

# Green Chemistry activities in the Asia-Pacific Region

*Leveraging Green and Sustainable Chemistry for  
Sound Management of Chemicals and Waste  
beyond 2020  
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# The United Nations Development Programme

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UNDP advocates for integrating chemicals management priorities into national environmental and poverty reduction planning frameworks;

- Supports countries access financial and technical resources,
- Provides technical assistance and oversight support to improve the holistic management of chemicals
- Tackle unsustainable consumption and production patterns, including poor design and material choices, which lead to resource depletion, waste generation and pollution.

UNDP's expertise covers:

- [Persistent Organic Pollutants \(POPs\)](#), [Ozone Depleting Substances \(ODS\)](#), [Mercury](#), Lead, and other heavy metals, waste management systems, including waste prevention, reuse/recycling, treatment and disposal. Safe and effective treatment of hazardous medical waste through innovative technologies is also underway.



# Chemicals & Waste: Roadmap to Green Chemistry

*The 12 Principles of*  
**GREEN CHEMISTRY**

Green chemistry is an approach to chemistry that aims to maximize efficiency and minimize hazardous effects on human health and the environment. While no reaction can be perfectly 'green', the overall negative impact of chemistry research and the chemical industry can be reduced by implementing the 12 Principles of Green Chemistry wherever possible.

<p><b>1. WASTE PREVENTION</b></p>  <p>Prioritize the prevention of waste, rather than cleaning up and treating waste after it has been created. Plan ahead to minimize waste at every step.</p>	<p><b>7. USE OF RENEWABLE FEEDSTOCKS</b></p>  <p>Use chemicals which are made from renewable (i.e. plant-based) sources, rather than other, equivalent chemicals originating from petrochemical sources.</p>
<p><b>2. ATOM ECONOMY</b></p>  <p>Reduce waste at the molecular level by maximizing the number of atoms from all reagents that are incorporated into the final product. Use atom economy to evaluate reaction efficiency.</p>	<p><b>8. REDUCE DERIVATIVES</b></p>  <p>Minimize the use of temporary derivatives such as protecting groups. Avoid derivatives to reduce reaction steps, resources required, and waste created.</p>
<p><b>3. LESS HAZARDOUS CHEMICAL SYNTHESIS</b></p>  <p>Design chemical reactions and synthetic routes to be as safe as possible. Consider the hazards of all substances handled during the reaction, including waste.</p>	<p><b>9. CATALYSIS</b></p>  <p>Use catalytic instead of stoichiometric reagents in reactions. Choose catalysts to help increase selectivity, minimize waste, and reduce reaction times and energy demands.</p>
<p><b>4. DESIGNING SAFER CHEMICALS</b></p>  <p>Minimize toxicity directly by molecular design. Predict and evaluate aspects such as physical properties, toxicity, and environmental fate throughout the design process.</p>	<p><b>10. DESIGN FOR DEGRADATION</b></p>  <p>Design chemicals that degrade and can be discarded easily. Ensure that both chemicals and their degradation products are not toxic, bioaccumulative, or environmentally persistent.</p>
<p><b>5. SAFER SOLVENTS &amp; AUXILIARIES</b></p>  <p>Choose the safest solvent available for any given step. Minimize the total amount of solvents and auxiliary substances used, as these make up a large percentage of the total waste created.</p>	<p><b>11. REAL-TIME POLLUTION PREVENTION</b></p>  <p>Monitor chemical reactions in real-time as they occur to prevent the formation and release of any potentially hazardous and polluting substances.</p>
<p><b>6. DESIGN FOR ENERGY EFFICIENCY</b></p>  <p>Choose the least energy-intensive chemical route. Avoid heating and cooling, as well as pressurized and vacuum conditions (i.e. ambient temperature &amp; pressure are optimal).</p>	<p><b>12. SAFER CHEMISTRY FOR ACCIDENT PREVENTION</b></p>  <p>Choose and develop chemical procedures that are safer and inherently minimize the risk of accidents. Know the possible risks and assess them beforehand.</p>

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Green chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances.

Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal.

Green chemistry is also known as sustainable chemistry.

