



## REQUEST FOR PROPOSAL (RFP) firms/institutes/organizations

Dear Sir / Madam:

We kindly request you to submit your Proposal for International Consultancy Firm to provide the technical assistance on the Assessment of industrial and production sectors that present opportunities for the introduction of Green Chemistry and energy saving measures in Vietnam (**Ref. B-181201**)

Please be guided by the form attached hereto as Annex 2 (a-b-c), in preparing your Proposal.

Proposals may be submitted on or before **5pm Wednesday, December 19, 2018** (Hanoi time) by the following methods:

|  |  |
|--|--|
| <p><b><u>By email: For green environment, this is preferred submission method</u></b></p> <p>E-mail address for proposal submission:<br/><a href="mailto:quach.thuy.ha@undp.org">quach.thuy.ha@undp.org</a></p> <p>Separate emails for technical and financial proposal.</p> <p><b><u>With subject line: (Ref. B-181201) RFP for Technical assistance for Green Chemistry</u></b></p> <p>Maximum size per email: <b>30 MB</b>. Bidders can split proposal into several emails if the file size is large)</p> | <p><b><u>By hard copy: (within working hours 8.00 am - 5.00 pm Monday - Friday only)</u></b></p> <p>Address for proposal submission:</p> <p>Procurement Unit<br/>UNDP Vietnam<br/>304 Kim Ma Street, Hanoi, Vietnam</p> <p><b><u>With envelop subject: (Ref. B-181201) RFP for Technical assistance for Green Chemistry</u></b></p> <p>When submitting hard copy proposals, please call one of the following staff to receive hard copy proposal:</p> <ol style="list-style-type: none"><li>1. Ms. Luu Ngoc Diep, Procurement Associate<br/>Tel: +84-24-38500200</li><li>2. Ms. Quach Thuy Ha, Procurement Assistant<br/>Tel: +84-24-38500143</li></ol> <p>The bidder is requested to sign a bid submission form when delivering proposal.</p> |
|--|--|

**Note:**

- For both submission methods, please send separate email (without attachment) to [procurement.vn@undp.org](mailto:procurement.vn@undp.org) notifying that you already submitted proposal and the number of email submitted (in case submitted by email). Notification emails should be sent to above address by submission deadline or right after you submit proposals).
- UNDP will acknowledge receipt of the proposals within 2 working days from the submission deadline. In case you do not receive acknowledgement, please contact us within 3 working days after submission deadline.

Your Proposal must be expressed in the English language, and valid for a minimum period of 120 days from the date of bid submission.

In the course of preparing your Proposal, it shall remain your responsibility to ensure that it reaches the address above on or before the deadline. Proposals that are received by UNDP after the deadline indicated above, for whatever reason, shall not be considered for evaluation. If you are submitting your Proposal by email, kindly ensure that they are signed and in the .pdf format, and free from any virus or corrupted files.

Services proposed shall be reviewed and evaluated based on completeness and compliance of the Proposal and responsiveness with the requirements of the RFP and all other annexes providing details of UNDP requirements.

The Proposal that complies with all of the requirements, meets all the evaluation criteria and offers the best value for money shall be selected and awarded the contract. Any offer that does not meet the requirements shall be rejected.

Any discrepancy between the unit price and the total price shall be re-computed by UNDP, and the unit price shall prevail and the total price shall be corrected. If the Service Provider does not accept the final price based on UNDP's re-computation and correction of errors, its Proposal will be rejected.

No price variation due to escalation, inflation, fluctuation in exchange rates, or any other market factors shall be accepted by UNDP after it has received the Proposal. At the time of Award of Contract or Purchase Order, UNDP reserves the right to vary (increase or decrease) the quantity of services and/or goods, by up to a maximum twenty-five per cent (25%) of the total offer, without any change in the unit price or other terms and conditions.

Any Contract or Purchase Order that will be issued as a result of this RFP shall be subject to the General Terms and Conditions attached hereto. The mere act of submission of a Proposal implies that the Service Provider accepts without question the General Terms and Conditions of UNDP, herein attached as Annex 3.

