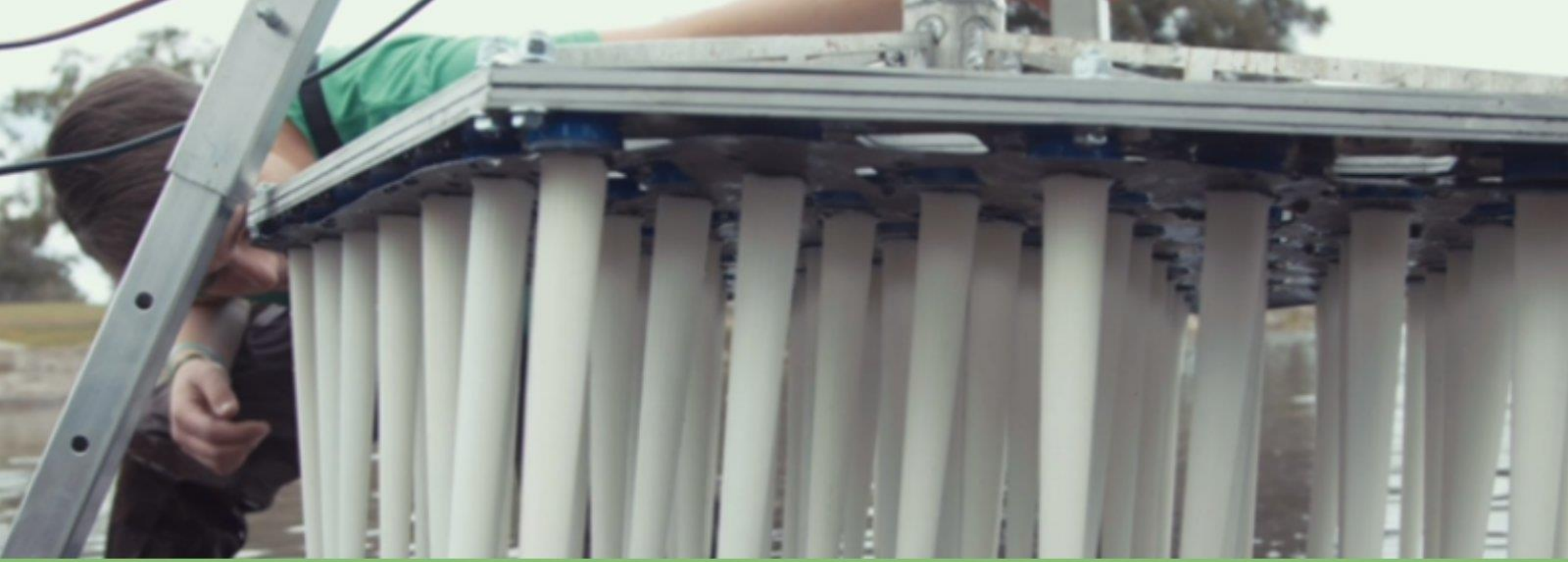


BRS COP - IPEN Side Event

IPEN
for a toxics-free future

PCB Elimination by 2028:

Potential of non-combustion destruction technologies

SPEAKERS

Sara BROSCHÉ

Science Advisor, IPEN | Moderator

Lee BELL

Mercury and POPs Policy Advisor, IPEN

Griffins OCHIENG

Executive Director, Centre for Environmental Justice and Development

Sergie ALBINO

Founder and CEO, ecoSPEARS

Douglas HALLETT

Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

BRS COP - FRIDAY 5 MAY, 2023

1:15 - 2:45 pm
Room B

IPEN SIDE EVENT

PCB ELIMINATION BY 2028

Potential for non-combustion destruction technologies

Visit us online for IPEN's research, policy analysis, and more on chemicals, waste, and threats to our health and the environment

https://ipen.org

IPEN
for a toxics-free future

AGENDA

Welcome and Introduction

- Sara BROSCHÉ | Science Advisor, IPEN | Moderator

Presentations

PCB Elimination by 2028: Potential of the non-combustion destruction technologies

- Lee BELL | Mercury and POPs Policy Advisor, IPEN

POPs in plastic consumer products and free-range chicken eggs from Kenya

- Griffins OCHIENG | Executive Director, Centre for Environmental Justice and Development

Green and Non-combustion Technologies to Extract and Eliminate PCBs and Forever Chemicals

- Sergie ALBINO | Founder and CEO, ecoSPEARS

On-site PCB Destruction and Remediation using Hydrogen Reduction

- Douglas HALLETT | Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

Q&A

Closing Remarks

Visit us online for IPEN's research, policy analysis, and more on chemicals, waste, and threats to our health and the environment

https://ipen.org

IPEN
for a toxics-free future

AGENDA

Welcome and Introduction

- Sara BROSCHÉ | Science Advisor, IPEN | Moderator

Presentations

PCB Elimination by 2028: Potential of the non-combustion destruction technologies

- Lee BELL | Mercury and POPs Policy Advisor, IPEN

POPs in plastic consumer products and free-range chicken eggs from Kenya

- Griffins OCHIENG | Executive Director, Centre for Environmental Justice and Development

Green and Non-combustion Technologies to Extract and Eliminate PCBs and Forever Chemicals

- Sergie ALBINO | Founder and CEO, ecoSPEARS

On-site PCB Destruction and Remediation using Hydrogen Reduction

- Douglas HALLETT | Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

Q&A

Closing Remarks

PCB Elimination by 2028: Potential of the non-combustion destruction technologies

Lee Bell - Mercury and POPs Policy Advisor

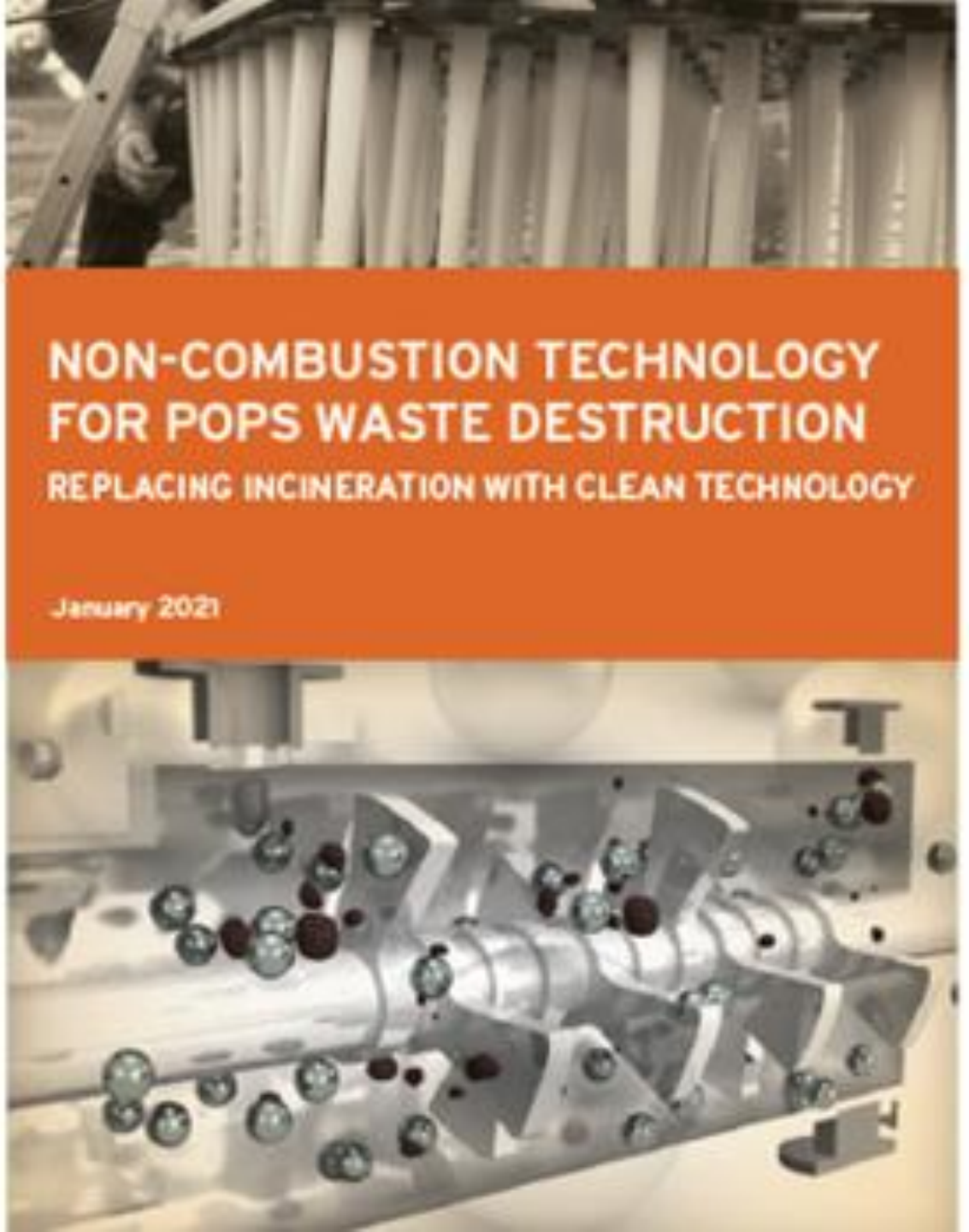
International Pollutants Elimination Network

Basel, Rotterdam and Stockholm COPs

May 5th 2023

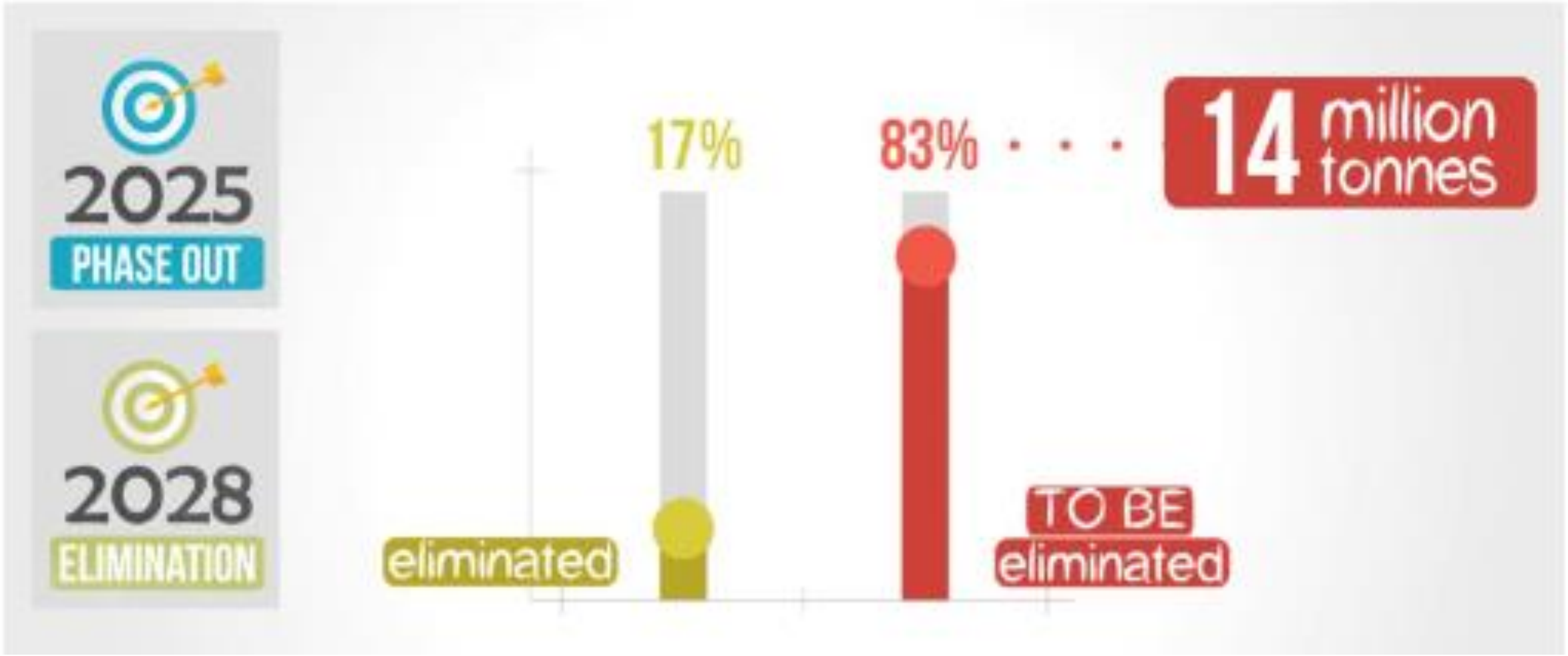
Non-combustion technologies for PCB destruction

- Destroy PCBs and other POPs waste
- Do not release U-POPs such as PCDD/PCDF (dioxins and furans) in emissions and residues
- Capable of flexible applications
- Can often be moved to the site of the PCB stockpile or contaminated site instead of shipping the waste.

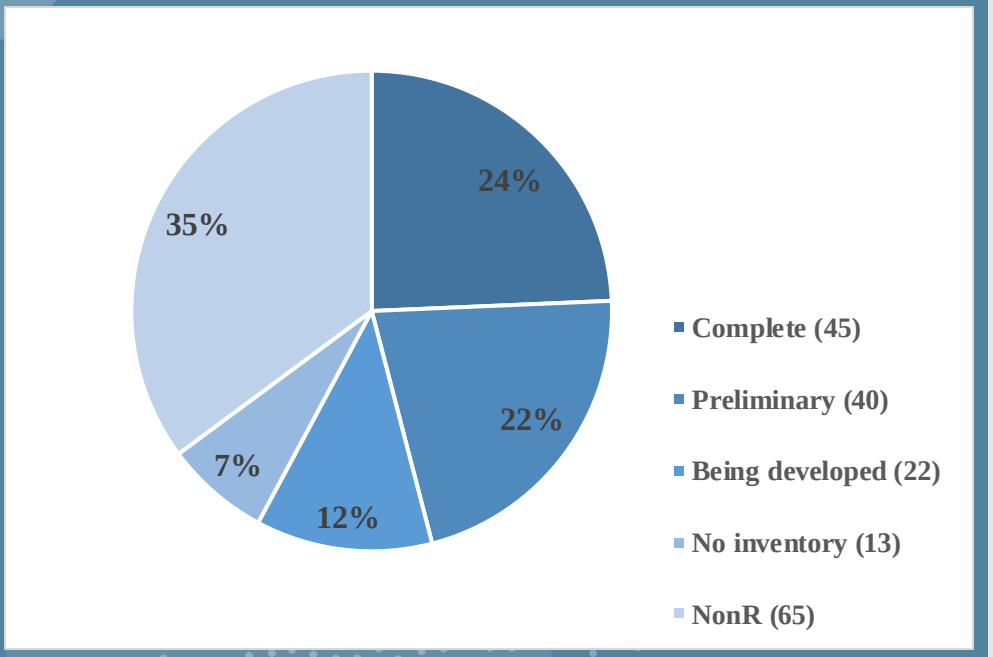


PCB elimination needs rapid acceleration!

2017 Assessment PCB Elimination Network



Report on progress towards the elimination of polychlorinated biphenyls (INF 11)



Many countries have not reported their inventories and/or lack capacity to analyse and identify PCB wastes –especially contaminated soils and sediments.

Table 5. Total quantities of PCB in inventory detailed by region.

Region	NR3 (t)	NR4 (t)	NR5 (t)	Cumulative total (t)	Total number of countries reporting PCB inventories
Africa	14,894	14,956	2,295	5,638	8
Asia-Pacific	64,844	98,519	459,459	556,079	8
Eastern Europe	47,396	19,094	7,180	22,611	16
GRULAC	164,677	129,535	3,620	3,999	12
WEOG	8,683	18,182	39,236	50,731	9
Grand Total	**300,495**	**280,287**	**511,790**	**640,014**	**53**

Table 6. Summary of quantitative global information on PCB reported under the Stockholm Convention and Basel Convention national reports.

