GEF-6 PROJECT IDENTIFICATION FORM (PIF)

PROJECT TYPE: Full-sized Project
TYPE OF TRUST FUND:GEF Trust Fund

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PART I: PROJECT INFORMATION

Project Title:	Application of industry-urban symbiosis and green chemistry for low emission and persistent organic pollutants free industrial development in Thailand		
Country(ies):	Thailand	GEF Project ID:[1]	9219
GEF Agency(ies):	UNIDO (select) (select)	GEF Agency Project ID:	150036
Other Executing Partner(s):	- Department of Industrial Works under the Ministry of Industry; - Pollution Control Department under the Ministry of Natural Resources and Environment; - The Federation of Thai Industries; and, - Chemical Engineering Department, Kasetsart University.	Submission Date: Resubmission Date:	07-30-2015 09-30-2015
GEF Focal Area(s):	Multi-focal Areas	Project Duration (Months)	60
Integrated Approach Pilot	IAP-Cities ☐ IAP-Commodities ☐ IAP-Food Security ☐	Corporate Program: SGP ☐	
Name of parent program:	[if applicable]	Agency Fee ($)	851,770

A. INDICATIVE FOCAL AREA STRATEGY FRAMEWORK AND OTHER PROGRAM STRATEGIES[2]

Objectives/Programs (Focal Areas, Integrated Approach Pilot, Corporate Programs)	**Trust Fund**	**(in $)**	
		GEF Project Financing	**Co-financing**
(select) CCM-1 Program 1 (select)	(select)	3,560,133	25,090,000
(select) CW-1 Program 1 (select)	(select)	980,234	1,440,000
(select) CW-2 Program 3 (select)	(select)	4,425,633	32,670,000
Total Project Cost		8,966,000	59,200,000

B. INDICATIVE PROJECT DESCRIPTION SUMMARY

Project Objective: To reduce greenhouse gas emissions, as well as releases of persistent organic pollutants and other harmful chemicals from industries and urban centers through the application of industry-urban symbiosis and green chemistry technology.

Project Components	**Financing Type[3]**	**Project Outcomes**	**Project Outputs**	**Trust Fund**	**(in $)**	
					GEF Project Financing	**Co-financing**
Policy development	TA	Outcome 1: GHG emissions and releases of POPs reduced through industry-urban symbiosis by transferring low carbon and green chemistry technologies, improving capacity, enhancing infrastructure, promoting innovative	Òutput 1.1 Necessary legislative and policy measures on industry-urban symbiosis principles, management of new POPs and market-based instruments enhanced	GEFTF	702,618	3,698,000
National capacity and awareness raising on industry-urban	TA		Output 1.2 Textile and electronic sectors confirmed based on	GEFTF	1,669,430	8,229,086

[1] Project ID number will be assigned by GEFSEC and to be entered by Agency in subsequent document submissions.
[2] When completing Table A, refer to the excerpts on *GEF 6 Results Frameworks for GETF, LDCF and SCCF*.
[3] Financing type can be either investment or technical assistance.

symbiosis and POPs		business models and raising awareness	inventory of new POPs and intervention plan developed Output 1.3 Opportunities for industrial-urban symbiosis elaborated through material and waste stream analysis Output 1.4 Increased capacity and awareness on risks of new POPs and the benefits of (i) industrial-urban symbiosis, (ii) resource efficient and cleaner production, (iii) green chemistry			
Pilot demonstration on industry-urban symbiosis	TA		Output 1.5 Industry-urban symbiosis implemented through ithe demonstration of low carbon and green chemistry systems in selected enterprises, industrial zones and neighbouring urban settlements	GEFTF	5,767,000	5,889,200
	Inv			(select)		40,000,000
Monitoring and evaluation	TA	Outcome 2: Project achieves objective on time through effective monitoring and evaluation	Output 2.1 Periodic monitoring and evaluation of project implementation completed	GEFTF	400,000	700,590
			Subtotal		8,539,048	58,516,876
			Project Management Cost (PMC)[4]	GEFTF	426,952	683,124
			Total Project Cost		8,966,000	59,200,000

For multi-trust fund projects, provide the total amount of PMC in Table B, and indicate the split of PMC among the different trust funds here: ( )

C. INDICATIVE SOURCES OF CO-FINANCING FOR THE PROJECT BY NAME AND BY TYPE, IF AVAILABLE

Sources of Co-financing	Name of Co-financier	Type of Co-financing	Amount ($)
Recipient Government	Ministry of Industries	Unknown	7,800,000
Recipient Government	Ministry of Natural Resources and Environment	In-kind	1,000,000
Private Sector	Federation of Thai Industries and its Industrial Envrionment Institute	In-kind	2,000,000
Private Sector	Participating industries and industrial parks/clusters	Equity	48,100,000

[4] For GEF Project Financing up to $2 million, PMC could be up to10% of the subtotal; above $2 million, PMC could be up to 5% of the subtotal. PMC should be charged proportionately to focal areas based on focal area project financing amount in Table D below.

Private Sector	Kasetsart University	Unknown	100,000
GEF Agency	UNIDO	Grants	100,000
GEF Agency	UNIDO	In-kind	100,000
Total Co-financing			59,200,000

D. INDICATIVE TRUST FUND RESOURCES REQUESTED BY AGENCY(IES), COUNTRY(IES) AND THE PROGRAMMING OF FUNDS [a)]

GEF Agency	Trust Fund	Country/ Regional/ Global	Focal Area	Programming of Funds	(in $)		
					GEF Project Financing (a)	Agency Fee (b)[b)]	Total (c)=a+b
UNIDO	GEFTF	Thailand	Climate Change	(select as applicable)	3,560,133	338,213	3,898,346
UNIDO	GEFTF	Thailand	Chemicals and Wastes	POPS	4,725,633	448,935	5,174,568
UNIDO	GEFTF	Thailand	Chemicals and Wastes	SAICM	680,234	64,622	744,856
Total GEF Resources					8,966,000	851,770	9,817,770

a) Refer to the Fee Policy for GEF Partner Agencies.

E. PROJECT PREPARATION GRANT (PPG)[5]

Is Project Preparation Grant requested? Yes ☒ No ☐ If no, skip item E.

PPG AMOUNT REQUESTED BY AGENCY(IES), TRUST FUND, COUNTRY(IES) AND THE PROGRAMMING OF FUNDS

Project Preparation Grant amount requested: $200,000				PPG Agency Fee: 19,000			
GEF Agency	Trust Fund	Country/ Regional/Global	Focal Area	Programming of Funds	(in $)		
					PPG (a)	Agency Fee[6] (b)	Total c = a + b
UNIDO	GEF TF	Thailand	Climate Change	(select as applicable)	85,000	8,075	93,075
UNIDO	GEF TF	Thailand	Chemicals and Waste	POPS	100,000	9,500	109,500
UNIDO	GEF TF	Thailand	Chemicals and Waste	SAICM	15,000	1,425	16,425
Total PPG Amount					**200,000**	**19,000**	**219,000**

[5] PPG requested amount is determined by the size of the GEF Project Financing (PF) as follows: Up to $50k for PF up to$2m (for MSP); up to $100k for PF up to $3m; $150k for PF up to $6m; $200k for PF up to $10m; and $300k for PF above $10m. On an exceptional basis, PPG amount may differ upon detailed discussion and justification with the GEFSEC.

[6] PPG fee percentage follows the percentage of the Agency fee over the GEF Project Financing amount requested.

F. PROJECT'S TARGET CONTRIBUTIONS TO GLOBAL ENVIRONMENTAL BENEFITS[7]

Provide the expected project targets as appropriate.

Corporate Results	Replenishment Targets	Project Targets
1. Maintain globally significant biodiversity and the ecosystem goods and services that it provides to society	Improved management of landscapes and seascapes covering 300 million hectares	*Hectares*
2. Sustainable land management in production systems (agriculture, rangelands, and forest landscapes)	120 million hectares under sustainable land management	*Hectares*
3. Promotion of collective management of transboundary water systems and implementation of the full range of policy, legal, and institutional reforms and investments contributing to sustainable use and maintenance of ecosystem services	Water-food-ecosystems security and conjunctive management of surface and groundwater in at least 10 freshwater basins;	*Number of freshwater basins*
	20% of globally over-exploited fisheries (by volume) moved to more sustainable levels	*Percent of fisheries, by volume*
4. Support to transformational shifts towards a low-emission and resilient development path	750 million tons of CO_{2e} mitigated (include both direct and indirect)	*1,300,000 metric tons*
5. Increase in phase-out, disposal and reduction of releases of POPs, ODS, mercury and other chemicals of global concern	Disposal of 80,000 tons of POPs (PCB, obsolete pesticides)	*620 metric tons*
	Reduction of 1000 tons of Mercury	*metric tons*
	Phase-out of 303.44 tons of ODP (HCFC)	*ODP tons*
6. Enhance capacity of countries to implement MEAs (multilateral environmental agreements) and mainstream into national and sub-national policy, planning financial and legal frameworks	Development and sectoral planning frameworks integrate measurable targets drawn from the MEAs in at least 10 countries	*Number of Countries:*
	Functional environmental information systems are established to support decision-making in at least 10 countries	*Number of Countries:*

PART II: PROJECT JUSTIFICATION

1. *Project Description.* Briefly describe: 1) the global environmental and/or adaptation problems, root causes and barriers that need to be addressed; 2) the baseline scenario or any associated baseline projects, 3) the proposed alternative scenario, GEF focal area[8] strategies, with a brief description of expected outcomes and components of the project, 4) incremental/additional cost reasoning and expected contributions from the baseline, the GEFTF, LDCF, SCCF, and co-financing; 5) global environmental benefits (GEFTF) and/or adaptation benefits (LDCF/SCCF); and 6) innovation, sustainability and potential for scaling up.

Climate change has been recognized as a threat to Thailand, which was the ninth hardest-hit country by extreme weather events between 1993 and 2012. Despite the efforts made to reduce greenhouse gas (GHG) emissions, the country is the world's 19th largest emitter of carbon dioxide (CO2) releasing 327 million tons of carbon dioxide equivalent (CO2e) in 2013. This is evidenced by the Thailand Greenhouse Gas Management Organization Report (2000-2010), which breaks down emission releases by sector. The energy sector was identified as the largest emitter of GHG, accounting for 69% of Thailand's emissions. In total, the use of energy in the industrial sectoraccounted for 24% of Thailand's total emissions amounting to 80 million tons of CO2e in 2010.

