions are then set out. Included is a provision to prepare "Codes of Practice" and this provides a useful mechanism to promulgate detailed OSH requirements for the protection of employees from hazardous substances.

2.3.2.19 National Quality Policy 2017

The National Quality Policy launched by the Kiribati Government in 2018 seeks to raise the quality and safety levels of products and services in Kiribati, both locally manufactured and imported, with the aim of protecting consumers, achieving better social and environmental protection, and improving livelihoods. The policy seeks to:

- regulate vessel tank discharges in the inbound/outbound zones near the lagoon
- develop, regulate or promote the use of energy efficient and energy smart standards and systems
- continue implementation of the recycling measures and assess the need to regulate items not yet covered (e.g. plastic bags, packaging)
- Introduce an import regulation for used cars (Pre-shipment inspection, age limits, wreckage tax)
- continue the elimination of car wrecks
- consider regulating the emission and elimination of wastes from animals and from visiting vessels as per KIEP

2.3.2.20 Kiribati Trade Policy Framework 2017-2027

The Trade Policy framework that was launched by the Kiribati Government in August 2018 seeks to implement measures including an environmental licensing system to support waste management and pollution control. It also seeks to build capacity to facilitate the notification and reporting requirements under existing waste and chemical related conventions. The trade policy broadly seeks to ensure trade and environmental sustainability.

2.3.2.21 Tobacco Control Act 2013

This Act regulates the importation and selling of tobacco products. Tobacco produces uPOPs.

2.3.2.22 Ozone Depleting Substance Regulations 2017

This regulation sets in place a range of measures to ensure that Kiribati is able to meet its obligations under the Montreal Protocol to control substances listed under the protocol that deplete the ozone layer.

2.3.2.24 Environment (General) Regulations 2017

These regulations cover several administrative matters, including fees, seizure of items, public consultation and EIA requirements for environmentally significant activities. These activities include a list involving harmful chemicals.

2.3.2.25 Kiribati 20-Year Vision 2016-2036 (KV20)

The KV20 is a long term development blueprint for Kiribati and it covers the period 2016 to 2036. It is motivated by a collective aspiration for a better society by the year 2036. The vision of the KV20 is for Kiribati to become a wealthy, healthy and peaceful nation. It seeks to achieve the development aspiration by maximising the development benefits from fisheries and tourism as key productive sectors. The development of the sector is expected to stimulate the development of other sectors through sectoral linkages.

The contribution of the fisheries and tourism sectors to the country's development aspirations is expected to directly contribute towards meeting the Sustainable Development Goals (SDGs) for I-Kiribati by 2036. The Vision is a product of a participatory and inclusive consultative process involving views from I-Kiribati and widely informed by the underlying challenges and inputs from various sector plans**.**

The Vision is anchored on four pillars: Wealth; Peace and Security; Infrastructure; and Governance.

The Vision further recognises that Kiribati's vulnerability to climate change as a key constraint to achieving the desired outcomes. The Vision therefore recognises the need to further the mainstream climate change adaptation and mitigation into various programmes to ensure that the working environment is sensitive to environment conservation, climate change and sustainable development. The environment conservation adaptation and mitigation measures will reduce risks and ensure that the development programmes implemented creates sustainable development for all.

2.3.2.26 Kiribati Development Plan (KDP) 2016-2019

This is the 10th Development Plan and has the vision "Towards a better educated, healthier, more prosperous nation with a higher quality of life". It is therefore clearly related to the KV20.

The plan states that credible national policies and strategies focussed on key underlying areas of priority will drive the KDP's implementation. The stated priorities are as follows:

- Managing population growth
- Strengthened governance
- Improved infrastructure
- Stable macroeconomic framework
- Economic growth
- Improved access to basic services
- Improved health standards
- Climate change adaptation
- Improved education standards
- Reduced poverty
- Gender equity and the empowerment of women
- A clean environment.

2.3.2.27 Kiribati Integrated Environmental Policy (KIEP) 2012-2016

The KIEP is a key environmental strategy document for Kiribati and was produced as a result of a broad three year consultation process. It is coordinated by the ECD, MELAD, and the Vision Statement is as follows:

> *"The People of Kiribati continue to enjoy a safe and healthy environment that is resilient to the impacts of global climate change and supports livelihoods, human health, and sustainable development"*

The KIEP acknowledges that the Government of Kiribati recognizes the environment as one of the three important pillars of sustainable development and that the environment, its goods and its services is the foundation of livelihoods, human health and economy in Kiribati.

The KIEP further acknowledges that protecting, managing and utilizing the environment in a sustainable way is vital, especially in a low-lying nation like Kiribati. Kiribati has suffered heavily from the impacts of globalization in particular global climate change. The transition from a traditional subsistence lifestyle to a contemporary market-based economy, has brought with it key environmental challenges that adversely affect the overall health of the environment. Some of these key environmental challenges like the loss of island biodiversity, waste and pollution and the unsustainable use of natural resources are further magnified by the impacts of global climate change.

The KIEP then sets out a clear and practical Strategic Environmental Plan to deal with these concerns, including a focus on waste management and pollution control, which is directly relevant to the management of POPs.

2.3.3 Multilateral Environmental Agreements

The Republic of Kiribati status in relation to key multilateral environmental agreements pertaining to the management of wastes, chemicals and hazardous substances is presented in Table 3. In becoming a Party to these agreements, the government has been able to demonstrate its commitment to addressing a number of environmental concerns, as well as supporting international environmental initiatives.

Kiribati is not a party to the Rotterdam Convention and may wish to become a party to support its initiatives under the Stockholm Convention. The Rotterdam Convention (formally, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade) is a multilateral treaty to promote shared responsibilities in relation to importation of hazardous chemicals. The convention promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labelling, include directions on safe handling, and inform purchasers of any known restrictions or bans. Signatory nations can decide whether to allow or ban the importation of chemicals listed in the treaty, and exporting as direct relevance to the Stockholm Convention and many of the substances that the Rotterdam Convention covers are also POPs substances.

Table 3: The Republic of Kiribati status in relevant conventions on wastes, chemicals, and hazardous substances

Convention	Description of Convention	The Republic of Kiribati status
Basel Convention on Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Aims to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries	Party
Waigani Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement of Hazardous Wastes within the South Pacific Region	The Waigani Convention Constitutes the regional implementation of the Basel Convention in the Pacific. However, unlike the Basel Convention, coverage extends to radioactive waste, and to the EEZ (200 nautical miles) of Parties	Party
Stockholm Convention on POPs	Aims to protect human health and environment from the adverse effects of POPs that, when released, persist in the environment and can lead to adverse human health and ecological impacts	Party
Montreal Protocol on Substances that Deplete the Ozone Layer	Protects the ozone layer by phasing out the production and consumption of a number of man-made substances responsible for ozone depletion	Party
The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78, MARPOL is short for marine pollution)	Prevents pollution from ships. There are six annexes that address the various categories of pollutants.	Party
Paris Agreement under the United Nations Framework Convention on Climate Change	An agreement within the United Nations Framework Convention on Climate Change (UNFCCC), dealing with greenhouse gas emissions mitigation, adaptation, and finance, starting in the year 2020.	Party
Convention on the Prevention of Marine Pollution by Dumping of	It covers the deliberate disposal at sea of wastes or other matter from vessels, aircraft, and platforms	Party

Convention	Description of Convention	The Republic of Kiribati status
Wastes and Other Matter 1972 (London Convention)		
Minamata Convention on Mercury	A global treaty to protect human health and the environment from the adverse effects of mercury. The Convention draws attention to a global and ubiquitous metal that, while naturally occurring, has broad uses in everyday objects and is released to the atmosphere, soil and water from a variety of sources.	Party

2.3.3.1 Stockholm Convention on Persistent Organic Pollutants

The Republic of Kiribati became a Party to this Convention on 29 June 2004 and is now working on its implementation through the review of the National Implementation Plan (NIP). This report focuses on this matter. The Ministry of Environment, Agriculture and Lands (MELAD) has day-to-day responsibility for matters relating to the Stockholm Convention, although other agencies are also involved.

2.3.3.2 The Basel Convention

The Republic of Kiribati is a Party to the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal. This agreement aims to achieve the environmentally sound management of hazardous wastes through the reduction in transboundary movements to the minimum consistent with:

- Environmentally sound and efficient management.
- Treatment and disposal as close as possible to the source of generation.
- Minimisation of generation.

The Basel Convention is of particular importance to the Republic of Kiribati when considering disposal of POPs and other hazardous wastes by export to treatment facilities in other countries. All exports of hazardous wastes are required to comply with stringent control procedures, including being approved by both the exporting and importing countries. The Ministry of Environment, Agriculture and Lands (MELAD) has day-to-day responsibility for matters relating to the Basel Convention, although other agencies are also involved.

2.3.3.3 Waigani Convention

The Republic of Kiribati is a Party to the Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region (Waigani Convention). The Waigani Convention objective is to prevent the importation of hazardous and radioactive waste into the South Pacific region, to minimize production within the region and to ensure the environmentally sound management and disposal of existing wastes. The Ministry of Environment, Agriculture and Lands (MELAD) has day-to-day responsibility for matters relating to this Convention.

2.3.3.4 London Convention

The Republic of Kiribati is a party to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972, commonly called the "London Convention". This is an agreement to control pollution of the sea by dumping and to encourage regional agreements supplementary to the Convention. It covers the deliberate disposal at sea of wastes or other matter from vessels, aircraft, and platforms. In Kiribati it is administered by the Marine Division of the Ministry of Information, Communication, Transport and Tourism Development (MICTTD).

2.3.3.5 Montreal Protocol

The Republic of Kiribati is a party to the Montreal Protocol on Substances that Deplete the Ozone Layer, which is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. The treaty is structured around several groups of halogenated hydrocarbons that deplete stratospheric ozone. In Kiribati this treaty is administered by MELAD

2.3.3.6 MARPOL

The Republic of Kiribati is a party to MARPOL and this is administered by the Marine Division of the Ministry of Information, Communication, Transport and Tourism Development (MICTTD). The six annexes of MARPOL are as follows:

- Oil and oily wastes
- Noxious liquids in bulk
- Harmful substances in packaged form
- Sewage
- Garbage
- Air Pollution

2.3.3.7 Paris Agreement

The Republic of Kiribati is a party to the Paris Agreement and is a strong and active supporter of the agreement. The Paris Agreement is administered by the Office of Te Beretitenti. The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change (UNFCCC), dealing with greenhouse-gas-emissions mitigation, adaptation and finance, starting in the year 2020.

The Paris Agreement's long-term goal is to keep the increase in global average temperature to well below 2°C above pre-industrial levels; and to limit the increase to 1.5 °C, since this would substantially reduce the risks and effects of climate change. Under the Paris Agreement, each country must determine, plan, and regularly report on the contribution that it undertakes to mitigate global warming.

2.3.3.8 Minamata Convention on Mercury

The Republic of Kiribati is a party to the Minamata Convention on Mercury, which is a global treaty to protect human health and the environment from the adverse effects of mercury. The Convention draws attention to a global and ubiquitous metal that, while naturally occurring, has broad uses in everyday objects and is released to the atmosphere, soil and water from a variety of sources. Controlling the anthropogenic releases of mercury throughout its lifecycle has been a key factor in shaping the obligations under the Convention. In Kiribati this convention is administered by MELAD.

2.4 Stakeholders' Roles

2.4.1 MELAD

The Ministry of Environment, Lands & Agricultural Development standing structure is holding 4 key divisions, including 1 major development unit which are serving the same purpose, mission and vision of this Ministry. The Divisions are as follows:

2.4.1.1 Administration and Policy

The Policy and Management Unit (PMU) is based in Bikenibeu. It has a total number of 23 staff which consist mainly of Administrative Officers, Project Planning Unit Officers, Account staff, registry staff and Information Technology. The PMU key role is to provide administrative guidance and

support to the three main divisions operated under this Ministry, known as, Lands & Management Division, Environment & Conservation Division and Agriculture & Livestock Division. One of the key important roles of PMU is to ensure that these 3 divisions carry out their activities and meet their obligations in line with the Kiribati Development Plan and Kiribati Vision 20 (KV20), National guidelines, Regulations and the Environment (Amendment) Act 2007, and more importantly to work in accordance to the budget approved.

2.4.1.2 Land and Management Division (LMD)

There is an increasing population in South Tarawa and this is resulting in overcrowding. This division manages addresses the resulting problems by dealing with planning and managing land use, whilst providing an enhanced environment in which economic and social sustainable development can flourish. Population pressures have resulted in overcrowding that is putting stress on crucial public infrastructure and the natural environment including the underground water reserves.

Kiritimati Island has recently become more open for citizens to visit or stay. The advent of more people into Kiritimati also put more pressure to the Government and the LMD Kiritimati branch in terms of squatters and other land issues.

LMD has a total number of 32 technical officers and 5 supporting staff, based at LMD office in Bairiki, while 8 technical officers are stationed at LMD office in Kiritimati Island. The total number of staff, both in South Tarawa and Kiritimati is focussing on dealing with on-going land issues such as land use management, and land squatters.

2.4.1.3 Environment and Conservation Division (ECD)

The Environment and Conservation Division play a critical role in ensuring that natural resources are not over exploited, extracted in proper manner and that all development happening in Kiribati is properly conducted in accordance to the law of Kiribati. ECD has two offices, one is based in Tarawa with a total number of 29 and another office responsible for the Wildlife section, which is based in Kiritimati with a total of 9 staff. The ECD is the main Kiribati focus for the Stockholm Convention and this NIP.

The main office is based in Bikenibeu, Tarawa comprising of seven units namely, Environment Inspectorate Unit, Environment Outreach Unit, Chemical Waste & Management Unit, Biodiversity & Conservation Unit, Climate Change Unit, Project Finance Unit and Development Control Unit. Despite, a number of issues and in particular the limited number of staffs, the ECD achieve success in mobilizing their resources to ensuring its obligations are met.

ECD is also an operational focal point of the Global Environment Fund, SPREP and other international and regional agencies. ECD/MELAD can also get access to technical and financial support through these agencies.

2.4.1.4 Agriculture and Livestock Division

The Agriculture and Livestock Division consists of five main sections namely:

- Crops, Research and Development
- Livestock production and animal health
- Information training and extension
- Biosecurity and plant health
- The sub-branch located in Christmas Island that serves the need of islands in the Line and Phoenix group.

There are agricultural assistants and nurserymen who staff the outer islands and their task is very specific and clear, namely to provide necessary support to people in the community, in order to improve local food production.

2.4.1.5 PIPA Implementation Unit

The Phoenix Islands Protected Area (PIPA) Implementation Unit was established to manage the implementation of the PIPA project that involves protection of the PIPA designated area from commercial or other exploitation activities. The total PIPA area is 408,250 sq km near Kanton Island in the Phoenix Islands group. PIPA therefore embodies the Government of Kiribati's conservation and sustainable use strategy for the Phoenix Islands and surrounding marine environment.

The PIPA Management Unit consists of 4 main staff headed by the Project Director. The other 5 subordinate staff includes the Education and Media Officer, Finance Officer, Administrative Assistant, Kanton Coordinator, and Kanton Assistant. The latter 2 will be based in Kanton and will move in into their office and residence there when they have been completed. The other staff are based in Tarawa and their Office is located within MELAD.

2.4.2 Ministry of Health and Medical Services (MHMS)

The MHMS provides health and medical services, public health and sanitation, community health and health promotion and a range of other related services, including health inspectorate services and environmental health.

MHMS therefore has a direct interest in POPs and related issues as they have the potential to affect the health of everyone who may be exposed. MHMS also manages clinical waste incineration which has a direct and large impact on uPOPs generation.

2.4.3 Ministry of Employment and Human Resources Development (MEHR)

The MLHRD covers everything to do with workers, including labour services, industrial relations, trade unions, and occupational safety and health. It is also responsible for the Marine Training Centre (MTC), the Fisheries Training Centre (FTC) and the Kiribati Institute of Technology (KIT).

The MLHRD will therefore have a direct interest in POPs and related issues as they have the potential to directly impact on workers. They need to be involved closely in the development of a hazardous substances management system.

2.4.4 Ministry of Foreign Affairs and Immigration (MFAI)

MFAI is responsible for all overseas interactions including foreign policy, international relations, diplomatic services and immigration services.

MFAI is also the focal point for international agreements, including acting as co-ordinator of national positions and national representation. This impacts on the Stockholm Convention and related conventions.

2.4.5 Ministry of Internal Affairs (MIA)

The MIA supports and manages local government – BTC, TUC, ETC, KUC and all outer islands councils. They manage rural and outer island development, community development, cultural affairs, and decentralisation.

The MIA therefore has a role in POPs and related issues, such as the way local councils manage waste and control open burning.

2.4.6 Ministry of Education (MOE)

The ME is responsible for all education matters except for trade training, including all schools and curriculums, the National Library and Archives, and USP.

The ME connection to POPs and related matters is firstly that it provides a vehicle for the education of young people regarding POPs, waste management, recycling and protecting the environment. The other important matter is the management of laboratory chemicals in schools and the disposal of old chemicals stockpiles.

2.4.7 Ministry of Commerce, Industry and Cooperatives (MCIC)

The MCIC is responsible for all commercial matters, including:

- Internal and international trade
- Cooperatives
- Private sector development
- Business and industry advisory services
- Copra production and marketing
- Bobotin Kiribati Ltd
- Kiribati Chamber of Commerce and Industry (KCCI)
- Kiribati Handicraft and Local Produce

MCIC also ensures that the investment and trade-related activities contributes to environmental sustainability.

The MCIC involvement with POPs and related matters is firstly that the development of an effective system for managing hazardous substances will have an impact on business (a positive one although there may be resistance). MCIC also needs to work with MLHRD to ensure effective OSH measures to protect workers from the impacts of hazardous substances. The private sector (represented by KCCI) is also expected to play an active part in making progress on POPs and related matters.

2.4.8 Ministry of Information, Communications, Transport and Tourism Development (MICTTD)

The MCITTD has a broad role covering a large number of concerns, with a focus on communications, transport and tourism. This includes transport services, civil aviation, airport fire and security, marine services, search and rescue, reef passages, Telecom, Air Kiribati, Kiribati Shipping Services Ltd, Betio Shipyard Ltd and the Kiribati Ports Authority.

The MCITTD impacts on POPs and related matters with issues such as marine spill control, airport fire management (fire-fighting foam can be a POP) and MARPOL issues.

2.4.9 Ministry of Fisheries and Marine Resources Development (MFMRD)

The MFMRD is responsible for all fishing matters including participation in international and regional fisheries programmes, and fisheries resource development and sustainability.

The MFMRD interest in POPs and related matters is that these matters can impact on ocean and lagoon pollution and thus also impact on the fisheries resource that is of vital importance to Kiribati.

2.4.10 Ministry of Infrastructure and Sustainable Energy (MISE)

The MISE has the responsibility for managing infrastructure, including Government building and infrastructure, public utilities services (power, water and sewage), energy management, Public Utility Board (PUB), KSEC (Kiribati Solar Energy Company), Kiribati Oil Company (KOIL) and the Plant and Vehicle Unit (PVU).

Several activities of the MISE impact on POPs and related matters. These include potential PCBS in old transformers, the management of used oil, control of oil spills at KOIL and the PVU, and the switch to renewable energy.

2.4.11 Ministry of Justice (MOJ)

The recently established Ministry of Justice is responsible for the administration of law and justice, prisons and the probationary system, legal aid and human rights, civil registration, elections, citizenship, customs services and law reform.

The MJ Customs Service will be an important agency in setting up an effective system for managing hazardous substances, as they will need to provide effective control of the import of hazardous substances including any POPs.

2.4.12 Office of the Te Beretitenti (OB)

The OB covers a wide range of matters, including state functions, cabinet secretariat, constitutional and political affairs, ministerial co-ordination, police and prisons, national security and civil defence, disaster management, climate change policy, meteorological office, national events, office and government buildings allocation, and public sector reform.

Some of these matters impinge broadly on POPs and related matters, including climate change policy (e.g. renewable energy), and government responsibilities.

2.4.13 Ministry of Women, Youth, Sport and Social Affairs (MWYSSA)

The MWYSA is responsible for a wide range of activities including women's affairs, community development, youth, senior citizens, incorporated societies, churches, NGOs, and liquor licencing.

POPs and related health and environmental issues have the potential to have a significant impact on women, children and older people, all of which are of interest to the MWYSA. Groups that come under the MWYSA can also be used effectively to promote community awareness and community education on POPs and related issues.

2.4.14 Private Sector and Non-Governmental Organisations (NGOs)

Several NGOs are directly interested in POPs and related issues. These groups are presented in Table 4 below.

Table 4 – NGOs interested in POPs

Name	Role	Interest in POPs
AMAK	National Woman's Group (not currently operational but may re-start soon)	Impact on women and family health, cooking practices
Bus Owner's Association	Represents bus owners in South Tarawa	Control of uPOPS produced from vehicles and the management of used oil
Church Groups	Focus for Church Activities	Education and Awareness
Youth Groups	Providing a voice for the youth of Kiribati	Education and Awareness

Name	Role	Interest in POPs
Kiribati Association of Non-Government Organisations (KANGO)	Umbrella Organisation for NGOs. Function is to disseminate information to members throughout Kiribati	To promote relevant POPs mitigation measures such as alternative cooking practices, recycling reducing open burning etc
Kiribati Family Health Association (KFHA)	Promotion of family health measures	POPs and related issues have the potential to impact significantly on families and especially children.
Kiribati Red Cross Society (KRCS)	In keeping with the aims of the International Red Cross, to prevent and alleviate human suffering and protect life and health	To be an active voice in any issues involving human health and potential suffering. This includes impacts from POPs and related issues
Kiribati Chamber of Commerce and Industry (KCCI)	Represents the interests of the private sector	To work with the Government in promoting environmentally friendly investment and business practices and sustainability.

3.0 POPs and Related Issues

3.1 General

The most common use of POPs has been for use as pesticides and the POPs pesticides are considered first in this section. Then the few other pesticides in common use in Kiribati are considered. These few pesticides are still hazardous and need to be used appropriately so it is therefore considered justified to cover these other pesticides in this document even though they are not POPs.

Annex 3 presents a detailed list of the POPs.

The following chapter sub-sections deal firstly with the rest of the POPs chemicals and groups of chemicals as follows:

- Polychlorinated Biphenyls (PCBs)
- Decabromodiphenyl Ether (c-decaBDE) and other Polybromodiphenyl ethers (PBDEs)
- Hexabromobiphenyl (HBE)
- Pentachlorobenzene
- Hexachlorobutadiene
- Hexabromocyclododecane
- Polychlorinated Napthalenes (PCNs)
- Short Chain Chlorinated Paraffins (SCCPs)
- Perfluoro-octane Sufonic Acid (PFOS) and its salts and Perfluoro-octane Sulfonyl Fluoride (PFOS-F).

Six other matters were also deemed appropriate to gain an overview on as they were also relevant to a plan to manage POPs. These matters are:

- Laboratory Chemicals - They can generate stockpiles of used and unwanted chemicals that are sometimes dangerous and present disposal difficulties. Unsatisfactory disposal of these chemicals may also lead to residues persisting in the environment.
- Used Oil – If used oil is not dealt with properly through a recycling process it can result in contamination of soil and water that will release unintentional POPs (uPOPs). The multiple constituents of used oil can also persist in the environment.
- The Future of Waste Management – The current waste management system is dealt with in Section 2.2.4 above. Future waste management needs to be considered here, as effective waste management will reduce and/or eliminate open burning of waste which is a major source of uPOPs.
- Recycling – Recycling removes or delays the disposal of many waste products. When waste products are placed in a landfill, they break down and can release a range of POPs and uPOPs.
- Renewable Energy and Energy Efficiency – Section 2.2.4 above addresses power generation together with some discussion of current recycling. The main method of power generation relies on the combustion of diesel which generates uPOPs. The move towards renewable energy and energy efficiency has a number of benefits including the reduction of uPOPs.
- Contaminated Sites – Sites can be contaminated by a range of contaminants, including hydrocarbons (such as used oil), heavy metals, pesticides, POPs, and asbestos. Leachate and evaporation from such sites can be a source of both POPs and uPOPs.

3.2 Important Background Considerations

3.2.1 Half Life

POPs chemicals in the environment (such as in soil) break down exponentially in a way similar to radioactive decay. With regard to POPs chemicals the term "half-life (t1/2)" is the time required to reduce to half the initial concentration. In the second "t1/2" the substance will have decayed to a quarter of the initial concentration. This is illustrated in Figure 2 below.

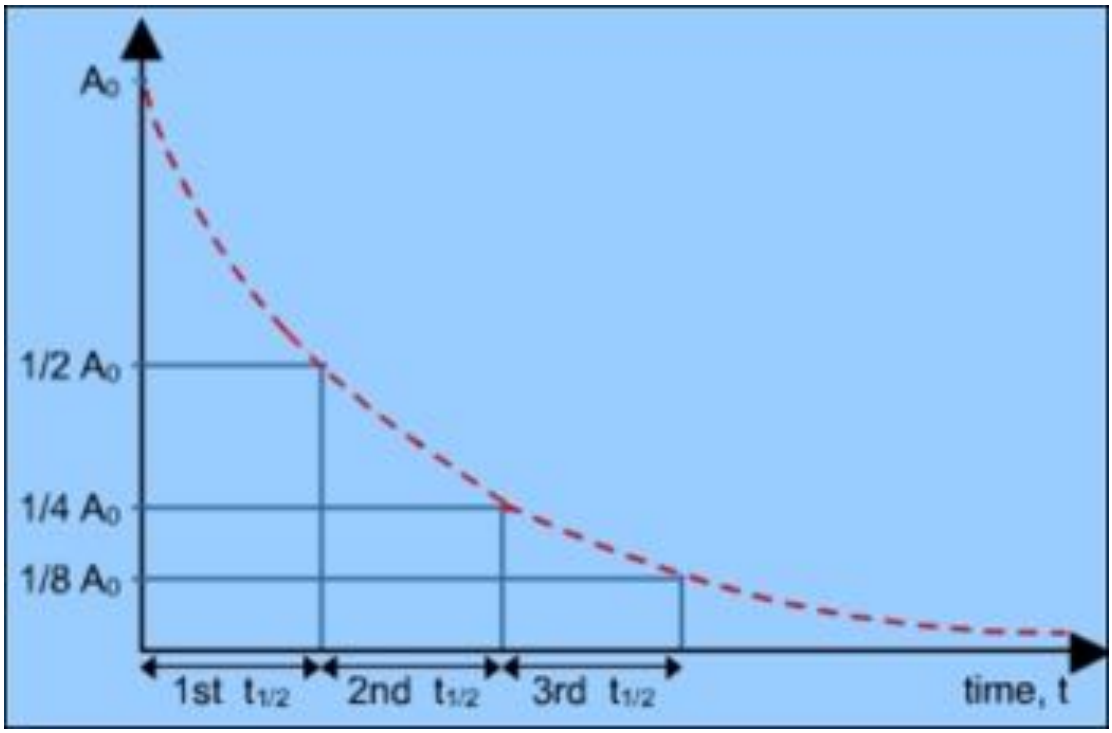

Figure 2 – Half Life Diagram

3.2.2 Toxicity Concepts

The following toxicity concepts are important to understanding POPs toxicity and indeed all chemical toxicity.

Acute toxic impacts cause harm immediately.

Chronic toxic impacts cause harm in the long term – e.g. cancers, liver damage, etc.

There are four main routes for toxic substances to reach the body:

- *Inhalation (breathing)*
- *Ingestion (eating and drinking)*
- *Adsorption (skin or dermal)*
- *Injection (accidental or deliberate)*

These routes are also called pathways. If the pathways are interrupted, such as with effective personal protective equipment (PPE), physical barriers, and strict cleanliness procedures, then the toxic substance can do no harm. The same applies to environmental pathways.

There are three main factors that influence how toxic substances harm you:

- *Time,*
- *Dose or concentration*

- *Individual Susceptibility*

Time and dose are quite objective concepts that are locked into toxicological assessments. Individual susceptibility is very important but cannot be objectively assessed. Some individuals are much more likely to be affected by certain hazardous substances than others, depending on their biological make-up.

"Bioaccumulation" refers to the accumulation of a toxic chemical in the tissue of an organ in an individual.

"Biomagnification" refers to the increased concentration of a toxic chemical, the higher an animal is on the food chain. Chemicals are passed along a chain with smaller species being eaten by larger species, with each step resulting in the magnification of the chemical concentration until the species at the end of the food chain (often humans) can experience quite large concentrations.

3.2.3 Hazardous Substances Management

3.2.3.1 Overview

There are essentially two parts to an effective system to manage hazardous substances. The first involves the classification of hazardous substances and the second involves the controls that need to be put in place to ensure safe management.

Effective controls flow out of an effective system of classification. When a substance is properly classified, then all its inherent hazardous properties will be known. When these hazardous properties are clearly known and stated, then methods of control can be developed. Simple examples are as follows:

- If a substance is flammable then rules must apply to its storage and use, such as setting up a surrounding exclusion zone for potential sources of ignition, providing signage, and segregation from incompatible substances (especially oxidisers).
- If a substance is toxic then routes of such substances into the human body need to be prevented, such as by using PPE including suitable respirators.
- If a substance is environmentally damaging (ecotoxic) then controls need to be put in place to stop it reaching the environment. This will include suitable bunding around hazardous bulk liquid containers.

Many hazardous substances regimes in many countries have been set up to cover a wide range of such complex controls. Kiribati needs to put in place a system of hazardous substance controls with a level of complexity suitable for its needs and for the chemicals used in the country. It therefore also needs a suitable system to classify hazardous substances that is wide-ranging enough to cover all the chemicals used in Kiribati but simple enough to be easily understood and effectively applied.
It should be noted that many of the necessary controls are usually covered, at least in a broad manner, by Safety Data Sheets (SDSs) (formerly known as MSDSs or Material Safety Data Sheets). SDSs should always be available wherever chemicals are used.

It should be noted that hazardous substances are definitely a concern in Kiribati. For example there are very large amounts of solid concentrated caustic soda stored and used at the Copra processing plant – Photo 3 shows one of the bags. Proper PPE is not used and there is no safety shower available in case of an emergency.

Photo 3 – Caustic Soda Used at Copra Plant

3.2.3.2 Classification System

When hazardous substances are transported, the term 'Dangerous Goods' is used. These are materials or items with hazardous properties which, if not properly controlled, present a potential hazard to human health and safety, infrastructure and/or their means of transport.

The transportation of dangerous goods is controlled and governed by a variety of different regulatory regimes, operating at both the national and international levels. Prominent regulatory frameworks for the transportation of dangerous goods include the United Nations Recommendations on the Transport of Dangerous Goods (UNRTDG).

Regulatory frameworks incorporate comprehensive classification systems of hazards to provide a taxonomy of dangerous goods. Classification of dangerous goods is broken down into nine classes according to the type of danger materials or items present.

- Explosives
- Gases
- Flammable Liquids
- Flammable Solids
- Oxidising Substances
- Toxic and Infectious Substances
- Radioactive Material
- Corrosives
- Miscellaneous Dangerous Goods

Whenever hazardous substances are imported into Kiribati (or exported from Kiribati as is the case with waste oil) it is necessary to use the UNRTDG classification

Because of shortcomings in the UNRTDG classification system, however, a new international classification system has been developed that is called the Globally Harmonised System (GHS). This system covers all stages of a hazardous substance life cycle and not only transport.

The Globally Harmonised System (GHS) of classification and labelling of chemicals is a system used to classify and communicate chemical hazards using internationally consistent terms and information on chemical labels and Safety Data Sheets. The following points should be noted about the GHS system of classification:

- The GHS provides criteria for the classification of physical hazards (e.g. flammable liquids), health hazards (e.g. carcinogens) and environmental hazards (e.g. aquatic toxicity).

- The GHS was created by the United Nations to create a single worldwide methodology for chemical classification, labelling and safety data sheets. The system ensures that users are provided with practical, reliable and easy to understand information on chemical hazards, and can take the appropriate preventive and protective measures for their health and safety.

- The GHS will update the way in which information about the hazards of chemicals and any precautions necessary to ensure safe storage, handling and disposal, is conveyed to users of chemicals. The GHS uses pictograms, signal words, and hazard and precautionary statements to communicate this information.

- Nine hazard pictograms in the GHS represent the physical, health and environmental hazards.

- The GHS uses 'Danger' and 'Warning' as signal words to indicate the relative level of severity of a hazard. 'Danger' is used for the more severe or significant hazard, while 'Warning' is used for the less severe hazards.

- Hazard statements are assigned to a class and category that describes the nature of the chemical hazard including, where relevant, the degree of hazard. For example the hazard statement 'Toxic if swallowed' is the hazard statement for Acute toxicity category 3 (Oral).

- Precautionary statements describe the recommended measures that should be taken to minimise or prevent adverse effects resulting from exposure, or improper storage or handling of a hazardous chemical.

- The GHS precautionary statements cover prevention, response, storage and disposal.

Not all the GHS hazard classes may be relevant to the hazardous substances entering Kiribati and some thought needs to go into the Kiribati classification system so that it is simple to operate. Once a classification system is adopted, associated controls can be set. The following are the elements of the GHS Classification System.

Physical hazards

Substances or articles are assigned to different hazard classes largely based on the UNRTDG system but with improvements. Additions and changes have been necessary since the scope of the GHS includes all target personnel and not just those who may be exposed during transport.

- *Explosives*, which are assigned to one of six subcategories depending on the type of hazard they present, as used in the UN Dangerous Goods System.
- *Gases* are category 1 flammable if they start to flame in a range in air at 20 °C and a standard pressure of 101.3 kPa. Category 2 is non flammable and non toxic gases, and category 3 is toxic gases. Substances and mixtures of this hazard class are assigned to one of two hazard categories on the basis of the outcome of the test or calculation method.