	Production (t)	PCB waste eliminated (Local destruction + exports) (t)	Inventoried PCB (t)
Global information reported under SC and BC	1,046,000 – 1,512,000	593,260	639,057

Progress on PCB destruction is too slow to meet the 2028 deadline

2017 remaining PCB waste to be destroyed

14 million tonnes

Since 2019 the total PCB waste that has been destroyed:

Locally	Exported	Total
151,000 tonnes	37,455 tonnes	188,455 tonnes

Inventoried → **639,057 tonnes**

Pure PCB has been diluted widely into products, equipment and the environment.

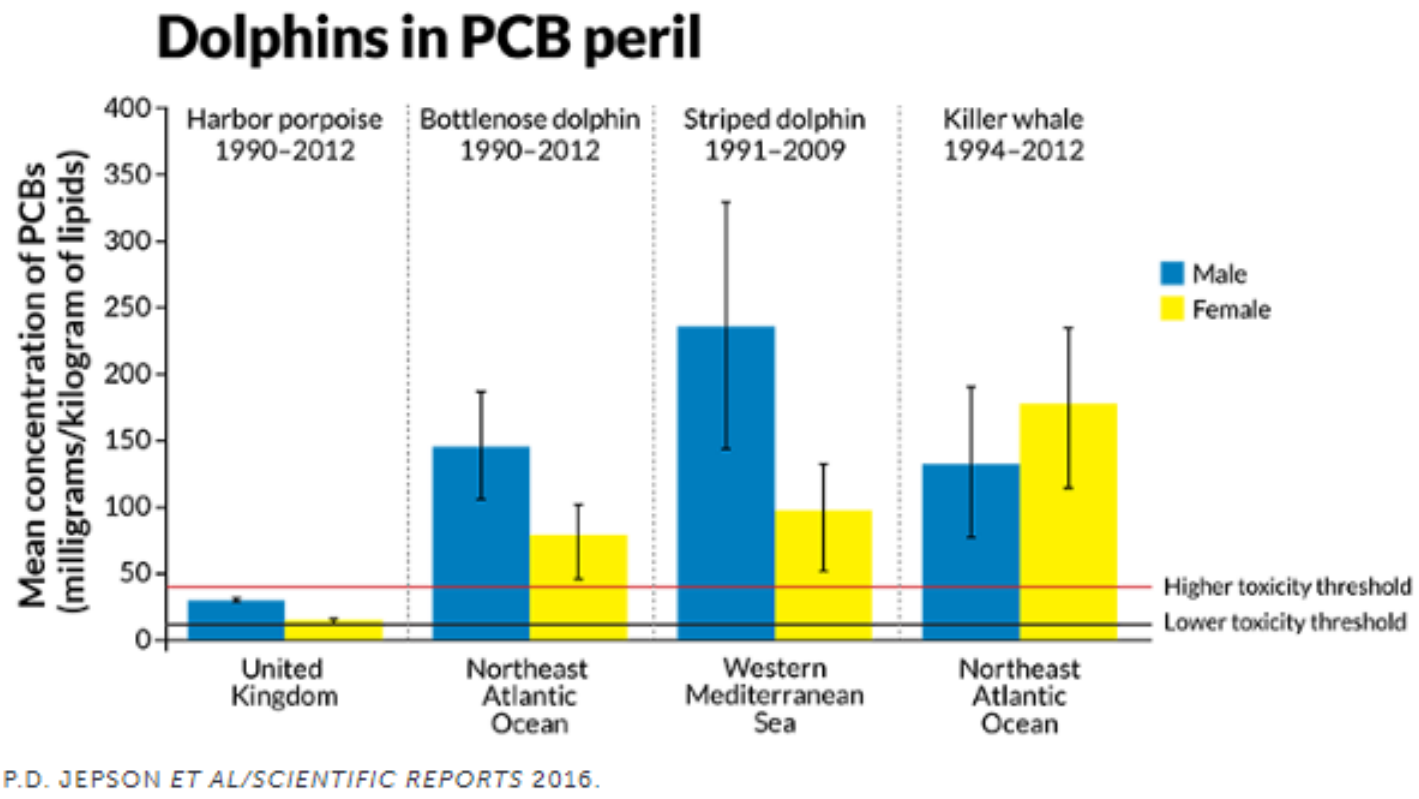
Commonly inventoried:

- **Transformers and other contaminated equipment/products**
- **PCB contaminated oils**

Not necessarily inventoried but often requiring treatment:

- **Contaminated sites and soil**
- **Contaminated sediments**
- **Open application wastes (paints, caulking)**

Ongoing food chain impacts of PCBs



Shocking levels of PCB chemicals in UK killer whale ‘Lulu’.

"The levels of PCB contamination in Lulu were incredibly high, surprisingly so. They were 20 times higher than the safe level that we would expect for cetaceans to be able to manage. That puts her as one of the most contaminated animals on the planet”, Dr Andrew Brownlow veterinary pathologist at Scotland's Rural College.

“Scotland’s killer whale population looks as if it’s going extinct” Dr Paul Jepson of the Zoological Society of London

Human exposure risks from PCB increasing

IMPACTS OF PCBs ON HUMAN HEALTH

Liver disorders

Elevation of serum triglycerides,
Induction of mixed function oxidases

Failure of reproduction

Reduced sperm counts, accumulation in breast milk, neurobehavioral deficits in newborns, conception rates, reduced birth weight

Risk of Cancers

Every commercial PCB mixture tested caused cancer,
Increases in rare liver cancers and malignant melanoma

Hormone system

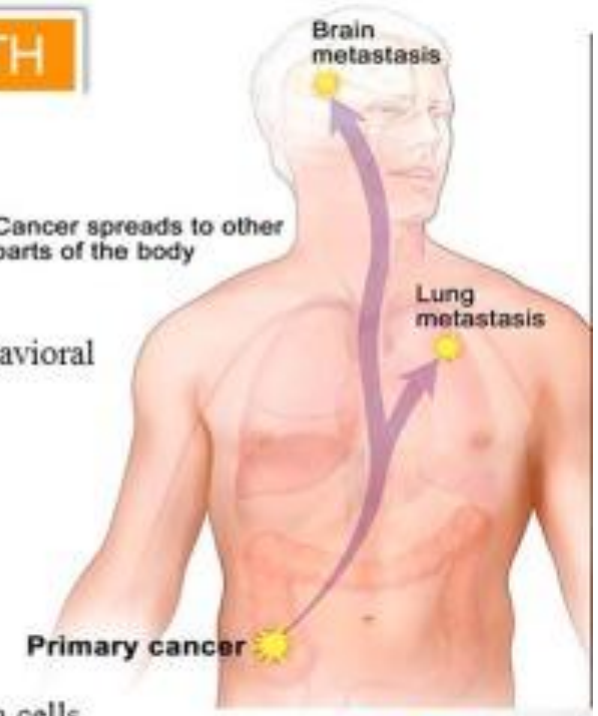
Several PCB metabolites induce gene mutations, chromosome breaks, chromosome loss and polyploidization in cells in culture.

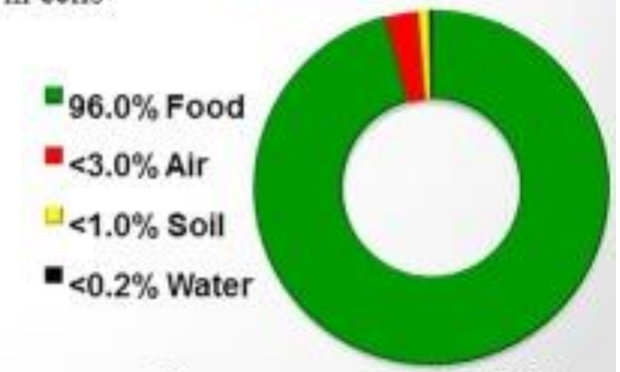
Suppress immune system

Decreases in IgA and IgM antibody levels,
decreases in monocyte and granulocyte counts,
decreases in natural killer cell count

Carcinogenic effects

EPA and DHHs consider PCBs a carcinogen for human
Based on animal studies data.
Also, IARC classified PCBs as Group-I carcinogen to humans.





Human exposure to PCBs via food, water, air and soil

Emerging Contaminants 8 (2022) 254–279

Contents lists available at ScienceDirect

Emerging Contaminants

journal homepage: www.keaipublishing.com/cn/journals/emerging-contaminants

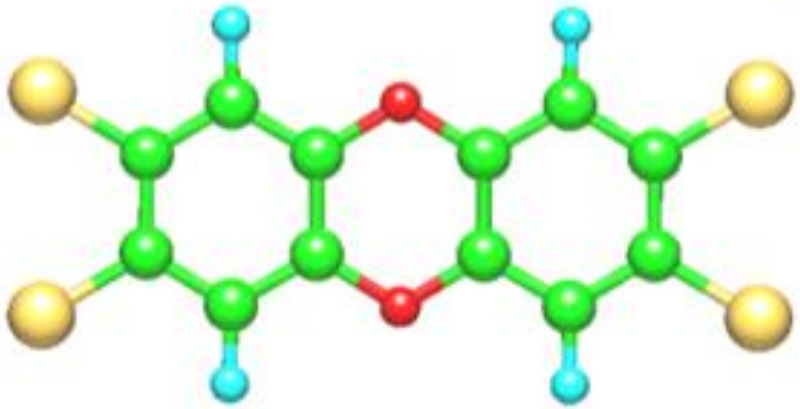
Review article

Monitoring dioxins and PCBs in eggs as sensitive indicators for environmental pollution and global contaminated sites and recommendations for reducing and controlling releases and exposure

Over 20 years IPEN monitored 127 pooled egg samples including samples from 113 chicken flocks at different locations around the globe.

The peer-reviewed analysis published in the journal Emerging Contaminants found that in nearly 90% of the areas studied, levels of dioxins and dioxin-like PCBs in free-range eggs exceed EU regulatory food limits.

New IPEN report from Kenya confirms serious PCB food chain contamination.



Which technologies destroy POPs?

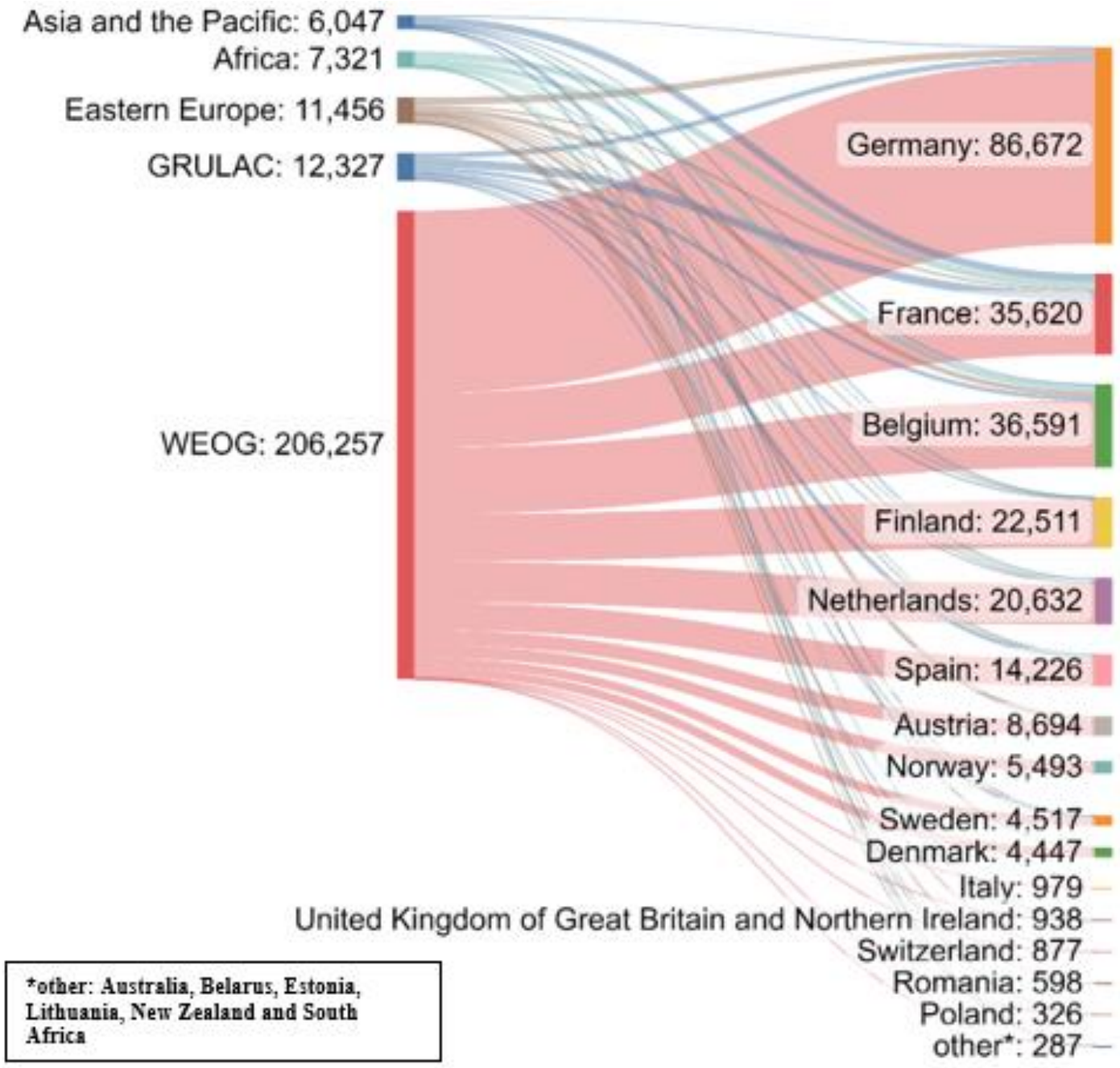
Technologies to destroy POPs waste are listed in the *Basel General Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of, Containing or Contaminated with Persistent Organic Pollutants* (Table 4).

Unfortunately, incinerators, cement kilns and metallurgy plants are included in this list.

- **These are combustion technologies.**
- **They are polluting technologies that burn POPs waste but create unintentional POPs (UPOPs) like dioxin in their emissions and in their residues like fly ash and bottom ash.**
- **These UPOPs go on to pollute soils, build up in the food chain and increase human exposure.**
- **They also produce huge volumes of green house gases.**

Barriers to PCB waste destruction

- Disposal Costs
- Shipping insurance costs sometimes exceed destruction costs
- Lack of facilities to destroy POPs in the global south necessitating shipment to the north.
- More than 90% of the exported PCB was destined to seven countries.
- Lack of analytical ability to identify PCB waste in many countries.