In terms of the release of persistent organic pollutants (POPs), a report from Greenpeace International on the industrial releases of POPs and other harmful chemicals in the Chao Phraya Basin underlined the seriousness of the

[7] Provide those indicator values in this table to the extent applicable to your proposed project. Progress in programming against these targets for the projects per the *Corporate Results Framework* in the *GEF-6 Programming Directions*, will be aggregated and reported during mid-term and at the conclusion of the replenishment period. There is no need to complete this table for climate adaptation projects financed solely through LDCF and/or SCCF.

[8] For biodiversity projects, in addition to explaining the project's consistency with the biodiversity focal area strategy, objectives and programs, please also describe which Aichi Target(s) the project will directly contribute to achieving.

current situation. This is confirmed by a study that collected a total of 300 surface water samples in 31 locations along the Chao Praya River and concluded that higher PFOS concentrations were measured in more industrialized and more densely populated areas. Following the washing of textile and electronic equipment after the coating process, the wastewater is cleaned in internal factory treatment plants equipped with activated sludge anaerobic digestion processes. However, even though POPs are partially removed from wastewater, they remain in the sludge, presenting a hazard.

Additionally, increasing environmental and health problems are related to issues of collection, disposal and recycling of hazardous substances, especially e-waste, as POPs and other chemicals are released at the industry and household levels when disposed in landfills or open burnt. Storage of industrial waste on site is widespread leading to high contamination risks, which can be attributed to lacking infrastructure, high pick-up costs and logistical challenges.

As a consequence of rapid urbanization and industrialization in Thailand combined with unsustainable industrial development patterns and insufficient e-waste management, pollution increased and contributed to the intensification of climate change, degradation of human health and the environment.

Root causes

The root causes of the identified major environmental issues regarding GHG emissions and POPs releases are summarized below. These root causes are systemic problems and therefore need to be addressed at the (i) national and provincial; (ii) industrial zone; and (iii) factory levels.

- Insufficient policy incentives and market-based instruments to encourage resource efficient production processes;
- Limited access to affordable financial schemes to invest in clean and low carbon technology;
- Lack of systematic linkages related to shared infrastructure resulting in incomplete material value chains, such as non-integrated and poor waste management practices encouraging unauthorized dumping by industries and municipalities;
- Suboptimal industrial process efficiency and lack of technical knowledge resulting in low resource productivity and excessive GHG emissions;
- Improper management of hazardous chemicals resulting in water and soil contamination.
- Poor e-waste management system based on informal dismantling and disposal; and,
- Inappropriate worker protection leading to human exposure to hazardous substances.

Barriers

Despite the political and economic efforts made by the government and its agencies to reduce the environmental impact of industries, Thailand will not be able to achieve its goals if the following barriers are not addressed.

- Policy: gaps in political and legislative frameworks (i) to support inclusive and sustainable industrial development through industrial-urban symbiosis, which refers to the collaboration, exchange of resources and sharing of infrastructure between companies and their use of by-products (wastes) from urban areas as alternative raw materials and energy sources in industrial operations, (ii) to provide policy incentives such as market-based instruments to encourage investment in resource efficient and cleaner production (RECP), and (iii) to implement the Stockholm Convention;
- Awareness: low awareness on the principles and benefits of sustainable development and industry-urban symbiosis, as well as on the risks of new POPs and other chemicals to human health and the environment. In terms of sustainable production, there is a wide gap in awareness between academia/large industrial conglomerates and the vast majority of SMEs;
- Capacity: there is a lack of institutional capacity to implement the concept of industry-urban symbiosis and resource (energy, water and raw material) efficiency principles, as well as a lack of inventory and data on sources and emissions of new POPs;

- Technology: environmentally sound technologies are present in Thailand, but only within the largest industrial groups that benefit from well-financed R&D departments or have the capacity to contract external expert organizations. There is a general lack of knowledge and financial means regarding green chemistryand RECP impeding their adoption; and,
- Economy: lack of investment incentive mechanisms and difficulties in accessing financial resources from commercial banks due to insufficient information and cumbersome processes in loan applications for SMEs. As such only 40% of SMEs gained access to credit in 2011.This results in inadequate financial resources for investments in clean and low carbon technology.

2) The baseline scenario or any associated baseline projects;

2a) Baseline scenario

As a signatory to the Stockholm Convention, Thailand developed a National Implementation Plan (NIP) with GEF resources that included an inventory on the initial twelve POPs in 2007. Since the addition of new substances, the Thai government has been working on a NIP update covering legal and institutional aspects, with its own means, but still lacking an inventory of new POPs. Efforts of the Thai government to track some of the new POPs were made by including PFOS under the Department of Customs Act in 2012, requiring a declaration for the import of 16 chemicals. In the same year, the following PFOS imports were recorded: 6,200 kg of tetraethylammonium perfluorooctane sulfonate and 5 kg of octanoic acid, pentadecafluoro-, methyl ester. However these records do not contain information on final PFOS users.

The textile and electronics sectors are particularly relevant for reducing or eliminating new POPs contaminants. With regards to the textile sector, a company visit during the PIF formulation phase confirmed the regular use of two new POPs in the production process, consuming annually up to 200kg of PFOS (ammonium salt) flame retardant and 240kg of hexaBDE water repellant. In the electronics sector it is estimated that PBDEs continue to be used as flame retardant additives. This is evidenced by the recent national status report draft, which estimates that approximately 5% of electronic and electrical appliance producers might still use OctaBDE due to limited investment and lack of technical knowledge. In order to confirm and upscale these accounts, a new POPs inventory needs to be established to improve the limited information that is currently available and to create the baseline for reduced consumption of new POPs in the textile and electronics sectors.

The issue of sound e-waste collection, disposal and recycling is very pressing in Thailand, hence according to the Pollution Control Department, around 2.68 million TV, 1 million digital camera and 1.5 million printers will be disposed of in 2015, while only 22 permitted factories related to e-waste collection and recycling existed by 2010. Thus, due to insufficient e-waste infrastructure the projects intends to develop sound collection and disposal systems at industrial and municipal levels to properly treat POPs containing waste. In this regard, recycling facilities need to be established or strengthened for the reuse of glass, metals and other materials contained in such products.

The project plans to focus on three provinces chosen based on their economic structure to address the previously identified GHG and POPs issues as well as their root causes. During the participatory selection process of the targeted provinces, together with the key stakeholders it was decided that in order to maximize knowledge sharing and scaling-up opportunities, a balance between recent industrial parks and older industrial zones need to be ensured. As such the following three provinces have confirmed their interest in the project: Ayutthaya, Samut Prakarn, and Samut Sakorn. The three selected provinces house a high number of electronic and auto-part industries as well as plastic manufacturers and textile factories. According to the national eco-industrial town plans, in all three provinces waste management and illegal contaminated dumping sites as well as water and air pollution are key challenges that need to be addressed. More information on these provinces and the national eco-industrial town plan can be found in annex 1.

2b) Baseline projects

(i) International organization initiatives: The International Finance Cooperation (IFC) has been active in Thailand in providing financing services for renewable energy in rural infrastructure projects. This has involved programs that are designed to strengthen the financial sector and to provide investment opportunities for SMEs. As such, IFC creates investment schemes and mobilizes partner banks to ensure increased access to affordable clean and renewable

energy projects.

Moreover, the project can benefit from the Cleantech Program for SMEs, which is funded by the GEF and currently being implemented by UNIDO in Thailand, through the sharing of best practices on local clean technologies. The project can build on the experience already gained when implementing clean energy technology, particularly in terms of energy efficiency, renewable energy and waste to energy.

(ii) Global initiatives: The project will benefit from UNIDO's vast experience in resource efficient and cleaner production (RECP). This approach aims to improve resources, reduce environmental pollution and contribute to sustainable industrial development within and beyond enterprise levels by applying clean and low carbon principles (more information in annex 2). UNIDO has been committed in implementing initiatives on RECP and working with both eco-cities and eco-industrial parks. A project entitled "Promote the Development of an Ecological Cities (Eco-Cities) Network in Southeast Asia" funded by the government of Japan was recently completed with phase II underway. The objective of the project was to set up a network and build capacity of selected eco-cities in five countries, including China (city of Pingtan), Viet Nam (Da Nang), Thailand (Map Ta Put), Malaysia (Iskandar) and the Philippines (Cebu). In 2014, UNIDO launched a project in Viet Nam entitled "Implementation of Eco-industrial Park Initiative for Sustainable Industrial Zones" funded by the GEF and the government of Switzerland. This project aims to increase the resource efficiency of industries and to promote industrial ecology, thus shifting from industrial zones to eco-industrial parks. Finally, UNIDO is cooperating with the city of Kitakyushu, Japan, in the field of environmental technology and waste recycling services.

(iii) National initiatives: The Thai government has been very active in moving towards cleaner production and a more sustainable approach on industrial development. In 2013, the Ministries of Industry, Interior, as well as Natural Resources and Environment formed a committee to study the model of eco-industries introduced in the existing industrial zones of Thailand. Subsequently, the Green Growth Strategy (2014 – 2018) was introduced to promote sustainable production and services as well as to increase the scope of industry-urban symbiosis, intensifying the collaboration among companies and exchange of by-products with urban areas. As of today, Thailand has started to develop a few eco-industrial towns, however the interactions between industries and towns remain limited not reaching the full potential of industry-urban symbiosis. To address this issue, the current national economic and social development plan (2012-2016) seeks to create awareness on the co-existence between industries and communities and to further transform eco-industrial towns. Annex 1 presents more information on Thailand's eco-industrial town program.

Another government led initiative, to support a shift towards more sustainable industrial development, is the introduction of an eco-industry certification system. The Government and the Federation of Thai Industries (FTI) developed two certification mechanisms namely the Green Industry (GI) Mark and the Eco Factory using a combination of incentives and benefits for accredited factories. The former is divided in five levels: (1) green commitment; (2) green activities; (3) green system (ISO certification required); (4) green culture and (5) green network. The latter focuses on enhancing environmental, economic and social performances. Additionally, the Department of Industrial Works (DIW) is currently putting in place an incentive scheme for enterprises with GI-Mark level 5, which will exempt them from the annual factory license fee in Thailand.