- *Flammable liquids* are liquids with a flash point of not more than 93 °C. Substances and mixtures of this hazard class are assigned to one of four hazard categories on the basis of the flash point and boiling point. A pyrophoric liquid is a liquid that, even in small quantities, is liable to ignite within five minutes after coming into contact with air. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis of the outcome of a UN Test.
- *Flammable solids* are readily combustible or may cause or contribute to fire through friction. Readily combustible solids are powdered, granular, or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source, such as a burning match, and if the flame spreads rapidly. The category is further divided into flammable solids and polymerizing substances.
- *Self-reactive substances*, are thermally unstable solids liable to undergo a strongly exothermic thermal decomposition even without participation of oxygen (air), other than materials classified as explosive, organic peroxides or as oxidizing.
- *Pyrophoric substance*s (or spontaneously combusting substances) are those solids or liquids that even in small quantities are liable to ignite within five minutes after coming into contact with air.
- *Self-heating substances* (other than pyrophoric substances), are substances which, by reaction with air and without energy supply, are liable to self-heat. Substances and mixtures of this hazard class are assigned to one of two hazard categories on the basis of the outcome of a UN Test.
- *"Dangerous When Wet" substances*, are substances which, on contact with water, emit flammable gases are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of the outcome of a UN Test, which measures gas evolution and speed of evolution.
- *Flammable aerosols* can be classified as Class 1 or Class 2 if they contain any component, which is classified as flammable.
- *Oxidizing substances and organic peroxides* contain category 1: oxidizing substances and category 2: organic peroxides, organic liquids, or solids that contain the bivalent "-O-O-" structure and may be considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. The term also includes organic peroxide formulations (mixtures).
  Substances and mixtures of this hazard class are assigned to one of seven 'Types', A to G, on the basis of the outcome of the UN Test Series A to H.
- *Substances corrosive to metal* are substances or mixtures that by chemical action will materially damage or even destroy metals. These substances or mixtures are classified in a single hazard category on the basis of tests (Steel: ISO 9328 (II): 1991 - Steel type P235; Aluminum: ASTM G31-72 (1990) - non-clad types 7075-T6 or AZ5GU-T66). The GHS criteria are a corrosion rate on steel or aluminum surfaces exceeding 6.25 mm per year at a test temperature of 55 °C.
- *Miscellaneous* dangerous substances which includes environmentally dangerous substances

Health Hazards

- *Radioactive Substances*
- *Infectious Substances*
- *Acute toxicity* includes five GHS categories from which the appropriate elements relevant to transport, consumer, worker and environment protection can be selected. Substances are assigned to one of the five toxicity categories on the basis of LD_{50} (oral, dermal) or LC_{50} (inhalation).

- *Skin corrosion* means the production of irreversible damage to the skin following the application of a test substance for up to 4 hours. Substances and mixtures in this hazard class are assigned to a single harmonized corrosion category.
- *Skin irritation* means the production of reversible damage to the skin following the application of a test substance for up to 4 hours. Substances and mixtures in this hazard class are assigned to a single irritant category. For those authorities, such as pesticide regulators, wanting more than one designation for skin irritation, an additional mild irritant category is provided.
- *Substances that cause serious eye damage*, i.e. the production of tissue damage in the eye, or serious physical decay of vision, following application of a test substance to the front surface of the eye, which is not fully reversible within 21 days of application. Substances and mixtures in this hazard class are assigned to a single harmonized category.
- *Substances that cause eye irritation*, i.e. changes in the eye following the application of a test substance to the front surface of the eye, which are fully reversible within 21 days of application. Substances and mixtures in this hazard class are assigned to a single harmonized hazard category. For authorities, such as pesticide regulators, wanting more than one designation for eye irritation, one of two subcategories can be selected, depending on whether the effects are reversible in 21 or 7 days.
- *Respiratory sensitizer* means a substance that induces hypersensitivity of the airways following inhalation of the substance. Substances and mixtures in this hazard class are assigned to one hazard category.
- *Skin sensitizer* means a substance that will induce an allergic response following skin contact. The definition for "skin sensitizer" is equivalent to "contact sensitizer". Substances and mixtures in this hazard class are assigned to one hazard category.
- *Germ cell mutagenicity* means an agent giving rise to an increased occurrence of mutations in populations of cells and/or organisms. Substances and mixtures in this hazard class are assigned to one of two hazard categories. Category 1 has two subcategories.
- *Carcinogenicity* means a chemical substance or a mixture of chemical substances that induce cancer or increase its incidence. Substances and mixtures in this hazard class are assigned to one of two hazard categories. Category 1 has two subcategories.
- *Reproductive toxicity* includes adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in offspring. Substances and mixtures with reproductive and/or developmental effects are assigned to one of two hazard categories, 'known or presumed' and 'suspected'. Category 1 has two subcategories for reproductive and developmental effects. Materials which cause concern for the health of breastfed children have a separate category: effects on or via Lactation.
- *Specific target organ toxicity (STOT)* category distinguishes between single and repeated exposure for Target Organ Effects. All significant health effects, not otherwise specifically included in the GHS, that can impair function, both reversible and irreversible, immediate and/or delayed are included in the non-lethal target organ/systemic toxicity class (TOST). Narcotic effects and respiratory tract irritation are considered to be target organ systemic effects following a single exposure. Substances and mixtures of the single exposure target organ toxicity hazard class are assigned to one of three hazard categories. Substances and mixtures of the repeated exposure target organ toxicity hazard class are assigned to one of two hazard categories.
- *Aspiration hazard* includes severe acute effects such as chemical pneumonia, varying degrees of pulmonary injury or death following aspiration. Aspiration is the entry of a liquid or solid directly through the oral or nasal cavity, or indirectly from vomiting, into the trachea and lower respiratory system. Substances and mixtures of this hazard class are assigned to one of two hazard categories this hazard class on the basis of viscosity.

Environmental hazards

- *Acute aquatic toxicity* means the intrinsic property of a material of causing injury to an aquatic organism in a short-term exposure. Substances and mixtures of this hazard class are assigned to one of three toxicity categories on the basis of acute toxicity data: LC_{50} (fish) or EC_{50} (crustacean) or ErC_{50} (for algae or other aquatic plants). In some regulatory systems these acute toxicity categories may be subdivided or extended for certain sectors.
- *Chronic aquatic toxicity* means the potential or actual properties of a material to cause adverse effects to aquatic organisms during exposures that are determined in relation to the lifecycle of the organism. Substances and mixtures in this hazard class are assigned to one of four toxicity categories on the basis of acute data and environmental fate data: LC_{50} (fish) or EC_{50} (crustacea) or ErC_{50} (for algae or other aquatic plants) and degradation or bioaccumulation.

The GHS approach to the classification of mixtures is also complex. It uses a tiered approach and is dependent upon the amount of information available for the mixture itself and for its components. Principles that have been developed for the classification of mixtures, drawing on existing systems such as the European Union (EU) system for classification of preparations laid down in Directive 1999/45/EC. The process for the classification of mixtures is based on the following steps:

Where toxicological or ecotoxicological test data are available for the mixture itself, the classification of the mixture will be based on that data. Where test data are not available for the mixture itself, then the appropriate bridging principles should be applied, which uses test data for components and/or similar mixtures;
If (1) test data are not available for the mixture itself, and (2) the bridging principles cannot be applied, then use the calculation or cut-off values described in the specific endpoint to classify the mixture.

3.2.4 POPs - Human and Environmental Health

The Stockholm Convention was established to deal with the direct and severe impacts of POPs chemicals on human health and the environment. Human health impacts include:

- Cancers
- Birth Defects
- Dis-functional Immune System
- Dis-functional Reproductive System
- Greater Susceptibilty to Diseases
- Damages to Central and Peripheral Nervous Systems

Environmental impacts are similarly very damaging and widespread, causing serious harm to aquatic and land-based species and destroying habitats.

These matters are dealt with more specifically in the following sections that address the impacts of individual POPs on human health and the environment. The overall general issues, however, are that POPs are very persistent, can travel long distances through numerous pathways, and can bioaccumulate in individuals and biomagnify in the food chain. These factors pose significant problems for Kiribati, as I-Kiribati can therefore be impacted by POPs generated by others and spread to them by air and by sea. In this way it is a similar problem to Climate Change, where Kiribati is being impacted through no fault of its own.

Data from the Global Monitoring Plan (GMP) has already indicated that the air in Kiribati contains DDT, “Drins” (Aldrin, Dieldrin and Endrin), Lindane and PCBs. DDT and Lindane have also been observed in breast milk samples. More recent data just came to hand has revealed PBDEs,

PCDD/PCDF, PCBs, DDT and beta-HCH in I-Kiribati breast milk. The levels detected are all low, but toxic impacts from POPs can indeed occur at low levels, especially with dioxins and furans (PCDD/PCDF).

Cancers and other disease impacts that may have originated from POPs are prominent in Kiribati but in these matters it is very difficult to link cause and effect because these diseases can have multiple causes. Much more data would be needed on POPs levels in the air, breast milk and other areas, especially in food, over a long period of time. These levels could then be related to incidences of cancers, birth defects and other disease impacts over a similar time period.

Such a programme of investigation should, however, be initiated. There is an important need for such future risk assessments of POPs on human health and environment. The data produced under the POPs GMP will certainly assist in this, and more information will be needed from food analyses and other sources. This data can then be fed into risk assessments, which will be invaluable for the Government decision makers and also useful to substantiate raising public awareness on the dangers of POPs.

3.2 Pesticides

3.2.1 POPs Pesticides

3.2.1.1 Dichlorodiphenyltrichloroethane (DDT)

Uses and Former Uses
DDT has been widely used worldwide for decades, to control disease and especially mosquito-borne disease. It was also sprayed extensively on many agricultural crops. It is still used against mosquitoes in several countries to control malaria.

Threats to Health and the Environment
Its stability, its persistence (15-30 years half-life), and its widespread use have meant that DDT residues can be found everywhere; residual DDT has been detected in the Arctic.

Perhaps the best-known toxic effect of DDT is egg-shell thinning among birds. Although its use is banned in many countries, it has been detected in food from all over the world.

The short-term acute effects on humans are limited, but long-term exposures have been associated with chronic health effects. DDT has been detected in breast milk, raising serious concerns about infant health.

Presence in Kiribati
DDT may have been used in Kiribati for disease vector (and in particular mosquito) control but there is no historical information available to verify whether this is the case. It has shown up in quite significant levels in breast milk studies and to a lesser extent in ambient air studies. The presence in breast milk studies in particular, does indicate that it was probably used for mosquito control in perhaps quite significant amounts.

3.2.1.2 Other POPs Pesticides

Uses, Health and Environmental Effects

The following other pesticides are listed POPs pesticides.

Aldrin - Applied to soils to kill termites, grasshoppers, corn rootworm, and other insect pests, aldrin can also kill birds, fish, and humans.

Dieldrin - Used principally to control termites and textile pests, Dieldrin has also been used to control insect-borne diseases and insects living in agricultural soils. Its half-life in soil is approximately five years. The pesticide Aldrin rapidly converts to Dieldrin, so concentrations of Dieldrin in the environment are higher than Dieldrin use alone would indicate. Dieldrin is highly toxic to fish and other aquatic animals, particularly frogs, whose embryos can develop spinal deformities after exposure to low levels. Dieldrin residues have been found in air, water, soil, fish, birds, and mammals, including humans. Food represents the primary source of exposure to the general population.

Chlordane - Used extensively to control termites and as a broad-spectrum insecticide on a range of agricultural crops. Chlordane may affect the human immune system and is classified as a possible human carcinogen.

Endrin - Sprayed on the leaves of crops such as cotton and grains. Also used to control rodents such as mice and voles. Highly toxic to fish.

Heptachlor - Used to kill insects and termites, crop pests and malaria-carrying mosquitoes. Believed to be responsible for the decline of several wild bird populations. Possible human carcinogen.

Mirex - Used mainly to combat fire ants, other types of ants and termites. Mirex has also been used as a fire retardant in plastics, rubber, and electrical goods. It is a very persistent possible human carcinogen.

Toxaphene - Used on cotton, cereal grains, fruits, nuts, and vegetables. It has also been used to control ticks and mites in livestock. Toxaphene was the most widely used pesticide in the US in 1975. Very persistent, very toxic to fish and possible human carcinogen.

Hexachlorobenzene (HCB) - First introduced in 1945 to treat seeds, HCB kills fungi that affect food crops. It is also a by-product of the manufacture of certain industrial chemicals and exists as an impurity in several pesticide formulations.

Chlordecone – Used mainly as an agricultural pesticide. Currently no use or production is reported, and many countries have banned its sale and use. Highly persistent and transported long distances. Possible human carcinogen and very toxic to aquatic organisms.

Endosulphan – Used for control of crop pests and other insects, wood preservative, and as a broad-spectrum insecticide for coffee, cotton, rice, soy, sorgum etc. Bioaccumulates and can be transported long distances. Adverse effects on a wide range of aquatic and terrestrial organisms.

Pentachlorophenol – herbicide, fungicide, insecticide, algaecide, disinfectant and in antifouling paint, cooling tower water, etc. Often contaminated with dioxins and furans. Detected in blood, urine, breast milk, etc. Significant adverse human health and environmental effects.

α-Hexachlorohexane, β-HCH, ɣ-HCH (HCH Stereoisomers) – α-HCH and β-HCH have both been phased out years ago as pesticides but are still produced as by-products of the production of ɣ-HCH (Lindane). For each tonne of Lindane produced, 6-10 tonnes of the others are produced so there

are large stockpiles. Lindane is a broad-spectrum insecticide for seed and soil treatment and many other uses including veterinary and human applications. All three isomers are highly persistent, bioaccumulate and biomagnify. They are possible carcinogens, adversely affect aquatic organisms and wildlife, and cause immune system disorder, reproductive and developmental effects.

Presence in Kiribati

Kiribati does not intentionally produce or use any of the POPs pesticides listed in Annex A, Part I and there is no evidence of any current trade. An assessment of the original eight Stockholm Convention pesticides carried out as part of the SPREP POPs in PICs project completed in 2003[20] found that none of these eight chemicals were present.

Breast milk and ambient air studies support the view that some POPs were used in the past, apart from DDT. In particular, Lindane and Dieldrin may have been used. Kiribati has no intention of using any of the POPs pesticides in future, although their import and use has never been formally prohibited.

3.2.2 Other Pesticides

Kiribati has imposed a general ban on pesticides, although the methodology for enforcing this ban is unclear, and this may need to be formalised through the legislative process. The ban does, however, appear to be mostly effective, as very few pesticides were found, in South Tarawa, at least, during the survey-preparation work for this NIP.

It is understood that the reason for imposing this ban is to protect the fragile environment in the islands of Kiribati, and especially their reliance on fish as a food source. The ban is commendable, and is supported by the fact that there is very little need for pesticides in Kiribati, as agricultural production is limited, and quite small, except for coconut and copra production, which does not need pesticides.

There is the issue of mosquito and other insect disease vector control, and this is managed at a household level by permitting a small range of insecticides, including mosquito coils, to be sold from supermarket outlets.

Government initiatives to control mosquitos are managed by the Ministry of Health and local councils. Again, however, insecticides are not used, and control is by way of discouraging mosquito breeding grounds, maintaining awareness, and the adoption of biological control.

Biological control research is currently being undertaken by the Environmental Health Unit of the Ministry of Health, under the World Mosquito Programme. This involves use of the parasitic microbe Wolbachia that inhibits mosquito reproduction. This programme is being undertaken by Monash University, Melbourne.

Table 5, below, shows the few insecticides for sale in supermarkets in South Tarawa. The Aerogard Tropical Strength insecticide was available in a hotel room, but was not found on sale. The final pesticide on the list, namely the Termite Bait, was left for disposal at the Nanikai Landfill, but there is no indication where it was purchased.

[20] SPREP POPs in PICs Survey 2003

Table 5 – Pesticides found in Kiribati

Product Name	Type	Hazardous Ingredient	Strength	Ingredient Hazard (NZ HZNO Classification)
Mortein Fast Knock Down	Insect Spray	Esbiothrin	1.26 g/kg	Skin and eye irritant, high acute toxicity, very toxic to aquatic life and bees
		Permethrin	0.5 g/kg	Medium acute toxicity, skin and eye irritant, target organ damage, very toxic to aquatic life.
		Bicycloheptane Dicarboximide	1.8 g/kg	Mildly toxic, mild skin and eye irritant
Aerogard Tropical Strength	Insect Spray	Diethyltoluamide	191 g/kg	Medium acute toxicity, skin and eye irritant, moderately toxic to aquatic life.
		Bicycloheptane Dicarboximide	40 g/kg	Mildly toxic, mild skin and eye irritant
Black Mosquito Repellent Incense	Mosquito Coil	Dimefluthrin	0.03 g/kg	Very high acute toxicity, target organ damage, very toxic to aquatic life
Mortein Odourless Mozzie Zapper	Mosquito Spray	d-Allethrin	40.4 g/kg	Medium acute toxicity, eye irritant, target organ damage, very toxic to aquatic organisms.
Ensystex Requiem Termite Bait	Termite Bait	Chlorfluazuron	1 g/kg	Mild human toxin, skin sensitiser, eye irritant, very toxic to aquatic organisms

Recently it was discovered by MELAD that a local applicator was using the following pesticides for pest control at a client's premises (see Photo 4 below):

- Ditrac – contains Brodifacoum at 0.05 g/kg. This is an extremely acutely toxic substance and also affects the blood and blood-producing system in the long term. It is also an eye irritant, and is extremely toxic in the aquatic environment. It is present in these rodent blocks in extremely low concentrations, however, which certainly limits the hazards.

- Biflex – contains Bifenthrin at 100 g/litre. This is also an extremely acutely toxic substance which affects the nervous system in the long term. It can also be absorbed through the skin. It is also extremely toxic in the aquatic environment and very toxic in the soil environment. This is of significantly more concern than the Ditrac as it is much more concentrated.

Photo 4 – Ditrac and Biflex

If each of the above products was used very carefully in accordance with instructions and safety data sheets (SDSs) and applied by trained people then their use is probably acceptable but it does raise the following questions:

- How effective is the Kiribati ban on pesticides?
- How did these substances get into Kiribati?
- Do the local applicators have SDSs, do they have the right PPE, and have they been properly trained?
- Why was MELAD not informed?
- What other similar pesticides are being used without proper controls?

3.2.3 Concerns about Pesticides

There may be little real concern about pesticides in Kiribati due to the small quantities available, and if restrictions on importation of pesticides are effectively maintained then this should continue. Clearly, however, given the example quoted above, these restrictions are not always effective. The ban needs to be clearly stated in the legislation and enforced effectively by Customs.

There may be good reason to import some pesticides, for specific reasons, including those sold on supermarket shelves, and these reasons should be clearly spelled out.

The use of any pesticides should be subject to the same controls proposed for all hazardous substances, as described in Section 3.2.3, above.

3.3 Polychlorinated Biphenyls (PCBs)

3.3.1 Uses and Former Uses

PCBs are industrial chemicals widely used as coolants and lubricants in electrical equipment (such as transformers and capacitors), hydraulic fluids, and additives in paint, carbonless copy paper, plasticisers and dye carriers. PCBs were used in these applications as they do not burn easily and are good insulators. PCBs were produced in several countries and most production was phased out by the 1990s.

3.3.2 Threats to Health and the Environment

There are 209 different types of PCBs, and 13 exhibit a dioxin-like toxicity. Their persistence in the environment corresponds to the degree of chlorination, and half-lives can be up to 30 years[21].

PCBs are toxic to a wide variety of animal and wildlife species including fish, killing them at higher doses and causing spawning failures at lower doses. Research also links PCBs to reproductive failure and suppression of the immune system in various wild animals, such as seals and mink.

Large numbers of people have been exposed to PCBs through food contamination. Consumption of PCB-contaminated rice oil in Japan in 1968 and in Taiwan in 1979 caused pigmentation of nails and mucous membranes and swelling of the eyelids, along with fatigue, nausea, and vomiting. Due to the persistence of PCBs in their mothers' bodies, children born up to seven years after the Taiwan incident showed developmental delays and behavioural problems. Similarly, children of mothers who ate large amounts of contaminated fish from Lake Michigan showed poorer short-term memory function. PCBs also suppress the human immune system and are listed as probable human carcinogens.

3.3.3 Presence in the Kiribati

The 2002 POPs and PICs Project resulted in the testing of a large number of transformers that were out of service, and no PCBs were detected in these transformers. More recently, an MFAT-sponsored project to replace existing transformers on South Tarawa resulted in a large numbers of operational transformers coming out of service. There were also several transformers that had come out of service since the 2002 POPs and PICs Project. Many of these transformers had been tested for PCBs by an initiative conducted by the PUB, and two of the transformers tested positive for PCBs at levels of 57 mg/kg, and 6.8 mg/kg. The latter figure would normally be regarded as PCB free, as it is below the 50 mg/kg level set by UNEP for Stockholm Report work.

The NIP survey team identified 21 transformers in South Tarawa that had not been tested, and samples were taken of the oil in these transformers (see Photo 5 below). The two transformers that had previously tested positive were also re-sampled. The results from these tests are presented in Annex 4. All the results were analysed as non-detect except for one that tested at 42 mg/kg. This was the one that was previously 57 mg/kg. Hence it is now testing below the 50 mg/kg level.

Earlier testing had been carried out on old transformers from the island of Banaba and Kanton, and these transformers were found to be PCB free. PCBs may well, however, be present in the spilled oil on both islands – see Section 3.17 below.

It has been reported that there are two large old transformers on Kiritimati Island, as well as a reservoir of used oil, some of which may have come from transformers. These two transformers, plus the used oil, should now be tested for PCBs, as well. Some PCB ground contamination may also have resulted from spilled transformer oil.

Several old capacitors in a store by the main radio transmission tower have been identified as probably containing PCBs (see Photo 6 below). There may also be other PCB capacitors in storage elsewhere, associated with radio transmission.

Results have recently been received for breast milk analyses and PCBs have been detected at low levels in Kiribati breast milk.

[21] Environ Int. 2015 Jan; 74:82-8. doi: 10.1016/j.envint.2014.09.014. Epub 2014 Oct 21.

Photo 5 – Sampling Transformer Oil for PCBs

Photo 6 – Possible PCB Containing Capacitor

3.4 Decabromodiphenyl Ether (c-decaBDE)

3.4.1 Uses and Former Uses

Decabromodiphenyl Ether belongs to a group of Polybromodiphenyl ethers (PBDEs). The tetra, penta, hexa and hepta BDEs are also POPs. These are known as POP-PBDEs and are industrial

chemicals whose multiple uses include flame retardants. They have been used since the 1970s. A few examples of the many uses include:

- Housings of business machines, computers, TVs and electronic equipment
- Plastics and foams in cars, buses and other vehicles
- Furniture and mattress additives
- Textiles and carpets additives
- Wire and cable coatings
- Additives in sealants, coatings and inks

PBDEs include Hexabromodiphenyl ether (hexaBDE), heptabromodiphenyl ether (heptaBDE), tetrabromodiphenyl ether (tetraBDE), and pentabromodiphenyl ether (pentaBDE). PBDEs were produced with three different degrees of bromination and marketed as:

- commercial pentaBDE (c-PentaBDE), in which tetraBDE and pentaBDE were the most abundant congeners;
- commercial octaBDE (c-OctaBDE) in which hexaBDE and heptaBDE were the most abundant congeners; and
- commercial decaBDE (c-DecaBDE).

It is believed that the production of c-PentaBDE and c-OctaBDE ended in 2004, whilst production of c-DecaBDE continues (UNEP 2017, p15).

3.4.2 Threats to Health and the Environment

DecaBDE is highly persistent and has a high potential for bioaccumulation and food-web biomagnification, as well as for long range transport. Multiple adverse effects are reported for many species including soil organisms, birds, fish, frogs, rats and mice. Acute toxicity for humans is low although there is evidence of chronic toxic effects in humans on the liver and thyroid. The Deca BDE is much less toxic than the Penta BDE and Octa BDE, which is reassuring if manufacture of Penta and Octa has stopped, but Deca continues to be manufactured.

3.4.3 Presence in Kiribati

No direct information is available on the presence or use of PBDEs in Kiribati. However, it is highly likely that PBDEs have entered the country in many imported manufactured articles. These PBDEs may be present in plastic components of common household and office goods, such as computers and electrical appliances, and in furniture fabrics and textiles, and in foamed plastics and rubbers such as that used in furniture, mattresses, carpet underlays, car seats, and in foamed building insulation. A large proportion of these items have ended up in various disposal locations which are therefore likely reservoirs of PBDEs.
Results have recently been received for breast milk analyses and PBDEs have been detected at low levels in Kiribati breast milk.

No measurements have yet been made of PBDEs in Kiribati food, but the chemicals have been found in other countries at trace levels in a wide range of food items, including meat, fish, cereals and dairy products. It is not surprising that PBDEs would also be found in the bodies of local Kiribati people because of the significant use of imported products, such as electronics goods, home appliances and home furnishings, for which tests in other countries have shown the presence of PBDEs. However, it is also likely that the concentrations in local Kiribati people would be lower than in other countries, because of the consumption of local seafood.

3.5 Hexabromobiphenyl (HBB)

3.5.1 Uses and Former Uses

HBB was used as a flame retardant in three main commercial products: ABS thermoplastics (used in business machine housings, and the industrial and electrical sectors), PUR foam for automotive upholstery, and coatings and lacquers. The available data indicate that the USA was the sole producer of HBB, producing approximately 5,400 tonnes of the chemical between 1970 and 1976.

3.5.2 Threats to Health and the Environment

Hexabromobiphenyl is highly bioaccumulative and exhibits long range transport properties, is a possible human carcinogen and has other health impacts.

3.5.3 Presence in Kiribati

It is believed that most HBB-containing materials were disposed of decades ago and HBB is therefore of little relevance to Kiribati. Due to the similarity in use between HBB and POP-PBDE, any minor amount of HBB that may be present will be addressed through national POP-PBDE management measures[22].

3.6 Pentachlorobenzene (PeCB)

3.6.1 Uses and Former Uses

PeCB was used as an intermediate in the manufacture of pesticides. It was also a component of a mixture of chlorobenzenes added to products containing PCBs to reduce viscosity. PeCB has also been used as a fire retardant.

3.6.2 Threats to Health and the Environment

PeCB is highly bioaccumulative, and exhibits long range transport properties, is toxic to humans with numerous impacts, and very toxic to aquatic organisms.

3.6.3 Presence in Kiribati

Manufacture of PeCB ceased decades ago and the pesticides it was involved with as an intermediate were not used in Kiribati. It was also added to PCBs and PCBs were not used to any extent in Kiribati. PeCB is therefore of little relevance to Kiribati.

3.7 Hexachlorobutadiene (HCBD)

3.7.1 Uses and Former Uses

HCBD was produced intentionally from a by-product generated during the manufacture of chlorinated solvents, and unintentionally during the production of certain organochlorines. It was used for several technical and agricultural applications including as heat transfer fluid in transformers, and as a fumigant, pesticide, seed dressing, fungicide, and biocide (UNEP 2017).

3.7.2 Threats to Health and the Environment

HCBD is highly bioaccumulative and is known to be very toxic to aquatic organisms and birds. It has significant adverse human health effects and has been observed to produce systemic toxicity following exposure via oral, inhalation, and dermal routes. Effects may include fatty liver degeneration, central nervous system depression and cyanosis. It is also a possible carcinogen.

[22] Stockholm Convention Secretariat (2017). *Guidance for the inventory of polybrominated diphenyl ethers (PBDEs) listed under the Stockholm Convention on Persistent Organic Pollutants*

3.7.3 Presence in Kiribati

Kiribati does not manufacture chlorinated solvents, thus the potential presence of HCBD in Kiribati would be due to imported products containing the chemical, including in transformer, heat exchange and hydraulic fluids. The tests to detect PCBs in transformers would also detect HCBD, and therefore measures to address PCBs in Kiribati will also be partly effective for HCBD. HCBD may also be present in obsolete insecticide stockpiles and fungicide waste and would be addressed through measures to manage POPs pesticides (which are not required for Kiribati as the country no longer has stockpiles of obsolete pesticides).

3.8 Hexabromocyclododecane (HBCD)

3.8.1 Uses and Former Uses

HBCD has been on the world market since the late 1960s and has been produced mainly in China, the European Union, and USA. It is used as a flame-retardant additive to reduce ignition of flammable polymers and textiles in buildings, vehicles and electrical equipment. The main application (90%) of HBCD is in expanded polystyrene (EPS) and extruded polystyrene (XPS) foams, which are used widely as insulation boards in building and construction. A smaller proportion of EPS and XPS is used in textile applications, including residential and commercial furniture and vehicle upholsteries, draperies and wall coverings. HBCD may also be added to high impact polystyrene (HIPS), used in electrical equipment such as audio-visual equipment cabinets and refrigerator linings, latex binders, adhesives, and paints.[23]

HBCD is currently used in four principal product types: expandable polystyrene (EPS), extruded polystyrene (XPS), high impact polystyrene (HIPS) and in polymer dispersions for coating textiles. By far the dominant use is in expandable polystyrene, which is often referred to as Styrofoam. This is used for insulation in buildings and refrigerated trucks and containers, as a fill and shape material in concrete construction, in packaging, and as the filling material for bean bags.

3.8.2 Threats to Health and the Environment

HBCD is found world-wide in the environment and wildlife. It is also found in human breast milk, adipose tissue, and blood. It bioaccumulates in living organisms and biomagnifies in the food chain. It is persistent in the environment and is transported long distances. HBCD is highly toxic to aquatic organisms. It also presents human health concerns based on animal test results indicating potential reproductive, developmental and neurological effects.

3.8.3 Presence in Kiribati

The quantities imported into Kiribati are unknown, but it may be present in imported articles, especially articles containing polystyrene. At the end of their service life, products containing HBCD are likely to be disposed of in landfills, so in the absence of information, improved national waste management practices will practically manage this issue in Kiribati.

3.9 Polychlorinated naphthalenes (PCNs)

3.9.1 Uses and Former Uses

PCNs, which are structurally like PCBs, consist of 75 possible compounds in eight homologue groups, seven of which are listed in the Stockholm Convention. Due to structural similarities to PCBs, PCNs were often intentionally produced for use in similar industrial and consumer applications as PCBs, including in transformer fluids, cable insulation, fluids in capacitors and condensers, wood

[23] *Stockholm Convention Secretariat (2017) . Guidance for the inventory of hexabromocyclododecane (HBCD), Draft*

preservation, and as an additive in paints and dye carriers (UNEP 2017). They also made effective insulating coatings for electrical wires and were also used in rubber and plastic additives, electronic components and lubricants. PCN is not in use now and production stopped in the 1980s.

PCNs were mainly used between 1920 and 1960 but have been used in certain applications until early 2000. In most applications, PCNs have not been produced or used for over 30 years and it can be assumed that most PCN-containing products with short lifetimes (e.g. textiles, papers, lubricants, cutting oils and grease) have already been disposed of. Some PCN-containing products (e.g. PCN-treated wood, paint) produced decades ago may still be in use today, for example in building construction, and painted ships and bridges (UNEP 2017, p18).

PCNs are also unintentionally formed and released together with dioxins and furans in thermal processes. Unintentionally produced PCNs are not separately addressed in this NIP as these PCN emissions will be reduced by the same measures applied to reduce dioxins and furans. PCNs have been around a long time and they started to be produced for high-volume uses around 1910 in both Europe and the United States, as "Nibren waxes" "Seekay", "Clonacire", "Cerifal", "Halowax" and others. Although trace amounts of PCNs may be released by natural processes such as wildfires, their industrial uses increased the apparent rates of accumulation in the environment by factors of 10,000 or more.

3.9.2 Threats to Health and the Environment

While some PCNs can be broken down slowly by sunlight and mocroorganisms, many PCNs persist in the environment. They are bioaccumulative, and health impacts include liver disease, reproductive toxicity, endocrine disruption, fatigue and nausea.

After about twenty years of commercial production, health hazards such as chloracne, severe skin rashes and liver disease began to be reported in workers exposed to PCNs. PCNs containing three or more chlorines per molecule have typically been found more hazardous than those with fewer, but as the maximum of eight is approached, hazards appear to decrease.

Surprisingly there was a lag of about forty years between disclosure of PCN hazards and government regulation. In the U.S. exposure to PCNs was drastically reduced after 1976, following enactment of the Toxic Substances Control Act. Major equipment manufacturers banned PCNs in their products, and major PCN producers discontinued operations. By 1983 worldwide PCN production had almost halted except for small amounts used in testing and research.

Increased cancer risks have been suspected but so far not shown. Current concerns about PCNs include their release as by-products of waste incineration.

While some PCNs can be broken down by sunlight and, at slow rates, by certain microorganisms, many PCNs persist in the environment. After more than 80 years of use and total production of several hundred thousand tons, PCN residues are widespread.

Based on the acute toxicity data it can be concluded that PCNs are toxic to cattle. From results from subchronic studies on guinea pigs and rats it can be concluded that especially penta- and hexa-CNs are very liver-damaging chemicals. PCNs are also toxic to aquatic organisms. The pattern of toxicity of PCNs resembles that of dioxins. Recent work has been done to determine the relative potency of PCNs (mixtures as well as individual congeners) in fish, birds and mammals. The potency of several PCN congeners is in the same range as some PCB congeners.

3.9.3 Presence in Kiribati

Because of their widespread use for a very long time and their persistence, PCNs will probably be present in Kiribati, although probably at very low levels, given that worldwide production stopped several decades ago. Their earlier widespread use will mean they are probably present in

breakdown products from old waste dumping areas. Probably the most likely source in Kiribati is from their earlier widespread use as insulating coatings for electrical wires. This would only apply to old electrical wires before the 1980s, but such old wires probably still exist in old houses and buildings. There is a practice in many countries, and possibly in Kiribati, of burning electrical wiring to recover the copper and this practice should be vigorously discouraged.

3.10 Short Chain Chlorinated Paraffins (SCCPs)

3.10.1 Uses and Former Uses

Chlorinated Paraffins of various chain lengths, including SCCPs, have been used since the 1930s as a plasticizer in rubber, sealants, coatings, textiles, leather fat, paints, adhesives, flame retardants for plastics, and high-pressure lubricants. Production has decreased globally but they are still produced. Technically feasible alternatives are now commercially available for all uses.

3.10.2 Threats to Health and the Environment

SCCPs are persistent in the air for long range transport. Many SCCPs can accumulate in biota. They lead to significant adverse environmental and human health effects. They are persistent and bioacccumulative, very toxic to aquatic organisms, they target the liver, kidney and thyroid, and are possible human carcinogens. SCCPs (average chain length of twelve carbons, and average chlorine by weight of 60%) are POPs and there is also a focus on their longer chain chlorinated paraffins, known as Medium Chain Paraffins or MCCPs. MCCPs are also toxic to the aquatic environment and persistent. MCCPs in soil, biota, and most of the sediment cores show increasing persistence.

3.10.3 Presence in Kiribati

Again because of their widespread use for a very long time and their persistence, SCCPs will probably be present in Kiribati, although probably at very low levels, given that worldwide production has slowed down, although it should be noted that they are still being produced and may still potentially be appearing in products that are being imported.

Their earlier widespread use will mean they are probably also present in breakdown products from old waste dumping areas.

3.11 Perfluorooctane sulfonic acid (PFOS), Salts & Perfluorooctane Sulfonyl Fluoride (PFOS-F)

3.11.1 Uses and Former Uses

Perfluoro-octane sulphonic acid (PFOS) and associated products are part of a wider group of chemicals known as Perfluoroalkyl sulfonic acid (PFAS) and a range of associated products. Current uses include electric and electronic parts, fire-fighting foam, photo imaging, medical equipment (mainly X-Ray photography), hydraulic fluids, toners, printing inks, coatings and coating additives, and in textiles and upholstery for their water and oil repellent properties. They are also the unintended degradation product of certain chemicals. They are still produced in several countries and the current global production of PFOS is estimated at 200 tonnes/year[24].

The use as fire-fighting foam has been a significant issue and fire training grounds throughout the world have become a focus of environmental clean-ups.