Benefits of mobile non-combustion technologies over fixed combustion technologies

- **Incinerators and cement kilns are typically static, expensive to construct and maintain and release UPOPs. In many countries they don't meet BAT BEP standards to minimise UPOPs emissions such as dioxin.**
- **More mobile, transportable and relocatable destruction technologies that don't emit UPOPs are needed to take the destruction capability to the waste rather than shipping waste long distances to overseas facilities.**
- **Flexibility, modularity and transportability are needed to meet the proximity principle and avoid the hazard and cost of shipping PCB and accelerate the destruction rate.**

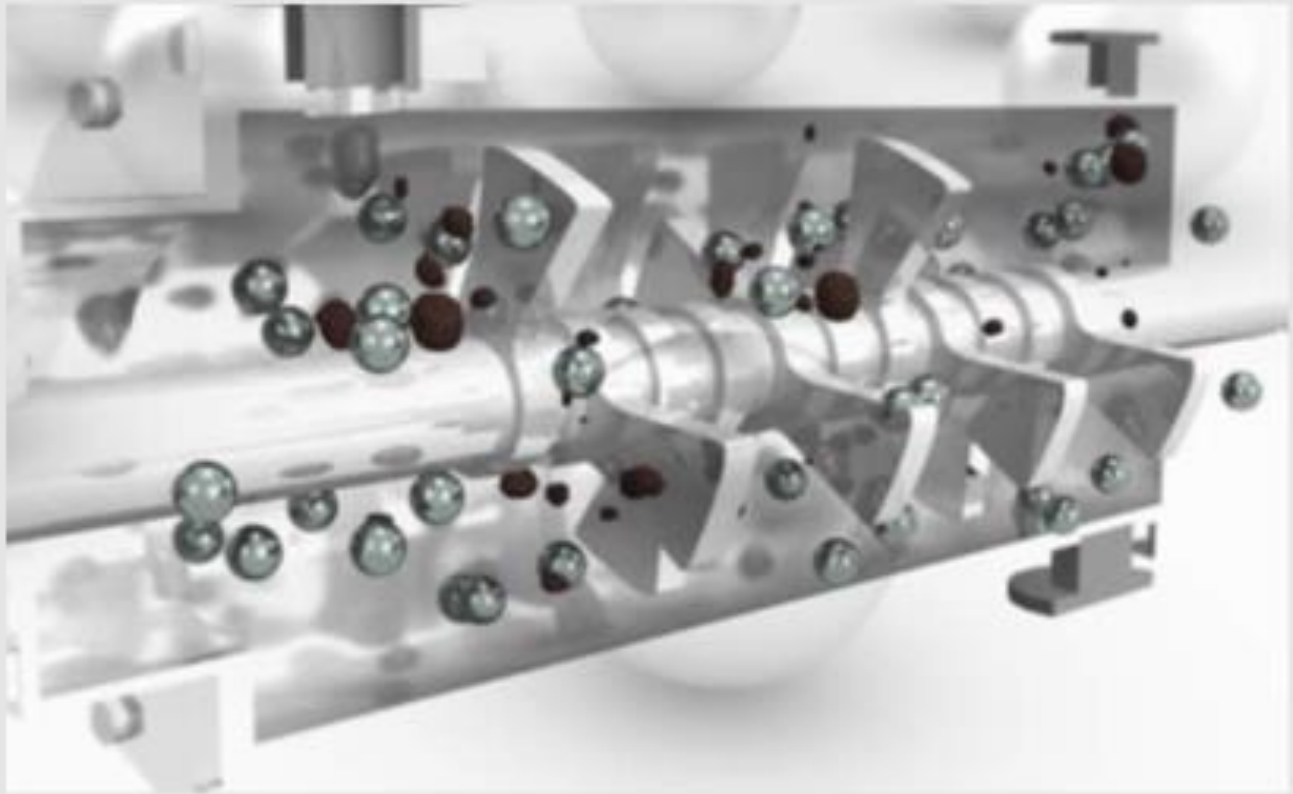
Non-combustion technologies don't create ash or UPOPs

The same Basel Guidelines on POPs waste also include non-combustion technologies:

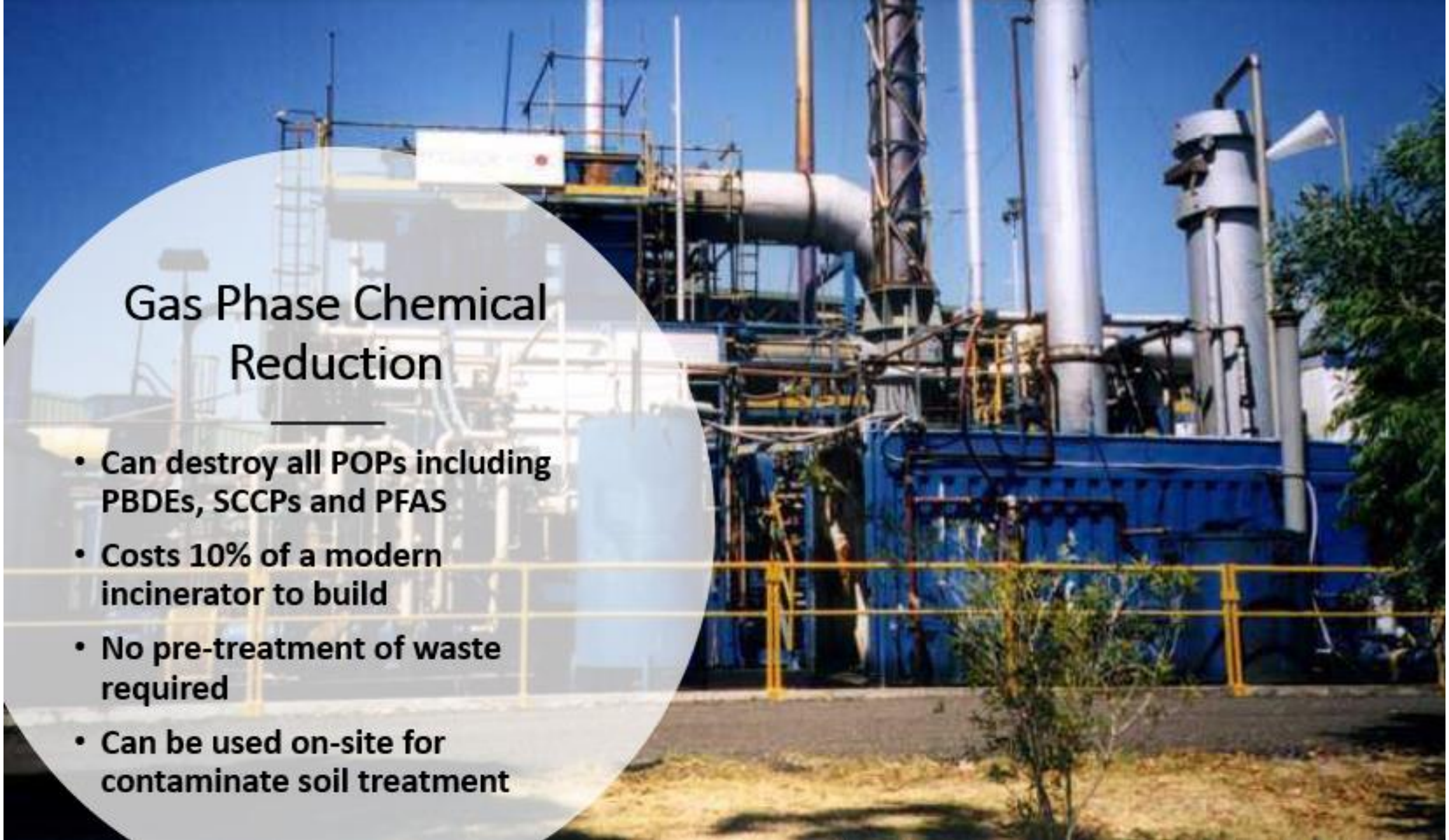
- **Alkali metal reduction**
- **Gas Phase Chemical Reduction (GPCR)**
- **Base catalysed decomposition (BCD)**
- **Supercritical water oxidation (SCWO)**
- **Catalytic hydrodechlorination**

and there are more….

New NC technologies for POPs destruction



- EcoSPEARS and RIDS – a new technology to remove dioxins and PCBs from underwater sediment and destroy it.
- Mechanochemcial Destruction (MCD) and Tribolysis – using ball mills and reagents to destroy high concentration POPs.
- Electrochemical oxidation – for destruction of PFAS
- Solvated electron technology



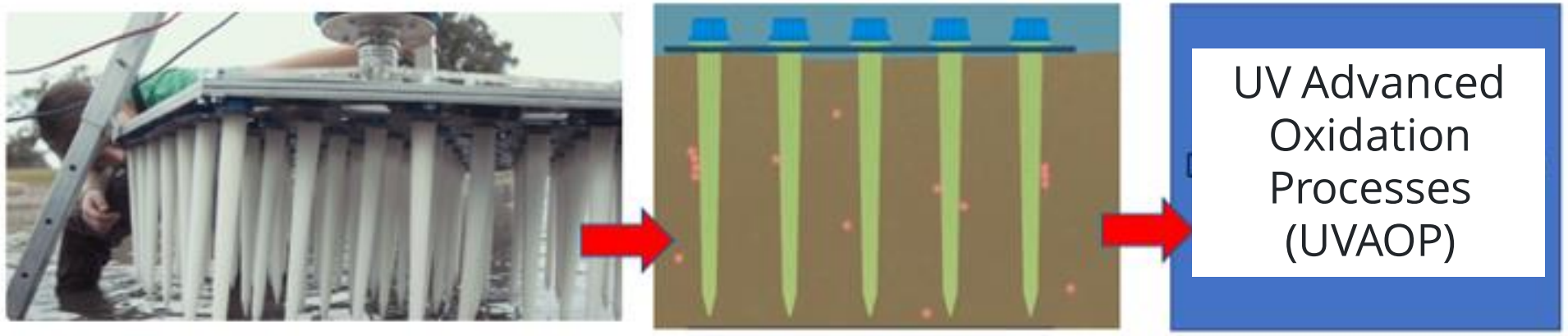
Gas Phase Chemical Reduction

- Can destroy all POPs including PBDEs, SCCPs and PFAS
- Costs 10% of a modern incinerator to build
- No pre-treatment of waste required
- Can be used on-site for contaminate soil treatment

Supercritical water oxidation

- **Can destroy all POPs waste including PBDE, SCCPs, hazardous waste and chemical weapons.**
- Mobile containerised units for difficult locations
- No hazardous emission or residues
- Installation costs were 15% less expensive and running costs for SCWO were only around 10% of the costs of incineration of hazardous liquids. SCWO is now used extensively by the US military for destruction of hazardous wastes and chemical weapons, including mobile ship-based units. (Aki et al. 1998).

Treatment train example 1 – ecoSPEARS and UVAOP



Step 1. Contaminants are adsorbed from sediment into specially designed, solvent filled polymer SPEARS that are inserted into the sediment profile. The affinity of PCBs for both polymers and certain solvents draws the contaminants into the SPEARS and out of thee sediment.

Step 2. The spears are decanted and the PCB laden solvent is destroyed in a UV oxidation process.

A major advantage is to eliminate dredging of sediment and resuspension of PCB in the water column impacting biota.

ITDU and BCD treating dioxin waste in Spolana - Czech Republic

Step 1 – POPs removal with Indirect thermal desorption unit.

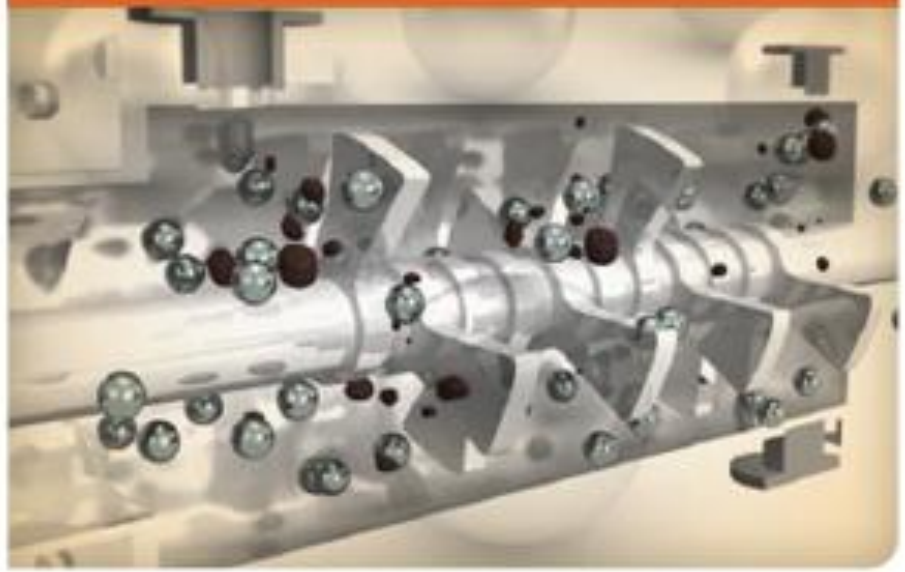
Step 2 – POPs Destruction with Base catalysed decomposition

IPEN
for a toxics-free future

NON-COMBUSTION TECHNOLOGY FOR POPS WASTE DESTRUCTION

REPLACING INCINERATION WITH CLEAN TECHNOLOGY

January 2021



Sweden
Sverige

IPEN

Advanced non-combustion technologies are making POPs waste incineration obsolete.

Find out more at https://ipen.org/documents/non-combustion-technology-pops-waste-destruction

Thank you for your attention!

leebell@ipen.org

AGENDA

Welcome and Introduction

- Sara BROSCHÉ | Science Advisor, IPEN | Moderator

Presentations

PCB Elimination by 2028: Potential of the non-combustion destruction technologies

- Lee BELL | Mercury and POPs Policy Advisor, IPEN

POPs in plastic consumer products and free-range chicken eggs from Kenya

- Griffins OCHIENG | Executive Director, Centre for Environmental Justice and Development

Green and Non-combustion Technologies to Extract and Eliminate PCBs and Forever Chemicals

- Sergie ALBINO | Founder and CEO, ecoSPEARS

On-site PCB Destruction and Remediation using Hydrogen Reduction

- Douglas HALLETT | Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

Q&A

Closing Remarks

POPs in plastic consumer products and free-range chicken eggs from Kenya

IPEN side-event on PCB elimination
Friday, 5th May 2023
BRS COPs 2023

Griffins Ochieng

Executive Director, Centre for Environment Justice and Development, CEJAD

Co-Chair – IPEN Toxics Plastic Working Group

Objectives

Reduce and eliminate the production, trade and use of toxic "non-circular" plastics, i.e. plastics that cannot be recycled due to content of hazardous chemicals, and protect the integrity of a non-toxic circular economy

1. Collect Information & Assess Plastic Waste Management Schemes
   - National assessments of policies and reports on plastic waste management
   - Pilot monitoring of hazardous chemicals in plastics and monitoring of related food chain contamination.

2. Present Information, Best Practices & National Financing Regulation Schemes
   - Produce evidence-based policy recommendations (using the new data generated in the project)
   - Present to national authorities and decision makers through meetings/workshops

3. Elevate Non-Hazardous Recycling & Financial Schemes to Developing Market Countries
   - Develop global report aggregating the results of Kenya's study report with other information from Asia and Central/Eastern Europe
   - Present expert meetings of the two Conventions. Policy recommendations to provide a basic framework for phasing-out non-circular plastics.

Key expected outputs

- Established national **baseline data for the phase-out of non-circular plastics in Kenya**

- Enhanced national policy dialogues on the **phase-out of non-circular plastics and use of extended producer responsibility schemes.**

- Enhanced regional and international policy dialogue on the **phase-out of non-circular plastics and extended producer responsibility under the framework of BRS Conventions and the Strategic Approach to International Chemicals Management (SAICM).**

STUDY ON POPs IN PLASTIC CONSUMER PRODUCTS AND FREE-RANGE CHICKEN EGGS FROM KENYA

Aim of the Study

1. To determine whether **POPs find their way into consumer products and human food due to recycling, dumping or burning.**

2. Contribute to **setting appropriate international standards and limits for the content of POPS in consumer products and waste**

Methodology – Eggs Sampling and testing

1. Pooled samples of free-range chicken were collected in the vicinity of potential POPs pollution hotspots

   - **Nairobi Dumpsite – Plastic waste burns/is burnt**
   - **Ngara Market – e-waste dismantling site**
   - **Mirema – community cooker, uses plastics as fuel**
   - **Nanyuki – near dumpsite with open burning and e-waste disposal**

2. The samples were analyzed in certified laboratories in Czechia, Netherlands, or Germany.

3. A daily dietary intake was calculated for PCDD/Fs plus DL-PCBs, PBDD/Fs, and PF0S. The results of the calculations were compared with the tolerable daily intake (TDI) established by different regulatory authorities.

Imported photo

List of POPs tested in eggs

- Polychlorinated and polybrominated dioxins (PBDD/Fs, PBDD/Fs),
- Polychlorinated biphenyls (PCBs),
- Hexachlorobenzene (HCB),
- Pentachlorobenzene (PeCB),
- Hexachlorobutadiene (HCBD),
- Polychlorinated naphthalenes (PCNs),
- Short-chain chlorinated paraffins (SCCPs),
- 3 isomers of hexachlorocyclohexane (HCH),
- 6 isomers of dichlorodiphenyltrichloroethane (DDT),
- 3 isomers of hexabromocyclododecane (HBCD),
- Polybrominated diphenyl ethers (PBDEs),
- six novel brominated flame retardants (nBFRs), and
- per- and polyfluoroalkyl substances (PFASs).

