

Investment in energy-efficient transformers as a cost-effective way to phaseout PCB containing or contaminated transformers



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Background



The United Nations Environment Programme (UNEP) is the leading global authority on the environment.

- UNEP works closely with its 193 Member States and representatives from civil society, businesses, and other major groups and stakeholders to address environmental challenges through the UN Environment Assembly, the world's highest-level decision-making body on the environment.
- UNEP's core mission is to find solutions to the triple planetary crisis. As the leading global authority on the environment, the institution helps its Member States to foster climate stability, live in harmony with nature and forge a pollution-free future, supporting the achievement of all 17 SDGs.
- Headquarter in Nairobi and regional offices in Africa, Asia-Pacific, Europe, Latin America and the Caribbean, New York, North America and West Asia.
- Several sub-regional and country offices for coordination.

Global Environment Facility



- ✓ As one of its founding agencies, we have been with the GEF on every step of its journey since 1992.
- ✓ UNEP has been working hand-in-hand with the Global Environment Facility to create a greener world for almost 30 years.
- ✓ Implemented 1,000 projects, inspiring, informing, and enabling the public and policymakers across more than 160 countries to improve their quality of life without compromising that of future generations.
- ✓ Today, UNEP continues to support the GEF to achieve its mandate of tackling our planet's most pressing environmental problems and is currently one of 18 GEF Agencies that can assist partners in accessing GEF finance.
- ✓ Working across all GEF focal areas, our dedicated GEF technical teams bring together the best in environmental science and policy expertise with the unique convening power of the United Nations to design and deliver high-impact projects that enable lasting change.

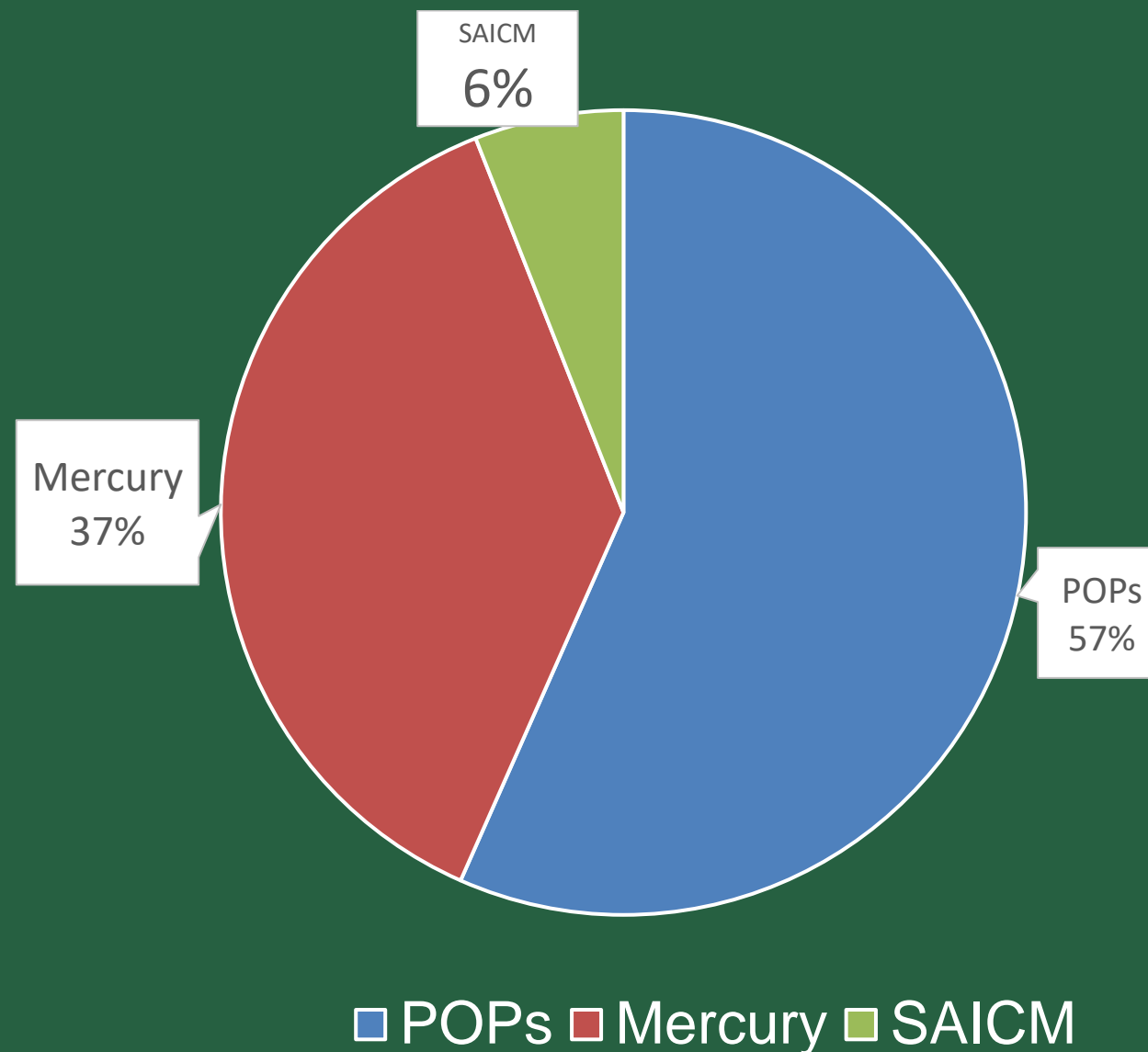
From flagship global GEF programmes to full-sized projects, medium-sized projects and enabling activities, UNEP works across all Global Environment Facility focal areas, with dedicated GEF technical teams in Biodiversity, Capacity Development, Climate Change Adaptation, Climate Change Mitigation, **Chemicals & Waste**, International Waters and Land Degradation.