[24] UNEP (2017). *Guidance for the inventory of perfluorooctane sulfonic acid (PFOS) and related chemicals listed under the Stockholm Convention on Persistent Organic Pollutants.* 125 pp

3.11.2 Threats to Health and the Environment

PFOS is extremely persistent and has substantial bioaccumulation and biomagnification properties, although it tends to end up in blood and liver proteins and not fat like most other POPs. It therefore accumulates mainly in organs such as liver, kidney, brain and spleen. In animal studies, PFOS has been demonstrated to cause cancer, neonatal mortality, physical development delays and endocrine disruption.

3.11.3 Presence in Kiribati

A large amount of fire-fighting foam was stored, and loaded onto fire trucks at the Bonriki International Airport. There are 15.5 IBCs containing approximately 15,500 litres in total of a concentrate that is diluted down to 6% (see Photo 7 below). There is also a total of 2150 litres of the dilute 6% foam loaded onto three fire-fighting trucks.

This foam is supplied by the Swedish company Fomtec, and is labelled “Fomtec AFFF ICAO”. Dafo Fomtec of Sweden has been contacted and advice has been received that the product does not contain PFOS POPs. It may, however, still contain some fluorinated compounds that are harmful to the environment, and care should be used in its use.

The fire-fighting foam at Bonriki International Airport should be stored in a bunded area as the building that houses the foam sits on the Bonriki water reserve area. The whole building should be bunded with a “speed bump” type raised bund that the fire service vehicles can easily drive over, as leakage could also occur from the fire vehicles.

Photo 7 – Fomtec Fire-Fighting Foam

Fire-fighting foam is also used by KOIL, who also supply it to Kiribati Police / Fire. This foam is supplied by the US company Chemguard, and the foam being used at the moment is Chemguard AFFF C-102. The US company has been contacted several times regarding PFOS POPs but no reply has been received. Until confirmation to the contrary is available, it must therefore be assumed that this foam may indeed contain PFOS POPs.

The MTC also hold some foam for fire-fighting. This foam is Angus Tridol-S, and is supplied from New Zealand. Chubb New Zealand has advised that this foam does not contain PFOS POPs. Again, however, it may still contain some fluorinated compounds that are harmful to the environment, and care should be used in its use.

The quantities of foam held by KOIL, Police / Fire and MTC are very small, in comparison with the quantity at Bonriki Airport.

3.12 Laboratory Chemicals

During the survey for this NIP, visits were made to the Nawerewere Hospital chemical store and to four high schools – Sacred Heart College, St Louis Catholic High School, Moroni High School and the King George V High School.

The survey team were also due to visit the USP campus, but this could not be arranged. This may not matter as the USP campus was built in 2016, and being a new campus, they are unlikely to have had a stockpile of old chemicals. Other stockpiles may also have been missed. For example the KHFA has reported that they have a stockpile of old chemicals and there may also be stockpiles on the outer islands, especially Kiritimati Island. A very old stockpile has also been noted on Kanton Island – see Section 3.17.2 below.

The hospital laboratory had some serious concerns with oxidisers, including Perchloric Acid, occupying shelves in close proximity to incompatible flammable liquids. If these were mixed, a fire could result. The Perchloric Acid was at 70% strength, and was, therefore, an unstable chemical, that, in some circumstances, could be explosive. The chemical store was in a crowded area, with fire exits partially blocked. Some of the hospital chemicals are shown in Photo 8 below. There were also two LPG gas cylinders in an adjacent room, which may explode in a fire. This situation represents a considerable fire risk, which was explained to hospital staff who are currently taking remedial action.

Photo 8 – Some Hospital Chemicals

All the school laboratories visited also had significant problems with old chemicals being stored. These problems included:

- Incompatible substances consistently stored together, and, in particular, oxidisers and flammables. In most of these locations, there is a practice of storing chemicals in

alphabetical order. This is logical from the point of view of helping to find the chemicals, although, unfortunately, it frequently results in incompatible chemicals being stored together, with potentially disastrous consequences.

- Numerous chemical containers that had lost their labels, meaning the contents were unknown.
- Numerous containers of highly concentrated acids, including sulphuric acid, nitric acid and hydrochloric acid. In some cases, the concentrated nitric acid containers had lost their lids due to fume attack.
- Containers with food labels containing unknown chemicals.
- Many hazardous and toxic chemicals without safety warnings – e.g. Sodium Azide is fatal if swallowed and even fatal in contact with skin.
- A 500ml container of Bromine that will require special disposal. It currently represents a significant risk. Bromine vapour causes severe skin and eye burns and it is likely fatal if inhaled.
- Flammable liquids stored near open windows, exposed to sunlight and weather
- Numerous substances, such as Chloroform, that will require special disposal and export from Kiribati
- Some chemicals, such as Ammonium Nitrate, Sodium Azide (if in contact with some metals) and Perchloric Acid are potentially explosive in certain circumstances. In this category, an old small container of an unknown Ether was discovered, the only readable part of the label being 'ether'. This container was taken to the Nanikai Landfill and crushed with a large front-end loader bucket, to ensure the immediate hazard was removed.
- There are no safety data sheets.

In the central chemical storage room at King George V High School, there are also three 200 litre drums in a badly corroded state in a corner below the window (see Photo 9). These drums were left by the clean-up team that carried out the removals as part of the "POPs in PICs" Project that was carried out from 2002 through to 2005. They have probably been sitting there for approximately 14 years. They came from Kanton Island, and were the chemicals that the clean-up team were not contracted to remove. The chemicals in these drums have no inventory attached to them, and the containers in them may be badly corroded. They potentially represent a time bomb, and they need to be urgently opened and dealt with by properly trained chemical specialists. Section 3.17 below covers some of the chemicals these drums may contain.

Photo 9 – Corroded Drums Stored at King George V School

At the back of King George V High School there is a large storage room containing a very large number of chemicals (see Photo 10), including many unknowns, in containers with missing labels. Many of the chemicals with labels are dangerous, and include 30 x 2.5L containers of sulphuric acid, and 20 x 2.5L of concentrated nitric acid. There are also numerous examples of incompatible substances being stored together. Many of these chemicals were supplied as part of a project to equip schools in the outer islands, but were never sent to the outer islands due to a lack of science teachers and laboratories. Photo 11 shows some of the chemicals stored in the central chemical storage room.

Clearly, from the above description, there are many serious and pressing problems in laboratories in South Tarawa, and there needs to be a very urgent focus on solving these problems. It will be important for secondary school science teachers to take some ownership of this problem and this could be done by setting up a Secondary School Science Teacher Task Force to focus on school chemistry laboratories and the practical solutions needed to address the problems these laboratories can cause, such as old stockpiles, chemical safety and dealing with incompatible substances.

Photo 10 – Large King George V Old Chemical Store

Photo 11 – Some Chemicals at King George V Central Store

3.13 Used Oil

During a visit earlier the previous year (February 2018) to KOIL, by a member of the survey team, it was calculated that KOIL imports approximately 135,000 litres of oil-based products. Based on a range of Pacific Island studies, carried out for SPREP, it is understood that approximately 50% of this imported oil will result in the production of used oil.

In addition to KOIL, several small companies also import some oil, and construction companies such as Dai Nippon, who are now rebuilding the Betio Causeway, also import some oil, as well as purchase it from KOIL. As an estimate, this may bring the quantity of imported oil up to approximately 150,000 litres a year, and may result in approximately 75,000 litres of used oil being produced.

KOIL made three shipments of used oil to India between 2014 and 2016, using flexi-tank bladders in containers. This was to the Jhoola Refinery in Kolkata. The most recent shipment was in July 2016, and involved 40,000 kg in two flexi-tanks. The other two shipments were also two flexi-tanks each. Jhoola no longer accepts used oil from Kiribati, because of high water quantity. Part of the used oil in the shipments was sludge from fuel tanks, and this sludge can typically contain large amounts of water.

KOIL no longer accepts used oil from local generators as they don't have the space. They are, however, aware that this is causing problems, and are actively working with MELAD to arrange an export shipment, probably to New Zealand. They will probably use flexi-tanks again, as that has worked well for them previously. KOIL has a small stockpile that has accumulated since the last shipment went to India, and they are encouraging local used-oil generators to store their used oil, in the meantime. This policy is not working well, as evidenced by the unsatisfactory stockpile that is accumulating at the PVU (see Section 3.17.4, below).

PUB are managing their used oil independently of KOIL. PUB has one power generator at their Betio plant, and three generators at their larger Bikenibeu plant. These generators have weekly and monthly servicing, and generate approximately 7000 litres/unit/year of used oil. For the four units, that is 28,000 per year of used oil. Some of this used oil is, in fact, diesel, as they use diesel to clean the oil from the generators. In addition, every two years they completely empty the oil from the units, which is approximately 1800 litres per unit. This means that the total amount of used oil generated by PUB is approximately 32,000 litres per year.

PUB store their used oil in sound 200 litre drums in a tidy storage area at the Betio plant (see Photo 12). They also have a full tank-tainer of 23,000 litres of used oil ready to ship, waiting for the Waigani paperwork to be cleared (see Photo 13).

Photo 12 – PUB Betio Used Oil Drum Storage

Photo 13 – Tank-tainer Waiting for Shipment

PUB has recently developed an arrangement with Pacific Bulk Fuel, of New Zealand, to receive supplies of diesel in tank-tainers. Pacific Bulk Fuel take, as a backload, used oil in the same containers. This used oil is to be delivered to the Salters Cartage Ltd, in New Zealand.
If the shipment to New Zealand is successful, then this could be used as a model for shipments of used oil from KOIL to New Zealand in the future. Salters Cartage Ltd is keen to collect as much used oil as possible from the Pacific for reprocessing at their facility. Salters Cartage Ltd is prepared to act as the importer into New Zealand. Problems are occurring, however, with the New Zealand EPA delaying permits for importing used oil, under the Waigani and Basel Convention, but it is believed that this can be resolved.

The other possibility that is frequently considered is the shipment of used oil to Bluescope Steel in Fiji. Bluescope Steel will not, however, participate in any used oil importing processes, although they will accept used oil if it is delivered to their site. This means that an importer has to be found in Fiji, and that presents significant difficulties.

It is prohibitively expensive to import used oil into Australia, as the Australian Government charges a very large fee to process Waigani and Basel Consent applications.

It is important that the Kiribati Government resolves the issue of used oil, and facilitates the process of exporting it to another country, and New Zealand may be the best option. The alternative is for used oil to be stockpiled, but this is unsatisfactory because stockpiles are not managed effectively, and used oil spills are common, contaminating precious groundwater resources.

3.14 The Future of Waste Management

3.14.1 Incineration

By far the most significant matter, from the point of view of dioxin emissions, is the incineration of clinical waste. This is currently being managed in an unsatisfactory fashion due to the failure of the recently installed incinerator (see Photos 14 and 15). Clinical waste is currently being burnt in old steel drums, which corrode quite quickly (see Photo 16). Combustion occurs with insufficient air and poor mixing, and significant odours and pollution are produced. If a simple one-chamber incinerator was manufactured, similar to the existing quarantine incinerator (see Photo 17), that would represent a good short-term improvement. The quarantine incinerator design could be improved by adding a grill for combustion, with an air space underneath so that air could be drawn through.

Photo 14 – Recently Installed Incinerator

Photo 15 – Corroded Control Panel

Photo 16 – Corroded Drums Currently Used for Clinical Waste Incineration

Photo 17 – Quarantine Waste Incinerator

Such a unit could be manufactured in Kiribati if steel fabrication capabilities were available. If not, it could be manufactured outside Kiribati and imported. It would be a straightforward matter to design such an incinerator and it could be manufactured and imported quite quickly, probably at a total cost of about $US10,000, plus freight costs.

Such a unit could be positioned in a remote location that was securely fenced, and it would need to be operated with the operator using suitable PPE, which would include a half-face respirator with combined particulate/organic filters, face shield, fire-retardant overalls, rubber gloves and safety boots. This PPE should in fact be used now for the combustion in drums, but it is not being used.

The use of such an incinerator would, however, be only a short-term solution, as the combustion temperatures would still be low, and there would be no secondary combustion chamber for burning the off-gases. Immediate plans should, therefore, also be made to investigate more suitable methods for the disposal of the clinical waste, and also the large amount of pharmaceutical waste that has accumulated at the hospital.

The clinical waste could be dealt with by the purchase, installation and commissioning of a suitable new clinical waste incinerator. There have already been several failed attempts to establish such an incinerator. A suitable incinerator could be purchased and installed, but it would need to be properly designed for the rigorous conditions in Kiribati, and in particular the corrosive maritime atmosphere. The present location, which is close to the sea, and also close to residences, is unsuitable.

Another problem with such incinerators is the need to operate the secondary-combustion chamber above 750degC to ensure the destruction of dioxins and furans. This high temperature is hard to achieve with small incinerators.

A suitable incinerator will also need good operational support from the manufacturer, including adequate training and spare parts.

All the above is achievable provided sufficient funds are available, but given the history of clinical incineration in Kiribati, and the difficulties involved, it may also be appropriate to consider the autoclaving of clinical waste. This has its own set of problems, including reasonably complex equipment, the need to provide testing to ensure the destruction of pathogens and the use of a reasonably high-technology unit to ensure the autoclave waste is shredded satisfactorily. The primary advantage of autoclaving is that it does not produce any emissions that may, potentially, contain harmful toxins, including dioxins.

The process for selecting, installing and commissioning a suitable method for the destruction of clinical waste may take some time, and a suitable source of funds also needs to be found. For this reason, the fabrication of a single-chamber unit, as described above, would be a good short-term measure.

It is still necessary to address the problem of pharmaceutical waste. Autoclaving would not be suitable for the disposal of pharmaceutical waste, although some of these wastes could be disposed of in a purpose-built clinical waste incinerator. More toxic clinical wastes, such as cytotoxic drugs, would, however, need to be held for export and disposal overseas.

Clinical waste on Kiritimati Island also needs to be dealt with effectively. It would probably be sufficient, at present, to manufacture a single-chamber unit, similar to the short-term incinerator proposed above, for South Tarawa. This should be remotely located in a secure area.

A longer-term solution could be considered as part of the process for finding a long-term solution for South Tarawa. It may be possible to resurrect the incinerator supplied by SPREP, provided the necessary missing components could be replaced.

Clinical waste on the other outer islands, generated by local medical clinics, could, perhaps, be brought to South Tarawa, periodically, in suitable sturdy locked containers, once a suitable method is found for the disposal of clinical waste on South Tarawa. Until then, this waste could simply be destroyed by current methods including remote open burning, as it is unlikely to be large in volume. Suitable PPE should, however, be worn, as described above.

3.14.2 Domestic Waste

Current arrangements for the disposal of domestic wastes in South Tarawa are generally satisfactory, and these arrangements have been carefully designed to adapt to the problems of waste disposal on an atoll environment. It is important that an effective method for the on-going compaction of the waste is obtained, and this matter is currently being addressed.

The matter of uncontrolled burning needs to be addressed, and the outbreak of spontaneous fires needs to be prevented, as such fires contribute significantly to the production of dioxins and other toxic emissions.

It would also be appropriate to separate out materials that may contain PBDEs and other fire-retardant materials. Such items could be disposed of in such a way that ensures there is good cover and prevents, as much as possible, the production of leachate.

The landfills should also be supervised, at all times, so that unsatisfactory materials are dealt with properly, and good management practices always apply.

The current method of domestic waste disposal on Kiritimati Island is unsatisfactory, with three dumping areas used and uncontrolled burning employed as the main disposal method. The locations where these dumping areas are situated are all quite remote, which reduces the impacts on the population, but it would be a good idea to plan toward the establishment of one properly managed facility that is operated in a similar fashion to the landfills in South Tarawa.

Domestic waste disposal in the outer islands is also generally managed by using a remote dumping area and uncontrolled burning. The open burning should be discouraged and consideration could be given on each island to the establishment of simplified versions of the South Tarawa landfills. How this could be done needs to be explored further.

3.14.3 Hazardous Wastes

Significant amounts of hazardous waste are generated on South Tarawa. These include laboratory chemicals, industrial waste, some discarded pharmaceutical drugs, agricultural chemicals and possibly some POPs, such as fire-fighting foam and PCB-contaminated oils. These items need to be accumulated in a safe storage area until they can be removed to a suitable overseas destination for destruction.

The storage area needs to have a concrete slab with bunded sides, a ramp over the bund for access, a secure fence and a roof. Matters such as effective waste aggregation and proper containment of individual wastes need also to be addressed.

The location of this facility should be remote from any residential housing, and needs to be properly supervised to avoid any interference.

Kiritimati Island currently has a remote, but uncontrolled, dumping area for hazardous wastes. Again, this could be managed in a more formalised way, with a simplified version of the arrangements proposed, above, for South Tarawa.

3.15 Recycling

3.15.1 Recycling of Domestic Refuse

Kiribati operates the "Kaoki Maange" project, launched in February 2005, including a container deposit/advance disposal scheme for aluminium cans, PET bottles, and lead-acid batteries. Early reports indicate 89% recovery of these commodities, which have now largely been excluded from the general waste stream. Given the success of this project, the authorities are considering extending it to include vehicles.

Kiribati has 'Container Deposit Legislation' (CDL) which is covered by the Special Fund (Waste Materials Recovery) Act 2005. This has established the Container Deposit Scheme (CDS). This requires that all aluminium drink cans, PET drink bottles, and PET cooking oil bottles pay a 5¢ deposit at import into the country. A 4¢ refund is paid out when these items are returned to the Kaoki Maange system for recycling. Cans and bottles are counted in a minimum of fives, so the lowest payout is 20¢.

Current private recycling efforts located in Betio show good recovery, in general, from the CDS, with one shipping container of aluminium cans and other nonferrous materials exported to Australia every four weeks. Another container of PET bottles and lead-acid batteries is exported to Hong Kong (China) every seven weeks. This private recycler, under contract with the Ministry of Environment, Lands and Agricultural Development (MELAD), also manages the CDS collection and container refund centres in Kiribati. Community recycling drop-off facilities are located at Bonriki, Bikenibeu, Teaoraereke, and Bairiki (main island only). Residents bring eligible containers to the centres to receive a redemption, based on volume. The receptacles are standard-size steel cages capable of housing 500 containers.

Recyclables collected at the community drop-off facilities are transferred for further processing to the Kaoki Mange Waste Recycling Facility that is located adjacent to the Materials Recovery Facility on the main road to Betio Port. A 10 m by 8 m hanger facility provides cover for the bailer and the processing of recyclables, later to be containerised prior to transfer to the port. Collection and community centre recycling services are restricted to the main island only.

Residents from the outer islands enter the main island through Betio Port. This way, they are able to deposit their bulk bags of CDS recyclables at the recycle centres. Residents on Kiritimati Island may participate in the CDS through their local council (KUC), which collects and pays them the deposit on the containers. The materials are then transferred to Betio or sent direct to market and the local council receives the income from the contractor of the Kaoki Mange facility.

The Materials Recovery Facility also receives and stockpiles whitegoods, e-waste, scrap metal, and end-of-life vehicles for export. These are then collected (uncompacted) by international recyclers on a barge for direct transfer to market. Vehicle tyres currently are stockpiled, cardboard and paper is reused, and lithium batteries landfilled.

3.15.2 Batteries

The CDS system also covers Used Lead-Acid Batteries. Lead-acid batteries of all types pay $5 on import into Kiribati. Anyone returning a battery for refund gets a $5 payment from the Kaoki Maange. These batteries are usually all from cars, trucks, motorcycles, boats or solar systems, although some are small sealed batteries from UPS power supplies. All vehicles imported pay the battery deposit as they contain batteries. Batteries are exported for recycling into new batteries.

3.15.3 E-Waste

E-Waste can be classed as just about any piece of old, out-of-use equipment that uses electricity in some part of it, for example electronics, power tools, telephones, fridges, air conditioners, electric motors etc. For the purpose of identifying uPOPs sources for the NIP, waste electronics is of particular interest, as some chemicals used in the manufacture of the equipment can become potential uPOPS. These chemicals may be used on the circuit boards, or also may be used as flame retardants in the casings to damp down any fire. Most of these chemicals are Brominated Flame Retardants (BFRs). These may be released as uPOPs if the equipment degrades in the open, or is dumped into a body of water, or burnt.

Once collected, e-Waste can then be broken down into different sub-assemblies, so that it can be exported for commercial processing; for example, printed circuit boards, power supplies, screens, cables, hard drives. The bulky part is usually the cases, and these will either be scrap metal, or plastic cases that need to be landfilled. With the miniaturisation of electronics, e.g. smart phones, iPads, & laptops the density of the items is increasing, and this means less local breakdown required and easier to export.

Tarawa has an e-Waste collection point at the Kaoki Maange Materials Recovery Facility (MRF) at the Betio Port. This Collection Point is operated by ECD, and was set up in 2012 with support from NZAID, and then later supported by the SPREP EU-funded PacWaste project.

Currently, however, there is no funding for an e-Waste Officer at ECD, and collections are on hold. The e-Waste Collection Point in the MRF has been collecting and dismantling e-waste intermittently since 2012. The e-Waste collected has been broken down and sorted into commercial categories of parts so it can be exported. About a full container load of e-Waste is currently sitting at the MRF waiting to be exported. This will require funding and a Basel Permit, along with a Buyer, probably from Singapore.

PBDE containing plastics continue to be used in some cases in housings of computers and TVs, wires and cables, and pipes, but are generally only present in older equipment. Open burning of e-Waste to capture copper and other non-ferrous metals can release dioxins and furans. Collection of e-Waste prevents open dumping and burning, both of which can be sources of POPs releases into the environment. Some good data has been collected from projects, especially for the materials collected by the MRF e-waste Collection Point – for example see Table 6 below:

Table 6: Dismantled e-Waste in MRF Collection point as of 2018

e-scrap item	Num of Sacks	Weight kg
Circuit Boards	19	2,100
CD ROM	1	195
Phones (landline)	1	45
cable	1	45
power supply	1	234
hard disk	1	95
aluminium heat sink	2	180
speakers	2	125
Cell batteries	1 drum	130
Totals	28 + 1 Drum	3,153

There are small e-Waste Collection Points at the landfills, but these are not working that well. It should be noted that the local electronics retail and repair sector are very supportive of efforts to deal with this issue, and have engaged with ECD and e-Waste projects in the past to help solve the problem.

3.15.4 Composting

Another important recycling measure in Kiribati is composting. Traditional methods of composting are described in Section 2.1.5.4 above but it these traditional methods of agriculture are not widely used now, especially in South Tarawa due to lack of space.

The main composting initiative is driven by the Taiwan Technical Mission (TTM). The TTM facility is at the eastern end of South Tarawa, near the airport, and was established as part of Taiwan's developmental support to Kiribati. The facility operates on approximately one hectare of land.

TTM offers agricultural training to the people of Kiribati in the areas of animal rearing and vegetable growing (see Photo 18 below). Very little soil is available on the islands of Kiribati, and, therefore, composting and fertilising is a very useful activity to promote. Members of the public are encouraged to spend time at TTM to learn how to garden and make compost. This training has been going on for approximately ten years, and no pesticides or herbicides are used. Fertiliser is made with imported molasses and soya bean powder, and the vegetables produced are donated to schools and hospitals.

The compost is manufactured in a low-technology manner, using pig manure, coconut husks and shredded green waste. Approximately 60 tonnes of compost is made annually. A team of workers hand turn compost (see Photo 19 below), moving it through a series of stations until it is ready to be put to use, a period of about six months. The only equipment used is a heavy-duty shredder and a chipper. TTM will pay for any green waste (coconut husks and leaves) that are brought to the facility, as they do not produce enough on site.

TTM also encourages the production of compost in private homes, and provides training for this to happen. They are currently also working with outer-island communities, encouraging agricultural activities, through training, and through the distribution of pigs. This pig-rearing project is in its fourteenth year, and the pigs provide manure for composting, as well as providing a source of income and meat.

TTM believes composting is more successful in the outer islands, where there is more land and less people. There are problems with composting in South Tarawa, apart from at the TTM facility, as there is very little farming activity or composting of raw materials.

TTM do, however, need more resources, such as pig food, and the one hectare of land is becoming very crowded.

Photo 18 – TTM Vegetable Growing

Photo 19 – TTM Compost Manufacture

3.16 Renewable Energy and Energy Efficiency

3.16.1 Kiribati Integrated Energy Roadmap

In 2015 the Government of Kiribati requested assistance from the International Renewable Energy Agency (IRENA), Pacific Community (SPC) and the Pacific Power Association (PPA) for the development of a comprehensive energy roadmap, which would review and report on renewable energy and energy efficiency potential in all sectors up to the year 2025. The resulting report - The Kiribati Integrated Energy Roadmap (KIER) - is comprehensive.

The KIER makes unequivocal links between energy and climate change. Within the same GHG emissions released by burning fossil fuels for transport, electricity generation and cooking, is also a toxic mix of uPOPs / dioxins. Kiribati's renewable energy roadmap includes an action plan that will decrease its reliance fossil fuels which will also reduce its uPOPs emissions.

The findings of the KIER show that the power sector is a key area where the ongoing efforts from deployment of solar PV will be continued and complemented with improvements in the efficiency of Kiribati's entire energy system, including electricity use, heating, cooling and transport.

The outer islands have an ongoing successful solar home systems (SHS) program, which is likely to be expanded and supported in the future. The potential for the development of coconut oil as an alternative fuel to diesel, for both power generation and transport, is also a key element that the KIER requires further development of, for a truly sustainable energy supply from renewable and local sources, complementing the important role of solar PV and (for Kiritimati Island) wind in the electricity sector.

Specific measures need to be put in place for making best use of solar and wind resources, as well as for deploying the necessary water desalination capacity using renewables after minimizing water losses. These issues have been assessed in two separate, in-depth studies[25], one on grid integration of solar PV in south Tarawa, the other on options for water desalination using renewables. The water desalination project has progressed to detailed design and tendering for construction. A new grid-connected PV system will be built to power as much of the desalination plant as the PV system can deliver, the remainder will come from the grid.

The KIER executive summary highlights some of the key challenges identified in the analysis and presents a summary of the solutions to overcome them. These solutions represent the core of the roadmap for the improvement of the energy sector in Kiribati, the Kiribati Integrated Energy Roadmap (KIER). Most of the information below comes from this executive summary.

3.16.2 Challenges for the sustainability of Kiribati energy sector

- **Supply:** As a remote small island state, Kiribati is highly dependent upon energy imports. In 2014, 63% of the national energy supply came from imported petroleum products while indigenous renewable energy sources (mainly bioenergy, then solar) accounted for the remaining 37%. The KIER shows that renewable energy has the potential to greatly reduce or even eliminate Kiribati's energy import dependence.
- **Demand:** The KIER "business as usual" estimate is that Kiribati's total energy demand will likely remain stable through to 2025. The KIER also identifies numerous energy efficiency measures that could lead to a decline in electricity demand in South Tarawa.
- **Government expenditures:** Electricity represents one of the Government of Kiribati's highest expenditures, in terms of cost for supporting electricity supply across the country as well as electricity bills. To reduce these costs, energy efficiency recommendations for the demand side (EE-DSM) focus on improvements in cooling loads, lighting in government buildings, state-owned companies and industries, and office equipment.
- **Cost recovery:** The significant loss in revenue for the Kiribati's Public Utilities Board (PUB) between 2010 and 2014 confirms that there is ample room for improvement in the performance of the electricity system. PUB faces several challenges; in particular, insufficient cash flow led to deferred or complete absence of maintenance of its diesel generators. A 2014 re-assessment of PUB power system losses showed that they were unacceptably high, and work needed to be done to reduce total losses from 21% to less than 5%.
- **Non-technical losses:** Measures should be taken to eliminate significant non-technical electricity losses. This would help with cost recovery and could also result in a significant reduction in demand when unbilled electricity is accounted for and billed. Non-technical

[25] The key findings from these studies, developed in support of the KIER, are integrated as part of the KIER, in chapters 5 and 11 of KIER respectively.

losses amount to just over 10% of total energy generation, roughly half of that is for unmetered services like water pumping and street lights, half being unbilled electricity.

- **Need for change:** The current fossil fuel-based power system is inadequate to meet future demand. Kiribati's readily available renewable energy resources (e.g. solar, wind, bioenergy) could be systematically exploited to move away from expensive and environmentally adverse overdependence on fossil fuels.
- **Modernisation:** As the level of variable renewable energy generation increases, PUB must ensure that operations of the power grids of South Tarawa and Kiritimati are improved, also accounting for the variability in the output from solar and wind using modern control systems, storage and improved operational practices. In 2018 PUB reported[26] that 'the real output power, as an acceptable percentage of the maximum output power that a PV system is designed to deliver, should be between 70% - 85%, and that all PV systems operated by PUB were typically delivering above 70% in 2017.

3.16.3 Solutions

3.16.3.1 KIER Targets

Looking towards 2025: Table 7 below defines the 2025 policy targets that drive the KIER analysis. This are the official targets adopted by the Government of Kiribati prior to the development of the KIER.

Table 7 – KIER Targets

KIER targets

Location	2025 fossil fuel reduction goal	of which	
		renewable energy	energy efficiency
South Tarawa	45%	23%	22%
Kiritimati	60%	40%	20%
Outer Islands	60%	40% (100% in rural public/private institutions)	20%

3.16.3.2 Optimise and reduce current fossil fuel use

- Enhance the existing petroleum-related infrastructure and ensuring that Kiribati Oil Company (KOIL) staff is fully and regularly trained in all aspects of fuel terminal operations and management.
- Implement the proposed conversion from kerosene use to liquefied petroleum gas (LPG) for cooking. This would lead to savings at all levels: from cleaner, cheaper, more efficient and more environmentally-friendly fuel to health benefits resulting from switching to LPG. The Government of Kiribati stands to accrue the greatest benefits — gross subsidy savings of close to 1 million Australian Dollars (AUD) — from the new LPG subsidy programme.
- Achieve significant savings on electricity—estimated at AUD 475,482 by 2025—through the Government's full implementation of all recommended measures
- Introduce PUB structural reforms, as recommended in the Kiribati Utilities Services Reform Programme, i.e. its separation into two new state-owned enterprises: "Kiribati Power" to manage electricity generation and transmission, and "Kiribati Water and Sewerage".
- Replace Kiritimati's currently fragmented generation systems with three independent grid systems or "zones".
- Reduce the use of fossil fuels for power generation by 22% through energy efficiency improvements on both the supply and demand side.

[26] BREARLEY, W. 2018. Power Engineering Progress Report 2018. South Tarawa, Republic of Kiribati: Public Utilities Board (PUB).

3.16.3.3 Expand the efficient use of indigenous renewable energy resources

There are numerous options to increase the renewable energy share in Kiribati's energy mix, with solar PV being the most recently proven and reliable of the newer technologies and wind for marine vessels (i.e. sailboats) being the most traditional Kiribati could focus on the following renewable energy options:

- More solar deployment for the electricity grid and for desalination in South Tarawa, including deployment of properly-sized battery systems as key enablers for further deployment of solar PV. Renewable energy desalination is already cost-competitive with fossil-driven desalination and advances in technology allow for direct use of solar PV to drive reverse osmosis systems, without the need for battery storage or connection to the grid system.
- More PV, wind and battery storage for Kiritimati. The least-cost future solution for Kiritimati presents the highest share of renewable energy, exceeding 55% in the larger zone and 80% in the smaller zone, thanks to the combination of PV, battery storage and wind power.
- More renewable energy and ice plants for fish preservation on the Outer Islands
- For variable renewable energy, increase PV penetration levels by reducing electrical demand, retaining levels of service through advanced control systems and energy storage. Options to integrate VRE include: controllable and deferrable loads, ice storage; load shifting; electric vehicles; specialised diesel generators; battery storage; automatic curtailment of excess PV and wind; VRE generation forecasting; and geographical distribution of PV generation. Some of these measures require detailed engineering studies for assessing the potential, cost and feasibility, but they can all facilitate the introduction of VRE in South Tarawa.
- Support the use of renewable energy sources for transportation; in particular, liquid biofuels for land and marine transport. Investigate the incremental introduction of coconut oil into the supply chain to replace diesel for power generation as priority. Replacement of traditional use of bioenergy for cooking with improved cook stoves.
- Introduce electric vehicle pilot projects to assess their feasibility for Kiribati and, if viable, support their adoption. Government of Kiribati should spearhead the adoption of more energy efficient vehicles, such as hybrid cars and electric vehicles that use solar PV for charging.
- Explore clean renewable energy applications in ships of all sizes, including options for primary, hybrid or auxiliary propulsion, as well as on-board and shore-side renewable energy uses. The best of multiple options, including wind (soft sail), hybrid solar and liquid biofuels such as coconut oil should be explored, introduced and refined between now and 2025.
- Before any investment in desalination takes place, the high rates of fresh water leakage and other issues with the water supply and sanitation system should be fully addressed. Once these issues are addressed, and rainwater collection potential is fully implemented, if a supply gap for fresh water is still present, reverse osmosis (RO) desalination powered by PV or wind (without battery storage) is the most suitable option. However, RO desalination plants previously installed in Kiribati failed due to lack of proper maintenance. Any future use of desalination needs to be accompanied by a comprehensive and well-funded plan covering the long-term maintenance.
- Ocean Thermal Energy Conversion (OTEC): A 1 MW OTEC plant is planned for deployment in Kiribati in 2020. A simple analysis presented in the Annex of this report indicates that the plant could increase the 2025 RE share from 35% to 59%. However, a detailed study base on the performance of the OTEC plant is required to determine its full potential.

3.16.3.4 Ocean Thermal Energy Conversion

Kiribati may become a global leader in the deployment of ocean thermal energy conversion

(OTEC). In cooperation with the Korea Research Institute of Ships and Ocean Engineering, Kiribati is exploring the deployment of a 1MW OTEC plant off the coast of South Tarawa. The plant, with funding from the Ministry of Oceans and Fisheries of the Republic of Korea, would be one of the first grid connected OTEC systems in the world.

OTEC is a renewable energy technology that uses the temperature difference between warm surface water and cold deep ocean water to drive a cycle in which a working fluid is repeatedly vaporized and condensed to power an electric generator. OTEC is most effective in coastal areas where the water surface temperature is consistently warm year round and deep waters are accessible a short distance from the coast, this makes South Tarawa an ideal location for OTEC. OTEC plants are designed to provide 24-hour power generation with minimal downtime required for maintenance. However, it should be noted that OTEC is an emerging technology and data on performance, cost and reliable operation at scale are still being established.

3.16.3.5 Climate Change

The 2014 Kiribati Joint Implementation Plan on Climate Change and Disaster Risk Management 2014-2023 defined priority adaptation measures to address current and ongoing risks from climate change. The 2014 energy sector contribution to greenhouse gas emissions was approximately 63,000 tons per carbon dioxide equivalent per capita, which is extremely small, representing approximately just 0. 0002% of global emissions (INDC[27], 2015).

Still, energy generation is the largest source of human-induced greenhouse gas emissions and has contributed to the cause of adverse global climate change, which has, in turn, negatively impacted human habitats and livelihoods that continually affect Kiribati.