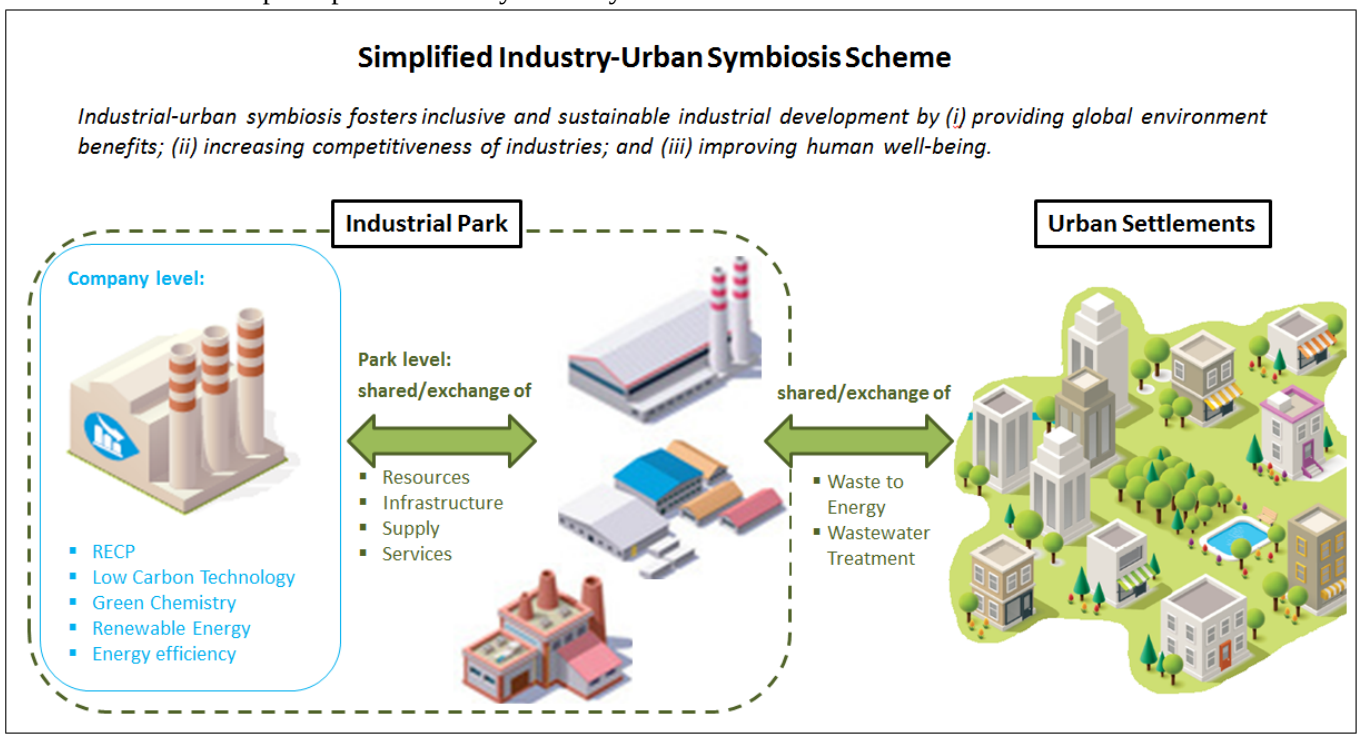
In the past two decades, several initiatives have been undertaken to promote the application of cleaner production (CP) in Thai industries. In the textile sector, these efforts include (i) the introduction of a carbon footprint manual by the Thailand Textile Institute (THTI); (ii) the issuance of the REACH manual (Registration, Evaluation, Authorization and Restriction of Chemicals) co-funded by the EU-Thailand Small Projects Facility; and (iii) the currently under development scheme for pollutant release and transfer register (PRTR) system with the support of JICA, Japan. In the electric and electronic sector, the Electrical and Electronics Institute (EEI) has supported a number of initiatives related to CP, such as Green Camp with the aim to (i) share technical and practical knowledge with SMEs in life cycle assessment, eco-design and CP and (ii) to provide expertise and consultancy in cleaner technology. There has been also rapid expansion in the application of CP in vocational training and universities, such as Kasetsart University. For this purpose, the CP Internship Program has been implemented by the National Science and Technology Development Agency (NSTDA) to promote research and capacity building in this area, which is a tripartite collaboration among government, university and industry.

3) The proposed alternative scenario, with a brief description of expected outcomes and components of the project;

After the identification process of the main environmental problems, their root causes, barriers and pilot opportunities, discussions followed with key stakeholders, in particular relevant ministries in Thailand and the Federation of Thai Industries (FTI). During these consultation rounds, it was decided to focus on two dominant sectors of Thai industry, the textile and electronic sector. It was further agreed that this will ensure a high technical level of intervention as well as profoundly target the release and use of harmful chemical substances, including new POPs.

In order to meet the objectives stated in Table F, the following methodologies and tools will be implemented in an integrated manner under the principles of industry-urban symbiosis: (i) RECP with low carbon technologies, and (ii) green chemistry with the substitution of POPs by less harmful substances. Under RECP, renewable energy (solar and waste-to-energy) and energy efficiency measures will be promoted to reduce GHG emissions. The proposed project will combine policy strengthening, capacity-building, awareness raising, and pilot demonstration in an integrated manner. The combination of these approaches intends to change behavior towards more inclusive and sustainable industrial development. In parallel, the project will demonstrate that industry-urban symbiosis is an economically sound business model that will provide benefits to the enterprises, the society and the environment at large.

The proposed project offers a holistic approach to reduce releases of GHG emissions and POPs at their source at factory, industrial zone and urban area level. The combination of proposed methodologies will encourage investment in technological solutions at three levels by applying a step-by-step approach: (i) within factories; (ii) among factories (eco-industrial zones), and (iii) between industry and urban centers (eco-industrial town). The below scheme illustrates the principles of industry-urban symbiosis.



Annex 2 and the following paragraphs describe the proposed approaches in more details.

To apply the above-mentioned methodologies and tools and to meet the project targets, the project's components and outputs are presented in more details hereafter.

Component 1: Policy development

Output 1.1 Necessary legislative and policy measures on industrial-urban symbiosis principles, management of new POPs and market-based instruments enhanced.

The main objective of this component is to put in place the necessary policies, which will promote the development and adoption of RECP, green chemistry and industry-urban symbiosis through the implementation of

environmentally sound technologies in Thailand. The policies will include components on (i) low carbon and clean technologies as tools to reduce raw material usage, GHG emissions and untreated wastewater discharges, (ii) sound chemicals management, including chemical pollution prevention and (iii) waste minimization through the reduction, reuse and recycling of raw materials, energy and water.

In addition to waste and hazardous substance related policies, market-based instruments (MBIs) will be assessed and adopted. MBIs are policy instruments that use market, price and other economic variables as incentives for companies. Within this project, the purpose of MBIs will be to incentivize polluters to reduce or eliminate negative environmental externalities. The project will thus assess some of the innovative market-based instruments to price pollutants and test them at pilot scale. Some examples of potential MBIs include environmental taxes and charges, environmental subsidies, environmental certifications, liability and compensation schemes, and tradable permits.

To achieve output 1.1, the following activities are planned:

- Activity 1.1.1 Review current legal, regulatory, policy and institutional frameworks on waste- and chemical management of new POPs and industrial-urban symbiosis mechanisms (in relation to waste value chains and urban planning);
- Activity 1.1.2 Identify needed policy reforms to ensure large-scale implementation of RECP, green chemistry and industrial-urban symbiosis;
- Activity 1.1.3 Develop and submit a draft policy to the legislative authority for formal appraisal based on the need to manage new POPs and to promote and implement industrial-urban symbiosis within the existing eco-industrial town development strategy of the Ministry of Industry;
- Activity 1.1.4 Support the development of other related policies (e.g. the e-waste legislation currently under discussion) in order to channelize the collection and recycling of POPs containing end-of-life products;
- Activity 1.1.5 Assess existing MBIs and if needed develop and introduce the most appropriate incentives; and,
- Activity 1.1.6 Analyze existing support mechanisms and banking conditions for SMEs and facilitate theiraccess to investment opportunities.

During PPG phase, a preliminary study of MBIs, support mechanisms and banking condition for SMEs, as well as the development of appropriate business models for clean technologies and green chemistry will be conducted.

Component 2: National capacity building and awareness raising on industrial-urban symbiosis and POPs

Output 1.2 Textile and electronic sectors confirmed based on inventory of new POPs and intervention plan developed

To comply with the requirements of the Stockholm Convention, the Thai government has been adapting its legislative framework, without requesting the GEF's Enabling Activity funds. However, the inventory of newly listed POPs and the updating of the original twelve POPs' inventory have not been carried out due to lacking resources, which will be undertaken under this output. The data collected on POPs value chains will support the policy development detailed under component 1.1 and facilitate the implementation of RECP and industrial-urban symbiosis activities. Based on the gathered information the main tools and instruments to be used in an intervention plan will be identified via participative approaches.

The main activities are described below:

- Activity 1.2.1 Conduct training sessions on a national inventory of new POPs and collect data for the initial national inventory of new POPs using material/substance flow analysis of new POPs at the provincial level. This will also include an updating of the inventory of the initial twelve POPs. During this activity, all industrial sectors will be covered;
- Activity 1.2.2 Draft a national inventory report for new POPs in use and in waste streams and the updated twelve original POPs inventory, including confirmation of the priority sectors for new POPs interventions in relation with the project target sectors (textile and electronics);

- Activity 1.2.3 Develop a proper new POPs database to collect, store and manage new and updated information on a national scale for annual quantification; and,
- Activity 1.2.4 Develop intervention plans for new POPs, submit the inventory of new POPs and updated inventory of the original twelve POPs to the authorities for further approval before submission to the Secretariat of the Stockholm Convention.