GEF- Chemicals and Waste



- ✓ The GEF is a financial mechanism for number of Multilateral Environmental Agreements (MEA)
- ✓ CW focal area: Stockholm Convention, Minamata Convention and SAICM
- ✓ Also supports projects on Montreal Protocol
- ✓ The main aim of this financial support is to help countries in meeting their obligations under MEAs
- ✓ UNEP is one of the Implementing Agency for GEF

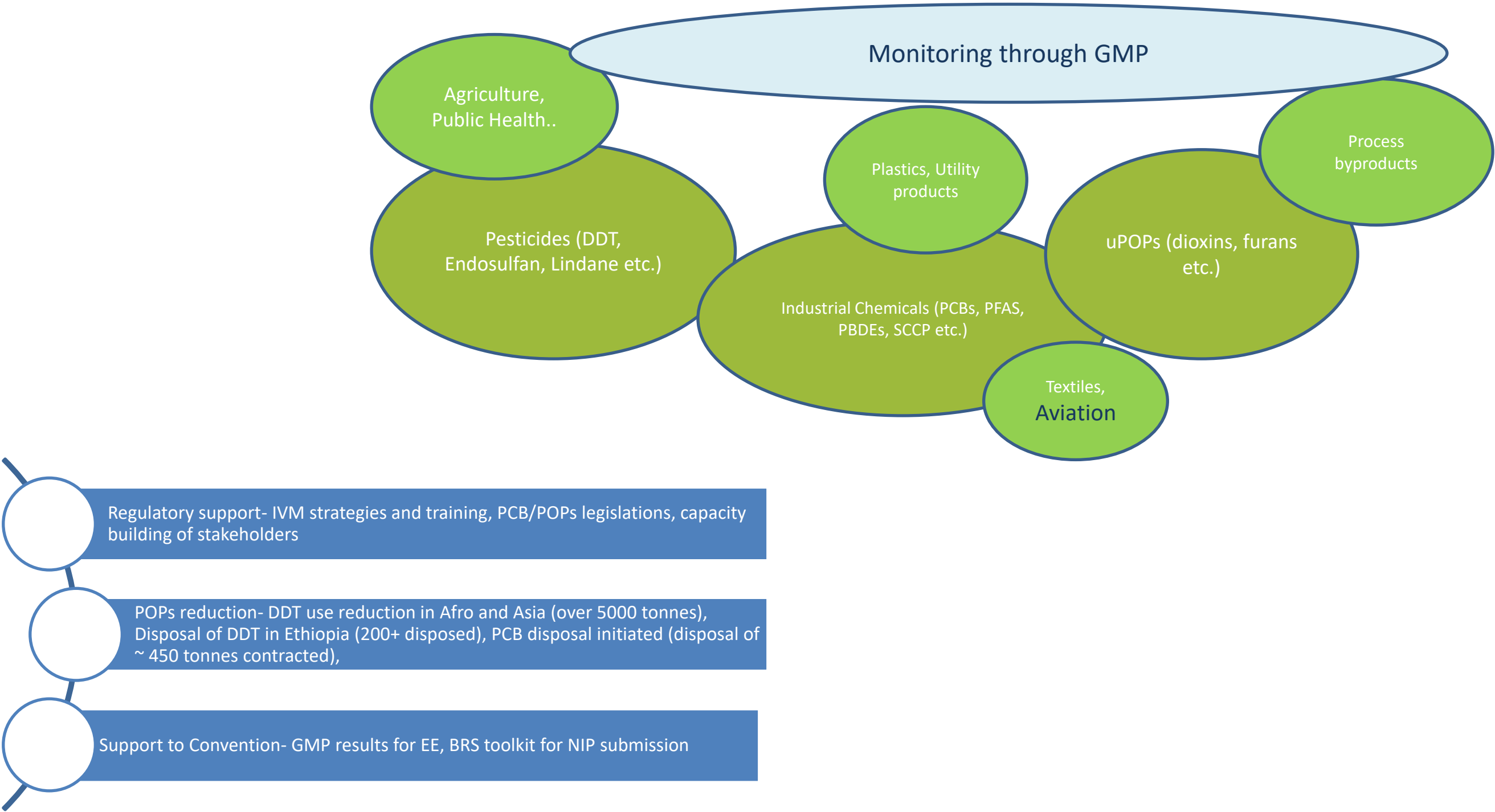