The KIER provides a policy and legal framework guide, as well as proposed activities with investments required for implementation to support the reduced use of fossil fuels in power generation and transport, thus reducing greenhouse gas emissions. The report states that it is imperative to note the importance of each country's legislative framework on its own domestic environmental degradation; in particular, the effect on land and water resources from the use of other renewable energy technologies' wastes. Kiribati is a small country with limited land area; therefore, the use of land and existing resources to set up renewable energy technologies, such as solar and wind, should be minimized.

In support of the government's climate change goals, the reductions in carbon dioxide emissions compared to the Business-as-Usual (BAU) electricity generation have been estimated for South Tarawa. Emission reductions from energy efficiency measures and renewable energy deployment options for South Tarawa, as presented in the KIER, have been estimated. Carbon dioxide emission reductions have been calculated for those scenarios versus the 2025 BAU scenario using emissions factors from the Intergovernmental Panel on Climate Change (IPCC).

The result is a significant reduction in carbon dioxide emissions, which would fall from 15,104 tonnes per year in the 2025 BAU scenario to 7,934 tonnes per year in the 'emission reductions scenario' (from energy efficiency measures and renewable energy deployment options) - a savings of around 47%. The least cost renewable energy deployment option represents 24.57% reduction in generation

[27] INDC, Intended Nationally Determined Contribution: a term used under the United Nations Framework Convention on Climate Change (UNFCCC) for reductions in greenhouse gas emissions that all countries that signed the UNFCCC were asked to publish in the lead-up to the 2015 United Nations Climate Change Conference.

from diesel versus BAU, or a 35% renewable energy share once the energy efficiency measures have been implemented.[28]

3.16.3.6 Resulting Kiribati NIP uPOPs Reductions

Diesel consumption contributes 0.02% of the Kiribati Grand Total TEQ (see Section 4 below). If diesel consumption does not rise to 15,104 tonnes per year as predicted in the '2025 BAU scenario' but remains relatively close to current levels of consumption (7336 tonnes per year) by rising only slightly to 7,934 tonnes per year, the effect on Kiribati Total TEQ of dioxins and furans (PCDD/PCDF) will be negligible.

If, for whatever reason, diesel consumption rises according to the extrapolated business as usual scenario to 15,000 tonnes per year, diesel consumption alone will likely still contribute less than 0.5% of the Kiribati Grand Total TEQ, small by comparison to the dominance in the Kiribati NIP Inventory of the quantities of dioxin released by incineration of medical waste and open burning of landfills.

3.17 Contaminated Sites and Waste Stockpiles

3.17.1 Banaba Island

There is extensive contamination on the island of Banaba, arising from the former phosphate industry activities, carried out by the British Phosphate Company (BPC) throughout most of the 1900s. Mining was stopped in the late 1970s, and the BPC made little attempt to decommission the phosphate mining plant and buildings, which, among other things, contain extensive amounts of asbestos building material. As a consequence, the island is extensively littered with asbestos, rusting steel buildings and other debris left over from the mining operations, including oil spills.

Banaba, therefore, is a huge contaminated site, with asbestos debris being the main contaminant, but also there are possibly numerous other contaminants. A thorough and detailed investigation is warranted, followed by the production of a detailed and costed clean-up methodology that could be used to raise funds for a comprehensive clean-up.

3.17.2 Kanton Island

The island of Kanton was used as a US military base during the Second World War, and the US military left Kanton without any proper decommissioning activities. A recent initiative resulted in the removal of old pesticides, together with three drums of other chemicals that have ended up in the King George IV School in South Tarawa. It is likely that other contamination also exists on Kanton as a result of the Second World War military activities, and this should be investigated.

The following is an extract from the 2002 Report on the Phoenix Island Mission undertaken by Paul Neilson who was working for the then MESD (Ministry of Environment and Social Development).

[28] EMANUELE TAIBI, P. J.-K., FRANCISCO GAFARO, 'APISAKE SOAKAI, NICK WARDROP, SOLOMONE FIFI TA, KOIN ETUATI, FRANK VUKIKOMOALA, ALAN BARTMANOVICH, MAKERETA LOMALOMA, ANDREW DAKA 2017. Kiribati Integrated Energy Roadmap: 2017-2025. Masdar City, Abu Dhabi, United Arab Emirates: International Renewable Energy Agency.

The main concentration of hazardous chemicals was located in the former Quarantine Station (Table 2).

***Table 2**. Summary of chemicals found at the Quarantine Station.*

Chemical	*Quantity*	*Condition*
Diazinon	*20 × 5ltr drum (complete), 12 × (part)*	*Poor*
Carbaryl	*52 × 10lb bags (complete)*	*Poor*
Malathion	*10 × 10ltr containers (part)*	*Extremely poor*
Trichloroethylene	*5 × 2ltr containers (part)*	*Extremely poor*
XP 50 Rust Stop	*10 × 200ltr drums (part)*	*Extremely poor*
Bitumen	*100 × 200ltr drums (part)*	*Poor*

Several materials within the shed could not be identified due to the extremely poor condition of the containers. The remains of many dead animals could easily be seen on the floor of the shed, including; rats, crabs and several different species of birds. There was also a noticeable difference in the vegetation surrounding the quarantine sheds, as species diversity and cover were considerably lower.

Several I-Kiribati government workers living on Kanton have tried to catalogue the contents of the shed. They complained of headaches, dizziness, blurred vision, tightness of chest, and even fainting after sometimes only venturing close to the area. Even with a simple respirator and a minimal amount of time in the shed it was clear that the contents were an extreme health hazard.

Asbestos lagging was a common sight in a number of facilities constructed during the military occupation including the two power stations, satellite tracking station, and communication facility. Only three transformers could be tested for Polychlorinated Biphenyls (PCB's). All positive results were less than 50ppm. Other transformers and switches had been either drained or their contents poured directly onto the ground.

All I-Kiribati on Kanton use the old officers housing in the main village. A Maneaba has been constructed in the village. The cladding from one of the generator housings has been utilized for the Manaeba roof, while the beams have been made from treated telegraph poles, used during the military occupation. The appearance of the poles indicated they have been treated with some form of insecticide (Copper/Chrome/ Arsenic?).

Apart from some salvageable materials that can be used for construction, all infrastructure donated to the Kiribati Government is now unusable. This is of considerable concern as some of the materials previously listed can seriously affect the environment and its future value.

The only chemicals that were removed from Kiribati by the POPs in PICs clean-up were the pesticides. The containers of trichloroethylene and XP50 Rust Stop may have been included in the drums sitting at King George V School in South Tarawa, which is a real concern. The tops of the drums have corroded and are now open to the school environment. Trichloroethylene is, among other things, a known human carcinogen.

It is clear from the above report[29] that there are still important issues to be resolved on Kanton Island:

- There were many unknown containers found in the 2002 visit and these containers are probably still on the island.
- Extensive contamination had occurred, including the spilled oil from all the transformers and switches that had been drained of their contents. The three transformers that were tested were all found to have PCBs at less than 50 mg/kg, but the spilled oil from the numerous drained transformers may well contain PCBs.
- There is extensive asbestos debris and contamination from several old buildings and some asbestos cladding has been re-used by the residents of the island. Some of the asbestos may be friable lagging.
- The treated telegraph poles may have introduced heavy metals contamination.

All these matters should be resolved on an urgent basis, although the solutions are difficult, given the problems and the remoteness of Kanton Island. It is noted Kanton Island is part of the Phoenix Islands, which are in turn part of the Phoenix Islands Protected Area, which is a UNESCO World Heritage Centre and the largest designated Marine Protected Area in the World.

3.17.3 Kiritimati Island

During the late 1950s, Great Britain carried out several atmospheric nuclear tests over the ocean, near Kiritimati Island. The United States of America also used Kiritimati Island as a base for conducting several nuclear tests in the early 1960s. These activities left a legacy of radioactive contamination, asbestos pipework and loose friable asbestos, batteries and other waste stockpiles and large bitumen spills. Numerous vehicles were deposited offshore at London Point, ostensibly to provide shoreline protection. A number of vehicles were also handed over to residents on the island, but these gradually fell into disrepair. Remaining steel and concrete structures fell into disrepair. Piles of demolition rubble remained.

In December 2004, a contract was awarded by the UK Government to Safety and Ecology Corporation (SEC) Limited to clean up the military waste left by the UK's Ministry of Defence. A paper was given at a US conference in 2009, which describes the clean-up activity.[30]

The paper describes a successful clean-up operation, where the radioactive and asbestos waste was removed by specialists and taken back to the UK, together with some other hazardous waste; scrap steel was taken to Singapore; and bitumen was cleaned up and left on the island, at the request of the residents, in order to repair their roads. The work was done with the cooperation and agreement of the Kiribati Government, and with assistance from local people, except for the specialist activities.

The clean-up was to remove all UK Ministry of Defence legacy waste, but it is not clear whether US legacy waste was also removed, as well as other hazardous waste on the island.

The project also cleared up ground contamination, to some extent, although some ground contamination may still remain.

It is known that there are transformers on the island that may contain PCBs, as well as a stockpile of transformer oil waste with PCBs.

[29] "Phoenix Island Expedition Report 2002" Paul Neilson, MESD

[30] "Remediation of Kiritimati Island and the Challenges of Hazardous Waste Disposal to the United Kingdom from the Central Pacific – 9526". R. W. Kerr, Safety & Ecology Corporation Ltd, WM2009 Conference, 2009, Phoenix, AZ

There is also a dumping area at a remote location on the island where hazardous waste is stockpiled.

Contamination also occurs from the regular burning of domestic waste.

3.17.4 South Tarawa

The main source of ground contamination on South Tarawa comes from oil spillages. Historical oil contamination exists at the two power stations, and especially the old Betio Power Station, which was observed in the 2002 POPs and PICs visit, to be heavily contaminated with oil. This contamination is no longer evident, but probably persists below the surface.

A visit was made by the NIP survey team to the government-owned Plant and Vehicle Unit (PVU). The PVU is part of the MISE and carries out plant and vehicle servicing for all government departments. Their facility is crowded with vehicle wrecks, and is heavily contaminated from the maintenance activities, especially with used oil (see Photos 20 and 21). MELAD has carried out compliance audits, but no action has been taken. There have been many spills over several decades, and corroded drums of waste oil are sitting on one part of the site, surrounded by spills.

Photos 20 and 21 – PVU Used Oil and Resulting Contamination

The 2002 POPs and PICs project[31] also identified seven tonnes of waste oil stored at KOIL. Since 2002, KOIL has made several successful efforts to remove used oil, and the used oil identified in 2002 would most likely have been removed as part of that process. There may, however, be residual oil contamination from spills that have happened in the past at KOIL.

The 2002 project also identified at the Agricultural store at Tanea[32]:

- 35 plastic pails (in bad condition) of CCA timber treatment chemical, with an average of about 10 kg in each pail
- About 400 kg of coumarin based rat poison that was still being used

[32] Kiribati Pops Project Country Plan (Prepared by SPREP, January 2003) John O'Grady

- Many smaller bottles and containers of chemicals including a range of acids, alkalis and salts, formic acid, acetic acid, propanol and glycerol.
- About 50 kg of zinc phosphide
- 40 kg of derris dust
- 10 full or partly full cylinders of methyl bromide gas
- Approximately 2000 kg of expired veterinary pharmaceuticals

An attempt was made by the 2019 survey team to find this stockpile, but the shed that it was stored in has disappeared and no one knows where the pharmaceuticals, chemicals, gas cylinders or zinc phosphide have gone. Zinc Phosphide is an extremely toxic substance to humans and to the environment. Methyl bromide is an extremely toxic gas. The missing chemicals need to be found, or at least there needs to be a clear understanding of their fate.

The 2002 project also described waste bitumen at the end of the airport runway. This waste bitumen had been abandoned by the Chinese contractors who had constructed the runway. They had left the bitumen against the wishes of the Kiribati Government. The contractors had also abandoned quite a lot of machinery that had become a liability.

The waste bitumen site was located right at the end of the runway, adjacent to the sea and right next to a village. There were about 500 drums in a very rusted condition, and most of the contents had spilt out. The bitumen was very sticky and was slowly flowing towards a village. Some of the small houses had been moved several times, away from the advancing bitumen. It was reported that one man had died recently and his death was being blamed on the well contamination from the bitumen. It was reported to be causing bad tastes and contamination in the neighbouring wells. It was apparently a reasonably frequent occurrence for cats, dogs, poultry etc, to get stuck in the bitumen and die. Probably an area of over 2000 square metres was directly contaminated at present. The bitumen had been flowing over the road that ran alongside the runway, and the Works Dept had scraped quite a bit of it onto the nearby beach, until this practice was stopped by the Dept of Environment, so parts of the beach were heavily contaminated as well.

In 2019 there was no evidence of this waste bitumen and it is understood that it had all been covered up by a reclamation. Presumably, however, the bitumen contamination and its harmful effects still remain.

Apart from the laboratory chemicals, already described in Section 3.2, above, there is a large stockpile at the hospital of expired pharmaceuticals.

3.17.5 Outer Islands

It is understood that there is approximately 15 tonnes of fertilisers stored on various outer islands. It is not known what other contamination present on the outer islands, except for those islands already covered above (Banaba, Kanton and Kiritimati). There may, however, be more contamination on the other outer islands, as well as possible clinical waste.

3.17.6 Marine Contamination

Marine pollution is the responsibility of the Marine Division of the Ministry of Information, Communication and Tourism Development (MICTTD). This is administered under the recent Maritime Act, 2017. The MICTTD, however, have no spill-response capability, so oil spills at sea cannot be dealt with.

Kiribati is signatory to MARPOL, but has no provision to collect oil, garbage or sewage from international ships. It is also unable to regulate the discharge of the various MARPOL wastes from ships in Kiribati waters.

It is also hard to control sewage and oil discharges from domestic vessels, although it is necessary to collect domestic refuse from them.

Port reception facilities are badly needed for sewage and refuse.

4.0 Assessment of Releases of Unintentionally Produced POPs (uPOPs)

4.1 Description of uPOPS

Unintentional POPs (uPOPs) are formed as the result of incomplete combustion of materials containing chlorine, or as the by-products of chemical reactions, and include:

- polychlorinated dibenzo-p-dioxins;
- dibenzo-furans (dioxins);
- hexachlorobenzene;
- polychlorinated biphenyls;
- pentachlorobenzene (PeCB) hexachlorobutadiene (HCBD); and
- polychlorinated naphthalenes.

Some of the above-listed substances are also POPs.

Polychlorinated dibenzo-p-dioxins (PCDDs)

Dioxins[33] are a group of highly toxic chemicals that are released from the burning of fuel and other combustion processes. These chemicals are classified as unintentional by-products under the Stockholm Convention for Persistent Organic Pollutants (POPs) and Parties to the Convention are required to take measures to reduce the releases over time, with the aim of elimination.

These chemicals are produced unintentionally due to incomplete combustion, as well during the manufacture of pesticides and other chlorinated substances. They are emitted mostly from the burning of hospital waste, municipal waste, and hazardous waste, and from automobile emissions, peat, coal, and wood.

There are 75 different dioxins, of which seven are of concern. One type of dioxin was found to be present in the soil 10 - 12 years after the first exposure.

Dioxins have been associated with many adverse effects in humans, including immune and enzyme disorders and chloracne, and they are classified as possible human carcinogens. Laboratory animals given dioxins suffered a variety of effects, including an increase in birth defects and stillbirths. Fish exposed to these substances died shortly after the exposure ended. Food (particularly from animals) is the major source of exposure for humans.

Polychlorinated dibenzo-furans (PCDFs)

These compounds are produced unintentionally from many of the same processes that produce dioxins, and during the production of PCBs. They have been detected in emissions from waste incinerators and automobiles. Furans are structurally like dioxins and share many of their toxic effects. There are 135 different types, and their toxicity varies. Furans persist in the environment for long periods and are classified as possible human carcinogens. Food, particularly animal products, is the major source of exposure for humans. Furans have also been detected in breast-fed infants.

Results have recently been received for breast milk analyses. PCDDs and PCDFs have been detected at low levels in Kiribati breast milk.

[33] The term 'dioxins' is used throughout this report to refer to mixtures of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzo-p-furans (PCDFs).

Under the Stockholm Convention, Parties must take measures to reduce the unintentional release of these chemicals, with the goal of continuous minimisation and, where feasible, ultimate elimination.

There are clear high priority sources of uPOPs emissions in Kiribati (Table 8).

Table 8: Priority sources of uPOPs emissions in Kiribati

Rank	Group	Category	Source
1	1	C	Medical waste incineration
2	6	B	Open burning of municipal waste at landfills
3	6	B	Open burning of domestic waste
4	3	D	Household heating and cooking - Biomass (virgin wood)
5	6	B	Open burning of hazardous waste at landfills

All sources of uPOPs relevant to Kiribati are looked at individually below.

The estimates of dioxin releases were determined using a Toolkit[34] developed by UNEP Chemicals, and this is described below with other aspects of the methodology. The source activity data and other information relevant to the release estimates is detailed below, together with a discussion of the options for reducing releases from the most significant sources.

Article 5 of the Stockholm Convention requires parties to take measures to reduce or eliminate releases of POPs that are formed and released unintentionally from anthropogenic sources, 'with the goal of their continuing minimisation and, where feasible, ultimate elimination'. The unintentional POPs, as listed in Annex C of the Convention, are:

- Polychlorinated dibenzo-p-dioxins
- Dibenzofurans (always form alongside dioxins)
- Hexachlorobenzene (HCB)
- Polychlorinated biphenyls (PCBs) pentachlorobenzene (PeCB) - recently added to Annex C.

The focus of this report, however, is on the first two of these, which, for convenience are generally referred to using the terms 'dioxins' and 'furans', or, because the two inevitably form simultaneously, simply as dioxins.

Animal studies show that some dioxin and dioxin-like compounds are extremely toxic. In addition, it is believed that dioxins have the potential to cause neuro-behavioural, developmental, reproductive and immuno-toxic effects at low doses in humans. One of the dioxins - 2,3,7,8-tetrachlorodibenzo-p-dioxin, (TCDD) has been classified as a 'known human carcinogen (class I)' by the International Agency for Research on Cancer (IARC).

Dioxins have never been produced intentionally, other than for research and incinerator testing purposes, but are formed as unintentional by-products in various chemical production processes and in most thermal processes, including combustion, providing chlorine[35], in any form, is present.

[34] FIANI, E., KARL, U., UMLAUF, G., ASSUNÇÃO, J. V. D., KAKAREKA, S., FIEDLER, H., COSTNER, P. & WEBER, R. 2013. Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs
Stockholm: UNEP.

[35] Chlorine is normally present in air.

The most toxic and widely studied dioxin is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and it is the toxicity of this dioxin to which the toxicities of all other dioxins (and furans) are compared and factored.
HCB, PCBs and PeCB are manufactured chemicals that have been used for a variety of purposes in the past. However, they can also be formed as unintentional by-products in a manner analogous to the formation of the dioxins.

This Inventory is limited however to release estimates for dioxins, mainly because the amount of data available on unintentional releases of HCB, PCBs and PeCB is extremely limited. In general, any actions taken to reduce dioxin releases will have similar effects on the unintentional releases of HCB and PCBs from those same sources.

Dioxins occur as complex mixtures of related chemicals (congeners) in the environment. As a result, dioxin measurements involve very complex data sets. Therefore, a system of Toxic Equivalents (TEQs) and Toxic Equivalent Factors (TEFs) has been developed so that the complex data can be reduced to single values. The TEQ method is based on the best available toxicological and biochemical data, knowledge of structural similarities among the different but related chemicals as well as the practical knowledge of experts. A panel of experts at the Stockholm Convention studied all available information and used it to develop a set of weighting factors called toxicity factors. There have also been other determinations of toxicity factors. Each toxicity factor expresses the toxicity of each dioxin congener as a number that expresses an equivalent amount of 2,3,7,8-TCDD, which is the dioxin most toxic to humans.

Multiplication of the activity rate – the concentration or number of units being consumed, processed or produced at the source[36] - by the Toxic Equivalence Factor (TEF) gives a corresponding TEQ concentration that is relative to one unit of 2,3,7,8-TCDD. The toxicity of any mixture of dioxins (PCDDs) and furans (PCDFs) is determined by adding-up the individual TEQ concentrations. This is reported as the 'Total TEQ' for a mixture.

The term "dioxin" has been used below as a generic term for all the uPOPS.

4.2 Waste Incineration

Poor management of hazardous healthcare waste (including syringes, live vaccines and cultures, laboratory samples, body parts and fluids, and sharps) poses occupational and public health risks to patients, health workers, waste handlers, waste transporters and communities.[37] In addition, healthcare waste disposal via low temperature incineration is estimated to be the second largest contributor to Pacific uPOPs releases, accounting for 17% of the emissions reported by PICs in their NIPs. Healthcare waste can contain high concentrations of organic (polyvinyl chloride and specific pharmaceuticals) and inorganic (saline solution and body fluids) chlorine that may alter combustion characteristics and enhance PCDD/PCDF formation in lower temperature burns. Under these conditions, stack emissions can include both "conventional" pollutants such as particulate matter, sulphur oxides, nitrogen oxides, volatile organic compounds and carbon monoxide, as well as dioxins and furans. The incinerator ash will also usually contain dioxins, furans and heavy metals.

The other major type of incinerator used in the Pacific is the quarantine incinerator for airport wastes from aircraft. Similar concerns relate to this type of incinerator as with healthcare incinerators.

[36] e.g. tonnes of diesel or green waste burnt, tonnes of compost produced.
[37] SPREP (2013). *Pacific health care waste: A regional management strategy and action plan 2013-2015*. SPREP, Apia, Samoa.

Progressive installation and enforcement of BAT technology for healthcare waste destruction (i.e. double incinerator chamber, and 850-1100°C incineration, operated and maintained as per manufacturer's instructions) is essential to minimise formation of dioxins and furans from this source in the Pacific. Such high temperatures are, however, very difficult to attain; all incinerators need ongoing repairs and maintenance, spare parts, adequate fuel supplies, correct operation, and staff operating incinerators must be trained. Conversely, poorly maintained and incorrectly operated incinerators are likely to release significantly higher levels of dioxins and furans into the environment than they should.

For example, according to the Stockholm Convention Toolkit, a class 2 incinerator (double-chamber, temperature-controlled, with minimal automatic pollution control system), if operated correctly and burning medical waste, has an emission factor to air of 3000 µg TEQ/t. The same incinerator, if operated incorrectly (perhaps due to limited availability of fuel or broken injectors, for example), would probably have an emission factor to air like that of a class 1 incinerator (single chamber, no temperature control, no pollution control), i.e. 40,000 µg TEQ/t – a thirteen-fold increase in emissions to air.

"Incineration was proposed as the preferable Healthcare waste treatment technology, as economically feasible under the socio-economic conditions present in the region. Proper sitting, proper operators training and proper maintenance programs are the main prerequisites to ensure there is no risks to the environment or health of humans and other species." [38]

4.3 Heat and Power Generation

Use of conventional fuel sources for power generation and heating results in emissions of uPOPs (primarily to the air) from a range of sources including fossil fuel power plants; household cooking with biomass (wood, coconut husks/shells); and from household cooking with fossil fuels (gas). Overall, uPOPs emissions from heat and power generation sources contribute approximately 10% of the total uPOPs emissions reported from Pacific Islands[39].

4.4 Transportation

uPOPs emissions from transport (road and off-road vehicles) result from incomplete combustion of fuel in engines. The presence of dioxins in car exhaust was first reported in 1978, although the exact magnitude of dioxin in vehicles emissions remains uncertain. Worldwide, motor vehicle emissions can account for up to 12% of total national annual national dioxin emissions. The levels of dioxins and furans in exhaust gases emitted from vehicles depend on many factors including the type of engine, its maintenance condition and age, technologies of emission reduction applied (catalysts), type and quality of fuel (gasoline, diesel, heavy fuel oil, biofuel), driving conditions, and ambient conditions[40]. Based on the available data, uPOPs emissions from transportation comprise about 0.1% of total reported emissions, or 115 mg TEQ/year in the Pacific.

4.5 Open Burning

Open burning (domestic refuse and green waste) is often considered to be the largest contributor to uPOPs emissions in the Pacific, contributing around 63% of the total reported emissions[41]. Open burning includes uncontrolled burning of biomass (agricultural crop residues including sugarcane which may or may not have been treated with pesticides; forests; and grasslands); and waste (mainly domestic or municipal solid waste burned in landfills, dumps, backyards, public spaces). The

[38] GKLEKAS, D. I. P. & CLARK, T. 2017. Mid-Term Evaluation of the EU 10th EDF Pacific Hazardous Waste Management Programme. Brussels Belgium.
[39] HILYARD, M. 2010. **Inventory of Dioxins and Furans.** *POPs Project 2010 Cook Islands.* Rarotonga: National Environment Service.
[40] UNEP (2012). *Toolkit for Identification and Quantification of Dioxins and Furans and Other Unintentional POPs*
[41] Richards (2015). *Pacific Regional Action Plan to Reduce Unintentional Persistent Organic Pollutants*. 34pp

resulting uPOPs are primarily released directly to air and land, with indirect releases to water if rainfall washes away the uPOPs contaminated ash particles into receiving waters. Fires on open dumpsites and backyard burning (in backyards and public spaces) are still common occurrences, especially in areas that lack access to reliable waste collection services. Backyard burning of piles of waste that include household garbage and garden waste are a common (daily) sight on many Pacific Islands.

4.7 Public Tobacco Smoking

Total reported emissions of dioxins from sources including drying of biomass, crematoria, smoke houses, dry cleaning residues, and tobacco smoking account for 171 mg TEQ/year, or 0.2% of the total reported dioxin emissions from Pacific Island countries. Tobacco leaf naturally contains both organic carbon and chloride ions (regardless of the presence or absence of pesticide residues or chemical/flavouring additives in the tobacco) and consequently, as for any thermal process, smoking of cigarettes and cigars produces dioxins.

Investigations of popular brands of cigarettes gave "emissions" of 0.1-1.0 pg I-TEQ/cigarette[42,43]. Cigars are estimated to release higher dioxin emission of approximately 0.3 pg I-TEQ. Essentially, this means that dioxin intake from smoking could be up to one third of that coming from food, and smokers are likely to have a measurably elevated dioxin intake compared to non-smokers. Non-smokers are also likely to be exposed to dioxins from passive intake of cigarette smoke. Smokers also place themselves at significant health risk from the many other toxic and carcinogenic components present in cigarette smoke.

4.8 Waste Disposal

Waste disposal is not a source of uPOPs, but rather a pathway whereby uPOPs from other sources already present in the waste becomes concentrated and is released to air, water and land[44]. Based on the available data, waste disposal and landfilling contribute approximately 9% of the total reported uPOPs releases in Pacific island countries. Waste disposal to land is the predominant method of solid waste disposal in Kiribati. It is important that waste management practices are implemented to ensure that polystyrene packaging and building materials, leather, fabric, upholstery and carpets, floor polish, photographic film, denture cleaners, shampoos, paints, and carpet cleaners and fire-fighting foams are stored and disposed of safely. This will help ensure that wastes potentially containing HBCD and PFOS are contained and safely managed.

4.9 E-Waste

E-waste is made from sophisticated blends of plastics, metals, and other materials and may contain a range of hazardous substances including heavy metals (such as mercury, cadmium and lead), and Brominated Flame Retardants (BFRs), including those that are listed under the Stockholm Convention) and other substances. Consequently, planned management and disposal of e-waste in Kirbati is important for the maintenance of long-term community and environmental health. The e-wastes of special concern regarding uPOPs are those from items containing a significant portion of circuit boards, or with cases that may contain BFRs such as television and computer housings.

Due to the wider proliferation of electronic products the problem of e-waste generation is increasing rapidly in Pacific Island Countries. The EU's Mid-Term Evaluation of the Pacific Hazardous Waste Management Programme (PACWASTE) states that *"…the strategy and results for e-waste have been*

[42] Ball M, Päpke O & Lis A (1990). Polychlordibenzodioxine und Polychlordibenzofurane in Zigarettenrauch. *Beitr Tabakforsch Int* 14: 393–402

[43] Löfroth G & Zebühr L (1992). Polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) in mainstream and sidestream cigarette smoke. *Bull Environ Contam Toxicol* 48: 789-94.

[44] UNEP (2012). *Toolkit for Identification and Quantification of Dioxins and Furans and Other Unintentional POPs. 445pp*

4.10 UNEP Tool Kit

4.10.1 Basis of the Tool Kit

The uPOPs may be released directly to air, land or water from industrial and non-industrial activities, as well as natural events such as forest fires. They may also be present in products or materials, including wastes and enter the environment during the use or disposal of these materials.

The UNEP Tool Kit[45] sets out a detailed methodology for creating and updating an Inventory that quantifies the dioxin releases to all environmental vectors. However, it should be noted that the relative contribution of the different sources to the exposure of a population or ecosystem is not necessarily indicated by a simple ranking of relative source strength. The distribution and conditions dioxins are subjected to once they enter the environment also mediate how dioxins affect humans and other life.

The methodology followed in this Inventory was based on the emission factor approach presented in the Standardised Toolkit for Identification and Quantification of Dioxin and Furan Releases published by UNEP[46]. The annual releases from each source are estimated by multiplying an activity statistic, also known as an *activity rate,* by a default *emission factor*:

Annual release (µg TEQ p.a.) = Activity rate (tonne p.a.) x Emission factor (µg TEQ / tonne)

Default emission factors are values for the quantity of PCDD/PCDF, expressed as TEQ, released to each vector (air, water, land, residue, product) per unit of activity (e.g., µg TEQ per ton of material produced, per ton of fuel burned, etc.). A panel of Toolkit experts assign and update the default emission factors for each class within each source category.

Activity statistics / rates are determined or estimated based on, for example, quantities of fuel consumed or quantities of production, or other similar measures. Source categories / classes characterised by many (often small and sometimes diffuse) emitters, the activities of the individual sources are grouped and summed, and the resulting total activity rate is multiplied with the default emission factor for that class.

The UNEP Toolkit was developed by UNEP Chemicals with the aim of achieving an effective and standardised approach to the compilation of dioxin emission inventories. It was intended to ensure a reasonable degree of consistency between the inventories reported by different countries and should assist in comparing Inventory results between countries and track changes over time. As indicated in the introduction to the Toolkit:

> *Only comparable sets of [dioxin] source release data can provide a clear global picture on the scale of releases as a step [towards] prioritising actions to control or reduce releases. International comparability is the goal of this process*.
>
> The UNEP Toolkit arranges all potential dioxins sources into the following ten source *groups*:
>
> 1. Waste incineration
> 2. Ferrous and non-ferrous metal production
> 3. Heat and power generation
> 4. Production of mineral products
> 5. Transportation[47]
> 6. Open burning processes
> 7. Production of chemicals and
> 8. Miscellaneous sources

[45] FIANI, E., KARL, U., UMLAUF, G., ASSUNÇÃO, J. V. D., KAKAREKA, S., FIEDLER, H., COSTNER, P. & WEBER, R. 2013. Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs
Stockholm: UNEP.

[46] Ibid.

[47] The transport category includes fuel used in stationary engines, such as those used in South Tarawa power stations and in generators

consumer goods

9. Disposal
10. Potential hot spots

Each dioxin/furan-forming group is then is divided into source *categories*. For example, source group 1, *Waste Incineration,* consists of seven source categories: incineration of hazardous wastes, incineration of municipal wastes, incineration of medical wastes, etc…

Each source category is further divided into *classes* that are ranked according to the degree of quality control (for example, emission / pollution control) involved in each process. Typically, class 1 processes are those with basic equipment and minimal levels of quality control. Higher numbered source classes perform 'better' and release fewer dioxins and furans than lower class numbers as the quality of each process (for example, incineration) or activity improves with each increase in class number.

Only source *classes* have emissions factors assigned to them; source categories and source groups are merely ways of summing, organising and presenting the resulting total TEQs produced by individual source classes so that sources can be ranked so that subsequent actions can be prioritised nationally, regionally and globally.

4.10.2 Toolkit Limitations

The main limitation with the Toolkit is the use of a one-size-fits-all approach. The only way to accurately determine the dioxin emissions from each source class is through an extensive emission testing programme. However, testing for dioxins is expensive, especially on a national scale. The main advantage of using the Toolkit is that the emission factors for most sources have been broken down into several different performance levels by drawing on the knowledge of a wide range of industry experts, published studies and best available science, as indicated previously.

Overall, for many source classes, the amount and quality of data used in developing their emission factors is variable and for some classes quite limited. In addition, some data is relatively dated.

However, evaluation of the quality of emission factors included or to be included in the Toolkit is the mandate of the Toolkit experts, who ensure that only scientifically-sound data are included in the Toolkit. Data quality ratings are assigned by the Toolkit experts to all emission factors published in the Toolkit.

It should also be recognised that the characteristics of some source classes may vary significantly between countries. For example, the emission factors for industrial coal combustion are based on studies of relatively large boilers.

The Toolkit emission factors are progressively revised, and classifications expanded, as new data becomes available. An Expert Group has been established under the auspices of the Stockholm Convention for this purpose.[48]

Considering the above, the Stockholm Conventions Expert Panel has assigned each emission factor a data quality rating according to the following definitions – see Table 9 below.

Table 9: Rating of emission factors

Qualifier/Level of confidence Criteria	Criteria

[48] UNEP. 2008. *Toolkit Methodology* [Online]. Stockholm Convention. Available: http://chm.pops.int/Programmes/ToolKit/ProcessesProcedures/tabid/196-/language/en-US/Default.aspx [Accessed 30th November 2018].

High	Peer review Low data range Broad geographical coverage Assumptions and/or expert judgment are not required High stability of the process
Medium	Any combination of high and low criteria
Low	No peer review Wide data range Limited geographical coverage Extrapolation is needed e.g. EF derived from similar class Low stability of the process

For those responsible for collecting data with which to calculate activity rates for sources of emissions, and for deciding how to classify a source, it is recommended to review *Chapter 4 and Annex 8* of the UNEP Toolkit, both on Data Quality.

4.10.3 Significance of the Inventory Results

The results of most emission inventories have a significant degree of uncertainty, and this is especially so for dioxin inventories. The relatively high cost of dioxin measurements means that the amount of available emissions data is quite limited. In addition, where sources have been studied intensively the data shows that emissions can be highly variable. There are also large uncertainties in the activity data, especially for some of the more significant areas, e.g. open burning of landfills, domestic rubbish and open burning of agricultural residues, scrub and grasses.

The emission factors used in the inventories were taken mainly from the UNEP Toolkit, although a limited amount of local source testing was used to check on the relevance of the factors. Activity data were derived from international energy statistics.

Despite these uncertainties, the authors concluded that the results were still quite acceptable for use in decision making, especially when considered in conjunction with other related EU policy initiatives such as those relating to waste management and ambient air quality.

4.11 Dioxin Release Estimates by Source Category for Kiribati

4.11.1 General

Release estimates have been prepared for the following source categories in Kiribati:

Medical waste incineration
Open burning of municipal waste at landfills
Open burning of domestic waste
Household heating and cooking - Biomass (virgin wood)
Open burning of hazardous waste at landfills
Open burning accidental fires in cars, buildings, houses
Thermal wire reclamation and e-waste recycling
Open burning of agricultural residue
Open burning of green waste
Municipal solid waste incineration (airport)
Transport - petrol
Asphalt mixing
Composting
Household heating and cooking - Fossil fuels (LPG, kerosene)
Transport - diesel and power generation
Tobacco smoking
Smoke houses

Other sources covered in the UNEP Toolkit that are of little to no significance for Kiribati are also discussed. Activity rates and emission factors used for the estimates are discussed below.