Output 1.3 Opportunities for industrial-urban symbiosis elaborated through material and waste stream analysis

This output is intended to identify and clarify the potentials for industry-urban symbiosis in the three selected provinces. The objective hereby is to select concrete solutions and processes on how low carbon and green chemistry technologies, through symbiotic collaboration among companies and with communities, can be implemented. In this process companies are encouraged to actively participate in the identification process of suitable technologies for pilot demonstration under component 3. Based on the results of output 1.2, a material/substance flow analysis (MFA/SFA) on new POPs will be carried out in the three targeted provices. The purpose is to identify stakeholders, location of related activities, material and energy use and releases to the environment. The use of MFA and SFA combined with the inventories will provide quantitative information on stocks within and flows between certain industrial processes. The mass balance obtained allows the (i) identification of flows and losses/emissions (ii) elaboration of alternative scenarios (iii) calculation of performance indicators to quantify savings and monitor improvement measures. The results of the MFA/SFA will highlight points of releases to the environment as well as opportunities for industry-urban symbiosis.

The main activities to achieve this output are described below. They will contribute to the GHG emissions reduction target.

- Activity 1.3.1 Collect field information and build the material flow model to highlight material paths as well as target (i) closed loop and (ii) industrial-urban symbiosis opportunities;
- Activity 1.3.2 Develop key performance indicators to monitor activities related to industry-urban symbiosis; and,
- Activity 1.3.3 Develop material flow and waste databases at industrial park level using collected data to encourage entrepreneurship and information exchanges. Establish an online database with restricted access for authorized users as well as an open access area for replication and scaling up opportunities.

During the PPG phase it is planned to elaborate a draft material flow analysis at the national scale for new POPs. The results obtained during the PPG will be further developed with a specific focus on the three selected provinces and on the re-use, recycling of by-products and waste and the efficient use of energy. Since energy is one of the main cost factors in textile and electronic sectors, improving energy efficiency is of primary concern to companies. Additionally, GHG mitigation technologies and practices to reduce POPs will be assessed for the pilot demonstration component of the project. When assessing suitable low carbon and clean technologies, priority will be given to the BAT/BEP solutions listed below.

GHG mitigation technologies:

i.Waste heat boiler: utilizes the heat from waste gases stemming from combutions processes or from hot waste air streams. In this process, hot waste gas is passed through a tube bundle, where it transfers heat to the water located in the boiler body;

ii. Efficiency monitoring systems: expose possibilities for saving energy of up to 10% including the following possible inputs: data burner capacity, fuel flow rate, flue gas temperature and oxygen content;

iii. Heat networks: allows the creation of symbiosis by using residue heat in plants for other companies situated in close proximity;

iv. Thermal solar systems: may be used to provide process heat at a temperature of up to a maximum of 120 C. Coupling solar-thermal energy directly to the process is suitable for cleaning, drying, evaporation, bleaching or boiling; and,

v. Solar PV installation: depending on the rooftop system, solar PV installations can cover a large amount of the

companies'annual energy requirements.

Practices to reduce POPs:

i. Chemical leasing: international demonstration projects of chemical leasing in various industrial sectors have evidenced that it is possible to reduce the consumption of chemicals by an average of 20%. Such projects facilitate new service-oriented business model to be piloted and implemented in companies in the industrial zones that manufacture toxic substances of global significance, hereby focusing on the textile and electronics industries; and,

ii. Fossil fuel combustion systems: coal combustion may be a source of HCB emissions and the potential of unintentionally produced POP emissions at a greater concentration from small and less well controlled fossil-fuel fired boilers. Hence, fuel quality and combustion control are the most important aspects in minimizing emissions of POPs. Parameters that can be controlled to reduce PCDD/F emissions in fossil fuel combustion systems are combustion quality, air pollution control temperatures, fuel parameters and operating parameters for air pollution control devices if installed.

iii. A proper e-waste management approach based on life cycle considerations will be evaluated according to the BAT/BEP guidelines under the Stockholm Convention. Some of the most relevant processes for POP-PBDE containing material flow involve recycling, material/energy recovery or disposal. As such POP-PBDE wastes often have to be stored and handled prior to treatment or final disposal. Hereby a number of technical requirements according to the before mentioned guidelines have to be met, such as appropriate storage drainage infrastructure or proper loading and unloading management systems as well as fire safety measures required for storage of plastic wastes according to the Basel Convention.

Output 1.4 Increased capacity and awareness on risks of new POPs and the benefits of (i) industrial-urban symbiosis, (ii) resource efficient and cleaner production, (iii) green chemistry;

Capacity building and awareness raising efforts will focus on national, industrial park, and enterprise levels. At the national level, the main target group will be IEAT, FTI and the partner institutes under the Ministry of Industries, such as the Thailand Textile Institute and the Electrical and Electronics Institute, as well as supporting academic institutions, such as Kasetsart University. Support will be provided to the management of the three selected industrial zones as well as to technicians and managers from the respective enterprises.

The main activities to achieve output 1.4, targeting at capacity building are described below:

- Activity 1.4.1 Review the current activities and infrastructure of relevant agencies and institutions;
- Activity 1.4.2 Design training programs and adapt academic curricula on the challenges faced in implementing RECP, low carbon technologies, green chemistry, and industrial-urban symbiosis in Thailand; and,
- Activity 1.4.3 Train technical staff and experts from partner institutes, the respective industrial zones and beneficiary industries on the topics mentioned under 1.4.2.

The main activities to achieve output 1.4, targeting at awareness raising, are described hereafter:

- Activity 1.4.4 Organize workshops and training seminars on the principles and benefits of RECP, low carbon technologies and industrial-urban symbiosis as well as on the risks of new POPs to human health and the environment. To reach the target audience of communities and company workers governmental officials (e.g. urban planners and policy makers), civil society organizations (e.g. NGOs and local community associations) and industry associations (private sector) will be involved;
- Activity 1.4.5 Disseminate lessons learned and best practices from component 3 (see below) through seminars, workshops, publications and outreach/educational materials for the replication and widespread adoption of RECP and industrial-urban symbiosis; and,
- Activity 1.4.6 Develop an awareness program on the topics to be used in universities and technical schools.

As a result of the second component, it is expected that behavior towards resource efficiency and management of hazardous waste will change. In particular, management of household hazardous waste will be addressed by informing and involving multi-level forms of governance and the inclusion of local population.

Component 3: Pilot demonstration of cleaner production and industrial-urban symbiosis

Under this component, the innovative approaches promoted by this project will be demonstrated at pilot scale. Following the industrial-urban symbiosis principles, the activities will focus initially on company level with the application of RECP and green chemistry to reduce resource consumption and switch to less hazardous chemicals. In addition, the installation of solar PV panels on the roof of industries will be promoted. Energy management systems and heat system optimization will also be introduced as measures to increase energy efficiency and reduce GHG emissions.

Secondly, at the industrial park level, exchanges between companies in terms of resources (supply chain, waste to raw material, heat, etc.), infrastructures (heat or power generation, wastewater treatment) or services elaborated under output 1.3 will be implemented.

Lastly, exchanges between the industrial parks and the neighbouring urban areas will be demonstrated with a specific emphasis on household waste management, with the underlying obejctive to shift from landfilling or open burning to waste-to-energy solutions. In order to maximize the benefits of waste-to-energy, initial recycling and recovering processes need to be strengthend and if absent implemented. Additionally, conventional burners will be replaced to allow for better recovery of metals and hightened elimination of contaminats. In this regard, air quality standards need to be ensured in order to avoid pollution and unintentionally releases of POPs. The project will benefit from the shared experiences and information via the ESEA Forum established by UNIDO and ensure the generation of positive impacts for the environment and human health.

Throughout this component, institutions offering financial mechanisms in Thailand for investments in low carbon and resource efficient technologies will be involved and their services made accessible to industries and SMEs in particular.

Output 1.5 Industry-urban symbiosis implemented through the demonstration of low carbon and green chemistry systems in selected enterprises, industrial zones and neighboring urban settlements

All pilot demonstration activities to be carried out in three industrial zones studied under activities 1.3.2 and 1.3.4 are grouped under output 1.5. The planned activities are detailed hereafter:

- Activity 1.5.1 Conduct RECP assessments in 60 facilities and introduce energy management system optimization measures. Perform technical and financial feasibility studies to present bankable pilots on (i) potential low carbon and green chemistry technologies, including the PV installation on factory roof, (ii) industrial ecology, and (iii) interactions between industrial parks and urban areas. There will be a strong focus on low hanging fruits in SMEs.

The main outputs for the demonstration of industrial-urban symbiosis at both industrial zone and provincial scale are described in the following activities:

- Activity 1.5.2 Introduce and demonstrate low carbon, and green chemistry technologies, that would allow official certification (Green Industry Mark or Eco-factory certification). Technically and financially sound business models are developed to demonstrate feasibility as well as economic, social and environmental benefits;
- Activity 1.5.3 Demonstrate industrial symbiosis between companies shifting from industrial zones to eco-industrial parks, and establish partnerships between industries and urban areas. A pilot waste to energy plant will be installed to dispose the household waste in an environmentally sound manner while offering alternative energy supply to the community and industrial park; and,
- Activity 1.5.4 Pilot a collection and take-back system of end-of-life POPs containing products for environmentally sound treatment and recycling.

During PPG, RECP and industrial-urban symbiosis assessments will be tested in some companies to deepen knowledge on industrial practices and needs. An initial opportunity study of industrial-urban symbiosis will also be conducted.

It is expected that this component will demonstrate that investments in low carbon and resource efficient technologies have short payback periods and lead to increased profitability and competitiveness making them

attractive to the private sector. Thus the goal is to provide a solid business model for industrial development in Thailand. This will in turn systematically change behavior at company level in utilizing the financing opportunities supporting in particular low carbon and RECP technology. The project will facilitate access to green financial schemes by disseminating information on available financial programs and their application processes. Subsequently, enterprises operating in numerous locations will be expected to replicate the project's success in other provinces and countries where they are operating.

Component 4: Monitoring and Evaluation

Output 2.1 Periodic monitoring and evaluation of project implementation completed

To ensure effective monitoring and evaluation, the project will include periodic progress reports on the impact status for each of the components of the project. The quarterly reports will be short activity reports while the semi-annual and annual reports will be technical reports on each of the project themes, which will serve as a basis for the mid-term and final evaluations.