UNEP's GEF CW Portfolio



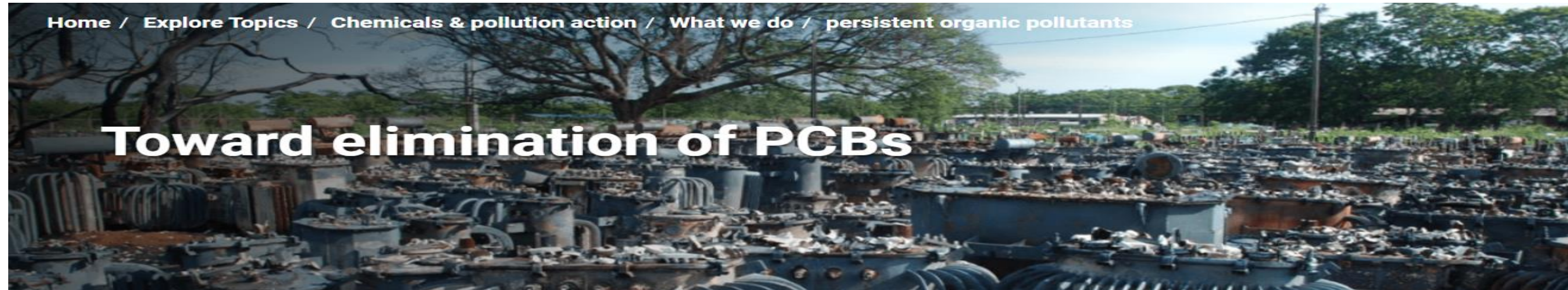
Convention wise breakup

Total Portfolio: ~US\$ 300 Million
 Over 110 countries
 Over 75 projects

Stockholm Convention and GEF



UNEP's work on PCBs



- Hosts PCB Elimination Network Secretariat
- Number of ongoing projects mainly focusing in Africa, Mediterranean region
- Technical assistance
- Phase out plans
- Support with respect NIPs etc.