To gather uPOPs information from the outer islands, they were sent a survey form – see Annex 2.

One important factor that needs to be raised is the methods that Emission Factors are dealt with in the POPs Toolkit for open burning of domestic refuse and green waste. These methods are probably not appropriate for atoll nations such as Kiribati.

Domestic refuse burning in atoll nations would not have as severe an impact as larger and more populous nations. In atoll nations, the land mass is generally small and narrow and subject to winds directed away from the source of the burning. This should result in a lower Emission Factor.

The burning of green waste does not have a direct Emission Factor as discussed in Section 4.11.2.4 below. An Emission Factor has, however, been calculated from other related activities.

The impacts of domestic and green waste burning are not that significant in the overall uPOPs calculation for Kiribati, but the uPOPs calculation process is on-going and as other larger sources of uPOPs are dealt with, then domestic and green waste burning may become significant. It would be useful, therefore if Emission Factors from the burning of domestic refuse and green waste are given special consideration for atoll nations.

4.11.2 Release Estimates for the Known Sources

4.11.2.1 Waste Incineration

Incineration of medical waste from the hospital on Tarawa is the second most significant source of uPOPs on Kiribati. Due to the inoperability of the new class 2 incinerator that was recently installed by the PACWASTE project incineration of medical waste in open drums has been adopted.

For airport / municipal waste incineration, a small quarantine incinerator operates at the agriculture site at the western end of South Tarawa. This incinerator is well located away from residences and staff at the Agricultural and Livestock Division of MELAD. The incinerator is a simple single-chamber unit, and combustion is manually initiated by simply igniting the waste. The incinerator has a stack, which helps direct smoke emitted. More efficient combustion could have been achieved by having the waste sit on a grill, with ventilation underneath for air to pass through.

The waste that is burned in this small incinerator is confined to small amounts of aircraft waste and waste that is impounded from flights by Custom's officials. The food waste from Fiji Air and Nauru Air flights are not left at Bonriki Airport (the Kiribati International Airport) but are returned to their points of origin. The only airline leaving food waste at Bonriki Airport is Solomon Airlines, which arrives once weekly, with the aircraft and crew staying overnight. Normally, there are only approximately 60 people on the aircraft, and the food waste represents the main waste being destroyed in the incinerator.

Various aid agencies have made several attempts to establish an effective clinical waste incinerator at Nawerewere Hospital, the main medical facility on South Tarawa, although these attempts have all failed, for a variety of reasons. The most recent incinerator was supplied under the SPREP PacWaste Programme, but it never operated successfully, and both burners and the control box are no longer operable. The incinerator's metal parts are also now quite corroded, as the location by the sea is a corrosive environment for metal. The location is also unsatisfactory from another point of view, namely, it is quite close to residential housing, and the prevailing wind blows in the direction of the residences.

Until an effective disposal method is found for clinical waste at Nawerewere Hospital, the waste is being burnt in steel drums at a remote location. These drums corrode regularly and need to be replaced. The odour from the drums is strong and unpleasant.

It is estimated that 12 full bags per day of clinical waste is produced from Nawerewere Hospital and that these bags weigh an average of 13 kg. This is only clinical waste and does not include pharmaceutical waste, which is accumulating.

There is also a small quarantine incinerator on Kiritimati Island, which is infrequently used as Fiji Air take waste food from their weekly flight back to Fiji with them. It is understood that this incinerator is, again, a simple single-chamber unit, like that used on South Tarawa.

The SPREP PacWaste Project provided a small two-chamber "Inciner8" incinerator to Kiritimati Island to be used for London Hospital's clinical waste. Unfortunately, it has never been commissioned, as the burners and control box went missing en-route to Kiritimati Island. There is potential for new components to be delivered, and for this incinerator to be commissioned, and this should be investigated. At present, the clinical waste is simply burnt at one of the landfills.

If incinerators are operated with best available techniques and the wastes are managed according to best environmental practices, dioxin and furan contaminated sites or hotspots should not be generated except for the deposits of fly ash and air pollution control residues which can still have relatively high levels of contamination. Experience has shown that incinerators, when not well-

operated and controlled, produce high levels of dioxin and furan emissions via air and residue and result in contaminated sites and hotspots.

Burning medical waste in open drums most closely approximates use of the lowest technology-type (lowest class) incinerator and consequently it can be assumed – with a high level of confidence – that they are emitting the highest levels of dioxin possible per volume of waste incinerated.

It should be noted that incineration of medical waste has one of the highest and therefore most significant emission factors in the uPOPS Tool kit; 40,000 µg TEQ/ton to air and 200 µg TEQ/tonne as residue. How medical waste is disposed of should therefore be given the highest priority in the NIP action plans.

4.11.2.2 Domestic Wood Burning

An activity rate for the category has been calculated using data from the 2015 Housing and Population Census[49]. Accordingly, 9772 of the 17,772 households in Kiribati use virgin wood biomass as their preferred fuel for cooking (see Photos 22 and 23). The average rate of wood consumption per day is estimated at 10 kg/household/day, resulting in a total mass of wood burned per day for cooking of 97720 kg per day (35,667,800 kg/yr) for the whole country.

The release factors given in the UNEP Toolkit are based on energy consumption rather than mass. To reflect the likely use of coconut shells as fuel, the Conventions Expert Panel recently revised their recommended factor for converting weight of biomass burnt to energy released from 12MJ/kg to 17MJ/kg.

Using the revised recommended conversion factor of 17 MJ /kg of energy released per kg of wood burnt, 35,667,800 kg of wood converts to 606.4 terajoules of energy released per year. Using the default emission factors of 100 µg TEQ/TJ of dioxin equivalent released to air and 0.1 µg TEQ/TJ released to residue, cooking on simple stoves with virgin wood contributes 1.3% (0.061 g TEQ) to the Kiribati Grand Total of 4.63 g/ TEQ.

Photos 22 and 23 – Domestic Wood Burning for Cooking

[49] 2016. 2015 POPULATION AND HOUSING CENSUS. Bairiki, Tarawa, Republic of Kiribati.

4.11.2.3 Domestic Rubbish Burning

Table 10: Open Burning of Domestic Waste

The 2015 Kiribati Population and Housing Census reports that 20% of all households in Kiribati prefer burning as their main form of solid waste disposal.

The World Bank estimates a waste generation rate of 0.86 kg/capita/day for Kiribati[50]. However, after visiting the landfills on South Tarawa and considering estimates provided by the Manager of those landfills, SPREP's lower rate of 0.5 kg/capita/day[51] was used.

Furthermore if those householders who prefer to burn their solid was from time to time also dispose of their solid waste by way of one or more of the six other methods surveyed (roadside collection, ground pit, community pit, beach, sea, other), then an estimate can be made that 50% of the SPREP lower rate may be burned. It is stressed that this is only an estimate based on limited knowledge of the situation and that it will be necessary in later total uPOPs calculations to arrive at a firmer figure.

The average number of persons per household is 5.8[52]. The following calculation can therefore be made (including for a reduction of 50% to allow for disposal of wastes by one of the other methods):

Open Burning of Domestic Waste (b3):		
Households that burn domestic waste (2015 Census):	3568	
Average persons per household (2015 Census):	5.8	
Domestic waste kg/day/person for Kiribati (SPREP, 2015):	**0.5**	kg/capita
	(World Bank 2016 rate of waste for Kiribati is 0.86kg/person/day)	
Waste burnt by households per year in Kiribati:	1888364	kg
	1888	tonnes

4.11.2.4 Open Burning of Green Waste

Table 11 – Open Burning of Green Waste

Open Burning of Green Waste (5a):		
Respondents who burn green waste (Clean School Report 2014):	42%	
Number of households on Kiribati	17,772	
Estimated number of households who burn green waste	7,464.24	
Estimated average volume burnt per month:	**1**	m3
Volume to weight conversion factor (Govt.WA Waste Authority.)	**0.15**	tonnes/ m3
	1120	tonnes

[50] KAZA, S., YAO, L., BHADA-TATA, P. & WOERDEN, F. V. 2018. What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. *Urban Development Series.* Washington, DC 20433: World Bank.

[51] LATU, K. **2016**. Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy 2016–2025. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme (SPREP), J-PRISM, EVR Environmental.

[52]

Estimating a Customised Emission Factor for the Open Burning of Green Waste

An initial assessment of national release inventories made with the UNEP Toolkit[53] has shown that open burning of biomass, such as forest, bush and grassland fires, burns in agriculture, and of waste are major sources of PCDD/PCDF in developing countries.

There are however no release factors given in the UNEP Toolkit for burning of domestic green waste. Based on nature of the wastes and the likely burning conditions, the emissions will be somewhere between the releases associated with domestic rubbish burning (e.g. 40 µg TEQ/tonne for emissions to air) and those due to the in-field burning of 'clean/non-impacted' agricultural residues (0.5 µg TEQ/tonne) for releases in residues. They will also be similar in some ways to the emission factor of open burning of wood wastes, e.g. on construction sites (60 µg TEQ/tonne).

Based on all the above, it was decided to use a release factor for green wastes of 10 µg TEQ/tonne for emissions to air.

Estimating an Activity Rate for the Open Burning of Green Waste

Without governments collecting data by way of household surveys / census, establishing an activity rate for opening burning of burning of green waste is challenging, anywhere. The best source of data found, reported that open burning of green waste was practised by 43% of respondents to a 2014 survey on household waste disposal practices[54].

To further inform estimate of household burning of green waste, a driving and walking survey was conducted over approximately half of South Tarawa. Measurements were made of burn piles and observations were made of the residues of burnt materials. It was then estimated that households burn approximately $1m^3$ waste per month.

Using a density conversion factor of 0.15[55] gives an estimated activity rate for green waste open burning of 1120 tonnes/year.

Driving/Walking Survey of Burn Sites – Data Quality

As mentioned above, a driving and walking survey was conducted over approximately half of South Tarawa. Measurements were made of burn piles and observations of the residues of burn materials.

The walking survey was however somewhat ineffective. It had been raining on-and-off in the days before the survey, and on the day itself, therefore all potential fuels for fires were damp and no fires were burning which, due to the lack of smoke, made identifying burn sites more difficult.

Furthermore, although several burn-sites were observed, access was not possible to most properties and therefore no meaningful count could be made, with which to estimate the proportion of households who might now and then burn green waste. It was also not possible to ascertain the frequency of burn events per burn-pile/per-household.

Since government employees can request access to each property and household, they can 1) identify how many households are engaging in open burning, 2) measure volumes of material, 3) estimate percentages of types of materials and 4) ask households how frequently they burn.

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[53] FIANI, E., KARL, U., UMLAUF, G., ASSUNÇÃO, J. V. D., KAKAREKA, S., FIEDLER, H., COSTNER, P. & WEBER, R. 2013. Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs
Stockholm: UNEP.

[54] TEAETE, R. 2014. Clean School Program report 2014 South Tarawa, Republic of Kiribati.

[55] 2009. Converting volumes to tonnes. The Government of Western Australia.

4.11.2.5 Fish Smoking

The UNEP Toolkit factor for releases to air from the production of smoked food using clean fuel is 6 µg TEQ/tonne of smoked product. For the purposes of this initial estimate, it will be assumed that the rate of smoked fish production is approximately double the rate of fuel use (i.e. 1 kg of fuel is needed to smoke 2 kg of fish).

It has not been possible to find data with which to estimate the number of smoke houses in Kiribati. It would, however, take a great number and high frequency of use to make any meaningful contribution to Kiribati total TEQ.

Ten smoke houses smoking twenty kilos of fish per week each makes smoke houses the least significant source of PCDD/PCDF releases in the Inventory.

4.11.2.6 Kerosene Combustion

The current Toolkit states that no PCDD/PCDF emission factors are available for kerosene when burned in airplanes as jet fuel.

Annual import data obtained from Kiribati Customs show that the total amount of kerosene and white spirits imported in 2018 was 4123 tonnes. While some of this may be used for cleaning purposes, the bulk of it is likely to be burned in kerosene lamps and spirit burners.

The most appropriate release factor for kerosene burning is that given in the UNEP Toolkit for household heating and cooking using oil-fired stoves; i.e. 10 µg TEQ/TJ for emissions to air. The Toolkit requires the kerosene quantities to be converted to an energy basis, which was done using a liquid density of 0.81 kg/litre and an energy content of 46 MJ/kg.

4123 tonnes of kerosene, burnt as a fuel for domestic cooking and heating, converts to 190 terajoules, releasing 0.002 µg TEQ to Kiribati environment, therefore making an insignificant contribution of the total TEQ for the country.

4.11.2.7 LPG Combustion

2018 customs records of yearly imports of butane (LPG) show 234 tonnes which, using a conversion factor of 46MJ/kg converts to 10.8 TJ/pa.

The 2015 Kiribati household survey shows that LPG was used by 882 (5%) of all 17,772 households. A reasonable estimate based on other Pacific locations average rate of use of 14.0 kg/month for cooking. Using the same rate for Kiribati it is estimated that a total consumption rate for cooking within the whole country is about 148 tonnes/year for households, the balance of 86 tonnes is assumed as consumed by restaurants and other industries. Using an energy content of 46 MJ/kg, then 234 tons of LPG = 10.8 Terajoules.

The release factors given in the UNEP Toolkit for domestic heating and cooking using LPG/Butane are a relatively insignificant 1.5 µg TEQ/TJ, emitted to air.

4.11.2.8 Petrol Combustion

Kiribati imported 8,647 tonnes of petrol in 2018. The UNEP Toolkit provides two emission factors for vehicles using unleaded petrol; 0.1 µg TEQ/tonne for 4-stroke engines, and 2.5 µg TEQ/tonne for 2-stroke engines.

With no vehicle registration data available for Kiribati, a visual estimate of the proportion of motorcycles to petrol-powered cars was made based on our observations of the number of

motorcycles compared with petrol cars. Observations were made each of the ten days the consulting team spent collecting data on South Tarawa, which included driving the length of the atoll's main road almost every day.

The difficulty of apportioning the total amount of petrol burned in Kiribati between 2-stroke (small motorcycles) and 4-stroke engines (cars) is further compounded by uncertainty of how much petrol a typical 2-stroke motorcycle engine burns relative to a 4-stroke car engine. Apportioning petrol consumption solely according to the numbers of each type of engine operate in Kiribati, even if those numbers were known, would not alone yield an accurate activity rate for each class of engine.

Vehicle import data for 2017 and half of 2018 was provided. With low level of confidence, it could be interpreted from this data that on average 77% of all petrol-powered vehicles that were imported in those years were motorcycles. This does not indicate that 77% of petrol-powered vehicles in Kiribati are motorcycles. Data covering the typical life expectancies of cars and motorcycles (e.g. ten or more years) would need to be analysed to make an estimate of the ratio of motorcycles to petrol-powered cars.

Therefore, based on visual observations, with low level of confidence, it is estimated that 35% of petrol consumption is by 2-stroke engines, the remainder to 4-stroke.

Catalytic converters help reduce dioxin emissions. Most vehicles on Kiribati are quite old and, given that catalytic converters typically last approximately 10 years or 160,000 kilometres, it was assumed that most cars in Kiribati to have relatively ineffective catalytic[1] converters. An EF of 0.1 µg TEQ per tonne per annum to air was therefore applied, appropriate to petrol burned in four-stroke engines without catalytic converters.

With 35% of petrol consumption in 2-stroke engines without catalytic converters and 65% in 4-stroke engines without catalytic converters, transportation, including all diesel burned in Kiribati, there is a contribution from petrol engines of only 0.18% to the Grand Total TEQ. Were *all* petrol consumed in Kiribati to be burned in 2-stroke engines without catalytic converters, transportation would contribute only 0.25% to the Kiribati Grand Total TEQ.

4.11.2.9 Diesel Combustion (Transport and Power Generation)

The 2018 import data for diesel indicates a rate of consumption of diesel for Kiribati of just over 7.3 tonnes, the bulk of this being consumed by the PUB power station diesel generators, the remainder in transport.

To estimate the releases from transport sources and power generation, using a density conversion factor of 0.85 kg/litre, the UNEP Toolkit factor for emissions to air from diesel combustion is 0.1 µg TEQ/tonne.

4.11.2.10 Landfill Fires

In the UNEP uPOPs Toolkit, landfill fires have a relatively high emission factor. In practice, they can have huge activity rates.

Landfill fires are clearly a very potent source of uPOPs in Kiribati. Even using conservative estimates with which to calculate their activity rate, open burning of municipal waste on landfills contribute 36.35% of Kiribati total TEQ.

[1] NZTA 2018. Vehicle emissions prediction model (VEPM 5.3) user guide. Wellington.

Landfill fires have occurred occasionally at the three landfills on South Tarawa, although last year they occurred only twice; once each at the Betio and Nanikai landfills. On Kiritimati some landfills are reported to burn almost continuously or at least very frequently.

Such fires tend to destroy a large part of the waste that sits on top of the landfill, but not the waste below ground level. With assistance from the Manager of those landfills we estimated that the fires destroyed approximately 50% of the annual waste coming into the Betio Landfill and approximately 30% of waste coming into the Nanekai Landfill per year, therefore about 25% waste going to all landfills[56] in Kiribati to have been destroyed by open burning in 2018.

No weighbridges are situated at any of the landfills to weigh waste coming in but, using World Bank and SPREP estimates of annual weights of waste arriving at landfills in Kiribati have been made.

Currently contributing 36.35% to the country total TEQ, landfill open burning of municipal waste could contribute a lot more PCDD/PCDF releases to the environment if landfill burning rates increase.

On Kiritimati Island the KUC operates three dumping areas for domestic waste. They also operate a remote dumping area for hazardous waste. The three dumping areas are not managed or controlled, and fires often burn there for long periods. Quantities of waste dumped at the three dumps on Kiritimati Island are not known. The quantity of waste dumped on Kiritimati can be estimated by calculating the per capital volume of waste dumped for Tarawa and multiplying that rate by the population on Kiritimati (6,456[57]).

The burning of waste on Kiritimati has been an active KUC policy in the past, to reduce waste quantities, and this also represents a significant source of uPOPs in Kiribati.

Waste management on all the outer islands is not carried out in a formal way, and usually the waste materials that cannot be reused on the islands are simply burnt, with the non-combustible materials accumulated at dump sites. Therefore, it is estimated that at least some hazardous waste is being burnt in landfills that are un-patrolled and estimated 0.25% of all waste destroyed by open burning at landfills to be hazardous waste. There is a low level of confidence in this activity rate.

Because some landfills (official and unofficial) are unsupervised, we have estimated that of all the landfills destroyed by open burning in Kiribati, some of it is likely to be hazardous. Because there are currently no emission factors for open burning of hazardous waste at landfills we have estimated a customised emission factor of 1/10th of those assigned to the incineration of hazardous waste. This is in line with the 10:1 ratio between emission factors for incineration of domestic waste and emission factors for open burning of landfill waste (also largely domestic waste), the two varying in nature mainly in terms of density of compaction and moisture content.

The UNEP Toolkit factor for releases to air from landfill fires is 1000 µg TEQ/tonne of wastes and there is a medium level of confidence in these estimates of an activity rate for open burning at landfills.

4.11.2.13 Accidental House & Vehicle Fires

In 2018 Kiribati experienced four accidental fires in vehicles and five in houses. The UNEP Toolkit factors for releases from house fires are 400 µg TEQ/tonne for releases to air and 400 µg TEQ/incident for releases to land, and the factors for vehicle fires are 94 µg TEQ/incident for releases to air and 18 µg TEQ/incident for releases in residues.

[56] World Bank estimate that 38% of total waste generated per capita in Kiribati is collected and goes to landfill.
[57] 2016. 2015 POPULATION AND HOUSING CENSUS. Bairiki, Tarawa, Republic of Kiribati.

Due to there being very few studies and a large range of resulting data from those few studies, and that the burning processes themselves are not stable, the emissions factors for house and vehicle fires are given by the Toolkit with a low level of confidence.

4.11.2.14 Tobacco Smoking

2018 import statistics confirm annual consumption rates for tobacco products as 1744 tonnes of cigarettes and 131 tonnes of loose tobacco. This gives a total annual consumption rate for all tobacco products of 1875 tonnes total. The UNEP Toolkit factor for releases to air from tobacco smoking is 0.1 µg TEQ per million cigarettes. Tobacco smoking contributes very little (0.1%) to the Kiribati Total TEQ.

4.11.2.15 Other Possible Sources

In the category of thermal wire reclamation and e-waste recycling, a release estimate has been made for open burning of cable because it is known to happen in Kiribati as individuals seek to reclaim valuable copper from old electrical cables. We assume some printed circuit boards are burnt each year, but no data is available, hence an estimate of 1 ton per annum per class item has been made, but with a low level of confidence as to the accuracy of our estimate.

An activity rate for asphalt mixing has been estimated by measuring the width of the newly sealed road on South Tarawa, multiplying its width by length by an estimated thickness of 100mm. This resulted in a total weight of asphalt mix of 48,384 tonnes[58].

Asphalt mixing has an emission factor of only 0.1 µg TEQ per tonne, so it makes a negligible contribution of 0.07% to overall dioxin releases, minute when compared to some of the more significant sources such as medical waste incineration and open burning at landfills.

4.11.2.16 Used Oil

Used oil is also dealt with in Section 3.13 above. Apart from used oil produced at the PUB Power Stations, used oil is not currently being removed from Kiribati. During storage and handling, diffuse emissions may occur.

Contamination of the environment has also resulted from significant spills at both PUB power stations. Improper disposal may result in contamination of land or water. It can be assumed that a site- or process-specific evaluation must be performed. Presently, no emission factors are known for any release vectors for waste oil.

4.11.2.17 Contaminated Sites

This matter is also dealt with in Section 3.17 above. Most categories of site contamination covered by the Toolkit are not relevant to Kiribati, but incineration is relevant, from site contamination at the hospital site of open burning of medical waste. Experience has shown that incinerators which are not well operated and controlled can emit high levels of dioxin and result in contaminated sites or hotspots.

To determine how much dioxin contamination is present in land and water at a contaminated site, a site-specific evaluation is necessary.

[58] https://www.aqua-calc.com/calculate/volume-to-weight/substance/concrete-coma-and-blank-asphalt

4.11.3 Source Categories Assessed as Not Applicable or Not Significant

No release estimates have been made for the following Toolkit Source Categories because the activities do not take place in Kiribati:

- Ferrous and non-ferrous metal production (including the melting of scrap metal, but excluding open burning of cable for recovery of copper, as noted above, and circuit boards); Production of mineral products; production of chemicals and consumer goods;
- Biomass drying;
- Crematoria;
- Discharges from municipal wastewater treatment plants.

4.12 The Kiribati Dioxin Inventory

4.12.1 Inventory Results

In the 2014 draft NIP, the four most significant sources of dioxin releases for Kiribati were reported as:

- Medical/quarantine waste incineration – 14 tonnes per annum, giving 0.560g TEQ emissions to air and 0.003g TEQ residue
- Cooking with virgin wood/biomass fired stoves - 2,563 TJ p.a., releasing 0.256 TEQ to air
- Agricultural residue burning (in field), not impacted (cleaning up bush) 36,702 tonnes p.a., releasing 0.018g TEQ to air and 0.367g TEQ to land
- Uncontrolled domestic waste burning – 219 tonnes p.a., releasing 0.066g TEQ to air and 0.131g TEQ to land.
- Together these accounted for 99% of the total dioxin releases to air and in residues.

Table 12 - 2014 Summary Table of Dioxin Source Groups for Kiribati

Cat.	Source Categories	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	0.6	0.0	0.0	0.0	0.0
2	Ferrous and Non-Ferrous Metal Production	0.0	0.0	0.0	0.0	0.0
3	Heat and Power Generation	0.3	0.0	0.0	0.0	0.0
4	Production of Mineral Products	0.0	0.0	0.0	0.0	0.0
5	Transportation	0.0	0.0	0.0	0.0	0.0
6	Uncontrolled Combustion Processes	0.1	0.0	0.5	0.0	0.0
7	Production of Chemicals and Consumer Goods	0.0	0.0	0.0	0.0	0.0
8	Miscellaneous	0.0	0.0	0.0	0.0	0.0
9	Disposal/Landfill	0.0	0.0	0.0	0.0	0.0
10	Identification of Potential Hot-Spots					
1-9	**Total**	**0.9**	**0.0**	**0.5**	**0.0**	**0.0**
	Grand Total	**1.4**				

In his 2010 Dioxin Inventory[59] for another Pacific country (Cook Islands), Dr Bruce Graham discussed and qualified the significance of his results, pointing out that nearly *all* emission inventories have significant degrees of uncertainty, and that this is *especially* true for dioxin inventories. The relatively high cost of laboratory testing for dioxins limits the amount of available emissions data for dioxins. In addition, even where sources have been studied intensively, the data shows that the

[59] GRAHAM, B. 2010. Dioxin Inventory for the Cook Islands, 2010. Cook Islands National Environment Service.

quantities of emissions can be highly variable. Furthermore, many dioxin-producing processes are unstable and therefore make processes that could be called similar quite different.

Furthermore, in 2014, according to the Stockholm Convention's uPOPs Toolkit[60], there were, and continue to be, large uncertainties in the reliability of some activity rate data and emissions factors, especially in Source Group 6, Open Burning Processes, which includes domestic rubbish burning, burning of green waste, fires at official and unofficial waste dumps.

Therefore, due either to changes made by the Stockholm Convention's Expert Panel to emissions factors (EFs), or because of improvements to the quality of data with which activity rates are calculated for a source class, some estimates, and therefore relative percentages in this report, differ significantly from those reported in the 2014 Dioxin Inventory and 2014 NIP.

The 2018 dioxin percentages are presented in Figure 3 below and the quantities are given in Tables 12 and 13 below. More detail is given in Annex 5.

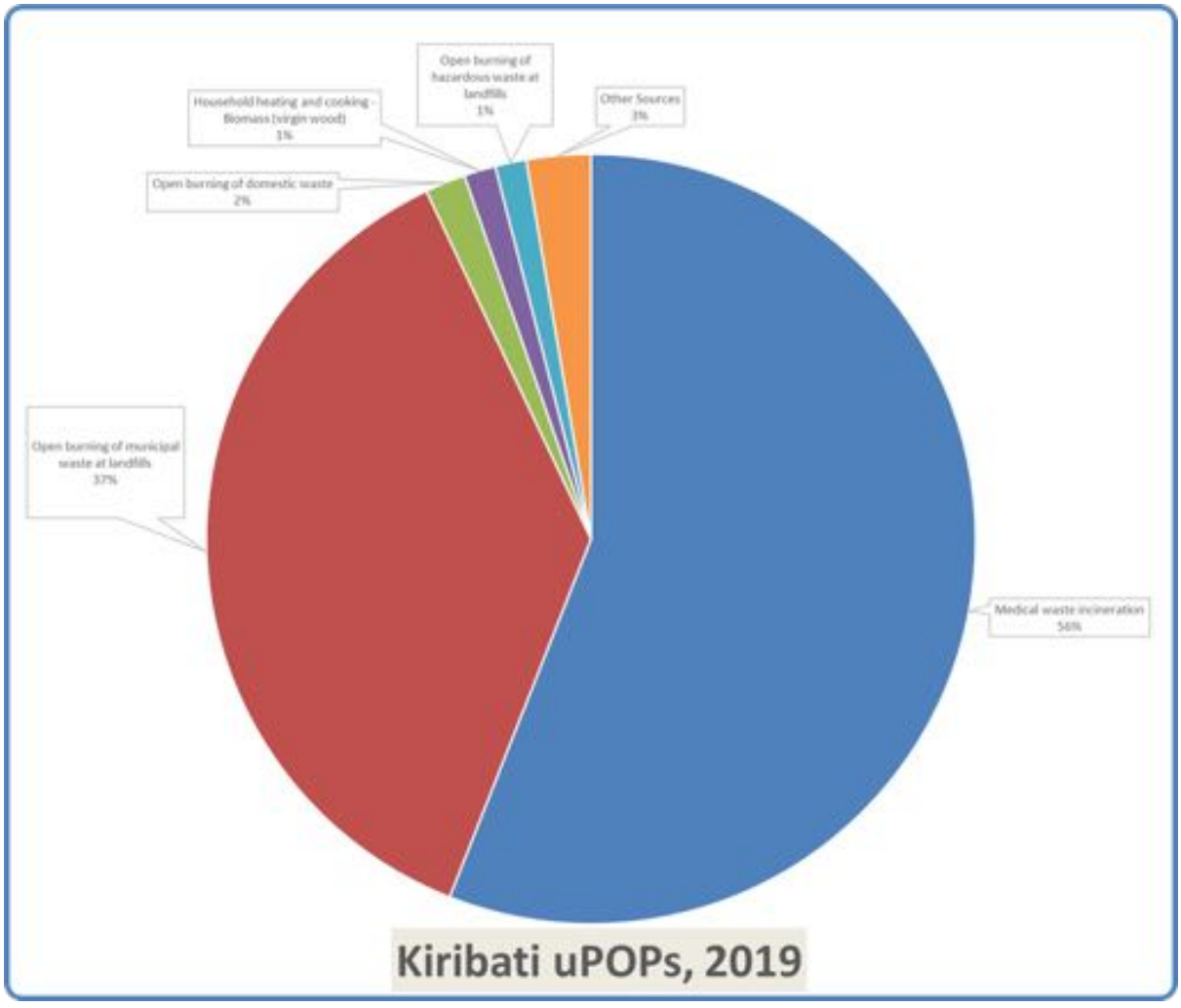


Figure 3 – 2018 Dioxin Sources, Pie Chart

[60] 2014. National Implementation Plan, Stockholm Convention on Persistent Organic Pollutants, Republic of Kiribati. Kiribati: MELAD.

Table 13 - 2018 Summary Table of Dioxin Sources by Groups

		Annual Releases (g TEQ/a)				
Group no.	Source Groups Name	Air	Water	Land	Product	Residue
1	Waste Incineration	2.547468	0.000	0.000	0.000	0.013
2	Ferrous and Non-Ferrous Metal Production	0.024100	0.000	0.000	0.000	0.000
3	Heat and Power Generation	0.062548	0.000	0.000	0.000	0.000001
4	Production of Mineral Products	0.003387	0.000	0.000	0.000	0.000
5	Transportation	0.008862	0.000	0.000	0.000	0.000
6	Open Burning Processes	1.803216	0.000	0.091	0.000	0.000
7	Production of Chemicals and Consumer Goods	0.000000	0.000	0.000	0.000	0.000
8	Miscellaneous	0.000250	0.000	0.000	0.000	0.000
9	Disposal	0.000000	0.000	0.000	0.003	0.000
10	Identification of Potential Hot-Spots				0.000	0.000
	Total per Release Vector (g TEQ/a)	**4.450**	**0.000**	**0.091**	**0.003**	**0.013**
	Grand Total (g TEQ/a)	**4.56**				

Table 14 - 2018 Summary Table of Dioxin Sources by Categories

4.12.2 Discussion of Inventory Results

Article 5, paragraph (a) (i) of the Stockholm Convention requires that Parties evaluate current and projected releases, including the development and maintenance of source inventories and release estimates of chemicals listed in Annex C, Part I, taking into consideration the source categories identified in Annex C, Part II and III, of the Convention.

In practice, this means that Parties must prepare their initial release estimates and update these estimates at regular intervals - every five years, for example. Parties may also find it necessary to revise their initial and subsequent estimates to establish and maintain the consistency necessary for discerning meaningful trends in releases over time and evaluate the efficacy of the adopted strategies for minimizing and/or eliminating PCDD/PCDF and other unintentional POPs releases[61].

It is important that previous inventories be revised using new or revised emission factors and new source categories and classes. Specific national factors, such as numbers of tourists, should also be reviewed and incorporated.

Revised emission factors have become available as have new source categories and classes and these have been included in our 2018 Kiribati uPOPs National Inventory.

In other Pacific Island countries, an important and ongoing change to an activity rate – incineration of quarantine and de-planed waste - is driven proportionally by increasing numbers of arrivals at international airports.

Currently, all international flights, except for Solomon Airlines, do not leave their in-flight-generated waste at Bonriki international airport. Therefore, far less de-planed waste is incinerated in the small quarantine incinerator that operates at the agriculture site at the western end of South Tarawa. The relevant Source Category, Municipal Waste Incineration, contributes just 0.16% of the dioxin released into the Kiribati environment.

However, were all international flights to de-plane their waste in Kiribati, at the current rate of arrivals, let alone any projected growth in tourism, the activity rate for the quarantine incinerator would rise proportionately.

Most notable is the 2013 Toolkit's reduction of the default emission factor for domestic waste burning from 300 µg TEQ/tonne to 40 µg TEQ/tonne to air. In 2014, the rates for open burning of domestic waste were given as 219 tonnes/annum giving 0.066g TEQ to air and 0.131g TEQ to land. There is no information on how the 2014 activity rate for open burning of domestic waste was established.

However, in the spirit of the obligation on Parties to the Convention to revise previous NIPs, working backwards to update the previous Inventory with new default factors and applying the new default emission factor of 40 µg TEQ/tonne to the 2014 activity rate of 219 ton[ne]s per annum, open burning of domestic waste would have produced just 0.01 µg TEQ to air and almost nothing to land and therefore 'disappeared' into the 2% mix of other sources.

However, with the new reduced default emission factor applied and using what is now consideed a more realistic estimated activity rate, open burning of domestic waste contributes 0.15 µg TEQ to air and 0.004 µg TEQ to land and contributes 3% to the Kiribati Grand Total TEQ.

[61] FIANI, E., KARL, U., UMLAUF, G., ASSUNÇÃO, J. V. D., KAKAREKA, S., FIEDLER, H., COSTNER, P. & WEBER, R. 2013. Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs
Stockholm: UNEP.

Having collected new data and information, and reviewed all sources to reflect the current situation, it would be appropriate to look back at how the 2014 Inventory should have been calculated. This would be so that Parties can establish consistent trends in releases over time. However, as the 2104 draft NIP gave no transparency regarding its data sources and data quality, it is impossible to check or comment on what may or may not have changed and how such changes might have affected its activity rates. Furthermore, the 2014 NIP was not formally submitted to the Stockholm Convention, hence is not registered with UNEP and cannot be used as an official base-line to reference the 2018 uPOPs Inventory.

Articles 5(d) and (e) of the Stockholm Convention requires parties to promote or regulate the application of best available techniques and best environmental practices (BAT/BEP) to both new and existing sources of dioxins and other unintentional POPs. The more stringent provision to regulate BAT/BEP only applies to new sources in the categories listed in Annex C, Part II, (refer the list of sources given previously in section 2.4).