Results and comparison with legal threshold - Eggs

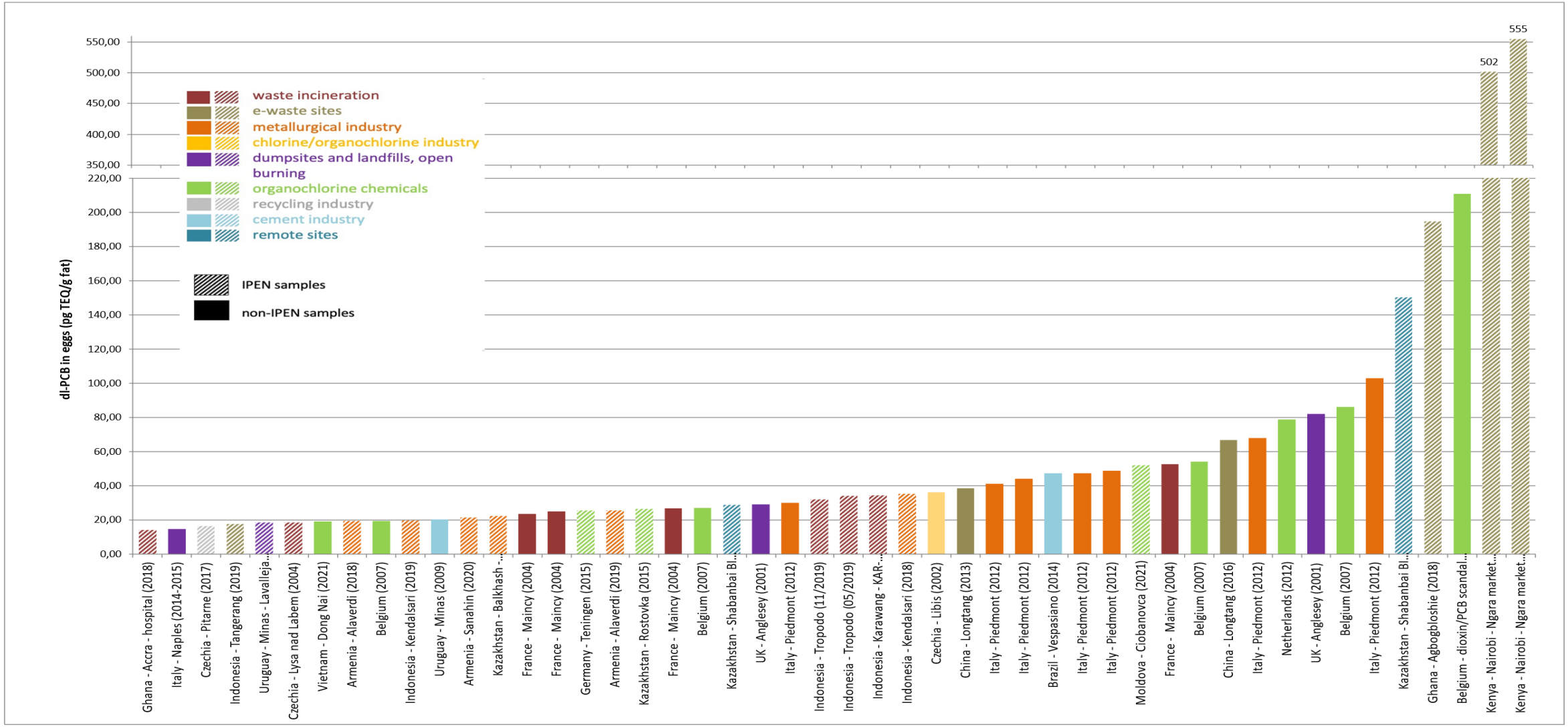
1. Analyzed POPs levels in the **eggs from the selected hot spots** in Kenya **exceeded by many times** the levels measured in reference **samples purchased from a supermarket in Nairobi**.

2. The levels of **dl PCB congeners** measured in both samples from the **Ngara market** were the **highest ever measured in free chicken eggs globally.**

3. The levels of indicator **PCB congeners** in the two **pooled egg samples** from **the Ngara market exceeded the EU regulatory limit** of 40 ng/g fat **by more than 30 and 55 times, respectively**.

4. The level of **indicator PCB congeners** in the eggs from the **Dandora dumpsite reached half of the EU limit.**

The highest levels of dl-PCB in eggs and related sources measured as part of IPEN studies(striped bars) and other scientific studies (filled bars).



Results and comparison with legal threshold- Eggs Cont……

5. The levels of **PCDD/Fs** in free-range egg samples were **two to eight times higher than the EU regulatory limit of 2.5 pg TEQ/g in fat**. The highest level was in eggs from the Dandora dumpsite, followed by eggs from the Ngara market and Mirema.

6. The **sum of PCDD/Fs + dl PCBs was 100 and 111 times, respectively, above the EU regulatory limit of 5 pg TEQ/g fat in two pooled egg samples from the Ngara marke**t.

5. Based on the above, the **average per capita consumption of eggs in Kenya** (36 eggs per year), would **exceed the TDI for PCDD/Fs + dl PCBs by 5 to 6 times**.

6. In addition, we can also say that a person eating just **one egg from the Ngara market** would be **exposed to a cumulative dose** of dioxins and dioxin-like compounds that would span nearly **200 days to more than 250 days**, based on the TDI set by EFSA.

POPs in plastic consumer products

Methodology – Plastics Sampling and Testing

1. **Eighteen black plastic products** (from recycled e-waste plastics and plastics from end-of-life vehicles (ELVs)) with **elevated levels of bromine and antimony** were purchased from markets in Kenya.

2. Laboratory analysis was conducted at the Department of Food Analysis and Nutrition, University of Chemistry and Technology based in Prague, Czechia.

3. Groups of **PBDEs, HBCD and nBFRs, and Tetrabromobishpenol A (TBBPA)** were analyzed in these products.

4. A toy car was also analyzed for brominated dioxins at the MAS laboratory in Muenster, Germany and for dioxin-activity by DR_{human}CALUX.

Results and comparison with legal threshold - Plastics

- **Of 18 samples** of consumer products made of recycled black plastic purchased in Kenya, **14 of them exceed the EU safety standard of 10 ppm**.

- Across all 18 samples, there were six novel BFRs found at concentrations ranging from 0.2 ppm to 412 ppm.

- Tetrabromobisphenol A (TBBPA), the most widely used BFR, was found in 16 out of the 18 samples, at concentrations ranging from 0.3 ppm to 980 ppm.

- **One sample, a toy car, was analyzed for brominated dioxins and was found to contain 6,590 pg TEQ/g, which is much higher than concentrations observed, for example, in waste incineration ashes or pyrolysis residues.**

Conclusion

1. Leakage and emissions of POP additives from waste is a source of contamination of free-range chicken eggs with BFRs and PFASs in the vicinity of dumpsites and/or community cookers using plastic waste as fuel.

2. **All forms of burning plastic waste**, including their use as fuel, **should be banned** as this releases POPs into the environment.

3. Wastes containing high levels of POPs can be treated by **non-combustion technologies**, which destroy POPs and do not generate new POPs.

Conclusion Cont….

4. Study shows that children toys, hair accessories, office supplies, and kitchen utensils in the Kenyan market are affected by **unregulated recycling of e-waste plastics**, which carry toxic brominated flame retardants (BFRs) into new products.

5. To stop this practice, stricter measures to control BFRs in products and waste need to be set and enforced.

6. The results of this study also highlight that the new global Plastics Treaty should focus on the chemical content in plastics.

Recommendations

1. **Halt the entry of plastic treated with BFRs for recycling into toys and other consumer goods**

2. **Set stricter limits for POPs in waste.** Low POPs Content Levels (LPCLs) for waste should be established at a level of 50 ppm as proposed by the African region and accompanied with setting an unintentional trace contamination (UTC) level at 10 ppm.

3. **Use separation techniques for POPs waste.** Methods based on the **total concentration of bromine** should be applied to **identify BFR-treated plastic** and **separate it out of the waste stream**. For example, X-ray fluorescence (XRF) and X-ray transmission (XRT) are used at the industrial scale. In the informal plastic recycling sector in India, a simple sink-and-float method is used for BFR plastic separation.

Recommendations Cont…

4. **Restrict BFRs as a class.** Only a class-based approach can address the regrettable substitutes and likely toxic nBFRs that are currently used without any regulation.

5. **Regulate and control plastic waste.** Facilities using plastic waste as a fuel such as community cookers need to be prohibited.

6. **Use non-combustion technologies for POPs waste.** Gas phase chemical reduction (GPCR) or supercritical water oxidation (SCWO) seem to be the most promising technologies to treat POPs waste. It could benefit African countries to cooperate regionally on establishing treatment center(s) for POP waste.

Thank You!!

info@cejadkenya.org

@cejadkenya.org

AGENDA

Welcome and Introduction

- Sara BROSCHÉ | Science Advisor, IPEN | Moderator

Presentations

PCB Elimination by 2028: Potential of the non-combustion destruction technologies

- Lee BELL | Mercury and POPs Policy Advisor, IPEN

POPs in plastic consumer products and free-range chicken eggs from Kenya

- Griffins OCHIENG | Executive Director, Centre for Environmental Justice and Development

Green and Non-combustion Technologies to Extract and Eliminate PCBs and Forever Chemicals

- Sergie ALBINO | Founder and CEO, ecoSPEARS

On-site PCB Destruction and Remediation using Hydrogen Reduction

- Douglas HALLETT | Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

Q&A

Closing Remarks

ecoSPEARS

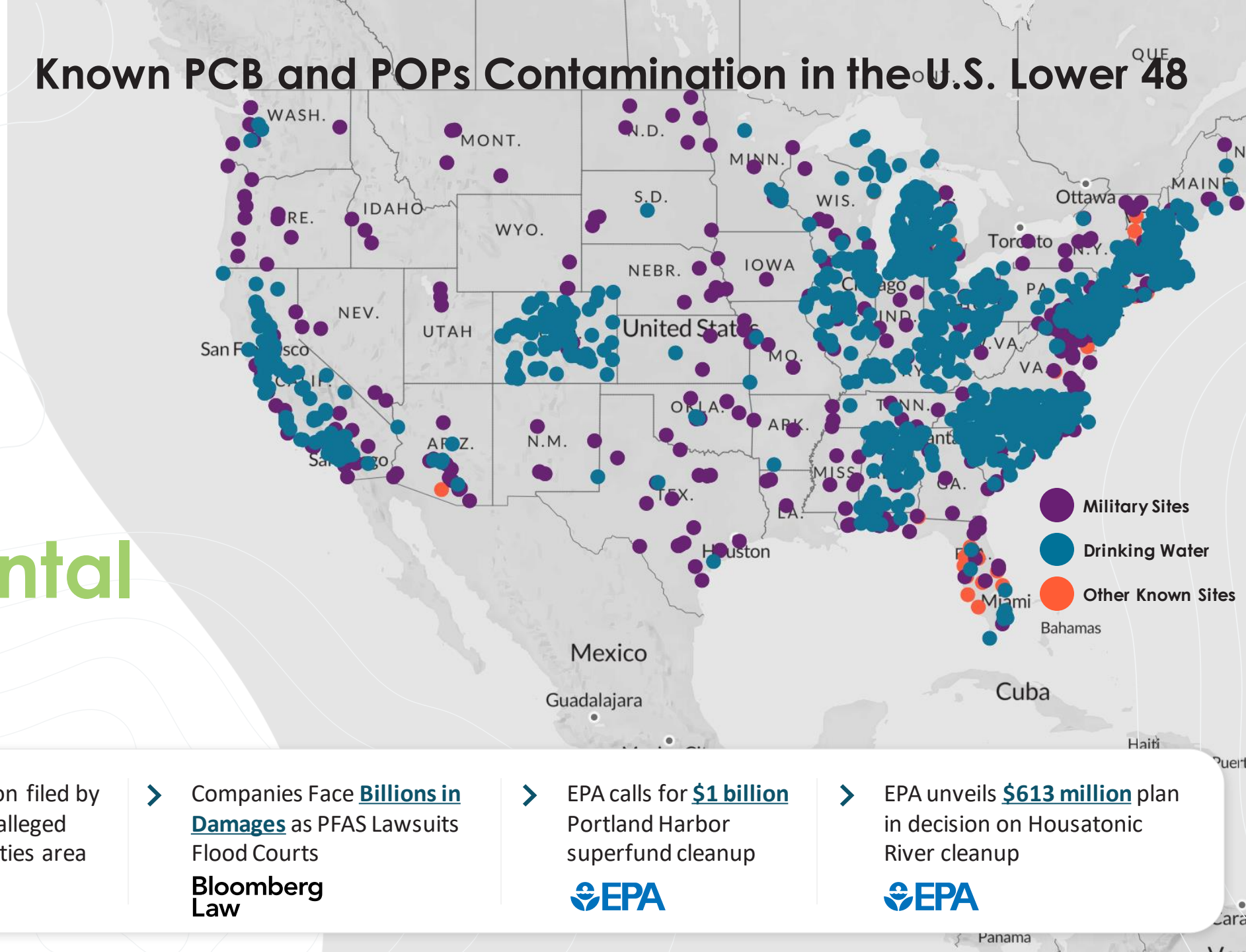
On-site, Non-combustion, Non-thermal Elimination of PCB + POPs

Sediment, Soil, Transformer Oil, and Groundwater

COPs
BASEL / ROTTERDAM / STOCKHOLM
CONVENTIONS

ecoSPEARS

Known PCB and POPs Contamination in the U.S. Lower 48



Forever Chemicals, Forever Environmental RISK

- [$850 million] settlement in litigation filed by the state of Minnesota regarding alleged PFAS contamination in the Twin Cities area
  REUTERS
- Companies Face [Billions in Damages] as PFAS Lawsuits Flood Courts
  Bloomberg Law
- EPA calls for [$1 billion] Portland Harbor superfund cleanup
  EPA
- EPA unveils [$613 million] plan in decision on Housatonic River cleanup
  EPA

Existing Solutions Are Costly & Environmentally Damaging

TSCA (Toxic) Landfills

Liners break, toxins leach into the ground & water, EPA no longer approving

Incinerator

The only EPA-accepted elimination solution, but destroys soil and emits UPOP

Perpetual risk REMAINS

True cost of full elimination is UNKNOWN

ecoSPEARS

Recent Issues

Feb 3, 2023

Train derailed in **East Palestine, OH**, 20 of affected cars contained **hazardous materials**

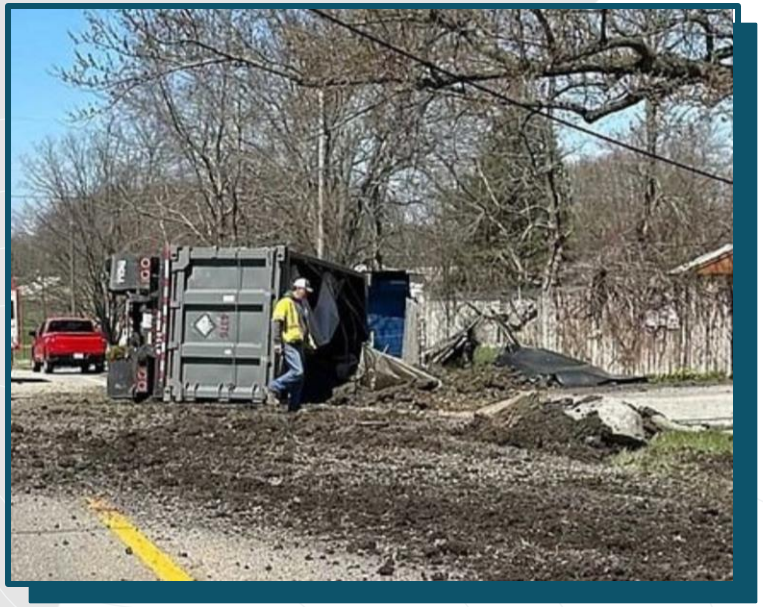
Newsweek

U.S.