Investment in energy-efficient transformers as a cost-effective way to phaseout PCB containing or contaminated transformers

Example from GEF-funded “Disposal of PCB oils contained in transformers and disposal of capacitors containing PCB in Southern Africa” (GEF ID 5532)



Question:
Is keeping a pre-1990s
transformer online cost
saving?

Cost Benefit Analysis

Estimate the necessary investment and the benefits for upgrading transformers in service that may contain PCB.





Many transformers built before the 1990s may contain PCB and have less energy efficient due to limited manufacturing techniques.

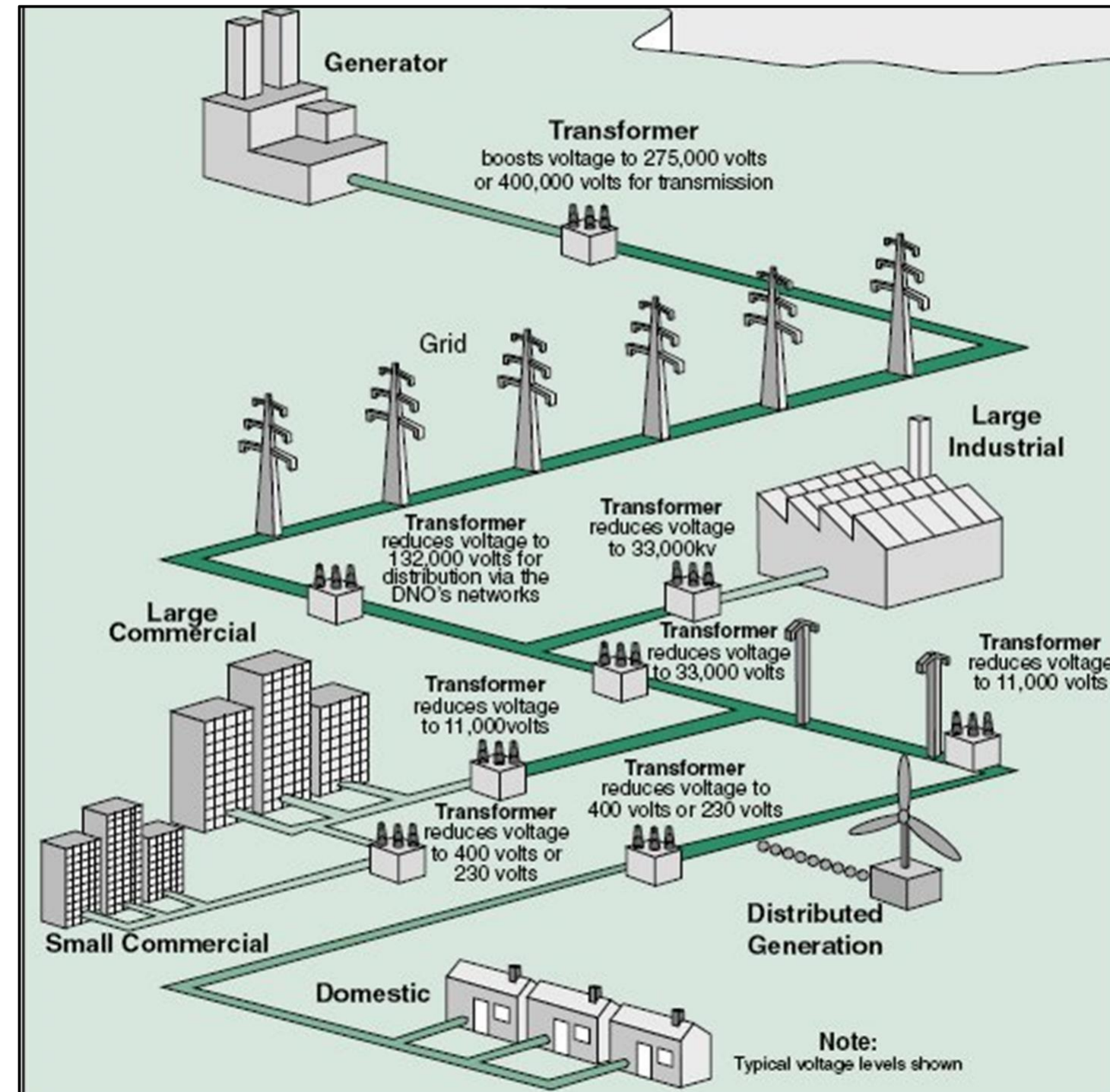
Energy Consumed by Transformers (Losses)