The requirement to *regulate* the application of BAT/BEP regarding Open Burning at Landfills, Incineration of Medical Waste and Open Burning of Domestic Waste is relevant to Kiribati. For all other sources identified in the Inventory, the main requirement under the Convention is simply to *promote* the use of BAT/BEP. This approach is consistent with the various options noted above for minimising releases from the main sources (other than incineration and open burning).

5.0 Strategy and Action Plan Elements of the National Implementation Plan

5.1 National Issues

The following matters are relevant at a national level, regarding the preparation of a suitable NIP Strategy and Action Plan.

- High-level strategies which explicitly address uPOPs management are required to successfully reduce uPOPs emissions at the national level. This includes development and enforcement of national policies, strategies, plans and legislation, and strengthening of institutional arrangements to support and promote best practice waste management, including uPOPs emission reduction. Regular collection, collation and release of data related to uPOPs management practices is also critical to this process.

- Implementation of best practice occupational health and safety measures are also needed for formal and informal workers in the waste management sectors and improved public awareness of the health impacts of uPOPs are priority management initiatives for national uPOPs reductions. This includes dissemination of information about resource recovery programmes that increase e-waste recycling and composting rates and reduce backyard burning.

- Additional Information is needed on the state of knowledge on stockpiles, contaminated sites and wastes, identification, likely numbers, relevant regulations, guidance, remediation measures, and data on releases from sites.

- Work is needed to promote awareness, and education among target groups; existing systems to communicate such information to the various groups.

- As a country that does not produce chemicals, Kiribati has no plans to intentionally produce any of the POPs chemicals. In addition, Kiribati does not have any plans to import any of these chemicals for use or release in the country and as such no exemptions are required.

- There are very limited existing programmes for monitoring releases and environmental and human health impacts, including findings. The POPs Global Monitoring Plan (GMP) II analyses several receptors such as water, ambient air, fish, breastmilk but this will terminate in 2020. A similar monitoring programme will be needed to take its place. This will be important for such matters as the management of PBDE-containing wastes that end up in the landfill.

- Kiribati attends Stockholm Convention COP meetings where the national status of chemical management is disseminated. However, a more integrated mechanism to manage Stockholm Convention requirements is required.

5.2 Technical Infrastructure

Kiribati has no suitable laboratory to test for POPs. Existing small-scale laboratory tests are undertaken at national health (pathology) and water testing laboratories. Analytical facilities for the analysis of POPs are available in Fiji (USP), Australia or New Zealand. A small facility should be established to manage sampling, packaging and off-shore shipment of collected POPs samples. On-

going training should be provided to a selected number of Officers with an appropriate background to help build the national basis of pesticide monitoring expertise in the country. Kiribati should continue to engage and participate in the Global Monitoring Programme (GMP).

There is currently no infrastructure to manage and destroy POPs in Kiribati. All materials for future disposal or destruction would need to be shipped to Australia or New Zealand.

5.3 Impacts of POPs

The potential threat posed to Kiribati from POPs is expected to be extremely low due to the absence of these chemicals in the country. Improved management of incinerator operation, together with reductions in burning of municipal waste at landfills would reduce this exposure still further.

5.4 Assessment and listing of new and existing chemicals

The relatively small number of chemicals being imported into Kiribati could be regulated relatively easily and this should be a government priority. The opportunity now exists to set up a system in Kiribati that manages the importing and use of all chemicals. A system is needed under Article 3 of the Convention to prevent the importing of any POPs chemicals, so this system could be broadened to regulate the importing of other hazardous substances. This system could be controlled by a Hazardous Substances Board.

Kiribati could adopt a hazardous substances classification system based on a modified GHS system. This would in turn allow a more effective control on imports and also for an effective system of controls to be put in place.

5.5 Implementation Status

Kiribati developed its first NIP in 2014 to address the management of the 12 initial POPs. This NIP was not formally submitted to UNEP and should therefore be regarded as unofficial.

This current NIP represents the first update to the initial NIP and it covers the 28 POPs chemicals listed under the Stockholm Convention to date.

5.6 Policy Statement

The Kiribati Government recognises the national and global environmental and public health risks of POPs and other hazardous chemicals and wastes and is committed to taking national action to reduce and eliminate the consumption and unintentional releases of these chemicals, in accordance with its obligation as a Party to the Stockholm Convention, and its responsibility as a global citizen.

The Kiribati Government also recognises that economic development will likely lead to an increase in the importation of chemicals and articles potentially containing POPs, and if improperly managed, chemicals will potentially have immediate and prolonged adverse impacts to the national environment and health of Kiribati. Faced with these realities, Kiribati believes that a core focus of the NIP must be to improve the management of all chemicals and wastes in the country, to protect human health and the environment. The revision and subsequent implementation of this NIP helps to achieve a clear pathway for the management of POPs and all other hazardous substances and thereby reduce the potential economic and environmental costs that result from their mismanagement.

The Government is committed to the implementation of this NIP through the lead agency, MELAD. The Government endorses this NIP to reaffirm its commitment to addressing the national management of POPs in accordance with its obligations under the Stockholm Convention. Timely

implementation of the actions and priorities in the NIP in partnership with stakeholders will contribute to progress under the Kiribati Development Plan (KDP) 2016-2019, to allow the people of Kiribati to:

"Enjoy the highest quality of life consistent with the aspirations of our people, and in harmony with our culture and environment"

5.7 Key Strategies

The implementation of this NIP is based around six key strategies as detailed below.

Strategy 1: Create appropriate legal and institutional frameworks to manage POPs.
Kiribati requires a modern legal and institutional framework that could provide the basis for complying with national obligations under the Stockholm Convention. This strategy presents measures to: prohibit the importation, manufacture and use of Annex A POPs; better regulate the importation, distribution and use of all hazardous substances; regulate, manage and minimise waste incineration and open burning processes; and provide greater oversight and coordination of national chemicals management.

Strategy 2: Improve data collection and management of POPs.
While this NIP has identified minor sources and quantities of POPs in Kiribati, further work is still needed to identify and quantify additional sources of POPs, particularly those contained in waste disposal sites and from far-flung sources. Accurate and updated data helps to inform policy- and decision-making and provides the basis for monitoring the effectiveness of such policies and decisions. Improved data also helps Kiribati to meet its reporting obligations under the Stockholm Convention and other wastes and chemicals conventions. Moreover, appropriately interpreted data and information underpins the transfer of information in appropriate and easy-to-understand formats to target groups under Strategy 5.

Strategy 3: Institute sound management of POPs.
The sound management of POPs is key to minimising, and ultimately avoiding, the adverse health, environmental, and economic impacts associated with mismanagement of POPs. This strategy seeks to ensure the implementation of best practices to reduce, and where possible eliminate, the environmental release of POPs and other hazardous chemicals. It addresses the entire chemical management chain, from importation, through to transportation, storage, use, and disposal.

Strategy 4: Develop national human capacity for POPs management.
The management of POPs and other chemicals is a specialised and sometimes technical area, which requires knowledgeable and capable human resources to effectively implement management strategies and sustain successful implementation outcomes. This strategy seeks to develop a critical mass of human capacity in a range of sectors involved in POPs chemicals management including health, environment, waste, and customs services. Human capacity needs to be developed not only in technical aspects of POPs and other chemicals management, but also in areas such as environmental communications, environmental project management, contract management, project/program monitoring and evaluation. This requires targeted short- to medium-term capacity development activities, supported by longer-term activities that seek to embed capacity development in relevant subject matters into the culture of responsible institutions and organisations.

Strategy 5: Raise stakeholder awareness levels for POPs management.
Full cooperation and participation of stakeholders in POPs management initiatives is critical to the success of such initiatives. People are more likely to support and comply with laws, procedures,

guidelines, and requirements for POPs management if they understand the consequences of action and lack of action and the personal impact of those consequences. This requires targeted short- to medium-term awareness campaigns supported by longer-term initiatives that embed good practice implementation into the national culture, until best practice implementation becomes routine, accepted practice.

Strategy 6: Improve implementation, monitoring, evaluation and reporting of NIP activities.
Many of the activities of the previous Kiribati NIP have not been implemented. This strategy seeks to address some of the previous implementation issues, for example, by requiring NIP activities to be embedded into the corporate work plans and budgets of relevant government departments and agencies, and by requiring implementation of awareness campaigns targeting politicians, Ministry of Finance officials, and other high-level decision makers and potential champions.

These six strategies have been used to shape eight action plans, which are described in detail in the subsequent sections.

5.8 Action Plans

5.8.1 General

5.8.1.1 Pesticides

There are 15 POPs pesticides, namely Aldrin, Chlordane, Chlordecone, Dieldrin, DDT, Endrin, Heptaclor, Hexachlorobenzene (HCB), the three Hexachlorocyclohexane (HCH) stereoisomers (α-HCH, β-HCH, and ɣ-HCH or Lindane), Mirex, Pentachlorophenol (PCP), Endosulphan and Toxaphene. None of these pesticides is currently being used in Kiribati. Based on anecdotal reports, DDT, Chlordane, Dieldrin and Lindane were all used prior to 1980 but very little if any of these pesticides have been used since.

There are therefore only likely to be traces of POPs pesticides in the environment as even with half-life considerations, in nearly 40 years, the results of any spills or releases into the environment will have very largely disappeared by degradation. We do not therefore consider that an Action Plan is needed for only for these POPs pesticides.

There are, however, some other pesticides being used in Kiribati and there have been a number of problems identified with these pesticides. Even though they are not POPs pesticides, it is considered that an Action Plan is needed to deal with pesticide use in general, as well as other hazardous substances. It is possible that some of the pesticides currently in use may become POPs pesticides in the future.

5.8.1.2 Other POPs

There are 13 other POPs, and two of these are produced unintentionally, namely dioxins and furans. Five of the other POPs are also produced unintentionally as well as intentionally, namely PCBs, PCNs, HCB, PeCB and HCBD. An Action Plan is needed for uPOPs.

The remaining eleven POPs and their implications for Kiribati are as follows:

- Three of the other POPs are really five POPs or perhaps one group of POPs. They are:
    - Decabromodiphenyl Ether (c-decaBDE)
    - Hexabromodiphenyl Ether and Heptabromodiphenyl Ether
    - Tetrabromodiphenyl Ether and Pentabromodiphenyl Ether

  These POPs and other related bromophenyl ethers can all be classified under Polybromodiphenyl Ethers (PBDEs). The POP-PBDEs are the five ones above. POPs-PBDEs need an Action Plan as they were commonly used for many purposes and especially as fire retardants. A large proportion of the items they were used on have ended up in various disposal locations which are therefore likely reservoirs of PBDEs.

- Hexabromobiphenyl (HBB) - This an old flame retardant that was never produced in large amounts and has not been produced since 1976. Due to the similarity in use between HBB and POP-PBDE, any minor amount of HBB that may be present will be addressed through national POP-PBDE management measures and can be covered under the same Action Plan.

- Hexabromocyclododecane (HBCD) – This may be in landfills as it has been widely used as a fire retardant for various forms of polystyrene and especially expandable polystyrene. It is still being produced. At the end of their service life, products containing HBCD are likely to

be disposed of in landfills, so again, improved waste management practices to address PBDEs will also deal with HBCD and can be covered under the same Action Plan.

- Hexachlorobutadiene (HCBD) – This was produced intentionally from a by-product generated during the manufacture of chlorinated solvents, and unintentionally during the production of certain organochlorines. It is very unlikely to be present in Kiribati.

- Pentachlorobenzene (PeCB) – Its manufacture ceased decades ago and the pesticides it was involved with as an intermediate were not used in Kiribati. It is therefore of little relevance to Kiribati.

- Polychlorinated Biphenyls (PCBs) – These are industrial chemicals previously widely used as coolants and lubricants in electrical equipment (such as transformers and capacitors), hydraulic fluids, and additives in paint, carbonless copy paper, plasticisers and dye carriers. PCBs were produced in several countries and most production was phased out by the 1990s. They have been found in Kiribati and there are several old transformers that have not been tested for PCBs. A PCB Action Plan is needed.

- Polychlorinated Napthalenes (PCNs) – These have not been produced or used for over 30 years and it can be assumed that most PCN-containing products with short lifetimes (e.g. textiles, papers, lubricants, cutting oils and grease) have already been disposed of. Because of their widespread use and persistence, PCNs will probably be present in Kiribati at very low levels. Their earlier widespread use will mean they are probably present in breakdown products from old waste dumping areas. Probably the most likely source in Kiribati is from their earlier widespread use as insulating coatings for old electrical wires. There is a practice in many countries, and probably in Kiribati, of burning electrical wiring. Again, improved waste management practices to address PBDEs will also deal with PCNs, and they can be covered under the same Action Plan, which also needs to cover off on burning old copper wires.

- Short-Chain Chlorinated Paraffins (SCCPs) – These have been used since the 1930s as a plasticizer in rubber, sealants, coatings, textiles, leather fat, paints, adhesives, flame retardants for plastics, and high-pressure lubricants. Production has decreased globally but they are still produced. Their earlier widespread use will mean they are probably also present in breakdown products from old waste dumping areas. Again, improved waste management practices to address PBDEs will also deal with SCCNs, and they can be covered under the same Action Plan.

- Perfluorooctane Sulfonic Acid (PFOS) and salts including PFOS-F – These chemicals are part of a wider group of chemicals known as Perfluoroalkyl sulfonic acid (PFAS) and a range of associated products. Current uses include electric and electronic parts, fire-fighting foam, medical equipment, hydraulic fluids, toners, printing inks, coatings and coating additives, and in textiles and upholstery for their water and oil repellent properties. PFOS / PFAS is still produced in several countries. The use as fire-fighting foam has been a significant issue and fire training grounds throughout the world have become a focus of environmental clean-ups. Kiribati has quite large quantities of Fire-fighting foams which do not contain PFOS but do contain related persistent fluorinated compounds. This can be dealt with in the overall hazardous substances Action Plan, which should also address the purchase of new foam materials.

5.8.1.3 Action Plans

Separate Action Plans can therefore be made for PCBs, POP-PBDEs (including HBB, HBCD, PCNs and SCCPs), and uPOPs. The POPs-PBDEs Action Plan will also deal with future waste management, including recycling.

The uPOPs Action Plan will also deal with incineration and renewable energy, as well as link to waste management.

In addition, a Hazardous Substances Action Plan will focus on the management of hazardous substances with a focus on pesticides, laboratory chemicals, and hazardous wastes.

A separate plan will be prepared for contaminated sites, used oil and related matters.

Three administrative Action Plans also address "institutional and regulatory strengthening", "public awareness, information and training", and "monitoring, evaluation and reporting".

The eight action plans are therefore:

1) Institutional and Regulatory Strengthening Action Plan
2) PCB Management Plan
3) POP-PBDEs and Waste Management Action Plan (which will also address HBB, HBCD, PCNs and SCCPs)
4) Hazardous Substances Action Plan which will also cover PFOS/PFAS.
5) uPOPs Action Plan
6) Contaminated Sites and Used Oil Action Plan
7) Public Awareness, Information and Training Action Plan
8) Monitoring, Evaluation and Reporting Action Plan

The action plans have been prepared on the following basis.

i) POPs are the focus but real achievements with POPs cannot be obtained without some progress on several other related areas.
j) The main related areas are waste management and hazardous substances management.
k) Other related areas are composting, used oil, renewable energy, recycling including e-waste, laboratory chemicals, hazardous waste, incineration, and the broader issues relating to contaminated site management and marine pollution.
l) There is an opportunity to achieve real progress in these related areas.
m) The overall cost of the action plans over 5 years is $US3.486M which is a substantial increase on the 2014 amount of $1.615M. It is expected, however, that many of these related issues may also be assisted with funding from other sources, rather than relying on funds arising entirely out of the Stockholm Convention Secretariat.
n) Management of the numerous strands of work will be a difficult and time-consuming exercise. If this management falters in any way the whole programme will be stalled. It is therefore considered necessary for MELAD to adopt a special focus for this project.
o) It is also thought necessary for an international project management company to be engaged from the outset and retained for the five-year duration, including regular interventions, reporting and audits, and ongoing availability for advice and support.
p) It should also be noted that as well as the Stockholm Convention, other international obligations can also be assisted by the action plans that have been set out below, including the Basel and Waigani Conventions, the Rotterdam Convention, the Montreal Protocol, MARPOL requirements, the London Convention and the Paris Agreement on Climate

Change. It makes considerable sense to achieve some coordination of these various international requirements.

5.8.1.4 Action Plan Cost Summary

Eight Action Plans (AP1 to AP8) totalling approximately $US3.30 million have been identified in this NIP, to enable the Kiribati Government to meet its obligations as a Party to the Stockholm Convention (Table 15). As part of the annual work planning and budgeting process, MELAD will select relevant Action Plan items to be implemented in the financial year, and endeavour to incorporate these items into its annual work programme and budget. Where external funding assistance is necessary due to lack of national funding, MELAD will prepare funding proposals with assistance from regional organisations including SPREP to be submitted to the donor community. A summary of the total action plan costs is shown in Table 16.

Table 15: Summary of Action Plans to implement the revised NIP

Action Plan	NIP Component
AP1	Institutional and regulatory strengthening measures
AP2	Identification and disposal of PCBs and equipment containing PCBs
AP3	Identification and appropriate management of fire retardant (deca-BDE, HBCDD, hexaBDE and heptaBDE, tetraBDE and pentaBDE) containing wastes including e-wastes
AP4	Hazardous Substances, Identification and appropriate management of PFOS and PFOS F
AP5	Releases from unintentional production of PCDD/F, HCB, PCBs
AP6	Identification and appropriate management of contaminated sites (Annex A, B and C Chemicals)
AP7	Public awareness, information and training
AP8	Implementation, monitoring and reporting

Table 16 – Total Action Plan Cost Summary

Costs per Year (AUD)	2019	2020	2021	2022	2023	Total
Action Plan 1 - Institutional and Regulatory Strengthening Action Plan	201,000	330,000	195,000	185,000	165,000	**1,076,000**
Action Plan 2 – PCB Management	100,000	5,000	15,000	5,000	15,000	**140,000**
Action Plan 3 - POP-PBDEs and Waste Management	180,000	445,000	245,000	165,000	175,000	**1,210,000**
Action Plan 4 - Hazardous Substances	225,000	270,000	155,000	30,000	20,000	**700,000**
Action Plan 5 - uPOPs	195,000	260,000	130,000	130,000	120,000	**835,000**
Action Plan 6 - Contaminated Sites and Used Oil	50,000	210,000	50,000	65,000	50,000	**425,000**
Action Plan 7 - Public Awareness, Information and Training	5,000	40,000	30,000	30,000	30,000	**135,000**
Action Plan 8 - Implementation, Monitoring and Reporting	75,000	50,000	50,000	50,000	95,000	**320,000**
Total	1,031,000	1,610,000	870,000	660,000	670,000	**4,841,000**
Convert to USD at 0.72 AUD/USD	**742,320**	**1,159,200**	**626,400**	**475,200**	**482,400**	**3,485,520**

5.8.2 Action Plan 1 - Institutional and Regulatory Strengthening Action Plan

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Budget Comments
			2019	2020	2021	2022	2023	
1. Improve national oversight of POPs and other chemicals in Kiribati								
1.1. Support operation of a National Chemical Unit within MELAD to serve as National Technical Body	MELAD		20,000	20,000	20,000	20,000	20,000	
1.2. Review and Update National Chemical Profile	MELAD		10,000	50,000				
1.3. Establish a centralised system for licensing and permitting chemical imports – it is recommended that a modified and simplified GHS system is used.	MELAD	KCS	10,000	50,000	30,000			
1.4. Train Customs Officers in the detection and classification of potentially illegal imports and export of POPs and other non-approved chemicals and wastes	KCS	MELAD, EHU-MHMS, KPS	5,000	30,000		20,000		
1.5 Analyse the benefits of Kiribati becoming a party to the Rotterdam Convention	MELAD	KCS, OAG, MFAI	10,000					Mainly administrative costs and annual contribution for member states, which would come from another budget
2. Establish a comprehensive legal and administrative system to manage all chemical related issues in Kiribati								
2.1. Develop and implement legislation, regulations and protocols that enables Kiribati to meet its Stockholm Convention obligations	MELAD	OAG, MFAI	5,000	20,000				
2.2. Develop comprehensive waste management regulations – this will be done in conjunction with one of the action plan items in Action Plan 3	MELAD	OAG, MIA, MHMS	-					See Action Plan 3
2.3. Create new legislation, regulations and protocols to improve management (importation controls, transport, storage, application and disposal) of imported chemicals – this will be done in conjunction with one of the action plan items in Action Plan 4	MELAD	MIA, TPD-MCIC, OAG, MICTTD, KPS, KCS, MISE	-					See Action Plan 4
3. Improve engagement with industry on POPs and chemical related issues in Kiribati								
3.1. Establish an industry taskforce comprised of	MELAD	MICTTD, MIA, PUB,	15,000	30,000	15,000	15,000	15,000	

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Budget Comments
			2019	2020	2021	2022	2023	
representatives from the energy and agricultural sectors to coordinate and drive implementation of relevant NIP activities in their respective sectors		KOIL, MCIC, KCCI, MISE, KCDL, KFL, KSEC						
4. Project Management System including personnel to oversee all NIP Action Plans								
4.1. Hire international or suitable local project management consultant, set up MELAD management capability, establish processes for procurement, programme work, evaluation of NIP implementation, set up systems for reporting to international funding agency, and support MELAD	MELAD	NEPO-MFED	50,000	50,000	50,000	50,000	50,000	
4.2. Strengthen MELAD Capability to take on the extra work	MELAD		80,000	80,000	80,000	80,000	80,000	
TOTAL			**201,000**	**330,000**	**195,000**	**185,000**	**165,000**	

5.8.3 Action Plan 2 – PCB Management

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1. Regulatory measures								
1.1. Ban the importation, manufacture, reuse, recycling, and export (except export for environmentally sound waste management) of PCBs and PCB-containing equipment	MELAD	PUB, MISE, KCS, TPD-MCIC	10,000					
1.2. Prohibit the landfill disposal and burning of PCB-containing equipment and oils	MELAD	MIA	10,000	5,000	5,000	5,000	5,000	
2. **Environmentally sound management measures**								
2.1. Complete the sampling and off-shore testing of all possible PCB containing transformers and identify all possible PCB containing capacitors, including those on Kiritimati Island	MELAD	PUB	20,000					This work will be partly completed as part of the NIP formulation process
2.2. Arrange for the containment and eventual off-shore shipment of any PCB contaminated oils	MELAD	PUB, MOI, KCS, MICTTD, KPA, KOIL	50,000					This will depend on how many transformers and other items contain PCBs so this is only a PC sum.
3. Capacity building measures								

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
3.1. Train customs officers on the meeting Basel and Waigani Conventions export requirements	KCS	MELAD	5,000		5,000		5,000	
3.2. Train MELAD and PUB in PCB sampling, containment and contaminant management	MELAD	PUB	5,000		5,000		5,000	
TOTAL			**100,000**	**5,000**	**15,000**	**5,000**	**15,000**	

5.8.4 Action Plan 3 - POP-PBDEs and Waste Management

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1. Regulatory measures								
1.1. Ban the importation, manufacture, reuse, recycling, and export (except export for environmentally sound waste management) of POP-PBDEs, HBB, HBCD, PCNs and SCCPs	MELAD	KCS, MFAI, MCIC, OAG	10,000	10,000				Legislation may be required
1.2. Restrict the importation of electrical and electronic products manufactured between 1975 and 2004 as these may contain POP-PBDEs, including a public awareness campaign	MELAD	KCS, MFAI, MCIC, MICTTD (HA, CCK, ICT), KPS	20,000	10,000	5,000	5,000	5,000	
2. Institutional measures								
2.1. Develop and maintain a directory of regional and international facilities with the capability for environmentally sound disposal of POP-PBDEs, HBB, HBCD, PCNs and SCCPs, and allow for local dissemination of this directory	MELAD		10,000	10,000	5,000	5,000	5,000	
3. Environmentally sound waste management measures								
3.1 Review and update national solid waste strategic plan (Kiribati waste management and resource recovery strategy).	MELAD	MIA, Local Authorities, CSO's, MHMS and all stakeholders						This activity is important to formalise the structure and mechanisms. There is a NZ funded project to coverf costs.

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
3.2. Strengthen existing Waste Management Task Force to broaden the focus of the waste management and waste disposal needs of South Tarawa (including POPs) and also to cover the Outer Islands.	MELAD	MIA, Local Authorities, Others including international consultants	25,000	75,000				
3.3. Establish sound waste management on South Tarawa and All Outer Islands, based on the outcomes of the above Task Force	MELAD	MIA, MFED, Local Authorities, Others including international consultants		50,000	70,000	60,000	50,000	This is an expensive item and the money allocated here is what could be made available under the NIP Process
3.4. Parallel and related process to address all recycling needs – Set up Recycling Task Force to re-examine procedures for recycling e-waste, glass, plastics, paper, metals recycling, including the examination of ADFs	MELAD	MIA, Local Authorities, Others including international consultants	50,000	100,000				
3.5. Establish sound and financially viable recycling where practicable on South Tarawa and All Outer Islands, based on the outcomes of the above Task Force. This may include imposing further ADFs to aid recycling.	MELAD	MIA, Local Authorities, MFED, Others including international consultants		40,000	50,000	30,000	30,000	This is an expensive item and the money allocated here is what could be made available under the NIP Process
3.6. Establish secure storage at landfill facility for e-wastes	MELAD	MIA	5,000	10,000	5,000	5,000	5,000	
3.7. Develop and implement an e-waste management program, which includes sustainable financing measures for environmentally sound management	MELAD	MIA	10,000	20,000	10,000	10,000	10,000	
3.8. Develop and implement an end-of-life vehicle management program, which includes sustainable financing measures	MELAD	MIA, MFED	20,000	100,000	80,000	50,000	50,000	This may involve purchasing a car crushing machine for South Tarawa, for which additional funds beyond these amounts would be needed.
3.9. Set up programme (training and awareness) to prevent burning of coated copper wires (that may be coated with PCNs) for the recovery of copper	MELAD			10,000				

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
4. Capacity building measures								
4.1. Train waste management workers in environmentally sound management of POP-PBDEs, HBB, HBCD, PCNs and SCCPs wastes	MELAD	MIA	10,000		10,000		10,000	
4.2. Train customs officers on the detection of POP-PBDEs and articles containing POP-PBDEs, HBB, HBCD, PCNs and SCCPs and on checking exports for compliance with the Basel and Waigani Conventions	MELAD	KCS, KPS	10,000		10,000		10,000	
4.3 Build technical capacity and awareness around the linkages between trade and environment.	MELAD	MCIC, KCS, MHMS	10,000	10,000				
TOTAL			**180,000**	**445,000**	**245,000**	**165,000**	**175,000**	

5.8.5 Action Plan 4 - Hazardous Substances and PFOS/PFAS

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1. Regulatory measures								
1.1. Establish a taskforce (including representatives from PUB, KOIL and Industry) to examine ways to set in place an effective system for managing hazardous substances (including a focus on hazardous wastes) in Kiribati. This could be based on a modified and simplified GHS System. It would also focus on worker protection	MELAD	MHMS, MCIC, MEHRD Customs, stakeholders and international consultants	40,000	100,000				
1.2. Set up a regulatory system for managing hazardous substances (including hazardous wastes)	MELAD	MHMS, MCIC, MEHR, OAG, KOIL, stakeholders and international consultants		50,000	30,000	20,000	10,000	
1.3. Ban the importation, manufacture, use, and export (except export for environmentally sound waste management) of PFOS and PFOS-containing articles.	MELAD	MFAI, Various Users of AFFF	20,000					
2. Institutional measures								
2.1. Identify safer alternatives to aqueous film-forming foams (AFFF) containing PFAS	MELAD	Various Users of AFFF	10,000					

2.2. Develop and maintain a directory of regional and international facilities capable of the environmentally sound disposal of PFOS contaminated articles and foams	MELAD	Various Users of AFFF	5,000		5,000			
3. Environmentally sound management measures								
3.1. Establish long-term storage areas at one landfill site for PFOS-containing and other intractable hazardous wastes	MELAD	MIA	20,000	50,000	50,000			
3.2. Construct effective bunding in Bonriki International Airport building housing the fire trucks, so that spills of firefighting foam from any source can be completely contained.	MICTTD	MELAD, MISE (PUB)	20,000					
3.3. Set up a system for effective management of laboratory chemicals in schools and other facilities. This will include training, collection of expired chemicals and disposal of expired chemicals. Immediately resolve all the current urgent problems with laboratory chemicals. This should also involve the establishment of a Secondary School Science Teacher Task Force to address chemistry laboratory issues.	MELAD	MOE, MHMS, USP, KMS	100,000	60,000	60,000			
4. Capacity building measures								
4.1. Train customs officers on the detection of PFOS-containing products and other products banned for import, and on checking exports for compliance with the Basel (and Waigani) Conventions	MELAD	KCS	10,000	10,000	10,000	10,000	10,000	
TOTAL			**225,000**	**270,000**	**155,000**	**30,000**	**20,000**	

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1. Regulatory measures								
1.1. Establish a taskforce (including representatives from PUB, KOIL and Industry) to examine ways to set in place an effective system for managing hazardous substances (including a focus on hazardous wastes) in Kiribati. This could be based on a modified and simplified GHS System. It would also focus on worker protection	MELAD	MHMS, MCIC, MEHRD Customs, stakeholders and international consultants	40,000	100,000				
1.2. Set up a regulatory system for managing hazardous substances (including hazardous wastes)	MELAD	MHMS, MCIC, MEHR, OAG, KOIL, stakeholders and international consultants		50,000	30,000	20,000	10,000	

1.3. Ban the importation, manufacture, use, and export (except export for environmentally sound waste management) of PFOS and PFOS-containing articles.	MELAD	MFAI, Various Users of AFFF	20,000					
2. Institutional measures								
2.1. Identify safer alternatives to aqueous film-forming foams (AFFF) containing PFAS	MELAD	Various Users of AFFF	10,000					
2.2. Develop and maintain a directory of regional and international facilities capable of the environmentally sound disposal of PFOS contaminated articles and foams	MELAD	Various Users of AFFF	5,000		5,000			
3. Environmentally sound management measures								
3.1. Establish long-term storage areas at one landfill site for PFOS-containing and other intractable hazardous wastes	MELAD	MIA	20,000	50,000	50,000			
3.2. Construct effective bunding in Bonriki International Airport building housing the fire trucks, so that spills of firefighting foam from any source can be completely contained.	MICTTD	MELAD, MISE (PUB)	20,000					
3.3. Set up a system for effective management of laboratory chemicals in schools and other facilities. This will include training, collection of expired chemicals and disposal of expired chemicals. Immediately resolve all the current urgent problems with laboratory chemicals. This should also involve the establishment of a Secondary School Science Teacher Task Force to address chemistry laboratory issues.	MELAD	MOE, MHMS, USP, KMS	100,000	60,000	60,000			
4. Capacity building measures								
4.1. Train customs officers on the detection of PFOS-containing products and other products banned for import, and on checking exports for compliance with the Basel (and Waigani) Conventions	MELAD	KCS	10,000	10,000	10,000	10,000	10,000	
TOTAL			**225,000**	**270,000**	**155,000**	**30,000**	**20,000**	

5.8.6 Action Plan 5 - uPOPs

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1. Regulatory Measures								
1.1. Develop comprehensive waste management regulations, including prohibition on open burning of waste except for defined exceptions, including consultation on this issue.	MELAD	MIA, Local Authorities, OAG		20,000				Mainly part of Item 3.2 of Action Plan 3

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1.2. Consider restrictions on the importation of motor vehicles without pollution control technology and encourage the use of electric cars through tax concessions and subsidies.	MELAD	MICTTD, MFAI, MFED, MISE, MCIC, KCS		20,000	10,000	10,000		
2. Institutional measures								
2.1. Review and implement a national waste management strategy that promotes environmentally sound waste management	MELAD	MIA, Local Authorities, OAG	-					Not costed here – see 3.1 and 3.2, Action Plan 3,
2.2. Develop and enforce the implementation of a national landfill management guideline that includes measures to eliminate the occurrence of dump fires and restrict public access to waste tipping faces	MELAD	MIA, Local Authorities	-					Not costed here – see 3.1 and 3.2, Action Plan 3,
2.3. Introduce ADF on vehicles to pay for end-of-life recycling costs	MELAD	MFAI, MFED, KCS	-					Not costed here – see 3.3 and 3.4, Action Plan 3,
2.4. Update the uPOPs inventory annually	MELAD		15,000	15,000	15,000	15,000	15,000	
2.5. Support Ministry of Health initiatives to reduce the incidence of smoking and tobacco use.	MHMS	MELAD	10,000	10,000	10,000	10,000	10,000	This will be done in conjunction with the MHMS who would administer this funding.
3. Environmentally sound management measures								
3.1. Assist the exisiting Health Care Waste Management Committee (HCWMC) to determine the most effective long term solution (including incineration and autoclaving) to the disposal of health care wastes in South Tarawa.	MHMS	MELAD	10,000	40,000				
3.2. Once an effective solution is decided upon, it needs to be implemented. This will be expensive and beyond the scope of this NIP. Some money should be allocated, however, to facilitate the implementation of the solution. This would include funding proper health care waste storage and PPE.	MHMS	MELAD	10,000	10,000	10,000	10,000	10,000	The money shown here is facilitation money only.
3.3. Until an effective solution can be put in place, design and operate an effective and safe interim solution with a solid, purpose-built single chamber steel incinerator that is well aerated and has a stack. At least two may need to be constructed.	MHMS	MELAD	50,000	50,000				

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
3.4. Require holders of environmental permits relating to wastes and chemicals to collect and report data specific to their sector (e.g. quantity of wastes incinerated, and average incineration temperatures for healthcare waste incineration)	MELAD	MHMS, Others as appropriate	10,000	5,000	5,000	5,000	5,000	
3.5. Promote the adoption of best practice in the solid waste management sector to minimise uPOPs release	MELAD	MIA, Local Authorities	-					Not costed here – see 3.1 and 3.2 of Action Plan 3
3.6. Provide support to the TTM as required for Composting Initiatives	MELAD	TTM, MIA	30,000	30,000	20,000	20,000	20,000	This support will cover both South Tarawa and the Outer Islands.
3.7. Monitor progress on and provide support to the renewable energy programme of Kiribati.	MELAD,	MISE, KMS	50,000	50,000	50,000	50,000	50,000	These funds will enable some extra support to be provided to this important programme from MELAD
4. Capacity building measures								
4.1. Provide uPOPs-related training at regular intervals to environment, agriculture and health workers to enable them to provide a minimum level of sound waste management advice to communities during the course of normal duties	MELAD	MHMS						Done by MELAD – refer Item 4.2 in Action Plan 1
5. Education and awareness measures								
5.1. Deliver public education and health campaigns on uPOPs prevention, in collaboration with other agencies where possible (e.g. health, transportation)	MELAD	MWYSA, MCIC, MLHRD, MOE	10,000	10,000	10,000	10,000	10,000	MELAD will do most of this. Additional funding required for advertising campaigns.
TOTAL			**195,000**	**260,000**	**130,000**	**130,000**	**120,000**	