Texas Train Derailment Occurs Just Days After Ohio Disaster

March 31, 2023

EPA and **DOJ** file complaint against **Norfolk Southern Railway Company** for **unlawful discharge of pollutants**



CNN US Crime + Justice Energy + Environment Extreme Weather Space + Science

Normal operations resume after hazardous spill in Tucson partially closed highway and led to shelter-in-place order, officials say

April 10, 2023

Truck carrying **40,000 lbs.** of **contaminated soil** from **East Palestine** overturned

abc NEWS VIDEO LIVE SHOWS GUNS IN AMERICA

News Sports Politics Opinion Obituaries • Personal Finance Food & Drink Bee Curious Equity Lab Homebuyers Guide

NATIONAL

Another Norfolk Southern train has derailed, this time in Michigan, authorities say

ecoSPEARS

How We Started

ecoSPEARS is the **exclusive licensee** of **NASA-developed green technology** to extract **polychlorinated biphenyls (PCBs) + POPs** from the environment – **forever**.

NASA TECHNOLOGY TRANSFER PROGRAM

ROLLINS COLLEGE · FIAT LUX · MDCCCLXXX

3 GOOD HEALTH AND WELL-BEING

6 CLEAN WATER AND SANITATION

13 CLIMATE ACTION

14 LIFE BELOW WATER

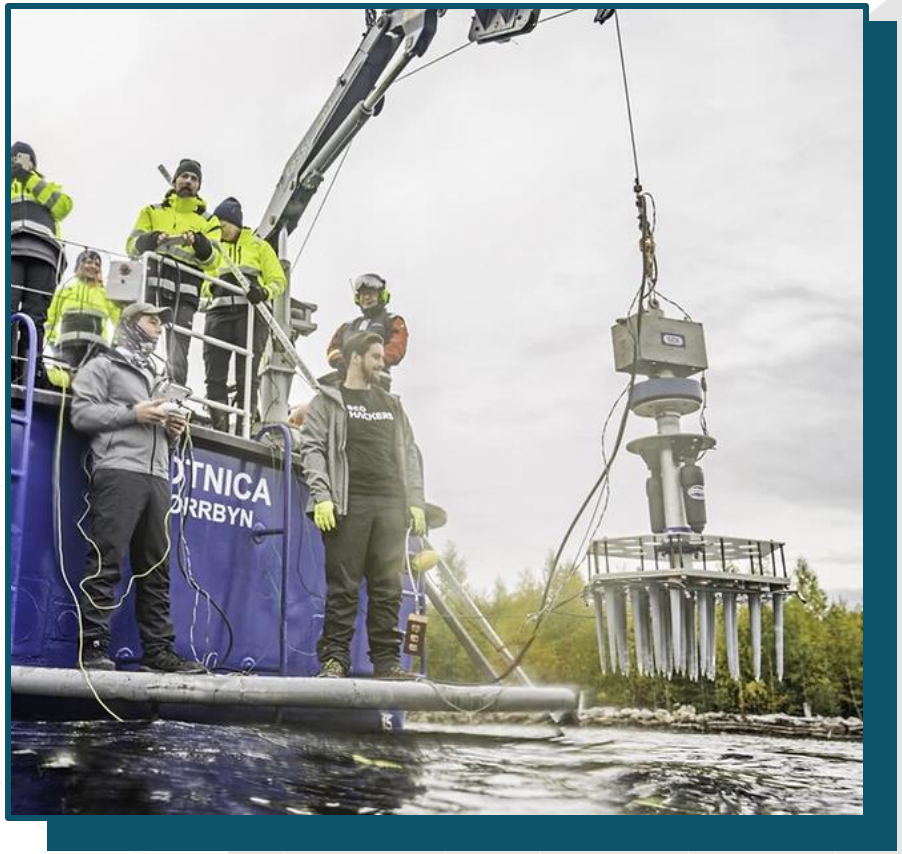
"ecoSPEARS is bringing NASA technology back to Earth

NASA Technology Transfer Program

Environmental Technologies

- **SPEARS - In-situ** passive sediment remediation technology
- **AMTS** - **In-situ** activated metal treatment past application
- **EZVI** – **In-situ** emulsified zero valent metal treatment for ground water

Success Stories



ecoSPEARS

Transformative Technology for On-site Non-Combustion Elimination of PCBs + POPs

EXTRACTION

ecoĀINA

Soil

ecoĀINA is a patented ex-situ technology that extracts PCBs, dioxins, and PFAS from contaminated soil or dewatered sediment.

ecoSPEARS

Sediment

The Sorbent Polymer Extraction and Remediation System (SPEARS) is a patented in-situ technology that extracts PCBs and dioxins from contaminated sediments.

ELIMINATION

ecoCUBE

Liquids

The ecoCUBE is a patented ex-situ system to destroy PCBs, dioxins and PFAS from aqueous contamination utilizing proprietary ultraviolet technology.

ecoSPEARS International Deployments

ecoSPEARS works with public and private partners to eliminate **PCBs + POPs**

ecoSPEARS

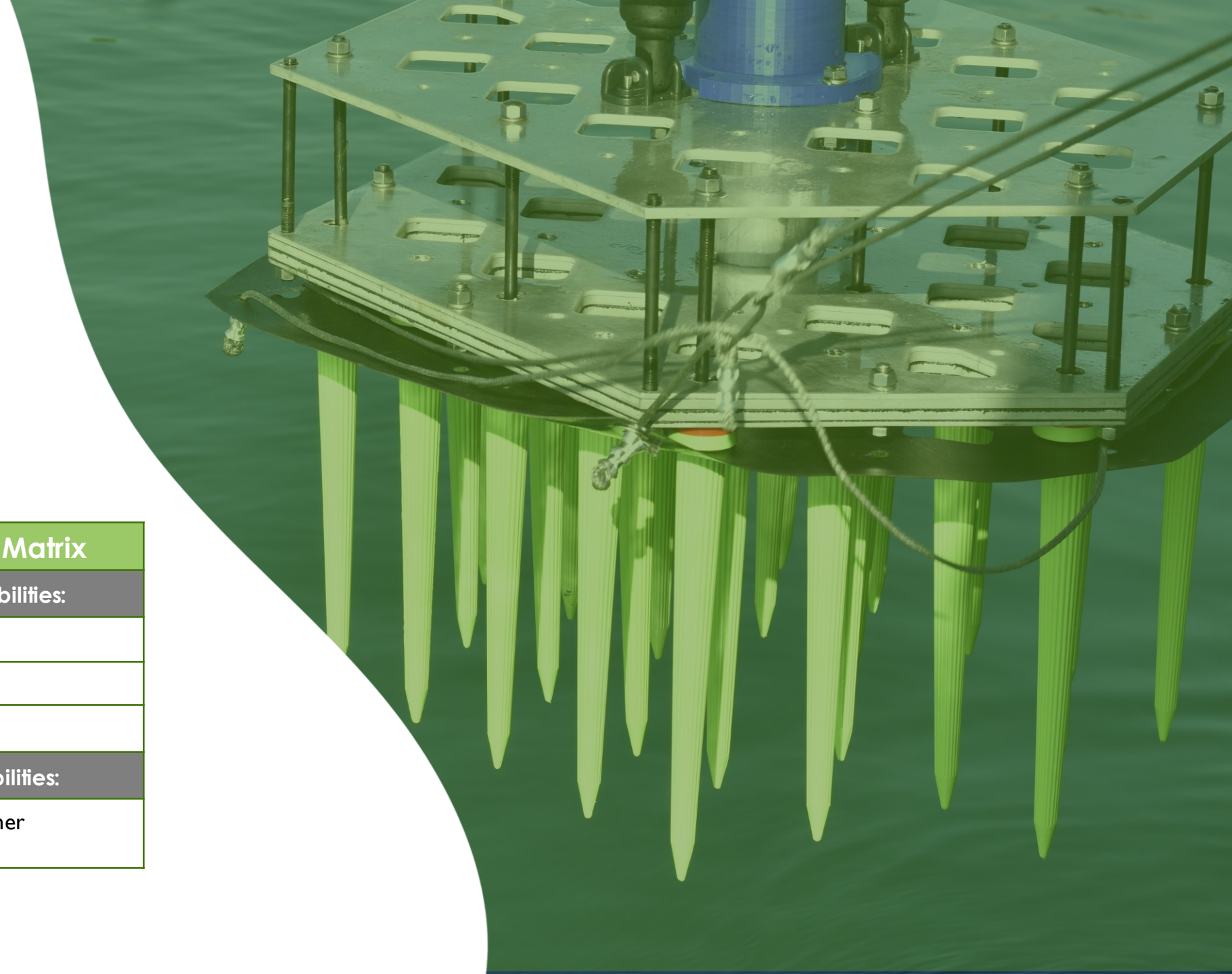
ecoCUBE

ecoTERRA

ecoSPEARS Delineation & Remediation Technology

for contaminated sediment

ecoSPEARS Capability Matrix
Current Contaminant Capabilities:
PCBs
Chlorobenzene
DDx
Target Contaminant Capabilities:
PFAS, TPH, dioxins, and other chlorinated compounds



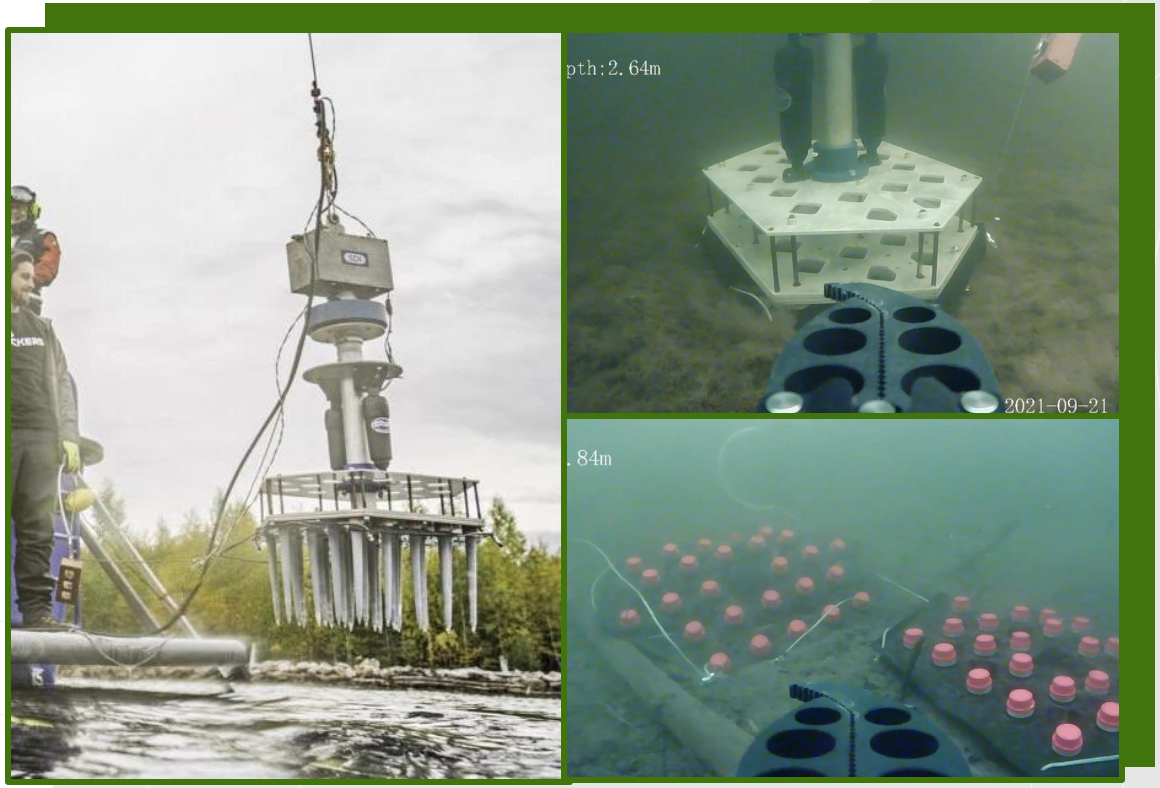
Internationally-Recognized Technology

Best Available Techniques (BAT) and **Best Environmental Practices (BEP)** for managing sites co-contaminated with Persistent Toxins.

IPEN
for a toxics-free future

"ecoSPEARS technology is quite unique in its ability to extract contaminants from sediment without dredging and resuspension of persistent toxins (POPs) into the water column and thus increase PCB/dioxin bioavailability for aquatic life... managing the social impact of remediation as well as environmental impact. So the ecoSPEARS technology provides a way to overcome these challenges."

- Lee Bell, IPEN Mercury and POPs Policy Advisor



ecoSPEARS

Post-Validated by NASA

In **2012**, NASA conducted the first SPEARS **pilot deployment** in **Region 3** to study the efficacy of the SPEARS technology within **PCB-impacted sediments** over a 9-month period.

Deployment Time

9 months

Concentrations (PPM)

74.2 - 151

Average % Reduction

62%

Table 7 – Box 2

Sample ID	Conc. (ppm) 9/24/2013	Conc. (ppm) 2/4/2014
NW	74.2	26.8
NE	92.1	26.2
C	85.1	66.9
SW	151	28.3
SE	144	21.4
Overlying water	N/A	2.4 (ppb)

Table 6 – Box 1

Sample ID	Conc. (ppm) 9/24/2013	Conc. (ppm) 2/4/2014
NW	74.2	26.8
NE	92.1	26.2
C	85.1	66.9
SW	151	28.3
SE	144	21.4
Overlying water	N/A	2.4 (ppb)

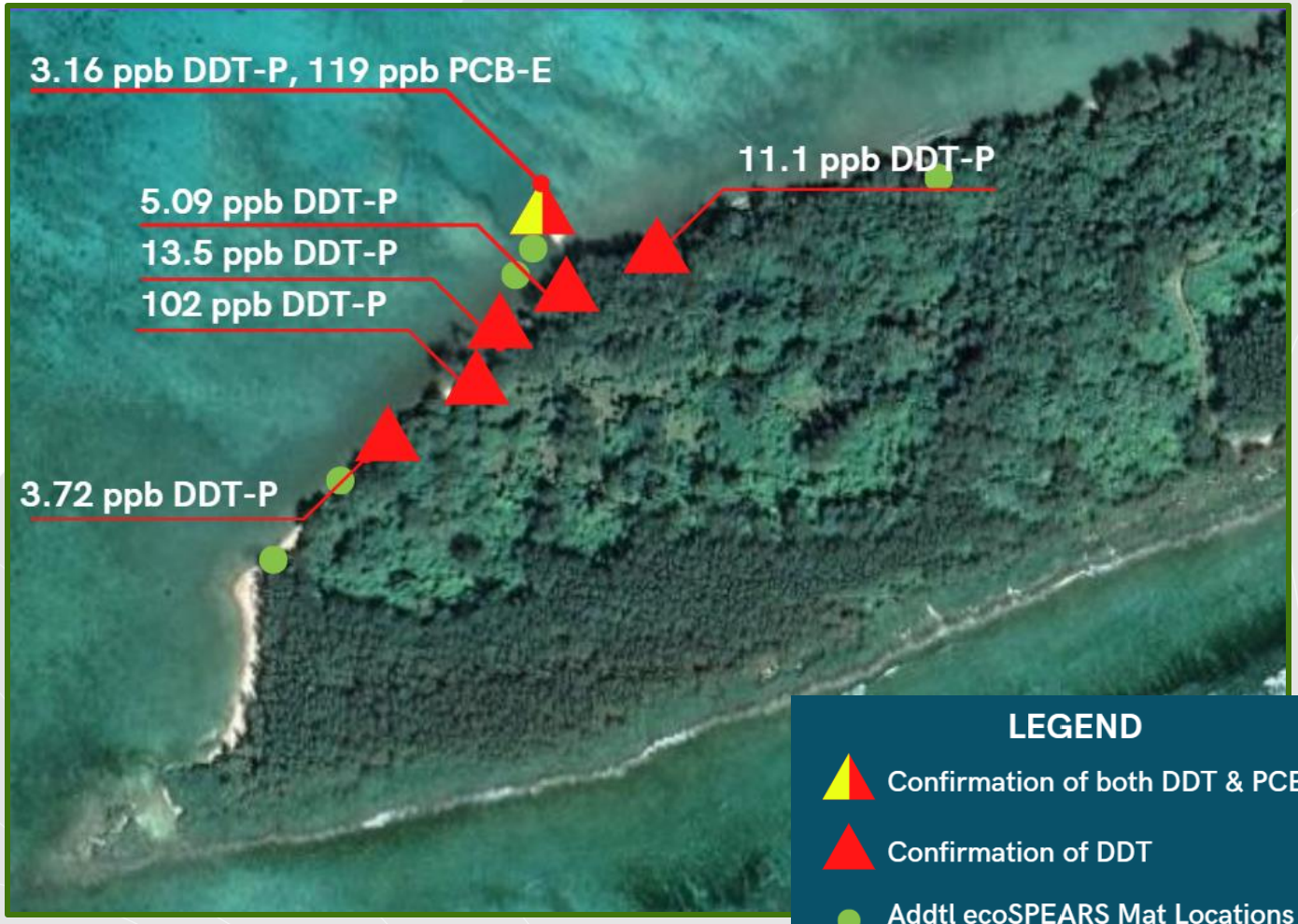
ecoSPEARS

Phase 1: DELINEATION Study
U.S. Federal Client in Guam

ecoSPEARS 3rd Party Analytical Data Summary-8 Month Interval

	HDPE Plastic				Reagent			
Porewater Location	PCBs	DDT	DDD	DDE	PCBs	DDT	DDD	DDE
1	ND	3.16	10.1	ND	119.0	ND	ND	ND
2	ND	ND	26.7	10.4	ND	ND	ND	ND
3	ND	ND	63.7	17.9	ND	ND	ND	ND
4	ND	11.1	17.5	86	ND	ND	ND	ND
5	ND	5.09	4.14	14.3	ND	ND	ND	ND
6	ND	13.5	51.9	49.4	ND	ND	ND	ND
7	ND	3.72	9.91	19.4	ND	ND	ND	ND
8	ND	102	692	1280	ND	ND	19.0	24.3
9	ND	ND	7.93	3.49	ND	ND	ND	ND
Control	ND	ND	ND	ND	ND	ND	ND	ND