Core Losses / No-Load Losses

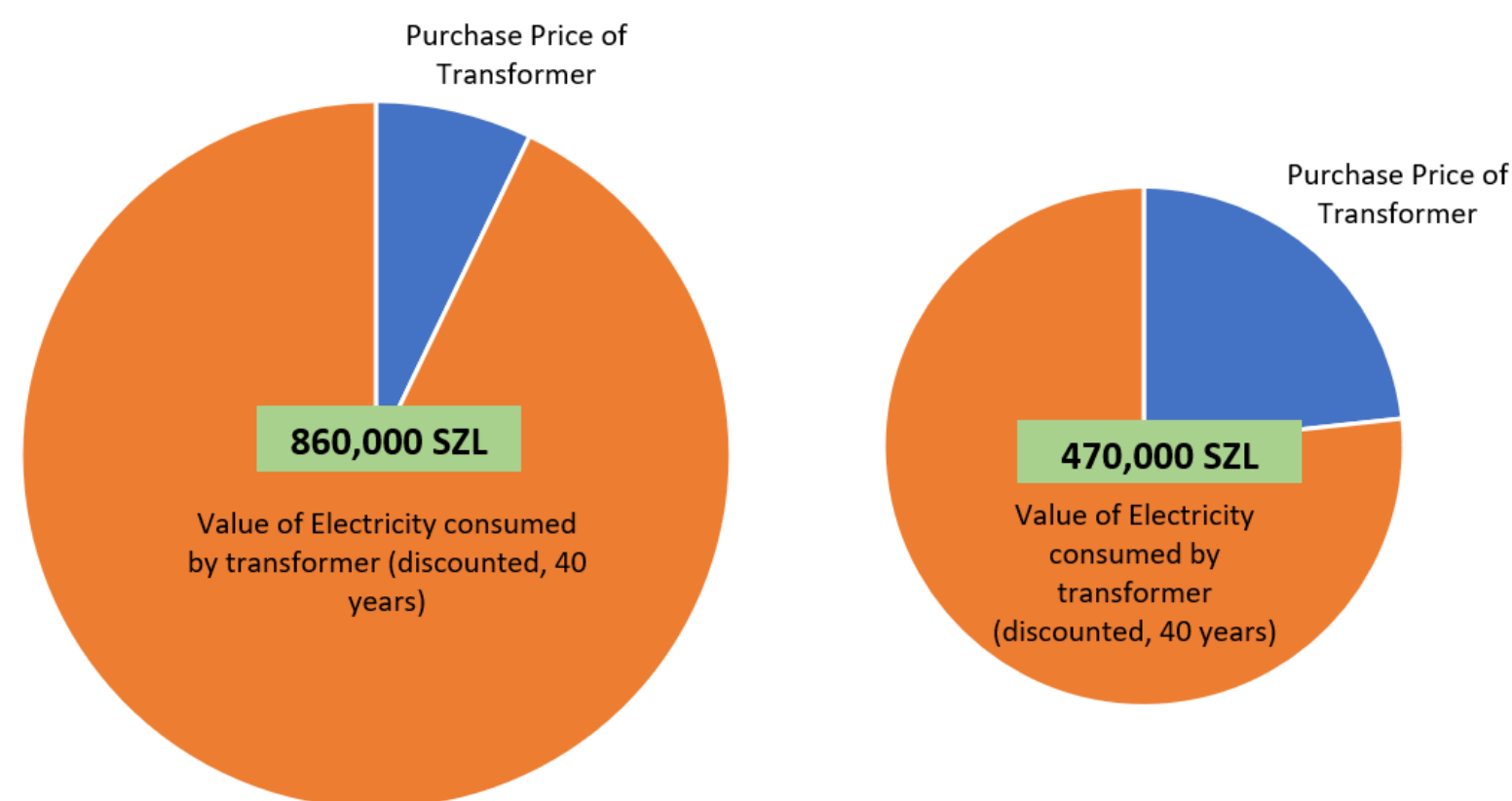
- Present whenever the transformer is connected to the grid (energized).