5.8.7 Action Plan 6 - Contaminated Sites and Used Oil

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1. Regulatory measures								

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1.1. Amend the legislation if required, to require proponents of development proposals or chemical importers to demonstrate what infrastructure will be put in place to ensure safe storage and containment of chemicals and wastes	MELAD	MISE, MCIC, MLHRD, MOI	10,000					Actioned largely under Item 1.2 of Action Plan 4.
1.2. Enforce marine pollution provisions of the Maritime Act 2017, including upgrading the MICTTD Spill Response capability and providing spill response training. This activity is confined to ship based pollution sources.	MICTTD		20,000	20,000				Provision of MARPOL equipment/tools/gears with a Reception facility
1.3. Enforce marine pollution provisions of the Environment Act 2007 focussing on land based pollution activities.	MELAD	OAG	20,000	20,000				
2. Institutional measures								
2.1. Establish a national 'contaminated site register'.	MELAD	MIA, MISE		20,000	20,000			
2.2. Develop and implement a chemicals compliance inspection program to assess compliance of chemical management and storage practices with best practices.	MELAD			25,000	10,000	10,000	10,000	Initiate in 2020 by regular audits
2.3. Examine the best ways to support and strengthen the current programme to manage used oil in Kiribati, including rapid processing of Waigani Permits. All used oil generated should be stored safely in a suitable location until it can be safely shipped. This could be funded by an AFD on imported oil. Prepare a suitable plan.	MELAD	PUB, KOIL, MISE		25,000				
2.4. Visit Banaba and prepare a detailed plan with costings for the large site remediation exercise, which will cover asbestos and the recycling of bulky wastes as well as dealing with contaminants, including POPs contaminants.	MELAD	Banaba Council, MIA, MISE		100,000				
2.5. Implement the plan to manage used oil.	MELAD	PUB, KOIL, MISE			20,000	20,000	20,000	This will be an expensive item and the contribution from this programme is intended to support but not fully fund it.
3. Environmentally sound management measures								

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
3.1. Where possible, restrict activities on, and public access to confirmed contaminated sites, based on the risks and level of contamination	MELAD	MHMS				10,000	5,000	
3.2. Progressively remediate contaminated sites commencing with the highest priority sites	MELAD	Others as relevant				10,000	10,000	Remediation of contaminated sites is an expensive process. Funding would support further testing and planning to prioritise remediation.
4. Capacity building measures								
4.1. Provide relevant officers with accredited national training in field investigation and contaminated site assessment techniques	MELAD	Others as relevant				10,000		
5. **Education and awareness measures**								
5.1. Educate communities in proximity to contaminated sites of the potential health impacts and actions to minimise exposure to the contamination	MELAD	MWYSA				5,000	5,000	
TOTAL			**50,000**	**210,000**	**50,000**	**65,000**	**50,000**	

5.8.8 Action Plan 7 - Public Awareness, Information and Training

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1. Regulatory measures								
1.1. Require holders of chemical import/export permits, and environmental permits to report activity data to MELAD at regular intervals (e.g. quarterly or semi-annually)	MELAD		5,000	5,000	5,000	5,000	5,000	Partially covered by other initiatives.
2. Institutional measures								
2.1. Establish a training and outreach unit within MELAD dedicated to provision of training (including training identified in this NIP) and awareness-raising for public and private sector stakeholders and the general public	MELAD	MWYSA						Done by MELAD - Refer Item 4.2 in Action Plan 1

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
3. Capacity building measures								
3.1. Provide comprehensive training to relevant MELAD staff in project and contract management	MELAD							Done by MELAD – refer Item 4.2 in Action Plan 1
3.2. Develop a school curriculum to include POPs and the effects of hazardous chemicals as an essential component to ensure long term public awareness and education	MELAD	MOE		20,000	10,000	10,000	10,000	Develop resources and provide support to schools.
4. Education and awareness measures								
4.1. Conduct an annual national "Chemicals in Kiribati" forum to raise high-level political awareness of POPs and chemical management issues in Kirbati	MELAD	MEHRD, MCIC, MIA, MHMS		15,000	15,000	15,000	15,000	This includes funding for outer islands representatives.
TOTAL			**5,000**	**40,000**	**30,000**	**30,000**	**30,000**	

5.8.9 Action Plan 8 - Implementation, Monitoring and Reporting

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1. Institutional measures								
1.1. Embed activities from this NIP into relevant departmental work plans and budgets to ensure implementation	MELAD	MFED	30,000	10,000	10,000	10,000	10,000	Coordination by MELAD supported by international project management consultant. Refer Items 4.1 and 4.2 in Action Plan 1.
1.2. Prepare an annual progress report of NIP implementation against the action plans	MELAD	International Consultant	15,000	15,000	15,000	15,000	15,000	Completed by international project management consultant as part of an auditing process. Refer Items 4.
1.3. Revise NIP activities as needed, for example to reflect changing priorities and emerging issues	MELAD	International Consultant		5,000	5,000	5,000	5,000	This would also be done as part of Item 1.2 above.
1.4. Submit four-yearly national reports to the Stockholm Convention Secretariat	MELAD	International Consultant	15,000				15,000	These reports will be prepared after the audits are carried out.
1.5 Carry out detailed Health and Environmental Risk Assessment of the Impact of POPs in Kiribati	MELAD	MHMS					30,000	

Activity	Lead Responsibility	Support Responsibility	Timeframe and Budget (AUD)					Comments
			2019	2020	2021	2022	2023	
1.5. Develop and implement sampling plans for ambient concentrations of POPs and other relevant substances such as non-POP pesticides (including PCBs) in air, land, water, food, animals and humans within the GMP	MELAD	MHMS, KMS, MFMRD, and international laboratories		20,000	20,000	20,000	20,000	This would support the audits and provide hard data on progress to the Stockholm Convention Secretariat.
1.6. Establish a small facility to be used as a focal point for collecting and storing samples before overseas analysis. This would include training in taking samples.	MELAD		15,000					
TOTAL			**75,000**	**50,000**	**50,000**	**50,000**	**95,000**	

Annex 1: NIP Workshop Report

KIRIBATI POPs National Implementation Plan (NIP) Inception Two Day Workshop

23rd and 24th of January 2019

About

The Stockholm Convention on the Persistent Organic Pollutants (the Stockholm Convention) is the international treaty that requires Parties to phase-out and eliminate the production and use of the most persistent and toxic chemicals that have adverse impacts on human health and the environment.

Kiribati ratified the Stockholm Convention on the 4th of April 2002 with entry into force on the 6th of December 2004. Under Articles 7 of the Stockholm Convention, Kiribati is required to develop, endeavour to implement, and update as appropriate a National Implementation Plan (NIP), outlining how its obligations under the Convention will be met.

The development of an effective NIP requires input from stakeholders with a vested interested in the Stockholm Convention, therefore a workshop was designed to both inform key stakeholders and encourage discussion around persistent organic pollutant issues. These discussions would then play a large role in the development of the NIP.

List of Recipients of Invitations

MELAD identified and invited key stakeholders to attend the two day workshop.

Organisation	To the attention of
Secretary, Ministry of Environment, Lands and Agricultural Development	Director of ALD, Attn: Roiti Kienene Susana Ratu
	SPO-PPU, Attn: Toreka Itaaka
Secretary, Ministry of Health and Medical Services	Director of Public Health, Attn: Bungia Kirata Aritu Iotia Terikano Nakekea
	Chief of Laboratory Services, Attn: Touakai Kambati Chief Pharmacist, Attn: Bureteiti Rui Chief Dental Officer Chief Radiographer
Secretary, Ministry of Education	Attn: Temanibwebwe Ruoikabuti Principal, KGV& EBS, Attn: Teariki Utimawa
Secretary, Ministry of Internal Affairs	Clerk of TUC, Attn: Tiabere Itinibara Clerk of BTC
Secretary, Ministry of Finance and Economic Development	Director of NEPO, Attn: Jonathan Taake Republic Statistician, Attn: Kanikoa Tekaoki
Secretary, Ministry of Employment and Human Resources	Attn: Reea Aluta Roiti Kirata

Secretary, Ministry of Infrastructure and Sustainable Energy	Energy Planner of ED, Attn: Boanereke Fatali CEO of KOIL, Attn: Maareke Timiti and Fire Department CEO of PUB OIC of PVU, Attn: Tiiroba Tataua GM of KSEC, Attn: Tokitebwa Tawita
Secretary, Ministry of Commerce, Industry and Cooperatives	Senior Trade Officer, Attn: Tokarake Terube Tentoa Tentaku CEO of KCDL
Secretary, Ministry of Justice	Attorney General,, Attn: Monoo Mweretaka Kanrooti Aukitino
	Comptroller of KCS, Attn: Tooua Bateriki Metioteraka Mika
	Commissioner of KPS, Attn: Anre Anro
Secretary, Office of Te Beretitenti	Director of KMS, Attn: Mauna Eria
Secretary, Ministry of Information, Communication, Transport and Tourism Development	Headquarters, Attn: Tienimatang Reue
	Research and Development Div, Attn: Tibina Yeeting
	Marine Division, Attn: Kabeia Atanraoi
	Fire Department, Attn: Fire Superintendent
Secretary, Ministry of Women, Youth, Sport and Social Affairs	President of AMAK, Attn: AMAK Coordinator
Executive Director, Kiribati Family Health Association	Attn: Taboneao Kaireiti
General Secretary, Kiribati Red Cross Society	Attn: Maria Taua
President, KCCI	Attn: Naata Tekeaa Miriam Bataua Toani Benson
Director, University of the South Pacific	Attn: Bauro Tewareka
Principal of SHHS	Attn: Lab Technician
Principal of MHS	Attn: Lab Technician
Principal of WGMC	Attn: Lab Technician
Principal of SLHS	Attn: Lab Technician
Principal of SPC,	Attn: Lab Technician
Bishop, RC	

Moderator, KUC	
Moderator, KPC	
President, LDS	

List of Attendees - Day 1

Participant Name	Organisation/Ministry
1. Taboneao Kaiaeti	Kiribati Family and Health Association (KFHA)
2. Tokiteba Tawita	Kiribati Solar Energy Company (KSEC)
3. Maareke Timiti	Kiribati OIL (KOIL)
4. Metiotiraka Nita	Kiribati Customs Service (KCS)
5. Tiabere Itinibara	Teinainano Urban Council (TUC)
6. Touakai Kambati	Laboratory, Ministry of Health and Medical Service (MHMS)
7. Jonathan Taake	National Economic Planning Office (NEPO), Ministry of Finance and Economic Development (MFED)
8. Teariki Utimawa	KGV/EBS, Ministry of Education (MoE)
9. Mwata Keariki	Kiribati Metrological Service (MET)
10. Tebatibunga Kaongotao	Kiribati Metrological Service (MET)
11. Toreka Itaaka	Project Planning Unit (PPU), Ministry of Environment, Lands and Agriculture Development (MELAD)
12. Tokarake Terube	Ministry of Commerce, Industry and Cooperative (MCIC)
13. Anre Anro	Kiribati Police Service (Fire Brigade)
14. Bauro Tewareka	University of the South Pacific (USP)
15. Kabeia Atanraoi	Marine Division, Ministry of Information, Communication, Transport and Tourism Development (MICTTD)
16. Tienimatang Reue	Admin, Ministry of Information, Communication, Transport and Tourism Development (MICTTD)
17. Bureteiti Rui	Pharmacy, Ministry of Health and Medical Service (MHMS)
18. Susana Ratu	Agriculture and Livestock Division (ALD), MELAD
19. Roiti Kirata	Ministry of Employment and Human Resource (MEHR)
20. Reea Binataake Akita	Ministry of Employment and Human Resource (MEHR)
21. Taafa Tebikau	Environmental Health, Ministry of Health and Medical Services (MHMS)

22.	Tevikano Nakekea	Environmental Health, Ministry of Health and Medical Services (MHMS)
23.	Foiti Rienene	Agriculture and Livestock Division (ALD), MELAD
24.	Miriam Bataua	Kiribati Chamber of Commerce and Industry (KCCI)
25.	Harry Langley	Environment and Conservation Division (ECD), MELAD
26.	Raitiata Cati	ECD, MELAD
27.	Teburenga Tabwebweiti	ECD, MELAD
28.	Farran Redfern	ECD, MELAD
29.	Teema Biko	ECD, MELAD
30.	Teniti Taam	ECD, MELAD
31.	Rubeaua Iannang	ECD, MELAD
32.	Terubeieta Tuntaake	ECD, MELAD

List of Attendees - Day 2

Participant Name		Organisation/Ministry
1.	Bureteiti Rui	Pharmacy, Ministry of Health and Medical Service (MHMS)
2.	Bauro Tewareka	University of the South Pacific (USP)
3.	Anre Anro	Kiribati Police Service, Fire Brigade
4.	Tokarake Terube	Ministry of Commerce, Industry and Cooperative (MCIC)
5.	Toreka Itaaka	Project Planning Unit (PPU), MELAD
6.	Enoka Tauma	Public Utilities Board (PUB)
7.	Tebatibunga Kaongotao	Kiribati Metrological Service (MET)
8.	Mwata Keariki	Kiribati Metrological Service (MET)
9.	Teariki Utimawa	KGV/EBS, Ministry of Education (MoE)
10.	Miriam Bataua	Kiribati Chamber of Commerce and Industry (MPSO)
11.	Touakai Kambati	Laboratory, Ministry of Health and Medical Service (MHMS)
12.	Toani Benson	Kiribati Chamber of Commerce and Industry (MPSO)
13.	Susana Ratu	Agriculture and Livestock Division (ALD), MELAD

14.	Maareke Timiti	Kiribati OIL (KOIL)
15.	Tokitebwa Tawita	Kiribati Solar Energy Company (KSEC)
16.	Taboneao Kaireiti	Kiribati Family and Health Association (KHFA)
17.	Tevikano Nakekea	MHMS (EH)
18.	Maria Taua	Kiribati Red Cross Society (KRCS)
19.	Rodney Taniera	Kiribati Red Cross Society, KRCS (volunteer)
20.	Reea Binataake Akita	Occupational Health and Safety (OHS), Ministry of Employment and Human Resource
21.	Kabeia Atanraoi	Marine Division, Ministry of Information, Communication, Transport and Tourism Development (MICITD)
22.	Harry Langley	Environment and Conservation Division (ECD), Ministry of Environment, Lands and Agriculture Development (MELAD)
23.	Raitiate Cati	MELAD/ECD
24.	Teburenga Tabwebweiti	MELAD/ECD
25.	Farran Redfern	MELAD/ECD
26.	Teema Biko	MELAD/ECD
27.	Teniti Taam	MELAD/ECD
28.	Rubeaua Iannang	MELAD/ECD
29.	Terubeieta Tuntaaki	MELAD/ECD

Agenda

POPs NIP INCEPTION WORKSHOP PROGRAM, PARLIAMENT BOARDROOM, AMBO

23-24 January 2019

AGENDA ITEM	TIME	FACILITATOR
DAY 1		
REGISTRATION	8:30-9AM	MELAD
Opening Prayer	9am	Participant rep
Opening Remarks	0910-0930	MELAD & Consultants
Introduction	0930-0945	MELAD
Talk 1: Kiribati Chemical Governance Structure	0945-1000	MELAD
Group Photo followed by TEA	**1000-10.30**	**ALL**
Talk 2: Introduction to POPs	1030-1100	Consultants
Talk 3: Introduction to NIPs	1100-1200	Consultants
LUNCH	**1230-1330**	**ALL**
Talk 4: Introduction to uPOPs	1300-14-00	Consultants
Talk 5: Introduction to uPOPs inventory	1400-14.30	Consultants
Talk 6: Completing the NIP Inventory table	1430-1500	Consultants
TEA	**1500-1515**	**ALL**
Talk 7: Introduction to uPOPs Action Plans	1530-1600	Consultants

Summing up the Day and Closing	1600-1615	Consultants
DAY 2		
Opening Prayer	9am	
The First NIP	0910-1000	MELAD
Talk 8: Used vehicle and Ewaste management	1000-1030	Consultants
TEA	**1030-1045**	**ALL**
Discuss Implications for Related Issues - Climate Change, Minimata, Waste Management, Asbestos, Used Oil, Pesticides, Chemicals	1045-1230	Consultants
LUNCH	**12.30-13.30**	**ALL**
Reports on data collection: Urban and Rural Areas	1330-1400	MELAD
Breakout into Groups to discuss NIP Actions, with Feedback from Group Leaders.	1400-15.	Groups and Group Leader
TEA	**1500-1515**	**ALL**
Prepare Timetable for the NIP Mission	1515-1545	Consultants
WHAT IS NEXT?	1545-1600	MELAD
Wrap-up and Close	1600-1615	MELAD and Consultants
CLOSING RECEPTION	**1630-1800**	**ALL**

Presentations

Presentations were given in powerpoint format and digital copies were made available to participants at the end of the workshop. MELAD received digital files of all presentations.

Presentations by MELAD and visiting consultants on a variety of POPs based topics.

Group Work

At the end of the second day participants were divided up into five groups and asked to discuss and answer the following questions:

1) What are the most serious environmental problems in Kiribati?
2) What concerns are there about chemical management?
3) What can be best done about these problems?
4) How can public consultations be improved?
5) How can everyone best assist MELAD with their work?
6) How can data gathering be improved?
7) Should there be a focus on composting in Kiribati?
8) What training and capacity building is needed?
9) Should open burning of domestic waste be more controlled?

Groups were given approximately two hours to work together and then each group was given a few minutes to present their answers to all participants. Answers to the questions by each of the groups are shown in Table 1: Group Responses

Participants break out into groups to discuss a series of questions and present back to the workshop. This information goes into the formulation of the NIP.

Table 1: Group Responses

Question	Group 1	Group 2	Group 3	Group 4	Group 5
1) What are the most serious environmental problems in Kiribati?	• Used oil, • Medical wastes, • Hazardous chemicals (LAB), • Open burning	• waste piles • littering • coastal erosion • open defecating • lack of understanding on waste management • illegal dumping of rubbish on beach/sea or on deserted areas (nappies, ice bags, etc)	• Pollution, • Waste management, • Climate change, • Population	• lack of knowledge about uPOPs and POPs pithing the general public. Discard of hazardous waste without knowing or understanding the consequences • Unable to quantify amount of oil (hazardous waste) being imported. Not only KOIL but also other private businesses. Import of razor fuels. • - unregulated/uncontrolled importation of hazardous waste. • unreliable incinerator at national hospital. lack of PPE. Location near people. • unregulated importation of tin cans and meat that have not been tested for uPOPs and POPs.	**Natural Causes:** seawater intrusion coastal erosion climate variability **Human Activities** pollutions
2) What concerns are there about chemical management?	• Improper storage (garage, power house), • proper PPE for handling (UCO?), • Lack of awareness (public) health and environment impact	• lack of skills on chemical handling and spills • lack of knowledge on chemical disposal • no idea on chemical impact on the environment and health	• Knowledge on environment and health effect, • Proper disposal facility, • Importation regulatory	• Concerns about health and environment at land and sea. This in turn may affect the country's population and economy.	Chemical spills by improper handling during storage and disposal of chemicals

Question	Group 1	Group 2	Group 3	Group 4	Group 5
3) What can be best done about these problems?	• Fundings (equipments, facility), • Awareness programs	• more awareness especially to officers working with chemicals • training on proper disposal methods (chemical, hazardous, wastes, etc) • recruit village community mobilisers focusing only on these problems	• Public awareness, • Consultation, • NQP (National Quality Policy) Health,	• Integration of uPOPs and POPs into school curriculum (long term). • Public awareness through media awareness and posters that show what uPOPs/POPs are and their impacts to health and environment. • Have stronger legislations and regulations on importation of oils/hazardous waste. • Have imported food tested for POPs and uPOPs. • Have an isolated area for incineration of medical waste that is secure and away from the public. • Make sure that PPE imported is certified or meets standards.	**Human activities:** pollution awareness, addressing proper disposal to the public enforcement of environmental laws; provision of facilities (e.g. public bins) **Natural Caused problems:** control/reduce human activities that contributes the cause of these problems **Chemical Management** guidelines/manuals should be available to ensure proper handling of chemicals **Other Options** Encourage the use of natural source ie solar energy for everyday use. (environmentally friendly practices)
4) How can public consultations be improved?	• Video presentations, introducing chemicals at early education (school curriculum), • Social media	• through village community mobilisers • radio promotion campaigns • road shows • youth drama	• Practical awareness, • Practical and effective data,	• Through direct public and church community visits. • Media awareness • Press awareness	• Improve frequency of conducting consultation • Use of various media outlets to reach out to the public (e.g. Social media, emails, tv, radio)
5) How can everyone best assist MELAD with their work?	• Data collection, compliance, • Improve storage standards, • Inventory / m-supply	• awareness materials (posters, pamphlets, factsheets, etc) • emails sent to stakeholders for forwarding on their wider network • reporting of non-compliance by public to ECD • police officer help enforcement	• Enforcement and reporting through inspection activities, • KCCI to assist in providing contacts businesses, • Who deals with chemicals, • Business awards, • Joint inspection (MELAD, MHMS, MEHR), • Reporting and monitoring (custom)	• Through the NCCC and through the sub committee meetings.	MELAD should be prioritised by KV20

Question	Group 1	Group 2	Group 3	Group 4	Group 5
6) How can data gathering be improved?	Have capacity building to enable personnel's to identify and collect the right and relevant data Collect data or data sharing by relevant stakeholders To centralise these data For stakeholders to have access to these data's.	• sharing of questionnaires to relevant stakeholders • reporting template/format on data needed (e-waste, chemicals, etc) to share to stakeholders and submit on a consistently such as on a monthly basis	No answer		• MELAD team to request assistance from KMCC members for data collection • Encourage the use of modern form of communications for sharing and entering of data from outer islands through use of websites
7) Should there be a focus on composting in Kiribati?	• Improve soil for gardening, • Reduce open burning, • Increase/extend life of landfill	• yes, lots of organic materials • home gardening practices • more training on agricultural practices (organic agriculture; composting) • safe, environmentally friendly • organic waste is a very good soil enhancer which can provide adequate nutrients to the plant	• Enrich the soil, • Save and prolong landfill capacity life	yes	Yes, there should be a focus on composting in Kiribati because it help to improve soil nutrients. Before this waste sorting should be encouraged first.
8) What training and capacity building is needed?	waste management	• proper solid waste and chemical/hazardous waste management • organic agriculture practices eg. composting • data gathering • public consultations • enforcement	• Training and analysing data, • Assessment on contaminated site, • Restoration on contaminated site	• Training on how to operate machines within the National Testing Laboratory • Training and appointment of hazardous waste officer • National capacity building on how to properly store chemicals. This includes training on understanding the different hazardous signs, etc. • seek assistance from TA on developing national awareness materials and dissemination.	• E-waste reuse capacity training • Chemical Handling training • Composting training • Hosting of competition for capacity building on waste reuse by the public e.g. design robotic products

Question	Group 1	Group 2	Group 3	Group 4	Group 5
9) Should open burning of domestic waste be more controlled?	yes. In the context of Kiribati, all outer islands in Kiribati do not have a waste disposal facility and therefore open burning is an option for the well being of the environment. But should be done in a controlled and supervised environment. Open burning is the common way for meal prepartorial and therefore to control open fire will have significant impact to the public. Therefore it is recommended that open fire is to be controlled to some extent.	• yes • to reduce potential POPs impact to the environment and human health • bury/composting of organic waste, and reuse of inorganic wastes • bins provided at roadside • music garbage trucks	yes, awareness / consultation (communities) outer islands, because it produces uPOPs, to promote the composting	yes	yes, open burning of domestic waste should be more controlled because it can be seen as a common practice on South Tarawa.

Follow Up Presentation of Draft Action Plans

To ensure stakeholders were given an opportunity to effectively contribute to the development of the NIP it was decided that there would be a presentation by the consultants of the draft action plan at the end of their time in Kiribati. The draft would reflect the information gathered by and provided to the consultants during their time in Kiribati. The action plan was presented to stakeholders on the evening of the 29th of January 2019.

Below is the meeting minutes as taken by MELAD:

ECD MEETING RECORD

Title of the meeting: DRAFT ACTION PLAN POPs NIP presentation
Date: 30/01/2019
Venue: TEUANETE BOARDROOM Taborio
Chaired by: DS. Felicity Kaiuea

Present: John O'Grady, Elizabeth Vanderburg, Vanya Smythe, DS Felicity Kaiuea (MELAD), Taulehia Pulefou (ECD-MELAD), Farran Redfern (ECD-MELAD), Teema Biko (ECD-MELAD), Teniti Taam (ECD-MELAD), Harry Langley (ECD-MELAD), Tokitebwa Tawita (KSEC), Tibina David Yeeting (MICTTD), Bureteiti Rui (Pharmacy-MHMS), Teariki Utimawa (KGV&EBS), Touakai Kambati (LAB-MHMS), Reea Binataake Aluta (MEHR), Miriam Bataua (KCCI), Taboneao Kaireiti (KFHA), Mauna Eria (MET), Enoka Tauma (PUB), Bungia Kirata (EHS-MHMS), Terikano Nakekea (EHS-MHMS), Tokarake Terube (TPD-MCIC), Maria Taua (KRCS), Bauro Tewareka (USP), Maareke Timiti (KOIL)

Purpose & Objective of the meeting: The purpose of the meeting is to present the preliminary draft action plan of the POPs NIP to the stakeholders for their feedbacks and comments.

Meeting starts: 5:56pm

Item	Discussion	Decision	Responsible Authority/Officer
Welcoming Remarks	Meeting starts with an opening prayer from Bungiia, EHU rep, followed by an introduction of reps around the table. DS gave opening remarks and stress on the opportunity		

Presentation of the DRAFT ACTION PLAN of the POPs NIP project.	28 POPs categories. 15 are POPs pesticides. 13 are other POPs, 2 of these are produced unintentionally, namely dioxins and furans. PCBs are likely to be present. The first test on transformers was conducted in 2002 but there were no PCBs. In this round of consultancy work, another sampling was conducted, as there are new transformers installed. PCNs can be found in the plastic coating of the wiring. PFOS and PFAS are used in fire firefighting foams. Need separate Action Plans for PCBs, etc… Since it is a five year project, it is thought necessary for an international project management company to be engaged to avoid stalling of the project but to keep it moving. Good way to get money is the enthusiasm and commitment of the implementing partner.		John O'Grady John O'Grady John O'Grady

	AP1 - Lot of issues with chemicals in Kiribati. Need to know what they are. - Need some form of control of chemicals coming in the country. Classify them, toxic, flammable, etc… Adopt the Global Harmonizing System - Take a look at the Responsible Ministries. - Budget figures can be changed anytime, they are not fixed - Controlling the entry of chemicals to the country is to not import chemicals that you do not want, and if they do enter the country, there should be a safety card attached to it. AP2 - Place an Advance Disposal Fee (ADF), similar to adopting a wreckage tax (raised from MCIC), so the older the car, the higher the tax. - Pre-inspection of the car before their shipment, if possible to put in the Action Plan (raised from MCIC)… AP4 - Set up a taskforce to examine ways to set in place an effective system. Based on modified and simplified GHS. - Found hazardous substances that are wastes. Establish a long - term storage areas at one landfill site for all the hazardous wastes. - Capacity training on chemical management for Lab technicians on the island.		

	AP5 - Big issue in healthcare waste - Maybe incineration is not such a good idea in Kiribati but can try autoclaving. - Operate a safe interim solution for health care incineration. - Provide support to TTM for composting initiatives. - 3.7 Progress on renewable energy and also to insert MET as one of the responsible ministries. AP6 - Make a list of contaminated sites - Need a place to put used oil - Look at OZ and NZ to export used oil, though NZ charge too much for their Waigani papers - Remediation of a contaminated site is very expensive. Funding should be available when remediating process begins. - Definition of contaminated sites: are - landfills considered contaminated sites.? - Unmanaged old landfill sites are contaminated sites. The current operating landfills are not considered contaminated sites. AP7 - Community mobilizers to include - To add more public awareness since it is only talking about training. - OHS for workers. E.g. caustic soda in KCDL workshop, workers should wear PPE.		
	AP8 - Work with stakeholders on their parts in providing data for their report. - Need to do a yearly stocktake and submit a five-year national reports to the Stockholm Convention Secretariat		

Comments	FR - Thankful to the ICs for preparing the draft Action Plan - Nature of the Stockholm convention funding… - OHS - Timing of the POPs NIP training is timely with the national priorities review and update - KDP - Putting tax on vehicle importation. MT (KRCS) - Put in the issues during the site visit to some of the places on the island and if possible also the suggestions and options. TP - Timeline of the report, every 5 years, should submit to the Stockholm Convention Secretariat but need to submit an annual progressive report. JO - Banaba is a heavily contaminated sites. To clear all of Banaba, could be around AUD 5 million. DS - Fanning Island has asbestos and chemicals, contaminating the island. Need clearance on this island and this was the Cabinet's decision.		

Important Dates	30/01/2019 - John presented the draft section of the NIP on the Action Plan (version 1) to the national stakeholders. 15/02/2019 - Version 2 will be sent back by John and his team. ECD together with the POPs NIP stakeholders will spend 1 week to review and scrutinize this draft 20/02/2019 - 1 day full workshop on the POPs NIP version 2 draft 22/02/2019 - Send back our consolidated comments on Version 2 to John and his team. 1-5/03/2019 - To receive Version 3, a more finalized draft of the NIP after consultants have incorporated the stakeholders inputs. 11/03/2019 - Submit cabinet paper on POPs NIP		
	Meeting ends with a closing prayer by Taboneao Kaireiti, KFHA rep.		

Meeting adjourns: 9:30pm

Conclusion/Summary

The two day workshop was an effective mechanism for engaging key stakeholders in the development of the NIP. Participants were engaged in the subject matter and forthcoming with suggestions and insight into how it relates to their relevant fields. The opportunity to provide feedback and comment to the draft action plan by stakeholders was very beneficial and contributes greatly to the final NIP.

Annex 2: Outer Islands Questionnaire

Kiribati Survey for Sources and Releases of Unintentional Persistent Organic Pollutants (UPOPs)

Kiribati is updating its National Implementation Plan (NIP) for the Stockholm Convention to cover recently included unintentional persistent organic pollutants (UPOPs). The information collected in this survey will go towards developing a national baseline of sources and releases of UPOPs to comply with requirements as a signatory to the Stockholm Convention.

Following this survey there will be a two day workshop to work towards compliance of the Stockholm Convention. The information gathered in this survey will form the foundation of the workshop. Where possible, please provide as much detail to your answers. Please go ahead and submit survey even if some questions cannot be answered.

If you have any questions please contact:

Dr. Farran Redfern
Environment and Conservation Division
farranr@environment.gov.ki

Elizabeth Vanderburg
Consultant
vanderburg.elizabeth@gmail.com

Please return survey to Elizabeth Vanderburg: vanderburg.elizabeth@gmail.com by **Friday the 16th of November, 2018**.

Name:_____
__

Position:_____
__

Email:_____
__

Phone:
_____

Location (island) which survey covers:
_____

1) Waste Incineration

Number of medical waste incineration sites:_____	
List location(s)	Where possible please provide additional detail include, type of incinerator, and quantities incinerated

Number of light-fraction shredder waste incineration sites:_____ (used to break down cars, appliances and large objects)	
List location(s)	Where possible please provide additional detail include, type of wastes shredded and quantities shredded

Number of waste wood and waste biomass incinerators: _____	
List location(s)	Where possible please provide additional detail include, type of incinerator, and quantities incinerated

Number of animal carcasses incinerated per year: _____	
List location(s)	Where possible please provide additional detail include, including type of incinerator or burning used and quantity of carcasses per annum.

Number of any other solid waste incineration sites: _____ (this may include incinerators used in commercial, government or individual households which have not been mentioned above)	
List location(s)	Where possible please provide additional detail include, type of incinerator, and quantities incinerated

2) Power Generation

Number of fossil fuel power plants: _____	
List location(s)	Where possible please provide additional detail including how much diesel is used on an annual basis (only for power generation)

Number of households using biomass for cooking:____ (includes lpg, wood and kerosene)
Where possible, please provide additional detail, including types of cooking devices, fuel commonly used and amounts used annually:

3) Transport

Number of 4-stroke engines: ____ (examples include cars, outboard motors, other small motors)
Additional Detail:

Number of 2-stroke engines: ____ (examples include light motorcycles, scooters, and weed eaters and brush cutter)
Additional Detail:

Number of diesel engines: _____
Additional Detail:

Number of oil fired engines: ____ (examples include vehicles/engines running on used oil or coconut oil)
Additional Detail:

Number of large earthworks vehicles: _____
Additional Detail:

4) Open Burning Processes

Number of biomass burning sites:____ (examples of biomass used include wood, manure, green waste)	
List location(s)	Where possible please provide additional detail including quantities of biomass

Number of waste burning (household and commercial) and accidental fires (within last 12 months):_____
Where possible please provide additional detail including what types of open fires (household, commercial, etc):

5) Miscellaneous

Number of crematoria:____	
List location(s)	Hours of burning or any additional detail about types of incinerators

Number of smoke houses: _____ (eg. fish)	
List location(s)	Additional detail including size and frequency of use

Number of dry cleaning sites: _____	
List location(s)	Where possible please provide additional detail including size and how dry cleaning chemicals are stored and disposed of.