*All concentrations listed above in ppb. ND indicates non-detect.
**Data above provided by EPA-accredited third-party lab per EPA test method 8081B and 1668.
***Study is ongoing with Client with further additional sampling intervals and data analysis upcoming.



ecoSPEARS

Phase 1: Pilot Study
Long-term In-situ PCB Extraction

Port of San Diego (PoSD) remediation project to **extract PCB contaminants** within areas of **San Diego Bay**. The Bay contains a sensitive eel grass species that make SPEARS an ideal option, as it is **non-destructive** to the aquatic habitat.

PORT of SAN DIEGO
Waterfront of Opportunity

- **Deployment schedule**
  - Initiated Phase 1 – September 2020
  - Completed Phase 1 – December 2022
- **Sampling**
  - Yearly (Year 1 & Year 2)

ecoSPEARS

Phase 1: Pilot Study
Extracting PCBs in Anacostia River Sediment

We are working with a utility client to evaluate the **removal of PCBs** from sediments

- **Deployment Schedule**
  - Initiated Phase 1 - September 2022
  - Expected completed Phase 1 – September 2023
- **Sampling**
  - Bi-annual (6-months & 12-months)

ecoSPEARS

ecoĀINA

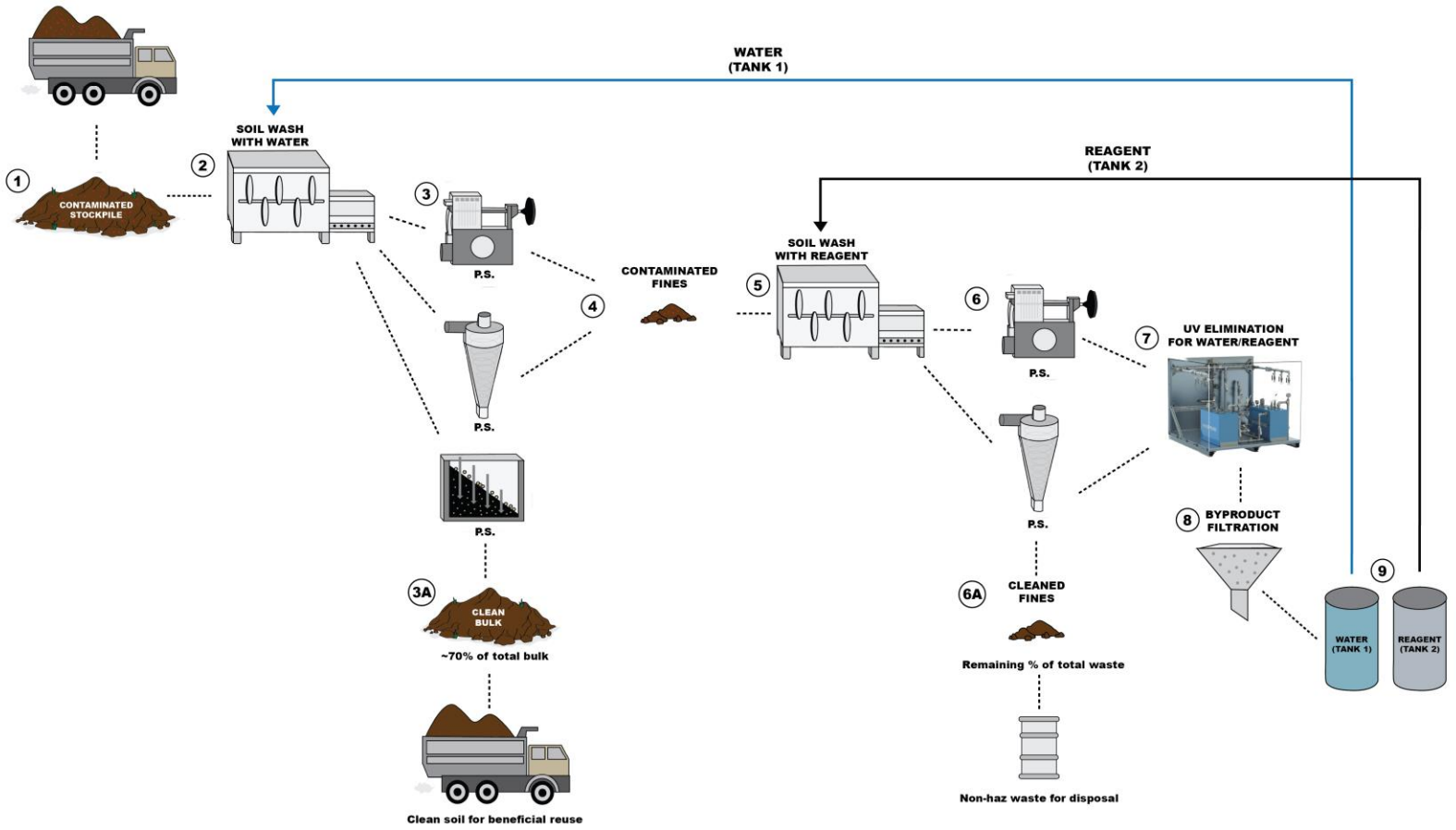
Remediation Technology

for contaminated soil or dewatered sediment

ecoĀINA Capability Matrix
Current Contaminant Capabilities:
PCBs
Dioxins
Target Contaminant Capabilities:
PFAS, TPH, TCE/PCE, DDx, and other chlorinated compounds

ecoSPEARS

ecoĀINA (ADS) Soil Washing + ecoCUBE (UV) Elimination Diagram



PROCESS

STEP	DESCRIPTION
1	Soil pile contamination
2	Mixing with water
3	Phase Separation (P.S.)
3A	Clean Bulk is sent for reuse
4	Separated Contaminated Fines
5	Mixing with reagent
6	Phase Separation (P.S.)
6A	Separated Clean Fines
7	UV Elimination for Water and Reagent
8	Byproduct GAC filtration
9	Contaminated water and reagent are treated for reuse

ecoSPEARS

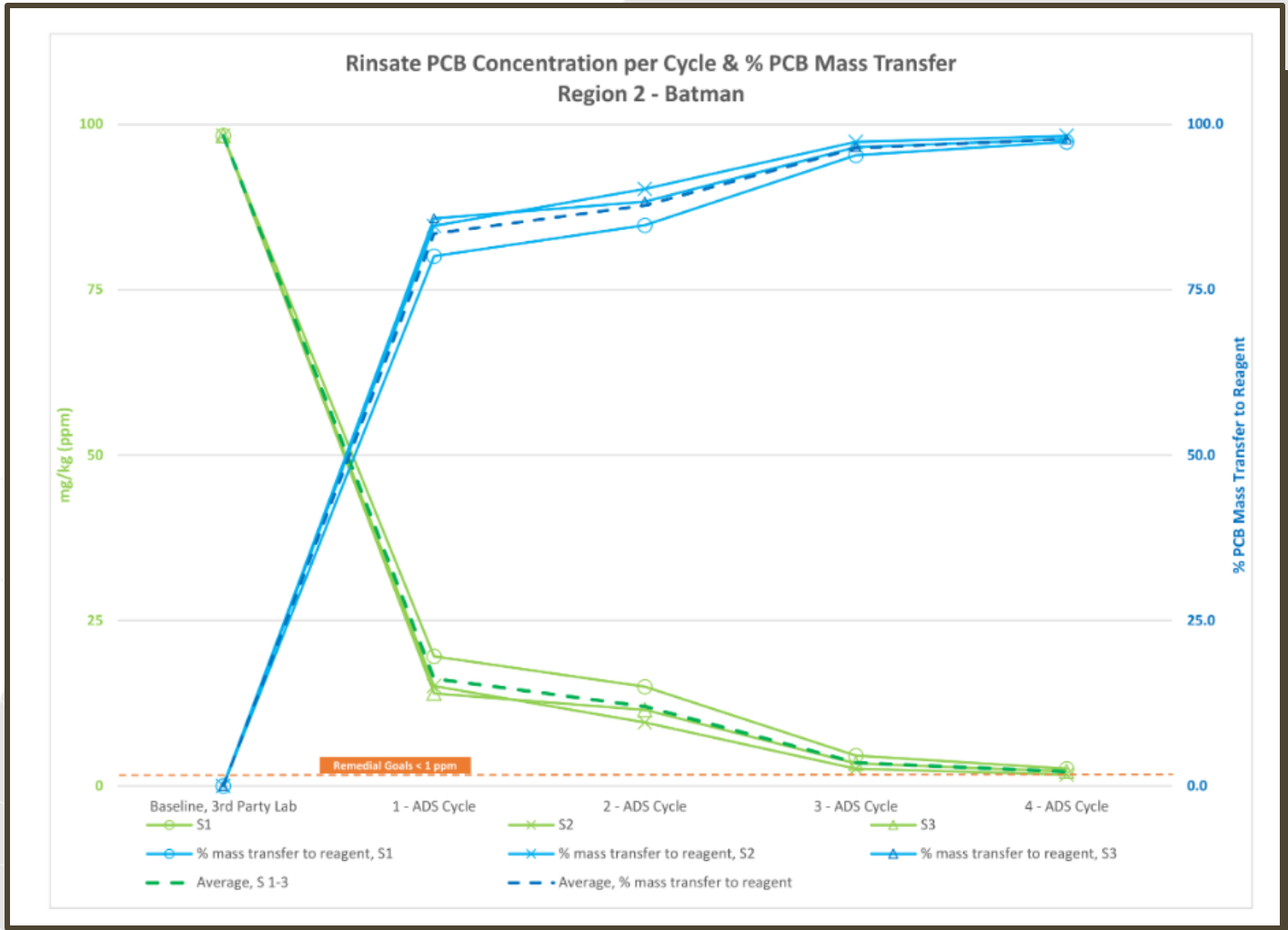
Phase 1: Case Study

Extracting PCBs in Hudson River Sediments Analyzed with U.S. EPA Method 8082

Initial concentration
98.3 PPM

Ending concentration
0.8 PPM

Total Percentage Reduction
99.2%

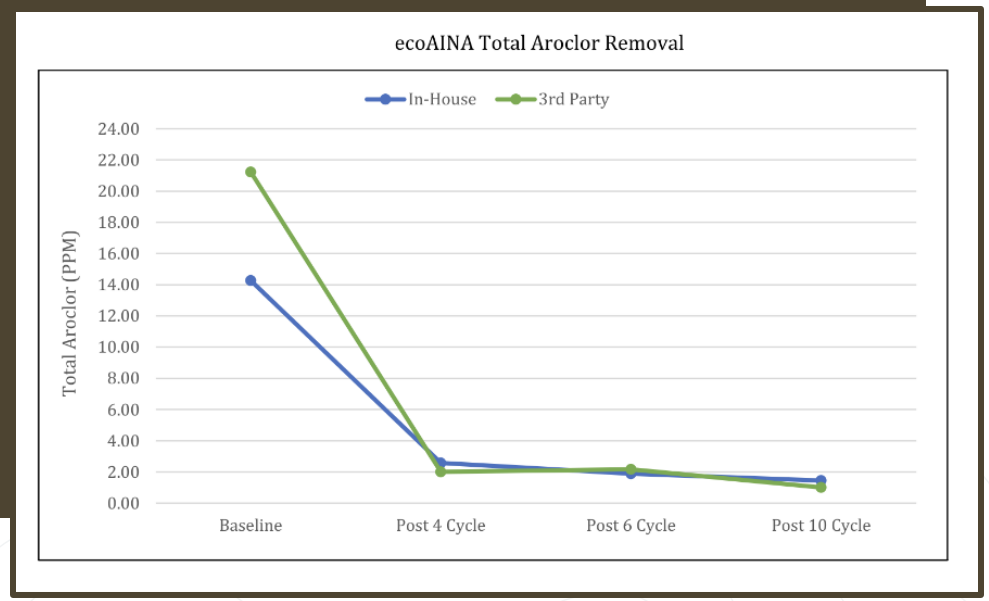


ecoSPEARS

Phase 1: Case Study

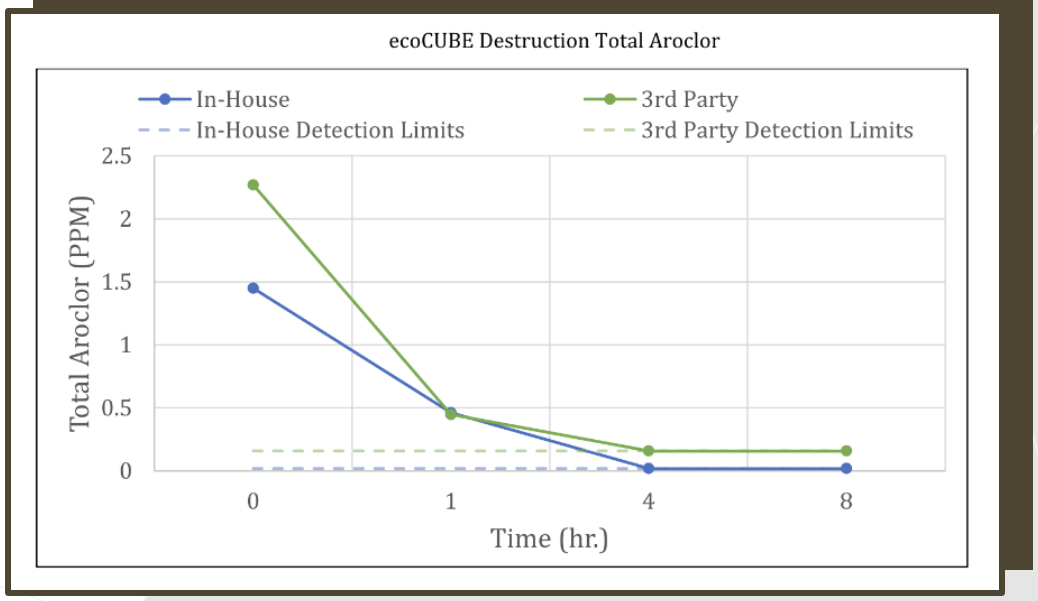
Extracting & Eliminating PCBs in Guam Soil using U.S. EPA Method 8082