Winding Losses / Load Losses

- Energy lost due to current flowing in the windings, caused by the electrical resistance of the windings.
- Losses increase by the square of the current being carried in the windings – thus core losses increase as the load on the transformer increases.



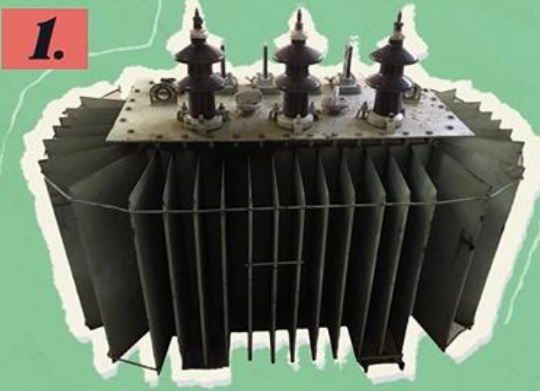
Purchase price of a transformer is just a fraction of the total cost of ownership of a transformer - the running cost, or the electricity that is lost in the transformer, is far greater.



Example: Comparison of purchase price (blue) and running cost (orange) over 40 years of an inefficient and efficient 200 kVA three-phase transformer in Eswatini

Case Study: 315 kVA Distribution Transformer

1.



REFURBISH OLD PCB-CONTAMINATED TRANSFORMER

INITIAL COST FOR PCB CLEANING UP: 715 USD
 TOTAL ENERGY LOSS: 60,198 USD
 TOTAL COST: 60,913 USD
 LIFETIME 20 YEARS

2.



BASIC UNIT INITIAL COST

PROCUREMENT INSTALLATION: 4,671 USD
 TOTAL ENERGY LOSS: 57,690 USD
 TOTAL COST: 62,362 USD
 LIFETIME 40 YEARS

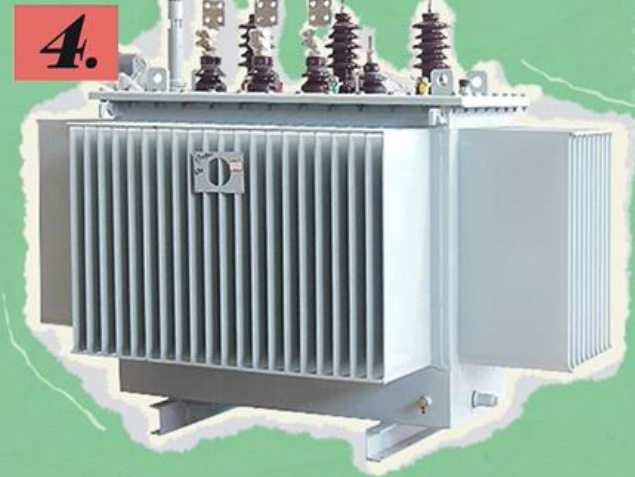
3.