4) Incremental/additional cost reasoning and expected contributions from the baseline, the GEFTF, LDCF, SCCF, and co-financing;

Despite the fact that the concepts of eco-factories and eco-industrial zones already exist in Thailand, interactions among companies and between industries and urban areas are still rare. The proposed project will have a catalytic effect in the country by providing the legal and institutional frameworks to support the adoption of an industrial-urban symbiosis mechanism and green chemistry measures. Therefore, the GEF's resources will add value by facilitating the uptake of the government's eco-industrial town concept and demonstrating the economic viability of investing in the sustainability of Thai industries. The GEF's contribution will be used to demonstrate the transformation of polluting industries into more resource efficient factories that evolve into an industry-urban symbiosis. This will also assist Thailand in meeting its obligations under the Stockholm Convention (inventory of new POPs and inventory update of twelve original POPs) and result in the reduced use of harmful chemicals, including POPs and releases of GHG emissions. Owing to the GEF's resources, the capacity of Industrial Estate Authority of Thailand (IEAT) will be enhanced to transform IEAT into a knowledge and service hub.Additionally, a curriculum will be developed to build capacities of universities and technical schools.

The Thai Government has been gearing towards inclusive and sustainable industrial development while also working on mitigating climate change and tackling chemical management issues. The private sector is making progress in this direction and will complement the resources offered by the GEF by financing the infrastructure needed to reduce GHGs emissions and the releases of POPs. Beyond completion of the project, the concept of industry-urban symbiosis has the potential to be replicated in other provinces.

5) Global environmental benefits (GEFTF) and/or adaptation benefits (LDCF/SCCF);

The project will deliver global environmental benefits by supporting Thailand to mitigate climate change through the reduction of GHG emissions and releases of POPs and other harmful chemicals to air, water and soil. The initiative will reduce many sources of pollution and waste, as well as decrease demand for natural resources by using innovative approaches of industrial-urban symbiosis, low carbon production, green chemistry, and the sound management of chemicals.

The project will directly benefit the local communities, those most affected by industrial pollution, by improving environmental situations and promoting green jobs. The wider community will also benefit, as climate change, GHG emissions and releases of POPs do not respect regional or national boundaries.

Through the development of the inventory on new POPs, pollution sources and intervention areas will be identified and selected while institutional capacity and policy analysis will help to detect and remove potential barriers to fulfill Thailand's obligations under the Stockholm Convention.

GHG emissions avoided: The calculation of the project's GHG emission reduction target is based on available information from the three proposed partner provinces and a combination of planned renewable energy (solar and waste to energy) and energy efficiency measures.

With a co-financing investment estimated at USD 7 Mio from the private sector to cover the total PV system cost

(USD 4.59/W) to be installed of the roofs of companies, a total capacity of 1.5 MW could be installed (0.5 MW per province). This corresponds to 6570 MWh/year based on 12 h of daily operation. Considering a grid emission factor of 0.5476 tons CO2/MWh for Thailand and a 10-year economic lifetime of the investment made, the total direct GHG emission reduction is estimated at 35,980 tons CO2. The associated indirect emission reduction will be evaluated in more details during the PPG phase. An indicative estimation assumes (i) that the result of induced market transformation effects will trigger the same capacity to become operational each year in other provinces as replication of the project, and (ii) a conservative GEF causality factor is 40%. This leads to a total GHG emission reduction from the solar measures of 503,720 tons CO2.

The demonstration of waste to energy infrastructures targeting households waste will make a significant contribution to GHG emission reduction as 1 ton of waste incinerated allows the reduction of nearly 1 ton of CO2 emission (from US-EPA EPA's Municipal Solid Waste Decision Support Tool). The savings are calculated by comparing waste burners equipped with co-processing of heat and electricity to landfilling without a gas collection and valorization system. A pilot plant in Thailand with a capacity of 57,000 ton per year (137 tons/day) will result in a saving of 50,000 tons of CO2 every year of operation. Over a 10-year economic lifetime, the total direct GHG emission reduction is estimated at 570,000 tons CO2. To estimate the associated indirect emission reduction, a conservative GEF causality factor is 40% leads to a total GHG emission reduction from the waste-to-energy facility of 798,000 tons CO2. Additional steam exchanges and the development of a steam production network in active and dense industrial areas may provide similar CO2 savings.

The implementation of RECP and energy efficiency recommendations made under activity 1.5.1 could further account for CO2 emission reduction. Industrial processes account for 7% of overall Thai GHG emissions, and preliminary field visits point towards a significant potential for waste prevention as well as energy and material savings in the Thai industrial sector. A five year RECP and energy efficiency program targeting textile and electronics companies may result in an additional 400,000 tons of CO2 including both material and energy efficiency improvements. However, this rough estimation will need to be further elaborated during the PPG phase and was not taken into account when setting the goals under Table F.

Disposal of POPs: Substitution and reduction of consumption of hexaBDE and PFOS with green chemicals in the textile industry presents a great potential to meet the project target. A green chemistry pilot, replicable in 100 companies, will account for a reduction of 22 tons in the consumption of these two specific new POPs. Awareness raising activities based on successful pilots may further increase the savings. Therefore, with a reasonable target of 1,000 textile mills, the project will aim to reduce new POPs consumption by 220 tons.

Based on the UNU E-waste Monitor estimate of 6.4 kg/inhabitant of e-waste is generated in Thailand with an overall 30% plastic fraction of which 12% is attributed to brominated flame retardants (BFR) additives, approximately 15,000 tons of BFR-plastics are disposed of every year. Using data on BFRs detected in a Swiss e-waste sample in 2003, a very rough estimate of 1,000 tons of BFRs are identified in the Thai e-waste stream as a whole. By assuming the disposal of 40% of the national e-waste stream through proper collection and treatment channels, 400 tons of new POPs releases may be prevented. In addition to being highly persistent, these substances are also a significant source of GHG emissions. POPs related activities might thus also contribute to the GHG reduction efforts of the project.

6) Innovativeness, sustainability and potential for scaling up.

Innovativeness

This is the second GEF project supporting a transition towards more sustainable industrial zones. The first one is currently being implemented by UNIDO in Viet Nam. The Thai project builds upon the Vietnamese initiative by adopting a multi-level governance approach on both RECP and green chemistry technology application, and waste management including electronic and industrial wastes. In addition, this project takes a step forward by targeting urban areas and their relations with industries.

The industry-urban symbiosis principles apply environmentally sound methods and practices in an innovative and holistic approach encompassing enterprises via the integration of RECP and industrial ecology. The proposed concept overcomes the virtual barriers that prevent companies to interact with one another and the nearby community and environment. Hence, the project proposes an innovative approach targeting the following three levels: (i) within industries; (ii) among industries within selected industrial zones; and (iii) among more resource efficient industrial

zones and their neighboring communities.

Due to the innovative and integrated nature of this project, environmental targets, such as the reduction of emissions and energy consumption, can be reconciled with social and economic well-being . By working jointly, the group of businesses and the local community seek a collective benefit that is greater than the sum of the individual benefits that each company and the selected urban areas would enjoy if they only optimized their individual performances.

This project will be one of the first GEF projects to apply the green chemistry technology concept, an innovative approach that involves substituting and reducing the use of new POPs. In addition, the project will assess some options for innovative market-based instruments to price polluters. This is fully in line with GEF 6's Programmatic Strategy, to not only to emphasizes the concrete reduction of GHG emissions and release of harmful chemicals, but also to establish innovative financial mechanisms that could leverage cost recovery from the private sector to clean up their environmental pollution.

Sustainability

Sustainability will be achieved by strengthening the regulatory framework to incentivize the development of industrial-urban symbiosis and sound management of chemicals and by creating institutional capacities in key public institutions. A series of training sessions will be conducted in selected industries and national institutions to ensure stakeholder ownership of technologies, tools and methods introduced by the project beyond its completion. During the trainings and workshops, awareness will be raised on national certification mechanisms and existent financial programmes in order to encourage companies to invest in clean and low carbon technologies. Financial investment schemes can serve as an incentive for the private sector to implement a more sustainable and inclusive business model. The project will bridge the gap between financing institutions and private companies, since SMEs in particular lack access to available investment schemes for clean and low carbon technologies .

Potential for scaling up

Enabled by the dedicated regulatory framework, the proposed project will serve as a model for replication and scaling up of industrial-urban symbiosis in other provinces, supporting the Government of Thailand to achieve the goals of the Environmentally Friendly/Green Industry Promotion Plan. The development of a curriculum for universities and technical schools will also contribute to the sustainability and potential for scaling up. Lessons learned and experiences gained with the synergies among industries and selected urban areas will be shared on a national and international level. In addition, the environmental and socio-economic gains achieved in this project serve as a model for national and international companies, as well as manufacturing countries in Asia facing similar challenges and seeking to implement green growth strategies. The awareness of the financial sector on the potential economic gains that the proposed technologies can offer will also be raised, encouraging investments in companies and industrial parks that are willing to increase their resource efficiency, as well as to promote sustainable and inclusive industrial development. The pilot applications will also demonstrate the soundness of industry-urban symbiosis as a business model that should trigger further replication.

Furthermore, the new POPs inventory will be the basis for priority setting for further implementation of the Stockholm Convention in Thailand.

2. Stakeholders. Will project design include the participation of relevant stakeholders from civil society and indigenous people? (yes ☒ /no☐) If yes, identify key stakeholders and briefly describe how they will be engaged in project design/preparation.

NO	STAKEHOLDER	ENVISAGED ROLE IN THE PROJECT
1	Department of Industrial Works under the Ministry of Industry	DIW will chair the project steering committee and provide strategic guidance and direction to the project team to contribute to the national Eco-industrial town and hazardous chemical policy development.
2	Pollution Control Department, under the Ministry of Natural Resources and Environment	PCD will be the project steering committee co-chair and provide strategic guidance and direction to the project team on POPs related issues.