Please be advised that UNDP is not bound to accept any Proposal, nor award a contract or Purchase Order, nor be responsible for any costs associated with a Service Providers preparation and submission of a Proposal, regardless of the outcome or the manner of conducting the selection process.

UNDP's vendor protest procedure is intended to afford an opportunity to appeal for persons or firms not awarded a Purchase Order or Contract in a competitive procurement process. In the event that you believe you have not been fairly treated, you can find detailed information about vendor protest procedures in the following link: <http://www.undp.org/procurement/protest.shtml>.

UNDP encourages every prospective Service Provider to prevent and avoid conflicts of interest, by disclosing to UNDP if you, or any of your affiliates or personnel, were involved in the preparation of the requirements, design, cost estimates, and other information used in this RFP.

UNDP implements a zero tolerance on fraud and other proscribed practices, and is committed to preventing, identifying and addressing all such acts and practices against UNDP, as well as third parties

involved in UNDP activities. UNDP expects its Service Providers to adhere to the UN Supplier Code of Conduct found in this link : [http://www.un.org/depts/ptd/pdf/conduct\\_english.pdf](http://www.un.org/depts/ptd/pdf/conduct_english.pdf)

Thank you and we look forward to receiving your Proposal.

Sincerely yours,

***Tran Thi Hong***  
*Head, Procurement Unit*  
12/6/2018

## Description of Requirements

|   |   |
|---|---|
| Context of the Requirement  | Please see information in the TOR   |
| Implementing Partner of UNDP  | Please see information in the TOR   |
| Brief Description of the Required Services  | International Consultancy Firm to provide the technical assistance on the Assessment of industrial and production sectors that present opportunities for the introduction of Green Chemistry and energy saving measures in Vietnam  |
| List and Description of Expected Outputs to be Delivered                                  | Please see information in the TOR   |
| Person to Supervise the Work/Performance of the Service Provider                          | Project Management Unit/Ministry of Industry and Trade (MOIT) and UNDP  |
| Frequency of Reporting  | Please refer to the TOR   |
| Progress Reporting Requirements   | Please refer to the TOR   |
| Location of work  | <input type="checkbox"/> Exact Address:<br><input checked="" type="checkbox"/> At Contractor Location, PMU and travels to provinces   |
| Expected duration of work   | Dec 2018-July 2019  |
| Target start date   | Late Dec 2018   |
| Latest completion date  | July 2019   |
| Travels Expected  | Please refer to the TOR   |
| Special Security Requirements   | Not applicable  |
| Facilities to be Provided by UNDP (i.e., must be excluded from Price Proposal)            | <input type="checkbox"/> Office space and facilities<br><input type="checkbox"/> Land Transportation<br><input type="checkbox"/> Others <i>[pls. specify]</i>   |
| Implementation Schedule indicating breakdown and timing of activities/sub-activities      | <input checked="" type="checkbox"/> Required<br><input type="checkbox"/> Not Required   |
| Names and curriculum vitae of individuals who will be involved in completing the services | <input checked="" type="checkbox"/> Required<br><input type="checkbox"/> Not Required   |
| Currency of Proposal  | <input checked="" type="checkbox"/> United States Dollars<br><input type="checkbox"/> Euro<br><input type="checkbox"/> Local Currency (Vietnam Dong)<br><br>For the purposes of comparison of all Proposals: UNDP will convert the currency quoted in the Proposal into the UNDP preferred currency, in accordance with the prevailing UN operational rate of exchange on the proposal submission deadline. |
| Value Added Tax on Price Proposal   | <input checked="" type="checkbox"/> must be inclusive of VAT and other applicable indirect taxes<br><input type="checkbox"/> must be exclusive of VAT and other applicable indirect taxes   |
| Validity Period of Proposals ( <i>Counting for the</i>                                    | <input checked="" type="checkbox"/> 120 days  |