25% LOWER ENERGY LOSS

INITIAL COST (PROCUREMENT & INSTALLATION): 5,498 USD
 TOTAL ENERGY LOSS: 45,743 USD
 TOTAL COST: 51,241 USD
 LIFETIME 40 YEARS

4.



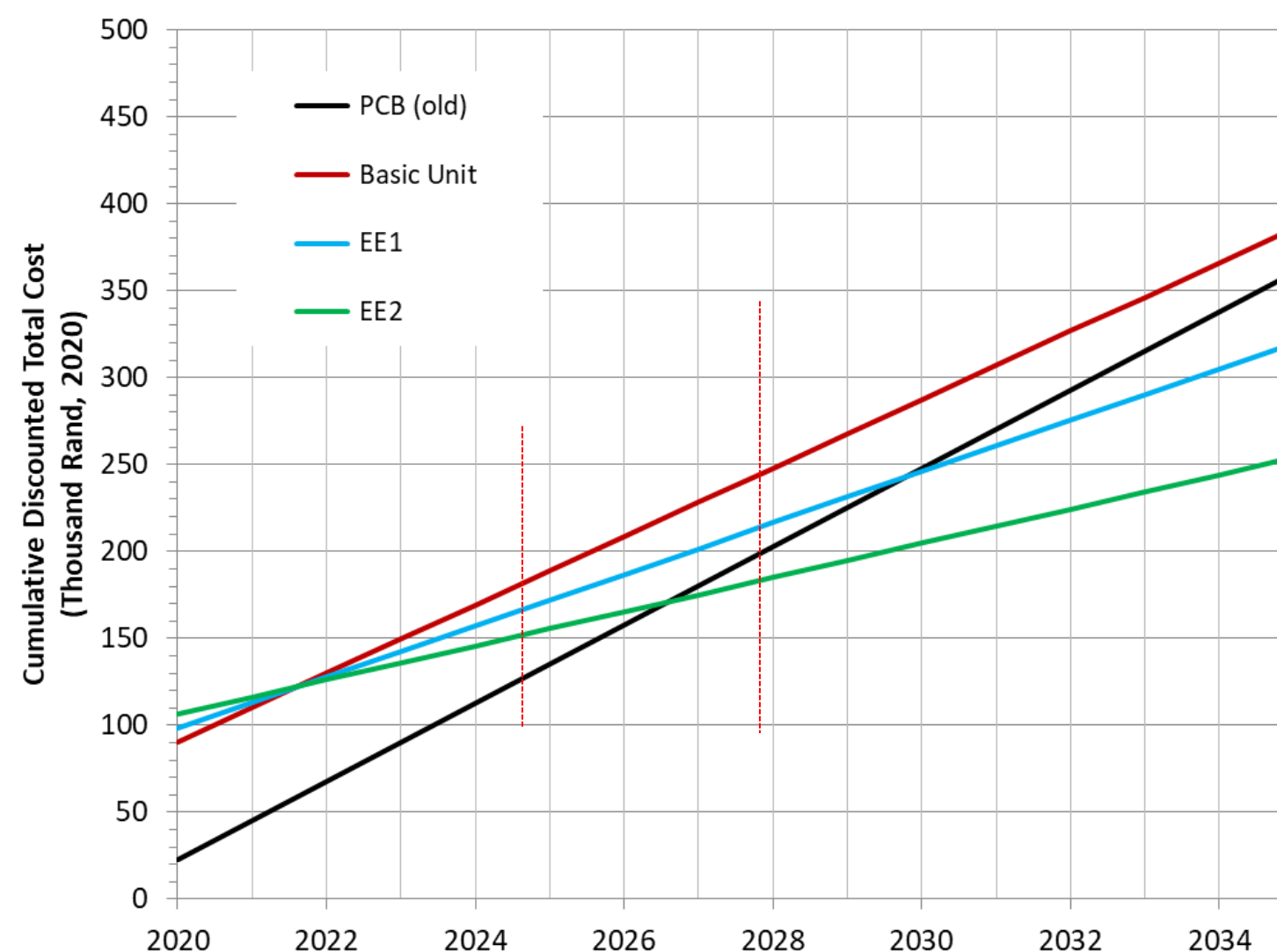
50% LOWER ENERGY LOSS

PROCUREMENT INSTALLATION: 6,367 USD
 TOTAL ENERGY LOSS: 33,729 USD
 TOTAL COST: 400,97 USD
 LIFETIME 40 YEARS



Total Life-Cycle Cost, Discounted to 2020 Rand

315 kVA, three-phase liquid-type, 11kV/400V



The energy efficient transformers start out more expensive, but the running cost yields a payback relative to the PCB (old) unit:

EE2: 6.3 years
 EE1: 8.6 years
 Basic: 19 years

Mozambique Example

An investment of 6 million USD by 2025 to replace all PCB transformers would save upwards of 11.3 million dollars effectively paying for itself by 2032.





Scale up to eliminate PCB from the electricity network of 12 Southern African nations

A total investment of \$34 million would be paid back in less than six years.

It would also save the equivalent of 27.3 thousand metric tonnes of CO₂ per year in emissions.

Seize the momentum

Climate actions



Improve energy efficiency to reduce greenhouse gas emissions and energy waste.

Actions on sound management of chemicals and waste

Eliminate the use of PCB in equipment by 2025. Environmentally sound waste management of liquids containing PCB and equipment contaminated with PCB by 2028.

More information

SADC PCB Project Dashboard



SADC PCB Project


Southern African Development Community polychlorinated biphenyls project
2016-2024

SADC PCB project's objective is the elimination of polychlorinated biphenyls (PCBs) contained in oil and equipment (mainly electric transformers and capacitors) in 11 countries in southern Africa.


Additionally, the project targets the improvement in the enabling environment for the management of PCB contaminated equipment currently in use and when it has already been decommissioned. This is has been achieved through the introduction of **best practices** and development of **phase-out plans**.

A large part of the work has involved the detailed **inventory of PCB equipment in project countries** to allow letting of a contract for the safeguarding, centralisation, international transport and disposal by an international contractor.