3	Department of Chemical Engineering, under the Faculty of Engineering of the Kasetsart University	Kasetsart University academic team will provide technical expertize on green chemistry, cleaner production, eco-factory and industrial-urban symbiosis for stakeholders in the country, including government agencies, the private sector, communities, students and other organizations. Kasetsart will develop technology and knowledge transfer capacities in green chemistry, GHGs mitigation technologies, industrial symbiosis from international experts through the development of an Excellence Center to be perpetuate after project completion.
4	Federation of Thai Industries and relevant industrial clubs under the FTI including Electrical, Electronics, Telecommunications and Allied Industry, and Textile Industry clubs	FTI will be the main executive agency with the important task of building collaboration with the private sector and reaching out to factories; thus facilitating data collection for industrial-urban symbiosis and cleaner production. FTI will collaborate with government agencies on policy and industrial-urban symbiosis development. Finally, FTI will support awareness raising activities and certificaiton processes in industry.
5	Electrical and Electronics Institute (under Ministry of Industry)	The Institute will act as subcontractor to execute some activities relating to the electronical and electrical sector. Activities will include training and capacity building and awareness raising in the industry, support to identify technologies and accompany change in the industry.
6	Thailand Textile Institute, THTI (under Ministry of Industry)	The institute will act as subcontractor to execute some activities relating to the textile sector. Activities will include training and capacity building and awareness raising in the industry, support to identify technologies and accompany change in the industry.
7	Participating industries	The private sector will be a direct beneficiary of the project as participating industries will provide input during the preparatory phase regarding their experiences, requirements and concerns to be addressed. The participating industries will invest and adopt low carbon/emission technologies, implement BAT/BEP, Green Chemistry and take part to urban/industrial symbiosis depending on their production process and technical and finanical feasibilities.
8	Governors office, officers and member of the provinicial committee of the Eco-indsutrial Town programme	Provincial governments will be direct beneficiaries of the project as the ones in charge of implementing the national Eco-industrial town programme from the Ministry of Industry. Local government counterparts will also act as project steering committee members to ensure

		that the project is in line with the provincial and municipality development plans. During preparation and project phase, Ayutthaya, Samut Sakorn and Samut Prakarn provincial offices will be the three beneficiary provinces. All provincial offices after project completion.
9	Industrial zone managers	Industrial zone managers, both public and private, will benefit directly the third beneficiaries of the project as in charge of the economic development and of equipement and infrastructure in industrial zones.
10	NGOs and non-profit organizations	Relevant Civil Society Organizations (CSOs) will be invited to participate during project implementation. Studies and assessments prepared throughout the project (e.g. review of policies) will be shared with interested organizations for feedback and comments. As the project aims to promote symbiosis, NGOs and non-profit organizations will represent local communities in the project steering committee and will connect the project with industries located in their municipalities/villages/towns. Also they will take part in Eco-industrial Town awareness rising activities.
11	Provincial Women Empowerment Funds under the Ministry of Social Development and Human Security	Representatives of the Provincial Women Empowerment Funds will be invited to participate to the National Steering Group. A gender-related group will ensure the mainstreaming of gender issues in the project. Additionally, it will provide inputs in the preparation of the gender assessment during the PPG phase.
12	Potential additional partners	Additional organizations, groups and partners implementing similar projects in the region will be engaged. In addition to the partners mention above, the project team is willing to add a representatives from the academic sector specialized in economy and finance to act as technical expert to support business and financial planning of measures as well as national financial institutions (green funds and SME banks) to ease access to funding to the private sector. During PPG phase, potential partners will be contacted. The collaboration potential with the Material Technology Center of the Ministry of Science and Technology and with the urban development departement under the Ministry of Interior will be investigated at PPG. Activities will be coordinated with these

		organizations to avoid overlaps and also to create synergies and increase impact.

3. Gender Considerations. Are gender considerations taken into account? (yes ☒ /no☐). If yes, briefly describe how gender considerations will be mainstreamed into project preparation, taken into account the differences, needs, roles and priorities of men and women.
UNIDO recognizes that gender equality and the empowerment of women have a significant positive impact on sustained economic growth and inclusive industrial development, key drivers of poverty alleviation and social progress. Gender mainstreaming will be based on GEF's Policy on Gender Mainstreaming and UNIDO's (i) Policy on Gender Equality and the Empowerment of Women (2009) as well as (ii) the Guide on Gender Mainstreaming Environmental Management Projects, an operational guide to support gender mainstreaming in environmental initiatives. Special attention will be paid to gender equality when evaluating and inviting members to participate at the National Steering Group or to attend trainings and awareness workshops. The time and location of these events will be adjusted according to the needs and cultural traditions of gender groups. The training materials will be adapted to the audience and gender sensitized, taking into account local specificities. As the project will deal with chemical products, and since different gender groups have distinctive sensibility or exposures to these substances, customized measures will be developed.

A gender assessment will be conducted during the PPG phase to further define the actions needed to mainstream gender issues into the project's execution. To encourage gender equality in the project, women in the local community, where the proposed pilot sites are located, will be highly encouraged to participate in the trainings, and awareness raising events.

At the current stage, it was noted that the high rate of teenage pregnancy remains a contributing factor behind youth unemployment and a challenging problem to be addressed in the country. In communities lacking social protection and economic opportunities, motherhood is mostly seen as the only prospect for many girls. As part of component 2 on capacity building, dedicated training could thus be provided for socially and economically-disadvantaged girls to facilitate their entry into the labor market.

Recommendations related to industrial regulations and legislation to support eco-industrial symbiosis will also be gender sensitized whenever appropriate.

Additionally, female candidates will be encouraged to apply during recruitment process and given preference when presenting technical qualifications similar to those of men. Furthermore, whenever possible staff will be trained and their awareness increased regarding gender issues.

4 Risks. Indicate risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and, if possible, propose measures that address these risks to be further developed during the project design (table format acceptable).

NO	**RISK**	**RATING**	**Mitigation**
1	Technical risk: Lack of awareness on technical opportunities for adopting environmentally sound technologies	Low-medium	Encourage a participatory approach and provide adequate information and training on planning and implementation of clean and low carbon technologies.
2	Socio-economic risk: Reluctance of industries to change towards climate resilient development, considering it as a burden instead of an opportunity. Besides cultural resistance, SMEs are often unable to undertake large investments, even though in the long run these generally pay off.	Low-medium	Awareness raising and capacity building initiatives will reinforce the environmental and socio-economic advantages of eco-industrial towns and the

			adoption of environmentally sound technologies. Examples of best practices and successful projects implemented by UNIDO will be presented to stakeholders based on results and indicators. Technical and financial feasibility studies will be offered by the project and investment plans developed for the companies. As awareness will be raised on national certification mechanisms and financial schemes available in the country. Facilitating access to these schemes will also serve as an incentive for companies to participate in the project.
3	Institutional risk: Developing industry-urban symbiosis is a complex undertaking and demands integration across many fields of planning and decision-making. Lack of collaboration and engagement among ministries, companies, local communities and other stakeholders may hinder the success of the project.	Medium	The Steering Committee will establish the institutional linkages among the stakeholders and the Project Management Unit will consult with executing partners and stakeholders to ensure their commitment to and ownership of the project. Meetings and workshops to strengthen the collaboration among main stakeholders will be organized on a regular basis to identify potential issues and develop adequate mitigation measures.
4	Regulatory risk: The proposed regulatory framework is not adopted and enforced.	Medium	Decision makers will be engaged early on in the project preparation and implementation to ensure their long-standing commitment.
5	Political risk: Political instability due to a military coup, violent protests and political division of society between	Medium-High	Members of the Steering Committee and UNIDO Regional Office in

	different factions may affect the project's development.		Thailand will monitor the political situation. Potential changes or adaptation of project activities will be discussed and endorsed by the Steering Committee.
6	Climate risk: Natural disasters in the form of prolonged droughts and severe floods may interrupt the project's progress.	Low-medium	Sensitivity to climate risks will be taken into account when selecting the industrial parks where the project will have demonstrations.

5. Coordination. Outline the coordination with other relevant GEF-financed and other initiatives.
The proposed project will closely liaise with other GEF initiated projects under GEF-TF and SCCF in the area of energy and water efficiency, as well as waste and chemicals management. These will be established during project preparation to ensure that there is no duplication, and that all related projects can benefit from the exchange of experience and best practices. Synergies and complementarities will be created with the following ongoing projects:

GEF funded:

- Industrial Energy Efficiency in Thailand, UNIDO. As this project will be completed by the time the proposed initiative starts, lessons learned in the country and knowledge gained in the energy sector will be used as a reference. The project intends to train a large number of national experts on energy efficiency and management. Consequently, the experts who participated in these trainings will be preferably recruited for energy related assignments under the industrial-urban symbiosis project;
- CleanTech in Thailand, UNIDO. The proposed project can also utilize the awareness that has been raised by the Cleantech Program on clean technology and climate change issues. Another key opporunity in terms of knowledge sharing on clean technology innovations and SME buisness models presents the National Cleantech Platform for SME associations and national agencies. Particularly valuable hereby are the identfication of effective business models and the connections with potential investors for the mobilizing of investments to implement the respective technologies;
- Greening Industry through Low Carbon Technology Application for Industries in Thailand, UNIDO;
- Reduction of GHG Emission in Thai Industries through Promoting Investments of the Production and Usage of Solid Bio-fuel, UNIDO; and,
- Eco-industrial park initiative in Vietnam, UNIDO.

If the three later projects listed above are still ongoing by the time the proposed project begins, meetings and workshops will be organized to coordinate activities among them in order to avoid overlap and also create synergies to strengthen the results of these projects. The meetings will also serve as a platform to share lessons learned and experience. In the case of the greening industry project focused on solid-bio fuel, the knowledge created will be used as a reference under the waste to energy activities.

Taking advantage of the similarities between the proposed project and the eco-industrial initiative in Vietnam, an international workshop will be organized to strengthen south-south cooperation and exchange lessons learned.

Other funding sources:

- South-East Asia Eco-city (Phase 2), UNIDO with funding from the Government of Japan.

The following two ongoing projects developed by UNIDO in the area of POPs will probably be completed before the start of this proposed initiative: (i) Regional Plan for Introduction of BAT/BEP Strategies to Industrial Source Categories of Stockholm Convention Annex C of Article 5 in ESEA Region, and (ii) Demonstration of BAT and

BEP in Fossil Fuel-fired Utility and Industrial Boilers in Response to the Stockholm Convention on POP. However, the project manager will consult with the implementation team of both projects to avoid duplication.

Thailand is also a member of the Strategic Approach to International Chemicals Management (SAICM), a policy framework to promote sound chemicals management, i.e. chemicals produced and used in order to minimize adverse impacts on the environment and human health. Among other chemicals, PFOS and its salts are also targeted by SAICM.

6. Consistency with National Priorities. Is the project consistent with the National strategies and plans or reports and assessements under relevant conventions? (yes ☒ /no☐). If yes, which ones and how: NAPAs, NAPs, ASGM NAPs, MIAs, NBSAPs, NCs, TNAs, NCSAs, NIPs, PRSPs, NPFE, BURs, etc.