|   |  |
|---|--|
| <i>last day of submission of quotes)</i>  | In exceptional circumstances, UNDP may request the Proposer to extend the validity of the Proposal beyond what has been initially indicated in this RFP. The Proposal shall then confirm the extension in writing, without any modification whatsoever on the Proposal.  |
| Partial Quotes  | <input checked="" type="checkbox"/> Not permitted<br><input type="checkbox"/> Permitted  |
| Payment Terms   | As indicated in the TOR.<br><br>Condition for Payment Release:<br><br>Within thirty (30) days from the date of meeting the following conditions:<br>a) UNDP's written acceptance (i.e., not mere receipt) of the quality of the outputs; and<br>b) Receipt of invoice from the Service Provider.   |
| Person(s) to review/inspect/ approve outputs/completed services and authorize the disbursement of payment | UNDP   |
| Type of Contract to be Signed   | <input checked="" type="checkbox"/> Contract for Professional Services   |
| Criteria for Contract Award   | <input checked="" type="checkbox"/> Highest Combined Score (based on the 70% technical offer and 30% price weight distribution)<br><input checked="" type="checkbox"/> Full acceptance of the UNDP Contract General Terms and Conditions (GTC). This is mandatory criteria and cannot be deleted regardless of the nature of services required. Non-acceptance of the GTC may be grounds for the rejection of the Proposal.  |
| Criteria for the Assessment of Proposal   | Proposal shall be considered technically qualified if it achieves minimum 70% of total obtainable technical points.<br><br><b>Weight of technical and financial point:</b><br><br><b><u>Technical Proposal (70%)</u></b><br><br><b><u>Financial Proposal (30%)</u></b><br>Financial score will be computed as a ratio of the Proposal's offer to the lowest price among the proposals received by UNDP.<br><br>See detailed evaluation criteria in the below table.                                  |
| UNDP will award the contract to:  | <input checked="" type="checkbox"/> One bidder   |
| Annexes to this RFP   | <input checked="" type="checkbox"/> Form for Submission of Proposal (Annex 2a: Technical proposal; Annex 2b: Financial proposal; Annex 2-c: Submission check-list)<br><input checked="" type="checkbox"/> Detailed TOR (Annex 3)<br><input checked="" type="checkbox"/> <a href="#">General Terms and Conditions</a> (Annex 4) <sup>1</sup><br><input checked="" type="checkbox"/> <a href="#">Institutional contract for service</a> & <a href="#">Contract for Professional services</a> (Annex 4) |
| Contact Person for Inquiries  | Ms Quach Thuy Ha - Procurement Assistant, UNDP Vietnam   |

<sup>1</sup> Service Providers are alerted that non-acceptance of the terms of the General Terms and Conditions (GTC) may be grounds for disqualification from this procurement process.

|                                       |   |
|---------------------------------------|---|
| (Written inquiries only) <sup>2</sup> | Email: quach.thuy.ha@undp.org<br><br>Any delay in UNDP's response shall be not used as a reason for extending the deadline for submission, unless UNDP determines that such an extension is necessary and communicates a new deadline to the Proposers. |
| Other information                     |   |

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<sup>2</sup> This contact person and address is officially designated by UNDP. If inquiries are sent to other person/s or address/es, even if they are UNDP staff, UNDP shall have no obligation to respond nor can UNDP confirm that the query was received.

## EVALUATION CRITERIA:

Evaluation forms for technical proposals are in the below table. The obtainable number of points specified for each evaluation criterion indicates the relative significance or weight of the item in the overall evaluation process. The Technical Proposal Evaluation Forms are:

Form 1: Expertise of Firm / Organisation Submitting Proposal

Form 2: Proposed Work Plan and Approach

Form 3: Personnel

*Note: The score weights and points obtainable in the evaluation sheet are tentative and should be changed depending on the need or major attributes of technical proposal*

| Summary of Technical Proposal Evaluation Forms |  | Score Weight | Points Obtainable | Company / Other Entity |   |   |   |   |
|--|--|--------------|-------------------|------------------------|---|---|---|---|
|  |  |              |                   | A                      | B | C | D | E |
| Form 1.  | Expertise of Firm / Organisation submitting Proposal | 20%          | 200               |                        |   |   |   |   |
| Form 2.  | Proposed Work Plan and Approach                      | 20%          | 200               |                        |   |   |   |   |
| Form 3.  | Personnel  | 60%          | 600               |                        |   |   |   |   |
| <b>Total</b>                                   |  |              | <b>1000</b>       |                        |   |   |   |   |