Number of tobacco smokers on island:_____

6) Disposal and Landfill

Number of landfills, waste dumps sites:_____	
List location(s)	Where possible please provide additional detail including size and quantities of waste disposed of annually

Number of sewage disposal sites and sewage treatment plants:____

List location(s)	Where possible please provide additional detail including size and quantities of sewage processed annually

Number of composting locations:____ (commercial and household)	
List location(s)	Where possible please provide additional detail including quantities of composted processed annually

List number of waste oil storage sites:____	
List location(s)	Where possible please provide additional detail including quantities stored

10) Contaminated Sites and Hotspots

Number of chemical or oil contaminated sites:____	
List location(s)	Where possible please provide additional detail including any information about type and quantities contaminating sites

Number of fire accidents (within 12 month period):____	
List location(s)	Where possible please provide additional detail including type of fire (vehicle, house, building, other)

List number of dredging (ocean or river) sites:___	
List location(s)	Where possible please provide additional detail including quantities of sediment dredged (within 12 month period)

List of pesticides used and quantity used	
Type of Pesticide / Herbicide	Quantity Used (within 12 month period)

Number of air fields (in used and historical locations): ____	
List location(s)	Where possible please provide additional detail including known usage of fire retardation chemicals

Number of old transformers manufactured prior to 1980 (both in and out of service): _____	
List location(s)	Where possible please provide additional detail including types of transformers and condition

Does burning plastic off of wires for metal recovery occur? Yes / No	
List location(s)	Where possible please provide additional detail including amounts of wire recovered using this process

Number of old vehicles (no longer road worthy): ____
List location(s):

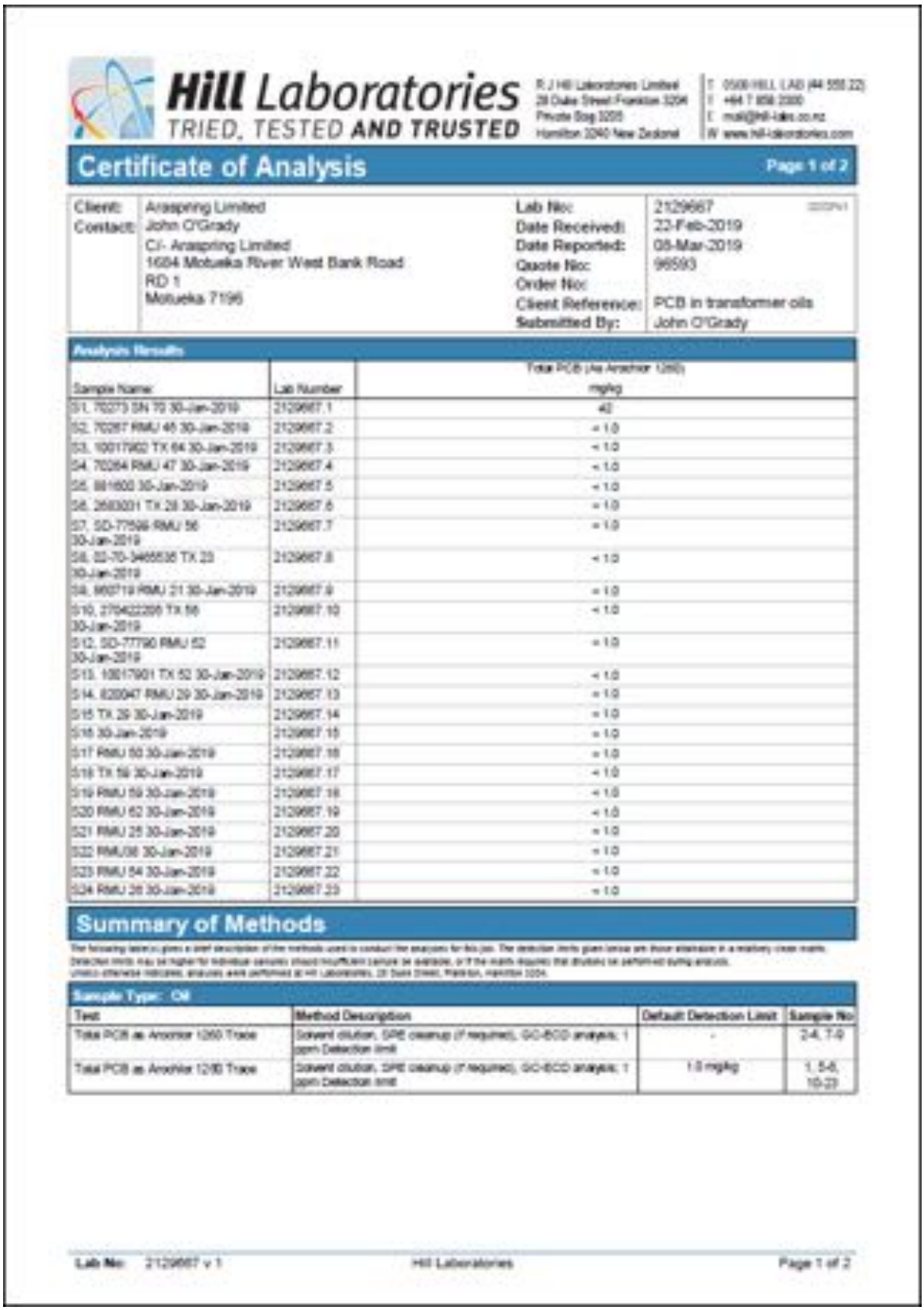
Fuel consumption		
Fuel Type	Quantity consumed per year	Provide any additional detail that may be relevant
Diesel		
Petrol		
Oil		

Additional comments and observations:

Annex 3: POPs Chemicals

Chemical	Date listed	Pesticide	Industrial chemical	By product
Annex A chemicals (elimination)				
Aldrin	May 2004	●		
Chlordane	May 2004	●		
Chlordecone	May 2009	●		
Decabromodiphenyl ether (commercial mixture, c-decaBDE	May 2017		●	
Dieldrin	May 2004	●		
Endrin	May 2004	●		
Heptachlor	May 2004	●		
Hexabromobiphenyl	May 2009		●	
Hexabromocyclododecane (HBCDD)	May 2013		●	
Hexabromodiphenyl ether & heptabromodiphenyl ether (Hexa BDE& Hepta BDE)	May 2009		●	
Hexachlorobenzene (HCB)	May 2004	●	●	●
Hexachlorobutadiene (HCBD)	May 2015		●	●
Alpha-hexachlorocyclohexane (α-HCH)	May 2009	●		
Beta-hexachlorocyclohexane (β-HCH)	May 2009	●		
Lindane (Y-HCH)	May 2009	●		
Mirex	May 2004	●		
Pentachlorobenzene (PeCB)	May 2009	●	●	●
Pentachlorophenol and its salts and esters (PCP)	May 2015	●		
Polychlorinated biphenyls (PCBs)	May 2004		●	●
Polychlorinated naphthalenes	May 2015		●	●
Short-chain chlorinated paraffins (SCCPs)	May 2017		●	
Technical endosulfan and its related isomers	May 2011	●		
Tetrabromodiphenyl ether (tetraBDE) and pentabromodiphenyl ether (pentaBDE)	May 2009		●	
Toxaphene	May 2004	●		
Annex B chemicals (restriction)				
DDT	May 2004	●		
Perfluorooctane sulfonic acids and salts (PFOS) and Perfluorooctane sulfonyl fluoride (PFOS-F)	May 2009	●	●	
Annex C chemicals (unintentional production)				
Hexachlorobenzene (HCB)	May 2004			●
Hexachlorobutadiene (HCBD)	May 2017			●
Pentachlorobenzene (PeCB)	May 2009			●
Polychlorinated biphenyls (PCBs)	May 2004			●
Polychlorinated dibenzo-p-dioxins (PCDD)	May 2004			●
Polychlorinated di-benzofurans (PCDF)	May 2004			●

Annex 4: PCB Testing Carried Out During Project



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Certificate of Analysis

Client:	Arapiring Limited	Lab No:	2129667
Contact:	John O'Grady	Date Received:	22-Feb-2019
	C/- Arapiring Limited	Date Reported:	08-Mar-2019
	1604 Motueka River West Bank Road	Quote No:	96593
	RD 1	Order No:	
	Motueka 7196	Client Reference:	PCB in transformer oils
		Submitted By:	John O'Grady

Analysis Results

Sample Name	Lab Number	Total PCB (As Aroclor 1260) mg/kg
S1, 70273 SN 70 30-Jan-2019	2129667.1	42
S2, 70267 RMU 46 30-Jan-2019	2129667.2	< 1.0
S3, 10017902 TX 64 30-Jan-2019	2129667.3	< 1.0
S4, 70264 RMU 47 30-Jan-2019	2129667.4	< 1.0
S5, 881600 30-Jan-2019	2129667.5	< 1.0
S6, 2583031 TX 28 30-Jan-2019	2129667.6	< 1.0
S7, SD-77598-RMU 56 30-Jan-2019	2129667.7	< 1.0
S8, 02-70-3465536 TX 23 30-Jan-2019	2129667.8	< 1.0
S9, 960719 RMU 21 30-Jan-2019	2129667.9	< 1.0
S10, 270422206 TX 56 30-Jan-2019	2129667.10	< 1.0
S12, SD-77790 RMU 62 30-Jan-2019	2129667.11	< 1.0
S13, 10017901 TX 52 30-Jan-2019	2129667.12	< 1.0
S14, 820047 RMU 29 30-Jan-2019	2129667.13	< 1.0
S15 TX 29 30-Jan-2019	2129667.14	< 1.0
S16 30-Jan-2019	2129667.15	< 1.0
S17 RMU 50 30-Jan-2019	2129667.16	< 1.0
S18 TX 59 30-Jan-2019	2129667.17	< 1.0
S19 RMU 59 30-Jan-2019	2129667.18	< 1.0
S20 RMU 62 30-Jan-2019	2129667.19	< 1.0
S21 RMU 25 30-Jan-2019	2129667.20	< 1.0
S22 RMU36 30-Jan-2019	2129667.21	< 1.0
S23 RMU 54 30-Jan-2019	2129667.22	< 1.0
S24 RMU 35 30-Jan-2019	2129667.23	< 1.0

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Oil

Test	Method Description	Default Detection Limit	Sample No
Total PCB as Aroclor 1260 Trace	Solvent dilution, SPE cleanup (if required), GC-ECD analysis. 1 ppm Detection limit	-	2-4, 7-9
Total PCB as Aroclor 1260 Trace	Solvent dilution, SPE cleanup (if required), GC-ECD analysis. 1 ppm Detection limit	1.0 mg/kg	1, 5-6, 10-23

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Annex 5: Details of uPOPs Sources in Kiribati

			Source categories	Potential Release Route (µg TEQ/t)						Production	Annual release					
								Residue		t/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
Group	Cat.	Class		Air	Water	Land	Product	Fly Ash	Bottom Ash		Air	Water	Land	Product	Fly ash	Bottom Ash
1			**Waste incineration**													
	a		**Municipal solid waste incineration**							3	0.009	0	0	0	0.000	0.0002
		1	Low technol. combustion, no APCS	3,500		NA	NA	0	75	2.6	0.009				0.000	0.000
		2	Controlled comb., minimal APCS	350		NA	NA	500	15	0	0.000				0.000	0.000
		3	Controlled comb., good APCS	30		NA	NA	200	7		0.000				0.000	0.000
		4	High tech. combustion, sophisticated APCS	0.5		NA	NA	15	1.5		0.000				0.000	0.000
	b		**Hazardous waste incineration**							0	0.000	0	0	0	0.000	0.000
		1	Low technol. combustion, no APCS	35,000		NA	NA	9,000			0.000				0.000	0.000
		2	Controlled comb., minimal APCS	350		NA	NA	900			0.000				0.000	0.000
		3	Controlled comb., good APCS	10		NA	NA	450			0.000				0.000	0.000
		4	High tech. combustion, sophisticated APCS	0.75		NA	NA	30			0.0000				0.000	0.000
	c		**Medical waste incineration**							63.5	2.538	0	0	0	0.000	0.01269
		1	Uncontrolled batch combustion, no APCS	40,000		NA	NA		200	63.46	2.538				0.000	0.013
		2	Controlled, batch, no or minimal APCS	3,000		NA	NA		20	0	0.000				0.000	0.000
		3	Controlled, batch comb., good APCS	525		NA	NA	920	ND		0.000				0.000	
		4	High tech, continuous, sophisticated APCS	1		NA	NA	150			0.000				0.000	0.000
	d		**Light fraction shredder waste incineration**							0	0.000	0	0	0	0.000	0.000
		1	Uncontrolled batch comb., no APCS	1,000		NA	NA	ND	ND		0.000					
		2	Controlled, batch, no or minimal APCS	50		NA	NA	ND	ND		0.000					
		3	High tech, continuous, sophisticated APCS	1		NA	NA	150			0.000				0.000	0.000
	e		**Sewage sludge incineration**							0	0.000	0	0	0	0.000	0.000
		1	Old furnaces, batch, no/little APCS	50		NA	NA	23			0.000				0.000	0.000
		2	Updated, continuously, some APCS	4		NA	NA	0.5			0.000				0.000	0.000
		3	State-of-the-art, full APCS	0.4		NA	NA	0.5			0.000				0.000	0.000
	f		**Waste wood and waste biomass incineration**							0	0.000	0	0	0	0.000	0.000
		1	Old furnaces, batch, no/little APCS	100		NA	NA	1,000			0.000				0.000	0.000
		2	Updated, continuously, some APCS	10		NA	NA	10			0.000				0.000	0.000
		3	State-of-the-art, full APCS	1		NA	NA	0.2			0.000				0.000	0.000
	g		**Animal carcasses burning**							0	0.000	0	0	0	0.000	0.000
		1	Old furnaces, batch, no/little APCS	500		NA	NA	ND	ND		0.000					
		2	Updated, continuously, some APCS	50		NA	NA	ND	ND		0.000					
		3	State-of-the-art, full APCS	5		NA	NA	ND	ND		0.000					
1			**Waste Incineration**								2.547	0	0	0	0.000	0.0129
			2.560												0.0129	

Group	Cat.	Class	Source categories	Potential Release Route (µg TEQ/t)					Production	Annual release				
				Air	Water	Land	Product	Residue	t/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
										Air	Water	Land	Product	Residue
2			**Ferrous and Non-Ferrous Metal Production**											
	a		**Iron ore sintering**						0	0.000	0	0	0	0.0
		1	High waste recycling, incl. oil contaminated materials, no air pollution control	20	ND	ND	ND	0.003		0.000				0.000
		2	Low waste use, well controlled plant	5	ND	ND	ND	1		0.000				0.000
		3	High technology, emission reduction	0.3	ND	ND	ND	2		0.000				0.000
	b		**Coke production**						0	0.000	0	0	0	0
		1	No gas cleaning	3	0.06	ND	ND	ND		0.000	0.000			
		2	Afterburner/ dust removal	0.03	0.06	ND	ND	ND		0.000	0.000			
	c		**Iron and steel production plants and foundries**						0	0	0	0	0	0
			Iron and steel plants						*0*	*0*	*0*	*0*	*0*	*0.000*
		1	Dirty scrap, scrap preheating, limited controls	10	ND	NA	NA	15		0.000				0.000
		2	Clean scrap/virgin iron or dirty scrap, afterburner, fabric filter	3	ND	NA	NA	15		0.000				0.000
		3	Clean scrap/virgin iron or dirty scrap, EAF equipped with APC designed for low PCDD/PCDF emission, BOF furnaces	0.1	ND	NA	NA	0.1		0.000				0.000
		4	Blast furnaces with APCS	0.01	ND	NA	NA	ND		0.000				
			Foundries						*0*	*0.000*	*0*	*0*	*0*	*0.0*
		1	Cold air cupola or hot air cupola or rotary drum, no APCS	10	ND	NA	NA	ND		0.000				
		2	Rotary drum - fabric filter or wet scribber	4.3	ND	NA	NA	0.2		0.000				0.000
		3	Cold air cupola, fabric filter or wet scrubber	1	ND	NA	NA	8		0.000				0.000
		4	Hot air cupola or induction furnace, fabric filter or wet scrubber	0.03	ND	NA	NA	0.5		0.000				0.000
			Hot-dip galvanizing plants						0	0.000	0	0	0	0.0
		1	Facilities without APCS	0.06	NA	NA	NA	0.01		0.000				0.000
		2	Facilties without degreasing step, good APCS	0.05	NA	NA	NA	2		0.000				0.000
		3	Facilities with degreasing step, good APCS	0.02	NA	NA	NA	1		0.000				0.000
	d		**Copper production**						0	0.000	0	0	0	0.0
		1	Sec. Cu - Basic technology	800	0.5	NA	NA	630		0.000	0.000			0.000
		2	Sec. Cu - Well controlled	50	0.5	NA	NA	630		0.000	0.000			0.000
		3	Sec. Cu - Optimized for PCDD/PCDF control	5	0.5	NA	NA	300		0.000	0.000			0.000
		4	Smelting and casting of Cu/Cu alloys	0.03	0.5	NA	NA	ND		0.000	0.000			
		5	Prim. Cu, well-controlled, with some secondary feed materials	0.01	0.5	NA	NA	ND		0.000	0.000			
		6	Pure prim. Cu smelters with no secondary feed	ND	0.5	NA	NA	NA			0.000			
	e		**Aluminum production**						0	0.000	0	0	0	0.0
		1	Processing scrap Al, minimal treatment of inputs, simple dust removal	100	ND	NA	NA	200		0.000				0.000
		2	Scrap treatment, well-controlled, fabric filter, lime injection	4	ND	NA	NA	400		0.000				0.000
		3	Optimized proces for PCDD/PPCDF abatement	0.5	ND	NA	NA	100		0.000				0.000
		4	Shavings/turnings drying (simple plants)	5.0	NA	NA	NA	NA		0.000				
		5	Thermal de-oiling, rotary furnaces, afterburners, fabric filters	0.3	NA	NA	NA	NA		0.000				
		6	Primary Al plants	ND	NA	NA	NA	ND						
	f		**Lead production**						0	0.000	0	0	0	0.0
		1	Lead production from scrap containing PVC	80	ND	NA	NA	ND		0.000				
		2	Lead production from PVC/Cl2 free scrap, some APCS	8	ND	NA	NA	50		0.000				0.000
		3	Lead production from PVC/Cl2 free scrap in highly efficient furnaces, with APC including scrubbers	0.05	ND	NA	NA	ND		0.000				
		4	Pure primary lead production	0.4	ND	NA	NA	ND		0.000				
	g		**Zinc production**						0	0.000	0	0	0	0
		1	Kiln with no dust control	1,000	ND	NA	NA	0.02		0.000				0.000
		2	Hot briquetting/rotary furnaces, basic control *	100	ND	NA	NA	1		0.000				0.000
		3	Comprehensive control *	5	ND	NA	NA	1		0.000				0.000
		4	Zinc melting and primary zinc production	0.1	ND	NA	NA	ND		0.000				
	h		**Brass and bronze production**						0	0.000	0	0	0	0.0
		1	Thermal de-oiling of turnings	2.5	NA	NA	NA	NA		0.000				
		2	Simple melting furnaces	10	NA	ND	NA	ND		0.000				
		3	Mixed scarp, induction furnace, bagfilter	3.5	ND	ND	NA	125		0.000				0.000
		4	Sophisticated equipment, clean inputs, good APCS	0.1	ND	ND	NA	ND		0.000				
	i		**Magnesium production**						0	0.000	0.0	0.0	0.0	0.0
		1	Using MgO/C thermal treatment in Cl2, no effluent treatment, poor APCS	250	9,000	NA	NA	0		0.000	0.000			
		2	Using MgO/C thermal treatment in Cl2, comprehensive pollution control	50	30	NA	NA	9,000		0.000	0.000			0.000
		3	Thermal reduction process	3	ND	NA	NA	NA		0.000				
	j		**Thermal Non-ferrous metal production (e.g., Ni)**						0	0.000	0	0	0	0
		1	Contaminated scrap, simple or no APCS	100	ND	NA	NA	ND		0.000				
		2	Clean scrap, good APCS	2	ND	NA	NA	ND		0.000				
	k		**Shredders**						0	0.000	0	0	0	0
		1	Metal shredding plants	0.2	NA	NA	ND	5		0.000				0.000
	l		**Thermal wire reclamation and e-waste recycling**						3	0.024	0	0	0	0
		1	Open burning of cable	12,000	ND	ND	ND	ND	2	0.024				
		2	Open burning of circuit boards	100	ND	ND	ND	ND	1	0.000				
		3	Basic furnace with after burner, wet scrubber	40	ND	NA	ND	ND		0.000				
		4	Burning electric motors, brake shoes, etc., afterburner	3.3	ND	NA	ND	ND		0.000				
2			**Ferrous and Non-Ferrous Metal Production**							0.0241	0.000	0.000	0.000	0.000
			0.0241											
			* In some cases (e.g. Waelz kilns) emission factors for residues can be as high as 2,000 µg TEQ/t of zinc											

Group	Cat.	Class	Source categories	Potential Release Route (µg TEQ/TJ)					Production	Annual release					Ash Generation
				Air	Water	Land	Product	Residue	TJ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	t/a
3			**Heat and Power Generation**							**Air**	**Water**	**Land**	**Product**	**Residue**	
	a		**Fossil fuel power plants**						**0**	**0.000**	**0**	**0**	**0**	**0.0**	
		1	Fossil fuel/waste co-fired power boilers	35	ND	NA	NA	ND		**0.000**					
		2	Coal fired power boilers	10	ND	NA	NA	14		**0.000**				**0.000**	
		3	Peat fired power boilers	17.5	ND	NA	NA	ND		**0.000**					
		4	Heavy fuel fired power boilers	2.5	ND	NA	NA	ND		**0.000**					
		5	Oil shale fired power plants	1.5	ND	NA	NA	ND		**0.000**					
		6	Light fuel oil/natural gas fired power boilers	0.5	ND	NA	NA	ND		**0.000**					
	b		**Biomass power plants**						**0**	**0.000**	**0**	**0**	**0**	**0.0**	
		1	Mixed biomass fired power boilers	500	ND	NA	NA	ND		**0.000**					
		2	Clean wood fired power boilers	50	ND	NA	NA	15		**0.000**				**0.000**	
		3	Straw fired boilers	50	ND	NA	NA	70		**0.000**				**0.000**	
		4	Boilers fired with bagasse, rice husk etc.	50	ND	NA	NA	50		**0.000**				**0.000**	
	c		**Landfill biogas combustion**						**0**	**0.000**	**0**	**0**	**0**	**0.0**	
		1	Biogas-/landfill gas fired boilers, motors/turbines and flaring	8	ND	NA	NA	NA		**0.000**					
	d		**Household heating and cooking - Biomass**					µg TEQ/t Ash	**606**	**0.06064**	**0**	**0**	**0**	**0.00000075**	Please enter mass of ash here
		1	Contaminated wood/biomass fired stoves	1,500	ND	ND	NA	1,000		**0.000**				**0.000**	
		2	Virgin wood/biomass fired stoves	100	ND	ND	NA	10		**0.000**				**0.000**	
		3	Straw fired stoves	450	ND	ND	NA	30		**0.000**				**0.000**	
		4	Charcoal fired stoves	100	ND	ND	NA	0.1		**0.000**				**0.000**	
		5	Open-fire (3-stone) stoves (virgin wood)	20	ND	ND	NA	0.1		**0.000**				**0.000**	
		6	Simple stoves (virgin wood)	100	ND	ND	NA	0.1	606.4	**0.06064**				**0.00000075**	**7.5**
	e		**Household Heating and Cooking with Fossil Fuels**					µg TEQ/t Ash	**200**	**0.0019**	**0**	**0**	**0**	**0.0**	Please enter mass of ash here
		1	High chlorine coal/waste/biomass co-fired stoves	1,700	ND	NA	NA	5,000		**0.000**				**0.000**	
		2	Coal/waste/biomass co-fired stoves	200	ND	NA	NA	NA		**0.000**					
		3	Coal fired stoves	100	ND	NA	NA	5		**0.000**				**0.000**	
		4	Peat fired stoves	100	ND	NA	NA	NA		**0.000**					
		5	Oil fired stoves	10	ND	NA	NA	NA	190	**0.002**					
		6	Natural gas or LPG fired stoves	1.5	ND	NA	NA	NA	10.8	**0.000016**					
3			**Heat and Power Generation**							**0.062548**	**0**	**0**	**0**	**0.00000075**	

Cat.	Class	Source categories	Potential Release Route (µg TEQ/t)					Production	Annual release				
			Air	Water	Land	Product	Residue	t/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
		Production of Mineral Products							Air	Water	Land	Product	Residue
a		**Cement kilns**						**0**	0.0000	0	0	0	0
	1	Shaft kilns	5	ND	NA	ND	ND		0.000				
	2	Old wet kilns, ESP temperature >300 °C	5	ND	NA	ND	ND		0.000				
	3	Wet kilns, ESP/FF temperature 200 to 300 °C	0.6	ND	NA	ND	ND		0.000				
	4	Wet kilns, ESP/FF temperature <200 °C and all types of dry kilns with preheater/precalciner, T<200 °C	0.05	ND	NA	ND	ND		0.000				
b		**Lime**						**0**	0.000	0	0	0	0
	1	Cyclone/no dust control, contaminated or poor fuels	10	ND	NA	ND	ND		0.000				
	2	Good dust abatement	0.07	ND	NA	ND	ND		0.000				
c		**Brick**						**0**	0.000	0	0	0.000	0.000
	1	No emission abatement in place and using contaminated fuels	0.2	NA	NA	0.06	0.02		0.000			0.000	0.000
	2	No emission abatement in place and using non-contaminated fuels; Emssion abatement in place and using any kind of fuel; No emission abatement in place but state of the art process control	0.02	NA	NA	0.006	0.002		0.000			0.000	0.000
d		**Glass**						**0**	0.000	0	0	0	0
	1	Cyclone/no dust control, contaminated or poor fuels	0.2	NA	NA	ND	ND		0.000				
	2	Good dust abatement	0.015	NA	NA	ND	ND		0.000				
e		**Ceramics**						**0**	0.000	0	0	0	0
	1	Cyclone/no dust control, contaminated or poor fuels	0.2	NA	NA	ND	ND		0.000				
	2	Good dust abatement	0.02	NA	NA	ND	ND		0.000				
f		**Asphalt mixing**						**48,384**	0.003	0	0	0	0.000
	1	Mixing plant with no gas cleaning	0.07	NA	NA	ND	ND	48,384	**0.003**				
	2	Mixing plant with fabric filter, wet scrubber	0.007	NA	NA	ND	0.06		0.000				0.000
g		**Oil shale processing**						**0**	0.000	0	0	0	0.000
	1	Thermal fractionation	ND	ND	ND	ND	ND						
	2	Oil shale pyrolysis	0.003	NA	ND	0.07	2		0.000			0.000	0.000
		Production of Mineral Products							**0.003**	**0**	**0**	**0**	**0.000**

Group		Source categories	Potential Release Route (µg TEQ/t)					Consumption	Annual release				
5	Class		Air	Water	Land	Product	Residue	t/a *	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
		Transport							**Air**	**Water**	**Land**	**Product**	**Residue**
a		**4-Stroke engines**						**5,620**	**0.000562**	**0.000000**	**0.000000**	**0.000000**	**0.000000**
	1	Leaded fuel	2.2	NA	NA	NA	NA		**0.000**				
	2	Unleaded gasoline without catalyst	0.1	NA	NA	NA	NA	5,620	**0.001**				
	3	Unleaded gasoline with catalyst	0.001	NA	NA	NA	NA		**0.000**				
	4	Ethanol with catalyst	0.0007	NA	NA	NA	NA		**0.000**				
b		**2-Stroke engines**						**3,026**	**0.007566**		**0**	**0**	**0**
	1	Leaded fuel	3.5	NA	NA	NA	NA		**0.000**				
	2	Unleaded fuel	2.5	NA	NA	NA	NA	3,026	**0.008**				
c		**Diesel engines**						**7,336**	**0.0007336**	**0.000**	**0.000**	**0.000**	**0.000**
	1	Regular Diesel	0.1	NA	NA	NA	ND	7,336	**0.001**				
	2	Biodiesel	0.07	NA	NA	NA	ND		**0.000**				
d		**Heavy oil fired engines**						**0**	**0.00000000**	**0**	**0**	**0**	**0**
	1	All types	2	NA	NA	NA	ND		**0.000**				
		Transport							**0.009**	**0**	**0**	**0**	**0**

Group	Cat.	Class	Source categories	Potential Release Route (µg TEQ/t)					Production	Annual release				
				Air	Water	Land	Product	Residue	t/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
										Air	Water	Land	Product	Residue
6			**Open Burning Processes**											
	a		**Biomass burning**						**36,702**	**0.018**	**0.000**	**0.002**	**0**	**0**
		1	Agricultural residue burning in the field of cereal and other crops stubble, impacted, poor burning conditions	30	ND	10	NA	NA		**0.000**		**0.000**		
		2	Agricultural residue burning in the field of cereal and other crops stubble, not impacted	0.5	ND	0.05	NA	NA	36,702	**0.018**		**0.002**		
		3	Sugarcane burning	4	ND	0.05	NA	NA		**0.000**		**0.000**		
		4	Forest fires	1	ND	0.15	NA	NA		**0.000**		**0.000**		
		5	Grassland and savannah fires	0.5	ND	0.15	NA	NA		**0.000**		**0.000**		
	b		**Waste burning and accidental fires**						**8,496**	**1.78487**	**0**	**0.089**	**0**	**0**
		1	Fires at waste dumps (compacted, wet, high Corg content)	300	ND	10	NA	NA	5,434	**1.630**		**0.054**		
		1.1	Fires at hazardous waste dump on Kiritimati	3,500		900			14	**0.048**		**0.012**		
		2	Accidental fires in houses, factories	400	ND	400	NA	NA	50	**0.020**		**0.020**		
		3	Open burning of domestic waste	40	ND	1	NA	NA	1,888	**0.076**		**0.002**		
		4	Accidental fires in vehicles (ug TEQ per vehicle)	100	ND	18	NA	NA	4	**0.00040**		**0.000**		
		5	Open burning of wood (construction/demolition)	60	ND	10	NA	NA	1	**0.000**		**0.000**		
		5a	DOMESTIC BURNING of GREEN WASTE*	10	ND	0.25	NA	NA	1,120	**0.011**		**0.000**		
6			**Open Burning Processes**						**17,006**	**1.803**	**0**	**0.091**	**0**	**0.000**

Group	Cat.	Class	Source categories	Potential Release Route (µg TEQ/t)					Production t/a	Annual release				
				Air	Water	Land	Product	Residue		g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
8			**Miscellaneous**							**Air**	**Water**	**Land**	**Product**	**Residue**
	a		**Drying of biomass**						**0**	**0.000**	**0**	**0**	**0.000**	**0.000**
		1	Highly contaminated fuel (PCP treated)	10	NA	ND	0.5	2,000		**0.000**			**0.000**	**0.000**
		2	Moderately contaminated fuel	0.1	NA	ND	0.1	20		**0.000**			**0.000**	**0.000**
		3	Clean fuel	0.01	NA	ND	0.1	5		**0.000**			**0.000**	**0.000**
	b		**Crematoria**						**0**	**0.000**	**0**	**0**	**0**	**0.000**
		1	No control (per cremation)	90	NA	NA	NA	ND		**0.000**				
		2	Medium control or open air cremations (per cremation)	10	NA	NA	NA	2.5		**0.000**				**0.000**
		3	Optimal control (per cremation)	0.4	NA	NA	NA	2.5		**0.000**				**0.000**
	c		**Smoke houses**						**10**	**0.0000624**	**0**	**0**	**0**	**0.00021**
		1	Contaminated fuels	50	NA	ND	ND	2,000		**0.000**				**0.000**
		2	Clean fuels, no afterburner	6	NA	ND	ND	20	10	**0.00006**				**0.000**
		3	Clean fuels, afterburner	0.6	NA	ND	ND	20		**0.000**				**0.000**
	d		**Dry cleaning**						**0**	**0**	**0**	**0**	**0**	**0.000**
		1	Heavy textiles, PCP-treated, etc.	NA	NA	NA	NA	3,000						**0.000**
		2	Normal textiles	NA	NA	NA	NA	50						**0.000**
	e		**Tobacco smoking**						**1,875**	**0.00018755**	**0**	**0**	**0**	**0.00018755**
		1	Cigar (per million items)	0.3	NA	NA	NA	0.3		**0.000**				**0.000**
		2	Cigarette (per million items)	0.1	NA	NA	NA	0.1	1,875	**0.000**				**0.000**
8			**Miscellaneous**						**1,886**	**0.000250**	**0**	**0**	**0.000**	**0.00040**

Group	Cat.	Class	Source categories	Potential Release Route (µg TEQ/t)					Production	Annual release					
				Air	Water	Land	Product	Residue		g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	
9			**Disposal**							**Air**	**Water**	**Land**	**Product**	**Residue**	
	a		**Landfills, Waste Dumps and Landfill Mining**						**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
		1	Hazardous wastes	NA	5	NA	NA	NA			**0.000**				
		2	Mixed wastes	NA	0.5	NA	NA	50			**0.000**			**0.000**	
		3	Domestic wastes	NA	0.05	NA	NA	5			**0.000**			**0.000**	
	b		**Sewage/sewage treatment**						**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	Please enter water discharge in L
		1	Mixed domestic and industrial inputs						0		*0.000*	*0*	*0*	*0.000*	
			No sludge removal	NA	10	NA	NA	NA			**0.000**				
			With sludge removal	NA	1	NA	NA	200			**0.000**			**0.000**	
		2	Urban and industrial inputs						0		*0.000*	*0*	*0*	*0.000*	
			No sludge removal	NA	1	NA	NA	NA			**0.000**				
			With sludge removal	NA	0.2	NA	NA	20			**0.000**			**0.000**	
		3	Domestic inputs						0		*0.000*	*0*	*0*	*0.000*	
			No sludge removal	NA	0.4	NA	NA	NA			**0.000**				
			With sludge removal	NA	0.4	NA	NA	4			**0.000**			**0.000**	
	c		**Open water dumping**						**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	Please enter water discharge in m3
		1	Mixed domestic and industrial wastewater	NA	0.005	NA	NA	NA			**0.000**				
		2	Urban and peri-urban wastewater	NA	0.0002	NA	NA	NA			**0.000**				
		3	Remote environments	NA	0.0001	NA	NA	NA			**0.000**				
	d		**Composting**						**50**	**0.000**	**0.000**	**0.000**	**0.002500**	**0.000**	
		1	Organic wastes separated from mixed wastes	NA	NA	NA	50	NA	50				**0.002500**		
		2	Clean compost	NA	NA	NA	5	NA					**0.000**		
	e		**Waste oil disposal**						**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
		1	All fractions	ND	ND	ND	ND	ND	0						
9			**Disposal/Landfill**							**0.000**	**0.000**	**0**	**0.003**	**0**	

Group	Cat.	Class	Source categories	Product (µg TEQ/t)	Occurrence (t)	g TEQ identified				
						Air	Water	Land	Product	Residue
10			**Contaminated Sites and Hotspots**			x indicates need for site-specific evaluation				
	a		**Production sites of chlorine**							
		1	Chlor-alkali production				x	x		
		2	Leblanc process and associated chlorine/bleach					x		
	b		**Production sites of chlorinated organics**							
		1	Production sites of chlorophenol				x	x		
		2	Former lindane production where HCH waste isomers have been recycled				x	x		
		3	Former production sites of other chemicals suspected to contain PCDD/PCDF				x	x		
		4	Production sites of chlorinated solvents and other "HCB waste"				x	x		
		5	(Former) PCB and PCB-containing materials/equipment production				x	x		
	c		**Application sites of PCDD/PCDF containing pesticides and chemicals**					x		
	d		**Timber manufacture and treatment sites**				x	x		
	e		**Textile and leather factories**				x	x		
	f		**Use of PCB**		**0**				**0**	
			Low chlorinated, e.g., Clophen A30, Aroclor 1242	15,000					**0**	
			Medium chlorinated, e.g., Clophen A40, Aroclor 1248	70,000					**0**	
			Medium chlorinated, e.g., Clophen A50, Aroclor 1254	300,000					**0**	
			High chlorinated, e.g., Clophen A60, Aroclor 1260	1,500,000					**0**	
		1	Leaching				x	x		
		2	Not leaching				x	x		
	g		**Use of chlorine for production of metals and inorganic chemicals**				x	x		
	h		**Waste incinerators**		**1**		x	x		
	i		**Metal industries**				x	x		
	j		**Fire accidents**				x	x		
	k		**Dredging of sediments and contaminated flood plains**				x	x		
	l		**Dumps of wastes/residues from groups 1-9**				x	x		
	m		**Kaolin or ball clay sites**				x	x		
10			**Hot spots**						**0**	**0**