This project is highly consistent with the commitments and strategies of Thailand to address climate change, GHG emission and chemicals management. The country is party to the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol (KP) and Stockholm Convention on POPs. Under the UNFCCC, Thailand submitted its Initial National Communication in November 2000 and the Second National Communication in March 2011. The GEF has endorsed a combined project, submitted by the UNDP in 2013, to develop the Third National Communication and a Biennial Update Report.

The country has also conducted the National Portfolio Formulation Exercise (NPFE) for the GEF-6 replenishment period. As indicated in the NPFE, the Thai Government has given high priority to this proposal, which is ranked in second place on the list of projects, after the Sixth Operational Phase of the GEF Small Grants Programme. Under the Stockholm Convention, Thailand has developed a National Implementation Plan (NIP) and also assessed the legal aspects related to the newly listed POPs under the Stockholm Convention with government funding. Despite the development of the NIP update and other projects to fulfil the treaty, the country has not yet conducted an inventory of the new POPs chemicals. By providing funds to prepare the new POPs and update the original POPs inventory, the GEF will complement the country's efforts to significantly reduce the exposure of harmful chemicals to humans and the environment.

At the national level, Thailand has developed two overarching national policies on climate change and GHG mitigation: the 11th National Economic and Social Development Plan (NESDP) 2012-2016, and the Draft National Climate Change Master Plan (NCCMP) 2012-2050. The key concept of the NESDP is to shift the development paradigm and redirect the country towards a low carbon and environmentally friendly economy. In order to set a long-term strategy and integrate policies related to climate change, Thailand developed the NCCMP, which includes a target of GHG emissions reduction in the range of 7% to 20% by 2020. The country has therefore set the following four sectoral policies on GHGs mitigation:

a) Alternative Energy Development Plan (2012-2021);

b) Energy Efficiency Development Plan (2011-2030);

c) Environmental Sustainable Transport and Climate Change Master Plan (2013-2030); and

d) Agricultural Strategy on Climate Change (2013-2016).

7. Knowledge Management. Outline the knowledge management approach for the project, including, if any, plans for the project to learn from other relevant projects and initiatives, to assess and document in a user-friendly form, and share these experiences and expertise with relevant stakeholders.

Knowledge management is inherent to UNIDO's operating modality by sharing experiences across its interventions worldwide. This has been demonstrated through many publications, events, webinars, and more. Moreover, a dedicated Knowledge Management Plan will be designed during the inception phase and implemented under the proposed project, which will function as the basis for gathering and distributing of information and lessons learned. The plan will also include the development of a knowledge management system; the final format shall be decided taking into consideration the nature of the information gathered, but could constitute a website and associated platform with information accessible by the public as well as targeted stakeholders. There will be a strong comittment towards transparency and communication to ensure the involvement of all project stakeholders.Once

the first outputs are achieved, factsheets and communication materials will be developed in English and Thai to dissiminate the results and successful approaches to other interested industries and regions to support the upscaling of the project.

Moreover, this project will benefit from the current expansion of the knowledge platform for the UNIDO/UNEP global resource efficient and cleaner production network (RECPnet). This knowledge exchange enables the dissemination of lessons learned and experiences particularly from other similar projects in the region and the world. The information available will also be used for this project.

PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

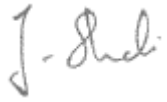
A. RECORD OF ENDORSEMENT[9] OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S):

(Please attach the Operational Focal Point endorsement letter(s) with this template. For SGP, use this SGP OFP endorsement letter).

NAME	POSITION	MINISTRY	DATE *(MM/dd/yyyy)*
Mr. Kasemsun CHINNAVASO	Permanent Secretary	**MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT**	**08-10-2015**

B. GEF AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF policies[10] and procedures and meets the GEF criteria for project identification and preparation under GEF-6.

Agency Coordinator, Agency name	Signature	Date *(MM/dd/yyyy)*	Project Contact Person	Telephone	Email
Mr. Philippe R. Scholtès, Managing Director, Programme Development and Technical Cooperation Division - PTC, UNIDO GEF Focal Point		09-30-2015	Jérôme Stucki 	+431 26026 3559	j.stucki@unido.org

C. ADDITIONAL GEF PROJECT AGENCY CERTIFICATION (APPLICABLE ONLY TO NEWLY ACCREDITED GEF PROJECT AGENCIES)

For newly accredited GEF Project Agencies, please download and fill up the required **GEF Project Agency Certification of Ceiling Information Template** to be attached as an annex to the PIF.

Annex 1: Selected provinces and Eco-industrial town program

PROVINCES FOR PILOT DEMONSTRATIONS

[9] For regional and/or global projects in which participating countries are identified, OFP endorsement letters from these countries are required even though there may not be a STAR allocation associated with the project.

[10] GEF policies encompass all managed trust funds, namely: GEFTF, LDCF, and SCCF

The following **three provinces** have confirmed their interest in the project:

Ayutthaya, north of Greater Bangkok had a Gross Provincial Product (GPP) at current market price of 367,571 million Thai Baht in 2013, of which the manufacturing sector accounted for 248,933 million Baht (67 %). At this stage, it is planned to work with the Rojana Industrial Park, 70 kilometers from Bangkok. The Rojana Industrial park has been in operation since 1997. It houses 188 factories among which electronic, electrical and auto-part industries account for more than 60%, which are potential users of PBDEs and/or HBCD. During 2010-2011, it worked with DIW to develop and implement industrial-urban symbiosis, thus there is already some level of awareness among the industries and urban fabric around the park. Two eco-forums involving all provincial stakeholders have been organized recently to raise awareness about environmental management and define what would an eco-industrial town be for Ayutthaya. The preliminary eco-industrial town master plan identified air, water pollution and solid waste as main issues for the environmental dimension.

Samut Prakarn, east of Greater Bangkok had a Gross Provincial Product (GPP) of 683,921 million Thai Baht in 2013, of which the manufacturing sector accounted for 312,403 million Baht (45 %). Samut Prakan Province is considered a high density industrial area with long established large-scale industries. 557 textile factories employing over 24,000 workers are active in the province, as well as 804 plastic manufacturers, employing over 20,000. Rapid expansion of Bangkok directly affects the public utilities and town structure of Samut Prakan. According to the first eco-industrial town master plan, land planning, water management and waste management are key issues to be addressed in the action plan as illegal dump site contaminated with carcinogenic chemicals and high level of zinc in waste water has been identify in 2014 in the Bangpoo industrial estate. Also, three eco-forums have been organized to develop the province eco-industrial town master plan. Main issues identified by stakeholders included inappropriate zoning including infrastructure, water pollution and waste disposal.

Samut Sakorn west of Greater Bangkok has a Gross Provincial Product (GPP) of 317,810 million Baht in 2013, of which the manufacturing sector accounts for 217,377 million Baht (68 %). Water quality in Samut Sakorn Province is rated as significantly degraded, especially along Thajin river. Approximately 83,027 m3/day of industrial wastewater is discharged from 467 factories, with around 42 % is from industries in the Kratumban industrial cluster. The Kratumban Industrial Cluster is located in Kratumban district, 14 kilometers from Samut Sakorn and adjacent to Greater Bangkok. The Kratumban Industrial cluster lies on both sides of Thajin River. The cluster houses more than 2,000 factories scattered around the district. Because of its location, the district has long been a “spill-over” industrial area from Greater Bangkok. Major industries include polymer (plastic), textile and ceramic handicrafts. The Kratumban industrial cluster was one of the first industrial clusters in the country. The first eco-industrial town master plan identified air and water pollution as well as solid waste as main environmental issues with houses, factories and vehicles as the main sources of pollution. Due to the environmental impacts of this cluster, Samut Sakorn Province has been included in DIW’s Eco-industrial town development plan.

ECO-INDUSTRIAL TOWN PROGRAM

In relation to its eco-industrial town program, the Thai government has been trying for 15 years to protect the environment at the country level by reducing the pressure generated by industries through the establishment of industrial-urban symbiosis. The concept of industrial ecology was introduced in Thailand in 2000 through the four-year Eco-Industrial Estate Development (EIED) project lasting from 2001-2004. The project had limited success due to several reasons including the lack of knowledge and experience of participating companies; lack of awareness among project staff and the public in general; and the taxation system of the export zones, which created high barriers to waste exchange among members. Experts highlighted poor and ineffective stakeholder collaborations as the main cause that obstructed the replication or up scaling of the project.

Between 2011 and 2012, the 11th National Economic and Social Development Plan (for the years 2012–2016) applied Eco Industry Town Development concepts for the rehabilitation of the environment in the country’s main industrial zone. The Ministry of Industry developed indicators of Eco Industry Development covering five dimensions: Physical, Economic, Social, Environment and Management.

Starting in 2009, the Department of Industrial Works (DIW) has implemented a concept on eco-industrial towns by adopting the following approaches:

- Promoting Zero Emission zones by using Cleaner Technology and 3R concepts (Reduce, Reuse and

Recycle);

- Building partnerships among industrial clusters sharing resources, energy efficiency and waste exchange by developing the concept of industrial-urban symbiosis;
- Establishing so-called Recycling Societies and Low-carbon Societies; and,
- Inclusive participation, especially with local communities within the industrial-urban symbiosis development plan.

During 2009-2015, DIW spent over 1 million USD on the well-received initiative. Some key success factors include (i) strong participation of local communities; (ii) solid participatory and extensive networks; and lastly (iii) Corporate Social Responsibility (CSR) by industries.

The eco-industrial towns master plan from DIW currently involve five pilot provinces, namly Samut Prakan, Samut Sakhon, Rayong, Chachoengsao, and Prachin Buri and nine industrial zones, namely the IRPC's production complex in Rayong; Bangkadi Industrial Park in Pathum Thani, 304 Industrial Park in Prachin Buri; Sahapat Industrial Park, Si Racha in Chon Buri; Sahapat Industrial Park, Kabin Buri, in Prachin Buri; Rojana Industrial Park in Ayutthaya; IPP Industrial Community in Rayong; Hemaraj Rayong Industrial Land in Rayong; and Hemaraj Saraburi Industrial Land in Saraburi. DIW has already set up provincial committees in some of the five provinces in charge of developing an action plan.