| <b>Form 1: Expertise and Capacity of Firm / Organization submitting proposal</b> |   | <b>Max Point</b>     |            |
|--|---|----------------------|------------|
|  |   | Sub core             |            |
| 1.1  | Experience in the field of chemistry and environment and more specially, in the management of POPs, hazardous chemicals and hazardous waste, green chemistry, cleaner production, environmental audits<br><ul style="list-style-type: none"> <li>- More than 5 years</li> <li>- 3-5 years</li> <li>- Less than 3 years</li> </ul> No working experience | 100<br>70<br>40<br>0 | 100        |
| 1.2  | Working experience in calculating POP and UPOP release and mercury<br><ul style="list-style-type: none"> <li>- More than 5 years</li> <li>- 3-5 years</li> <li>- Less than 3 years</li> </ul> No working experience   | 50<br>30<br>10<br>0  | 50         |
| 1.3  | Working experience with enterprises, industrial facilities/areas  |                      | 50         |
| 1.4  | Working experience with Viet Nam  |                      | 50         |
| <b>Total (Form 1)</b>  |   |                      | <b>200</b> |
| <b>Form 2: Solutions and Methodologies</b>                                       |   |                      |            |
| 2.1  | Clearly understanding the purpose of the package  |                      | 50         |
| 2.2  | Approach and methodology to be appropriate to the task  |                      | 100        |
| 2.3  | Implementation plan   |                      | 500        |
| <b>Total (Form 2)</b>  |   |                      | <b>200</b> |

| <b>Form 3: Personnel</b> |  | <b>Max Point</b> |             |
|--------------------------|--|------------------|-------------|
| <b>3.1</b>               | <b>Team Leader</b>   | Sub score        | <b>400</b>  |
| 3.1.1                    | Postgraduate or higher education degree in chemistry, , environment, engineering, or related fields;   |                  | 50          |
| 3.1.2                    | Practical working experience in environmental management, chemical and waste management in industrial processes, management of hazardous and toxic chemical including POPs/PTSs and Mercury; <ul style="list-style-type: none"> <li>- ≥ 10 years</li> <li>- More than 5 years</li> <li>- Less than 5 years</li> </ul>  | 120<br>70<br>10  | 120         |
| 3.1.3                    | Experience in in environmental audits, such as: energy saving in industrial processes, management of POPs, management of hazardous chemicals and hazardous waste, environmental monitoring of industrial processes (including the development of monitoring plans), sampling of waste and environmental indicators, handling of waste and hazardous substances; <ul style="list-style-type: none"> <li>- ≥ 10 years</li> <li>- More than 5 years</li> <li>- Less than 5 years</li> </ul> | 120<br>70<br>10  | 120         |
| 3.1.4                    | Knowledge of the use of chemicals in industrial processes with specific reference to two or more sectors among the six targeted industrial sectors;  |                  | 60          |
| 3.1.5                    | Good understanding and knowledge of MEAs (especially Stockholm Convention on POPs, Minamata Convention on Mercury, Basel Convention)   |                  | 30          |
| 3.1.6                    | Fluent in written and spoken English (with submission of at least two sample reports)  |                  | 20          |
| <b>3.2</b>               | <b>Team Member</b>   |                  | <b>200</b>  |
| 3.2.1                    | Postgraduate or higher education degree in chemistry, environment, engineering, or related fields;   |                  | 30          |
| 3.2.2                    | Practical working experience in environmental management, chemical and waste management in industrial processes, management of hazardous and toxic chemical including POPs/PTSs and Mercury; <ul style="list-style-type: none"> <li>- ≥ 10 years</li> <li>- More than 5 years</li> <li>- Less than 5 years</li> </ul>  | 50<br>30<br>05   | 50          |
| 3.2.3                    | Good understanding and knowledge of MEAs (especially Stockholm Convention on POPs, Minamata Convention on Mercury, Basel Convention)   |                  | 30          |
| 3.2.4                    | Good understanding and experience in POPs/mercury baseline assessment and calculation <ul style="list-style-type: none"> <li>- ≥ 10 years</li> <li>- More than 5 years</li> <li>- Less than 5 years</li> </ul>   | 70<br>50<br>10   | 70          |
| 3.2.5                    | Have working experience in developing countries, experience of Viet Nam is an advantage.   |                  | 10          |
| 3.2.6                    | Fluent in written and spoken English (with submission of at least two sample reports)  |                  | 10          |
| <b>Total (form 3)</b>    |  |                  | <b>600</b>  |
| <b>TOTAL POINTS</b>      |  |                  | <b>1000</b> |