Extraction



- Initial concentration: 21.2 PPM
- **Ending concentration: <u>1.0 PPM</u>**

Elimination



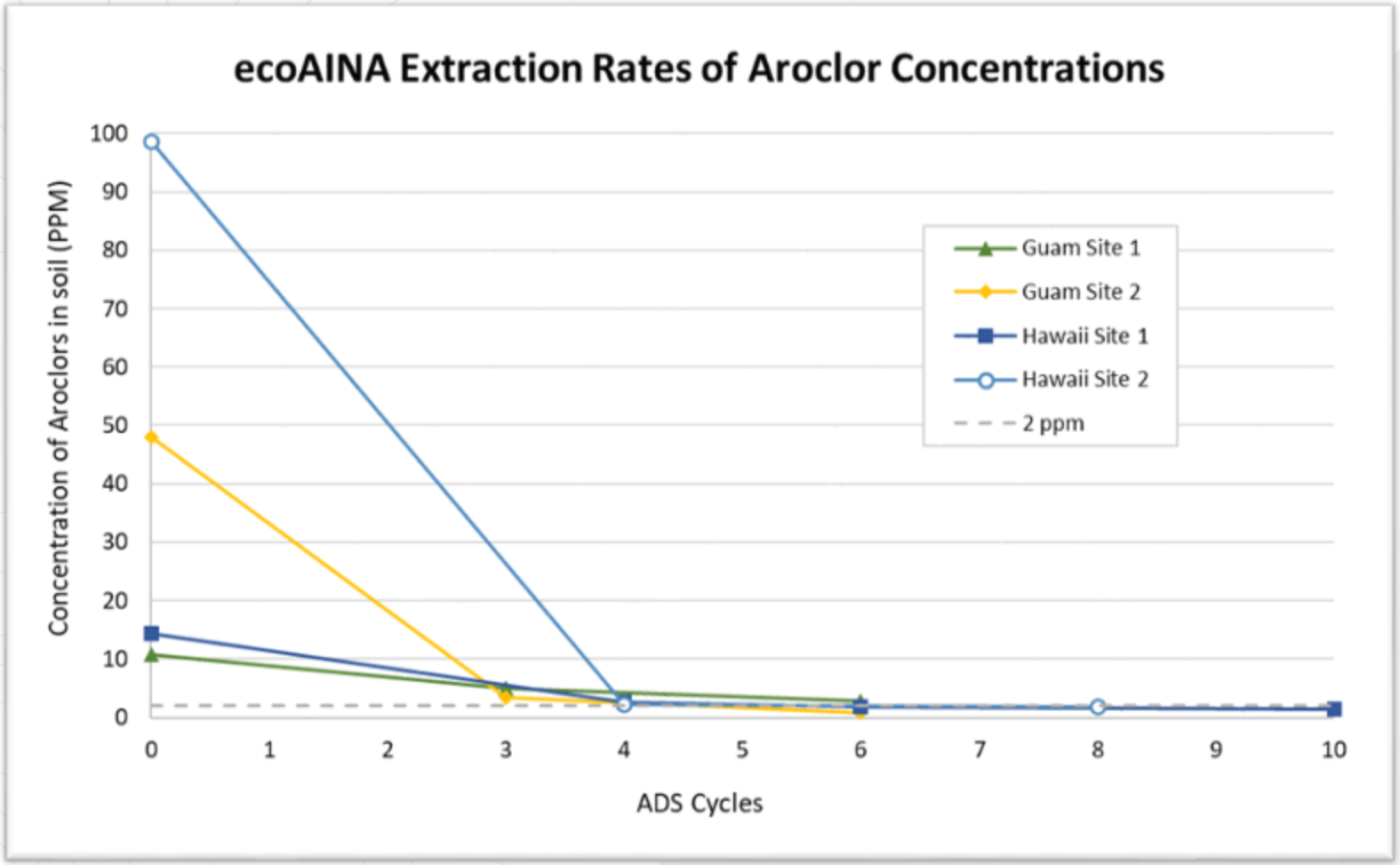
- Initial concentration: 2.3 PPM
- **Ending concentration: <u>Non detect</u>**

ecoSPEARS has achieved the requested remedial levels of soils under 2 PPM

ecoSPEARS

Phase 1: Case Study

Extracting PCBs with Various Soil Characteristics Analyzed with U.S. EPA Method 8082



ecoSPEARS

ecoCUBE

Remediation & Destruction Technology

for liquids (groundwater, surface water, transformer oils, and reagents)

ecoCUBE Capability Matrix
Current Contaminant Capabilities:
PCBs
1,4 - Dioxane
Target Contaminant Capabilities:
PFAS, TPH, TCE/PCE, DDx, and other chlorinated compounds

ecoSPEARS

ecoCUBE TECHNOLOGY:

Non-thermal, non-combustion elimination technology for PCBs + POPs.

Scalable, On-site, Modular to Treat

Transformer Oil
Groundwater
Leachate
Solvent

ecoSPEARS

Phase 1: CASE STUDY

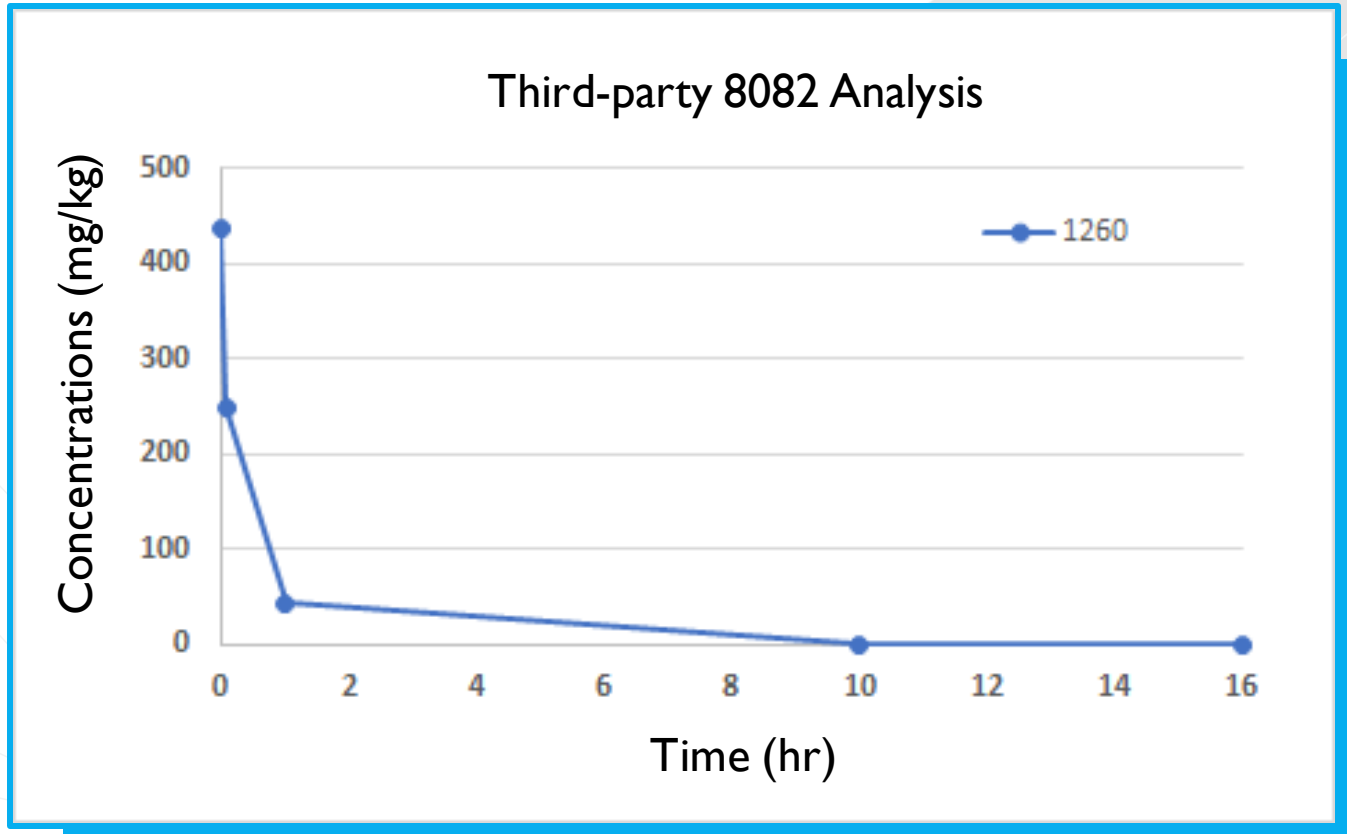
Eliminating PCB from Contaminated Mineral (Transformer) Oil Analyzed with U.S. EPA Method 8082

Initial Concentrations
450 mg/kg

Ending Concentrations
Non-Detect (.2 mg/kg)

Percentage Reductions
99.9%

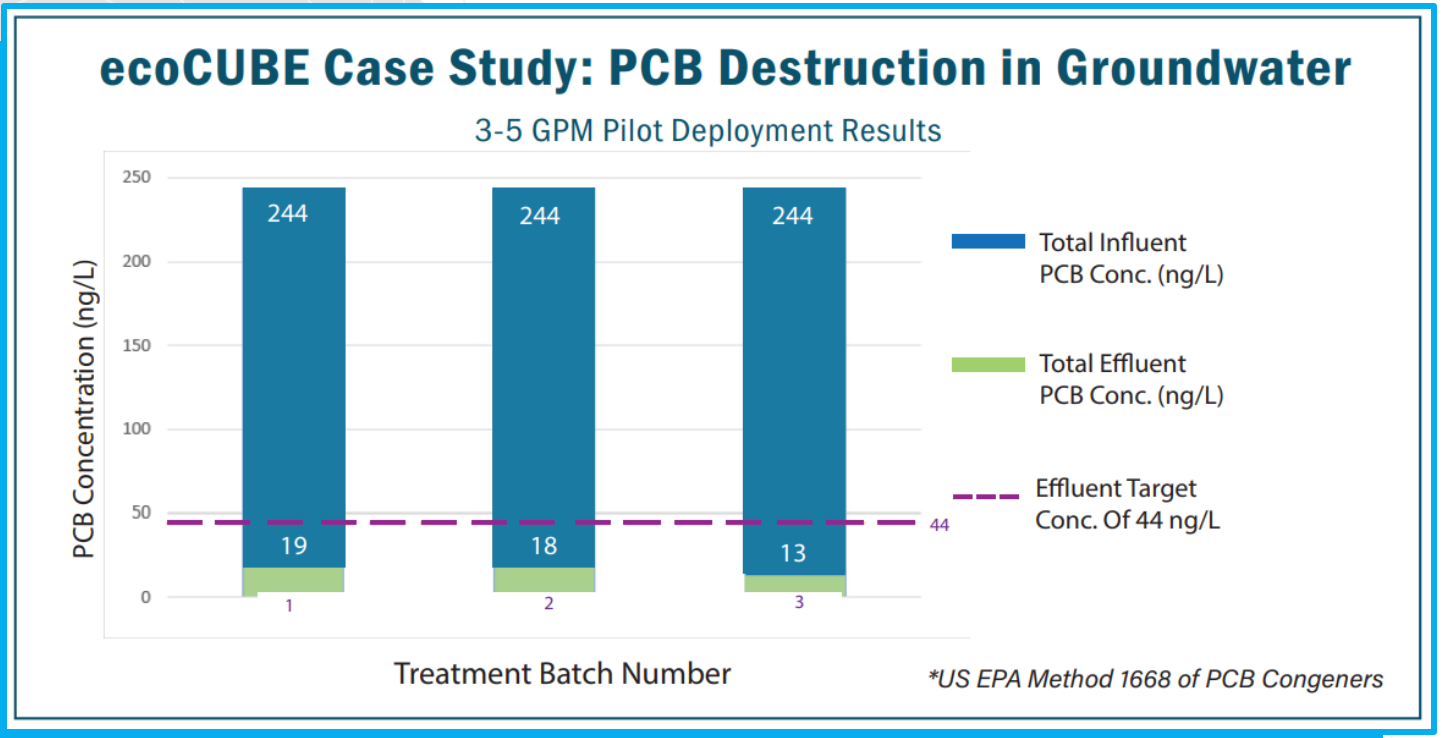
* validated by 3rd party lab using EPA 8082 method



ecoSPEARS

Phase 2: On-site Pilot Study

Destroying PCBs from Impacted Groundwater Analyzed with U.S. EPA Method 1668



Initial Concentrations
244 ng/L

Ending Concentrations
13 ng/L

Percentage Reductions
94.7%

* validated by 3rd party lab using EPA 1668 method

ecoSPEARS

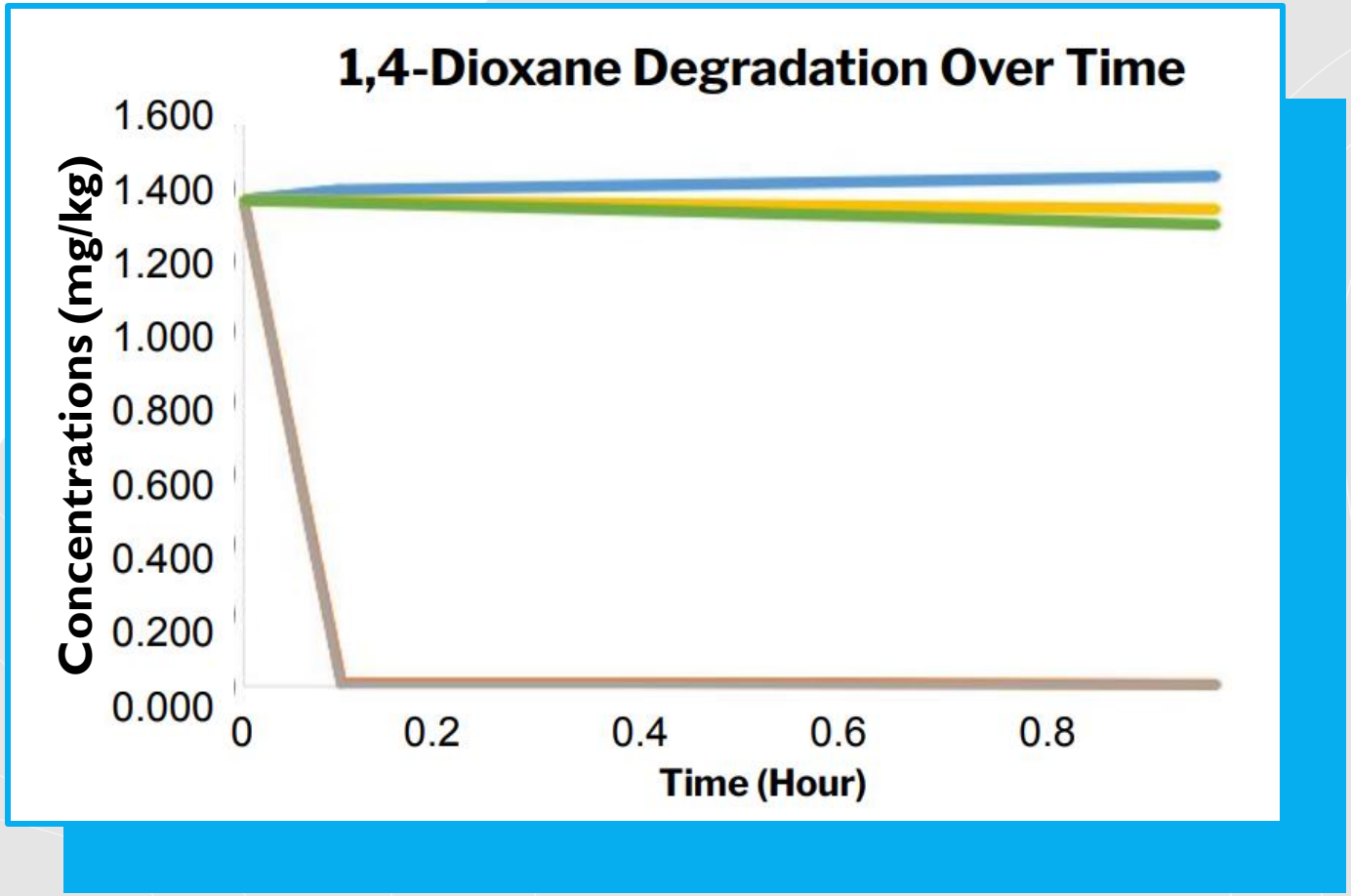
Phase 1: CASE STUDY
1,4 - Dioxane Contaminated Water