The master plan for the eco-industrial towns has been mapped out and will be used as a guideline for industrial zoning nationwide. It will be sent to relevant agencies and governors of the provinces where the eco-industrial towns are located. The master plan defines the following five key performance indicators (KPIs) to classify the level of development and maturity of an eco-industrial town:

Level 1: Law enforcement
- 80% of the factories comply with the town planning and environment
- Management, permission and inspection are revealed to the community

Level 2: Environmental and Safety Standard Compilation
- 80% of the samples meet the standard of Factory Act and the National Environmental Quality Promotion law for waste water quality, air quality as well as noise and vibration levels
- 80% of the factories conduct a risk assessment and comply with the measures efficiently.

Level 3: Resource and Energy Efficiency
- Reuse 80% of industrial waste
- Reduce electric use per industrial GDP
- Municipal waste not exceeding 0.9 kg/person/day
- Water use not exceeding 150 l/person/day

Level 4: Economic and Social Enhancement
- Industrial GDP accounts more than 50% of the GDP value in the entire province.
- 90% of the household access to basic facilities
- Life expectancy of the population in the Eco-industrial Town is higher than the country’s rate

Level 5: Low Carbon society
- Carbon emission intensity from the eco-industrial town not exceeding 5 ton per 1 million THB GDP

Annex 2: Description of resource efficient and cleaner production, and industrial-urban symbiosis methodologies

RESOURCE EFFICIENT AND CLEANER PRODUCTION: IMPROVING FACTORIES AND PRODUCTS

The project will benefit from UNIDO's vast experience in resource efficient and cleaner production (RECP). This enterprise-level approach aims at improving resources, reducing environmental pollution and contributing to sustainable industrial development. It is based on the continued application of an integrated preventive environmental strategy to processes (change of input materials, technology improvement, and operational management), products (design of environmentally-friendly products, extension of product life, and reduction or replacement of hazardous chemicals used during processing, utilizing, and disposing) and services in order to increase overall efficiency and to reduce risks to human beings and the environment. Under the RECP integrated approach, the following tools will be introduced:

- Low carbon technologies including waste to energy fuel substitution and process integration;
- Green chemistry technology: an innovative approach to reduce generations of hazardous substances at the design or beginning of a production process, rather than end-of-pipe pollution control. Green chemistry applies a product life-cycle approach, trying to reduce the use of chemicals and replace it for less harmful substances at all stages of the production process. Best available techniques (BAT) and best environmental practices (BEP) guidelines will also be implemented for the use, recycling, and disposal of products containing POPs such as PFOS, PBDEs, and related chemicals listed under the Stockholm Convention. These guidelines contain alternatives for these processes, general principles and cross-cutting considerations for recycling and disposal of articles containing such chemicals, and best environmental practices for their management. Feasibility studies will identify the most appropriate BAT, considering practical suitability, sustainability and economic viability of available techniques. A similar approach will be followed for BEP.
- Chemical leasing (ChL): This new business model shifts the focus from increasing sales volumes of chemicals towards a value-added approach. A chemical company supplies chemicals and services to a factory but retains ownership of the chemicals including responsibility for their disposal or recycling, as well as the management of the entire life cycle of those chemicals. The chemicals are effectively leased, and the customer pays for a service of chemical substance per unit function. This incentivizes both parties to reduce the consumption of chemicals.

The governing axiom is to increase the resource efficiency of industries. By applying clean and low-carbon principles, including Best Available Technologies and Best Environmental Practices (BAT/BEP), GHG emissions will be reduced. Green Chemistry (including substitution of POPs by less harmful substances), and Chemical Leasing will (i) lower the consumption of chemicals and (ii) reduce the toxicity and harmfulness of substances used. Other resources such as water and other raw materials will also benefit from these activities. In line with UNIDO's mandate and comparative advantage, the project will focus on industrial new POPs (mainly HBCD, PBDE and PFOS). At the end of this initial stage, industries will be more resource efficient, having reduced their environmental footprint while increasing their competitiveness. However, they will still require raw materials to operate and generate gaseous, liquid, and solid waste.

In the textile sector, POPs users have been identified and a significant need for awareness raising, green chemistry and cleaner production has been confirmed. Energy efficiency and process integration, as well as wastewater treatment improvement potential have been observed. There is a need to address the informal sector situation from a company perspective to identify how to avoid POPs emission.

INDUSTRIAL-URBAN SYMBIOSIS AS APPLICATION OF ECO-INDUSTRIAL TOWN PROGRAM: INCREASING COLLABORATION BETWEEN FACTORIES AND BETWEEN INDUSTRY AND URBAN CENTERS

Following the initial work done on individual enterprises, assessments on the resource needs and wastes generated by the various industries within the selected pilot zones and provinces will be carried out. Material, waste, water and energy consumption and pathways in the industry will be first assessed by performing material flow analysis (MFA) or Substance Flow analysis (SFA). MFA/SFA is an analytical method of quantifying flows and stocks of materials or substances in a well-defined system. One of its main purposes is to obtain a complete picture of the metabolism of certain elements or substances within the scope of the system. It is considered an important tool to assess the physical consequences of human activities and needs, where it is used on different spatial and temporal scales. The methodology is particularly adapted to the assessment of material flows within certain industries and connected

ecosystems, determination of indicators of material use by different societies, and development of strategies for improving the material flow systems in form of material flow management. Based on MFA results, potential symbioses will be identified and implemented in line with the principles of industrial ecology. Industrial symbiosis includes, firstly, closed materials loops, i.e. balancing input and output in order to reduce the total amount of industrial material that is landfilled or lost in intermediate processes. The development of waste-reusing/recycling networks is in line with the 3R principles and waste products from one entity may transform into raw materials for another entity or may be recycled to an acceptable quality. Secondly it seeks sharing of equipment, infrastructure, utility and services, i.e. grouping steam production to improve performance and reduce costs. Above all, industrial symbiosis turns industrial zones into an interacting system where industries collaborate for their mutual benefit.

Simultaneously, synergies between industries, industrial zones and the neighboring communities will be developed based on their specificities. An industrial-urban symbiosis is an area or town that is being sustainably developed by improving the economy of both industry and local community as well as improving the environment and social well-being. Material paths are known and value chain is reinforced with economic activities contributing to creating value by closing loops. It requires the involvement of all stakeholders including government actors, entrepreneurs, local administration, third-sector organizations and citizens in the target area. When successfully implemented, the coexistence of industries and the local community can result in a symbiosis, delivering benefits to each entity in a symbiotic manner.

At the provincial scale, potential waste-to-energy interactions between industries and urban centers will be assessed and, where relevant, demonstrated. To achieve this, the development of viable recycling and/or reuse networks is necessary. Such networks must contain waste recycling/exchange centers that are responsible for collecting, transforming and providing materials at a standard level to guarantee their quality. The project will support the establishment of such centers to facilitate exchanges between industries and communities, which will be operated by locals. Such approaches need to address the informal, yet highly developed existing waste recycling sector to identify how waste products can be derived to more efficient infrastructure but also how to improve their efficiency and working condition. In particular, working with the informal sector is required to address POPs emission problems typically associated during end of life treatment and disposal of products such as electronics.

During the PIF formulation, the following opportunities for industrial-urban symbiosis have been highlighted in partner provinces:

- Industrial and hazardous waste management: all 3 provinces need waste management centers for storage and segregation of waste prior to pick up by licensed recyclers or to be exchanges among factories. The platform business model should be adapted to SMEs to increase the percentage of waste entering the formal recycling sector. Each of the three provinces has shown interest in waste to energy during the PIF development;
- Equipment sharing for wastewater management as well as potentially for energy production and transformation;
- Creating a close loop system for WEEE management; and,
- Household waste to energy infrastructures have raised attention, as well as the development of recycling activities for urban waste such as PET, plastics or textiles.

Annex 3: Stakeholder's current capacities to contribute to the project targets, and capacities to be built during the project

	Stakeholder	Current capacity and capacity to be built
	nent of Industrial Works under istry of Industry	existing capacity: industrial and regional development strategy; environmental n the industry sector. (ii) Capacities to be built: pollution abatment strategy, hemistry, resource efficiency and sustainable urban development.
	n Control Department, under istry of Natural Resources and ment;	existing capacity: environmental policy, pollution control and pollution t action plans. However, their capacity to act directly on field (inside factories) d. (ii) Capacities to be built: cleaner production and related audit methdologies, flow analysis, hazardous chemical policy.
	nent of Chemical Engineering, e Faculty of Engineering of etsart University	tsart University existing capacity: track record in the fields of cleaner ion, chemical management and life cycle analysis. Their experience is used for gn of field activities and preliminary assessment on POPs during project tion. (ii) Capacities to be built: Green chemistry for POPs, industrial symbiosis ent and application in industry and industrial zones. rt University will potentially act as a focal point of a broader academic network, g .National Metal and Materials Technology Center (MTEC), Department of al Engineering, Srinakharinwirot University, Department of Chemical ering, King Mongkut's Univesity of Technology North Bangkok.
	ion of Thai Industries	s existing capacity: FTI's knowledge on industrial sectors and company needs n used during project preparation to develop activities. (ii) Capacities to be een chemistry, industrial-urban symbiosis, cleaner production e necessary capacity, the Institute will implement and replicate the industry- ymbiosis to other industrial zones.
	nical and Electrical Institute MOI)	ing capacity: The institute has capacity as an operation and standardization t is active in product testing (to comply with international standards), factory on for energy efficiency, lighting, chemical use, safety, material and mental, business to business linkages to find subcontractors, partners and access s. It offers technical service such as machine calibration and R & D in product In the last decade, the Institute has trained companies on quality and ivity (NESDB project under the prime minister office), product design and eco- as well as life cycle assessment to comply with EU regulation. They also have a ry facility in Samut Prakarn province for chemical testing, with equipement for m, chromium 6 and PBDE. (ii) Capacities to be built: technical knowledge on sage in industries, green chemistry and e- waste management.
	d Textile Institute, THTI MOI)	I currently provide expertise to the private sector such as technology ent, products promotion, information, awareness raising and training on now to t to norms and client requirements. THTI also have a testing center for standard nce. They have been involved in national policy development as well as in production, carbon footprinting and life cycle activities in the past 10 years. (ii) ies to be built: As executing agency, they will be trained by international to perform assessment in factories (cleaner production), implement green ry and symbiosis pilots.
	ating industries	ticipating industries will invest and adopt low carbon/emission technologies, ent BAT/BEP, green chemistry and take part to industrial-urban symbiosis ng on their production process and technical and finanical feasibilities.