Source: <https://www.epa.gov/greenchemistry/basics-green-chemistry>

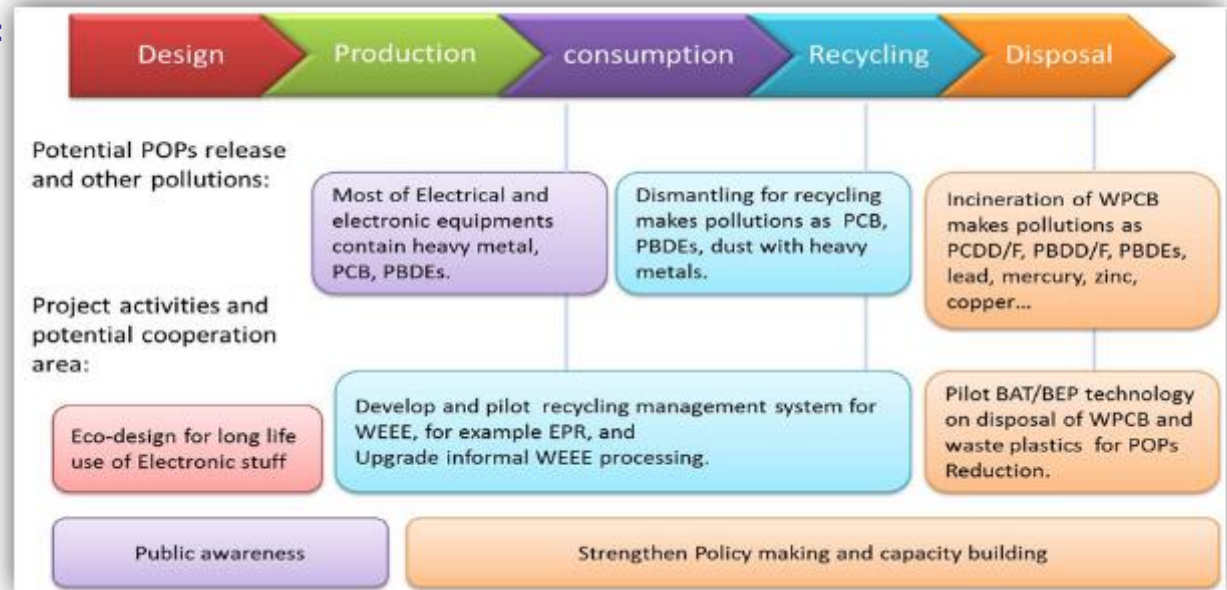
# China: E-waste and Green Design

GEF ID: 4862

Status: Completed



## Project's Theory of Change:



## Key Achievements:

- **6 EEE technical guidelines** on eco-design
- **One** Develop Eco-computer design launched in partnership with LENOVO
- **3 policy recommendations** on EPR subsidy funds
- **284,890 metric tons** of BFR containing plastic/resins performed/reused in this project
- **50% increase** in WEEE collected and processed

*97.9% reduction in chemicals (SCCPs/HBCDD/PFOS/Flame retardants...)*

*Weight reduced: 446.6g (26.6% of the whole laptop;*

*Based on the 2018 sales, 3.9 metric tonnes of POPs flame retardants were reduced through the eco-design introduced.*



Type: Zhaoyang K43c-80

# Indonesia: “Electronic Plastics” free of PBDEs

GEF ID: 5052

Status: Completed



**Baseline:** PBDE was used as a mixture to make casings (Mobile Phones, Laptops, etc.) and PCBs (Printed Circuit Board). Casings and PCBs waste also imported to be processed by recycling industries, PBDEs would re-enter the circular process through cross-contamination or end up washed to rivers, ocean or open burned.

**Project interventions:**

**KM:** collect experiences and support replications and scaling up



**Manufacturing Sector:** Guidelines and by-laws to eliminate imports and use of PBDEs, create EPR System



**Improve national capacities:** replace PBDEs and implement QA programmes at manufacturers



**Improve circularity:** Introduce BAT/BEP for recycling sector



**Sound Disposal:** safely dispose contaminated plastics and improve recycling of other types of plastics



## Key Achievements:

- 5 plastic processing units established
- 1,000 metric tonnes of e-waste PBDEs contaminated plastics disposed of.

# Vietnam: “Greening” the Chemical Industry



GEF ID:

Status: Completed

Improved regulatory framework on chemicals control and roadmap to GC in selected sectors.