Initial concentration
1.4 mg/kg

Ending concentration
Non-detect (.045 mg/kg)

Percentage Reduction
97%

* validated by 3rd party lab using EPA 8260D method (detection level of 4.5PPB)

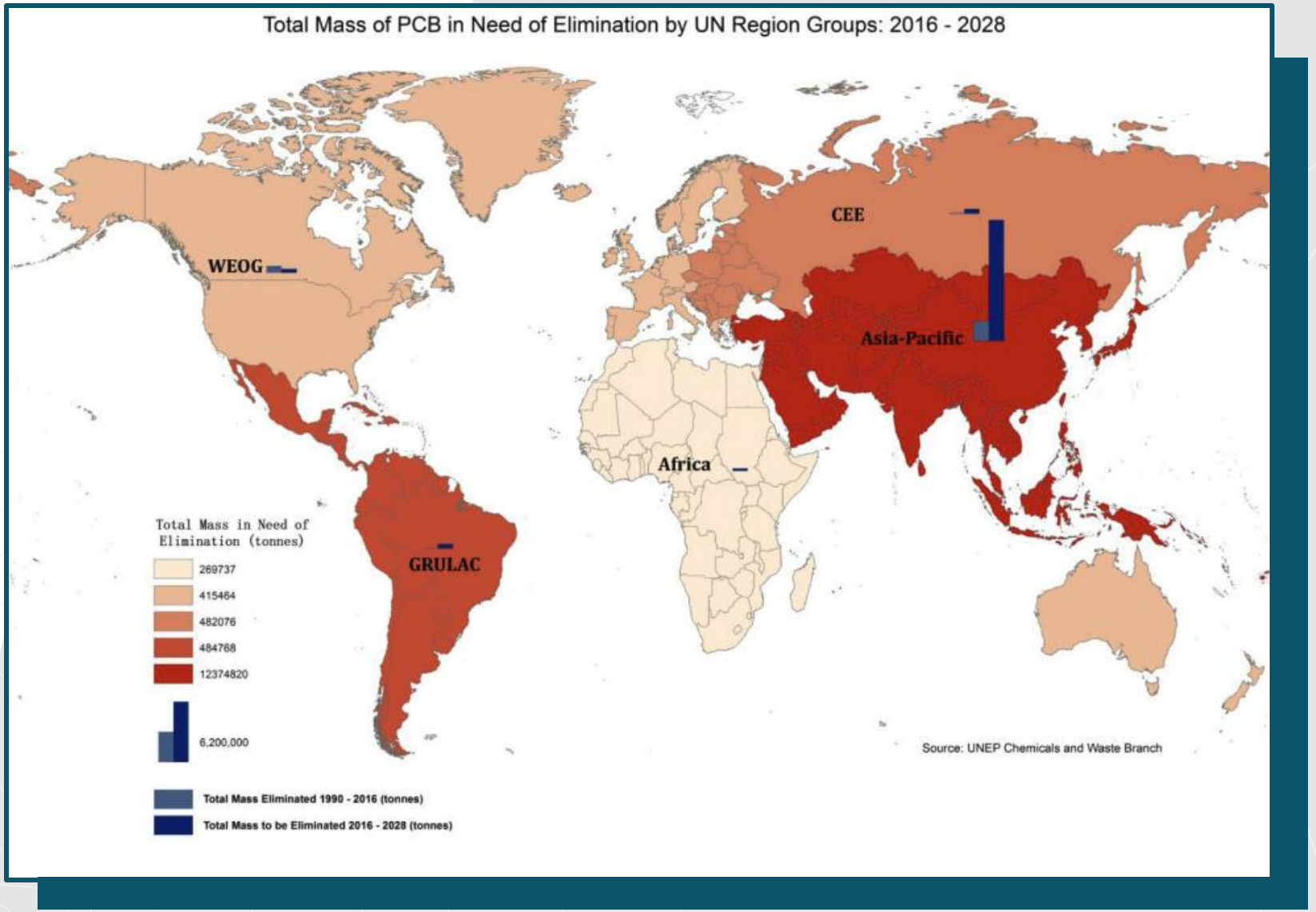


ecoSPEARS

On-going Issues We Still Face

The **UNEP** estimates that there are **14 million tons of PCBs** left in the world that need to be eliminated.

This is roughly **83%** of all the total **PCBs manufactured**



ecoSPEARS

ecoSPEARS

MISSION

Our mission is to protect people and the planet by ushering in the net-zero future of environmental remediation.

MAKE ENDING SLIDE

VISION

We imagine a world where every person has access to clean water, clean food, and clean air.

CONTACT

Sergie Albino

e: Serg@ecoSPEARS.com

Website: www.ecoSPEARS.com

AGENDA

Welcome and Introduction

- Sara BROSCHÉ | Science Advisor, IPEN | Moderator

Presentations

PCB Elimination by 2028: Potential of the non-combustion destruction technologies

- Lee BELL | Mercury and POPs Policy Advisor, IPEN

POPs in plastic consumer products and free-range chicken eggs from Kenya

- Griffins OCHIENG | Executive Director, Centre for Environmental Justice and Development

Green and Non-combustion Technologies to Extract and Eliminate PCBs and Forever Chemicals

- Sergie ALBINO | Founder and CEO, ecoSPEARS

On-site PCB Destruction and Remediation using Hydrogen Reduction

- Douglas HALLETT | Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

Q&A

Closing Remarks

Visit us online for IPEN's research, policy analysis, and more on chemicals, waste, and threats to our health and the environment

https://ipen.org

IPEN
for a toxics-free future

AGENDA

Welcome and Introduction

- Sara BROSCHÉ | Science Advisor, IPEN | Moderator

Presentations

PCB Elimination by 2028: Potential of the non-combustion destruction technologies

- Lee BELL | Mercury and POPs Policy Advisor, IPEN

POPs in plastic consumer products and free-range chicken eggs from Kenya

- Griffins OCHIENG | Executive Director, Centre for Environmental Justice and Development

Green and Non-combustion Technologies to Extract and Eliminate PCBs and Forever Chemicals

- Sergie ALBINO | Founder and CEO, ecoSPEARS

On-site PCB Destruction and Remediation using Hydrogen Reduction

- Douglas HALLETT | Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

Q&A

Closing Remarks

AGENDA

Welcome and Introduction

- Sara BROSCHÉ | Science Advisor, IPEN | Moderator

Presentations

PCB Elimination by 2028: Potential of the non-combustion destruction technologies

- Lee BELL | Mercury and POPs Policy Advisor, IPEN

POPs in plastic consumer products and free-range chicken eggs from Kenya

- Griffins OCHIENG | Executive Director, Centre for Environmental Justice and Development

Green and Non-combustion Technologies to Extract and Eliminate PCBs and Forever Chemicals

- Sergie ALBINO | Founder and CEO, ecoSPEARS

On-site PCB Destruction and Remediation using Hydrogen Reduction

- Douglas HALLETT | Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

Q&A

Closing Remarks

Visit us online for IPEN's research, policy analysis, and more on chemicals, waste, and threats to our health and the environment

https://ipen.org

IPEN
for a toxics-free future

THANK YOU!

Sara BROSCHÉ

Science Advisor, IPEN | Moderator

Lee BELL

Mercury and POPs Policy Advisor, IPEN

Griffins OCHIENG

Executive Director, Centre for Environmental Justice and Development

Sergie ALBINO

Founder and CEO, ecoSPEARS

Douglas HALLETT

Chairman and CEO, True Energy | Developer of Hydrogen Reduction Technology

BRS COP - FRIDAY 5 MAY, 2023

1:15 - 2:45 pm
Room B

IPEN SIDE EVENT

PCB ELIMINATION BY 2028

Potential for non-combustion destruction technologies

Visit us online for IPEN's research, policy analysis, and more on chemicals, waste, and threats to our health and the environment

https://ipen.org

IPEN
for a toxics-free future

GEN @ 2023 BRS COPS

tiny.cc/GEN2023BRSCOPs

COPs
BASEL / ROTTERDAM / STOCKHOLM
CONVENTIONS

CONFERENCE

Tackling the Hidden Basel Plastic Wastes | BRS COPs Side Event

08 MAY 2023 18:15 - 19:45
CICG | Room 14 & Online | Webex
Basel Action Network, IPEN

Chemicals and Pollution | Plastics
SDG3 | SDG12

CONFERENCE

Connecting the dots: Youth and the National Implementation Plans (NIPs) | BRS COPs 2023 Side Event

09 MAY 2023 18:15 - 19:45
CICG | Room 3 & Online
IPEN

Chemicals and Pollution
SDG3 | SDG12

CONFERENCE

Advancing a Human Rights-based Approach to Pollution for People and the Planet | BRS COPs 2023 Side Event

10 MAY 2023 13:15 - 14:45
CICG | Room C & Online
OHCHR, UNEP, UNDP, ILO, UNECE, FAO, Minamata Convention on Mercury, UN EMG, GEN

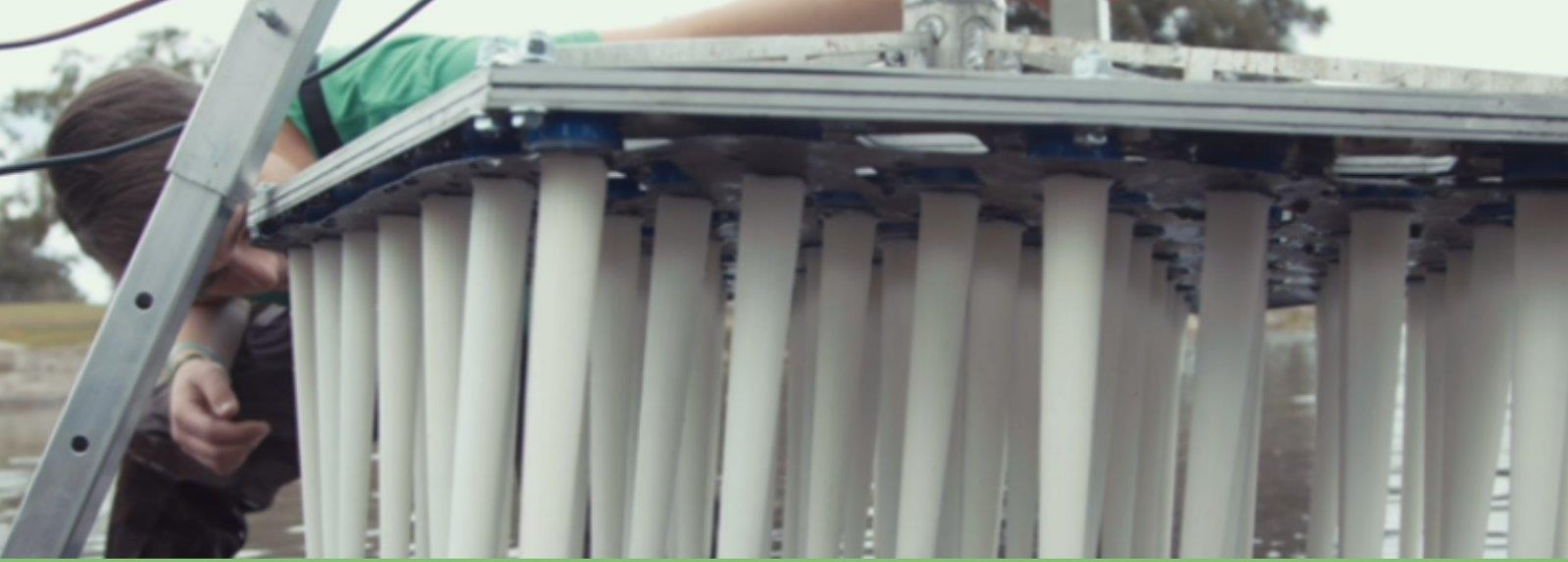
Chemicals and Pollution | Human Rights and Environment
SDG12

CONFERENCE

Unlocking MEAs' Potential: Supporting Parties' Environmental Action through Data and Knowledge Management | BRS COPs 2023 Side Event

10 MAY 2023 18:15 - 19:45
CICG | Room 11-12 & Online
BRS, Minamata Convention on Mercury, CITES, InforMEA, GEN

Chemicals and Pollution
SDG17

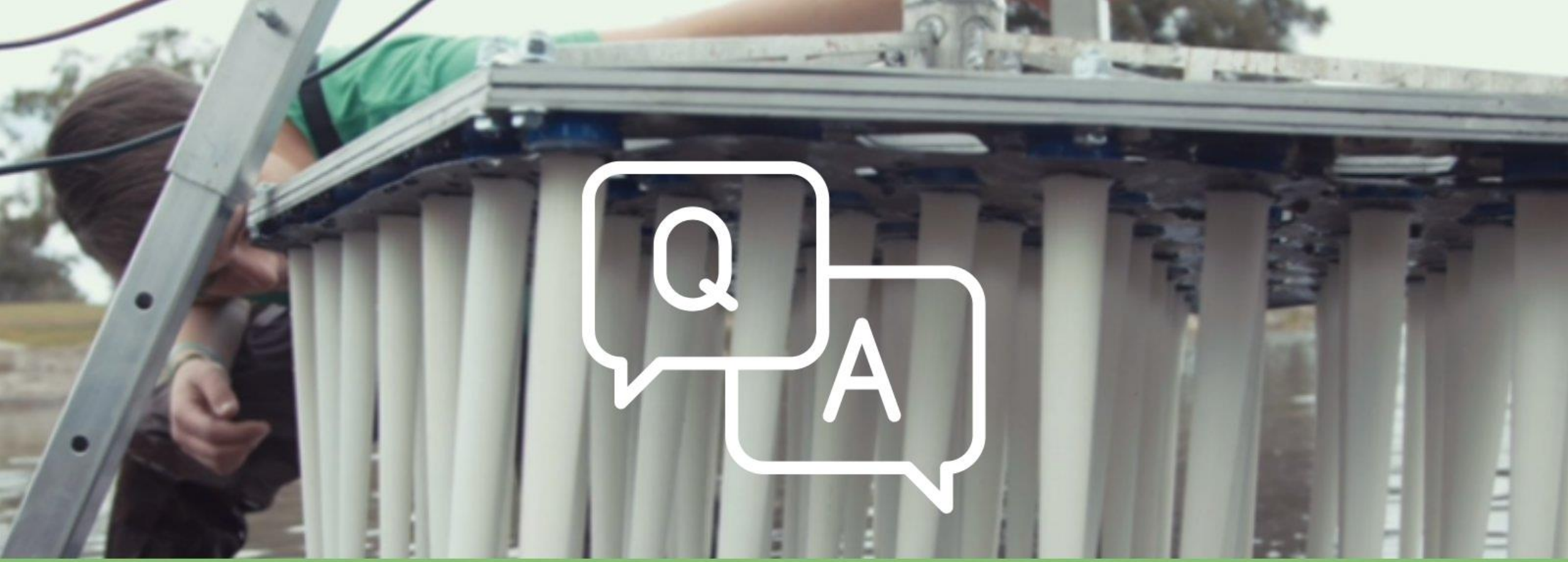


BRS COP - IPEN Side Event

IPEN
for a toxics-free future

PCB Elimination by 2028:

Potential of non-combustion destruction technologies



BRS COP - IPEN Side Event

IPEN
for a toxics-free future

PCB Elimination by 2028:

Potential of non-combustion destruction technologies