This dashboard displays the **quantity and location of the equipment**, the **risk** posed by the equipment and the results of a **cost benefit analysis** which shows the benefit of the replacement from the standpoints of improved efficiency and reductions in CO2 emissions.



PCBs Phase-out Plan



[Equipments](#)[Risk Factors](#)[Cost Model](#)

More info on polychlorinated biphenyls (PCBs)


Microsoft Power BI

[Open the dashboard in a separate tab](#)

TOOLKITS, MANUALS AND GUIDES

Polychlorinated biphenyls Phase-out Plan

30 April 2023



Through the GEF-funded project “Disposal of PCB oils contained in transformers and disposal of capacitors containing PCB in Southern Africa”, among other things, all participating countries are given support to develop a pragmatic PCB Phase-out Plan as provided for and committed to by ratifying the Stockholm Convention. The overall objective of the project is to reduce environmental and human health risks from PCB releases through the demonstration of a regional approach to the introduction of cost-effective and socially acceptable ESM of PCB oils, equipment and wastes held by electrical utilities and other PCB owners in twelve participating countries: Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Swaziland, Tanzania, Zambia and Zimbabwe.

The project also assists participating countries with a legal review, the verification of inventories, disposal of confirmed and decommissioned contaminated oils/equipment, and capacity building and risk communication up to 2022.

Download

Polychlorinated biphenyls Phase-out Plan

[English](#)[Cost-effectiveness payback Model \(Excel sheet\)](#)[Cost-effectiveness payback Model - Explanations](#)

<https://www.unep.org/explore-topics/chemicals-waste/what-we-do/persistent-organic-pollutants/toward-elimination-pcbs>

<https://www.unep.org/resources/toolkits-manuals-and-guides/polychlorinated-biphenyls-phase-out-plan>



Thank You

Contact Us

For any questions or clarifications

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