Green Chemistry Incentive Scheme designed and adopted

Demonstration in Electrochrome Plating industry: Replacement of SCCP with non-POP chemicals

## Key Achievements:

POP	Hg
<p>Two plants accepted to phase out POPs</p> <ul style="list-style-type: none"> <li>Plato (Electroplating): 572 kg PFOS/năm</li> <li>Nishu (Paint): 2900 kg SCCP/năm</li> </ul>	<p>No plants use Hg.</p> <p>Hg emits through electricity and fuel consumption.</p> <p>Sai Gon Paper emits the most Hg at 5368 g Hg/year</p>
U-POP	CO <sub>2</sub>
<p>Mainly from the processing of recycled materials with insufficient pollution treatment</p> <ul style="list-style-type: none"> <li>Electroplating: recycled aluminum (0,26 – 2,32 gTEQ/year)</li> <li>Paper: recycled paper (0,13 – 3,08 gTEQ/year)</li> <li>Plastic: recycled plastic</li> <li>Others: electricity, Gas, Oil (&lt;0,015 gTEQ/year)</li> </ul>	<p>Emission from using electricity, fuel</p> <p>Maximum in Alutec (Electroplating) 2,5 x 10<sup>6</sup> tons CO<sub>2</sub>/year (due to use gas)</p>

# PLATO

From Cr<sup>6+</sup> to Cr<sup>3+</sup>

# NISHU

Alternative, no use SCCP, water based

Green Chemistry

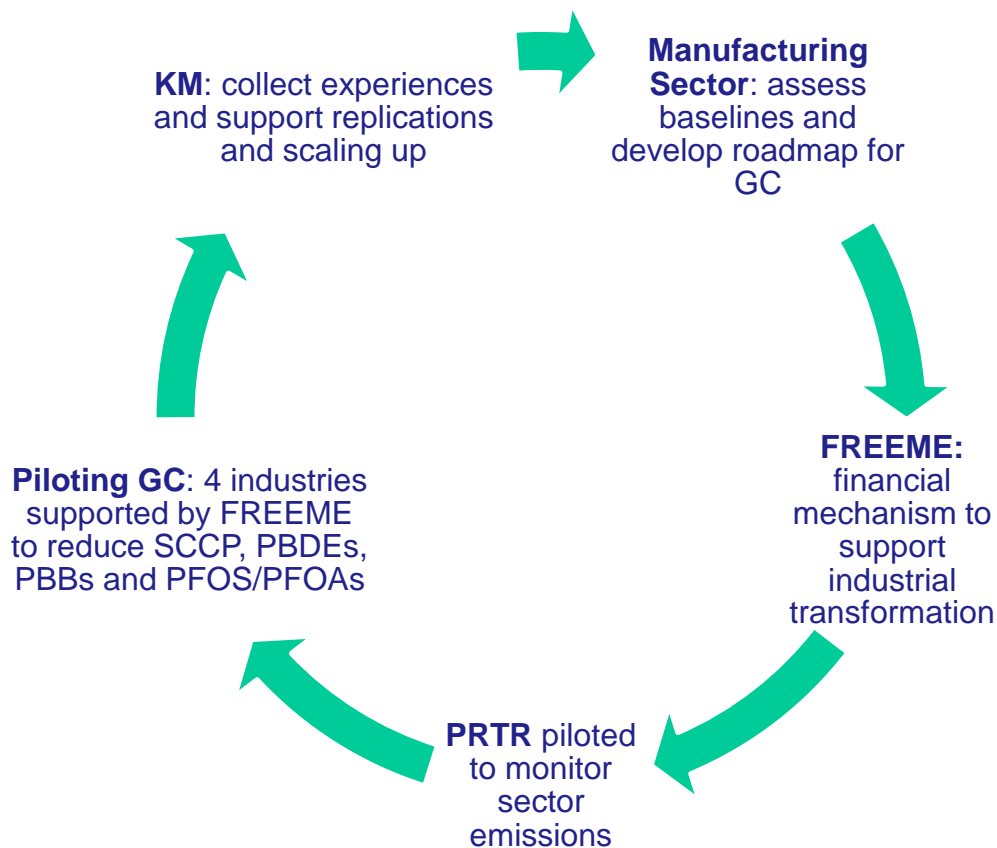
### REDUCTION

POP	3472 kg/year;	✓
U-POP	102,19 µg/year;	
Hg	7,98 g /year	
CO <sub>2</sub>	923,11 ton/year	✓

# Philippines: Green Chemistry

GEF ID: 10686

Status: Under development (PPG)





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**Thank you!**

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Global Policy Network (GPN)  
Bureau of Programme and Policy Support (BPPS)  
United Nations Development Programme (UNDP)*

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