## FORM FOR SUBMITTING SERVICE PROVIDER'S TECHNICAL PROPOSAL<sup>3</sup>

*(This Form must be submitted only using the Service Provider's Official Letterhead/Stationery<sup>4</sup>)*

[insert: Location].

[insert: Date]

To: Procurement Unit - UNDP Vietnam

Dear Sir/Madam:

We, the undersigned, hereby offer to render the following services to UNDP in conformity with the requirements defined in the RFP dated *[specify date]*, and all of its attachments, as well as the provisions of the UNDP General Contract Terms and Conditions:

### A. Qualifications of the Service Provider

The Service Provider must describe and explain how and why they are the best entity that can deliver the requirements of UNDP by indicating among others the following with appropriate supporting documents:

- a) Profile – describing the nature of business, field of expertise, licenses, certifications, accreditations;
- b) Business Licenses – Registration Papers, Tax Payment Certification, etc.
- c) Track Record – list of clients for similar services as those required by UNDP, indicating description of contract scope, contract duration, contract value, contact references

| Client | Contract value | Duration of activity | Services/goods provided | References contact (name, phone, email) |
|--------|----------------|----------------------|-------------------------|---|
|        |                |                      |                         |   |
|        |                |                      |                         |   |

- d) Certificates and Accreditation – including Quality Certificates, Patent Registrations, Environmental Sustainability Certificates, etc. (if any)
- e) Written Self-Declaration that the company is not in the UN Security Council 1267/1989 List, UN Procurement Division List or Other UN Ineligibility List.

**(Note:** Please refer to Form 1 – Evaluation criteria for providing appropriate information and supporting documents to demonstrate the bidders' capacity)

### B. Proposed Methodology for the Completion of Services

The Service Provider must describe how it will address/deliver the demands of the RFP; providing a detailed description of the essential performance characteristics, reporting conditions and quality assurance mechanisms that will be put in place, while demonstrating that the proposed methodology will be appropriate to the local conditions and context of the work.

<sup>3</sup> This serves as a guide to the Service Provider in preparing the Proposal.

<sup>4</sup> Official Letterhead/Stationery must indicate contact details – addresses, email, phone and fax numbers – for verification purposes

(**Note:** Please refer to Form 2 – Evaluation criteria for UNDP requirements when preparing this section)

**C. Qualifications of Key Personnel**

The Service Provider must provide:

- a) Names and qualifications of the key personnel that will perform the services indicating who is Team Leader, who are supporting, etc.;
- b) CVs demonstrating qualifications must be submitted if required by the RFP

(**Note:** Please refer to Form 3 – Evaluation criteria for UNDP requirements when preparing this section)

We agree to abide by this Proposal for 120 days from the date of proposal submission deadline.

*[Name and Signature of the Service Provider's Authorized Person]*  
*[Designation]*  
*[Date]*

## FORM FOR SUBMITTING SERVICE PROVIDER'S FINANCIAL PROPOSAL<sup>5</sup>

*(This Form must be submitted only using the Service Provider's Official Letterhead/Stationery<sup>6</sup>)*

The Proposer is required to prepare the Financial Proposal in an envelope separate from the rest of the RFP as indicated in the Instruction to Proposers.

The Financial Proposal must provide a detailed cost breakdown. Provide separate figures for each functional grouping or category.

Any estimates for cost-reimbursable items should be listed separately.

In case of an equipment component to the service provider, the Price Schedule should include figures for both purchase and lease/rent options. UNDP reserves the option to either lease/rent or purchase outright the equipment through the Contractor.

The format shown on the following pages is suggested for use as a guide in preparing the Financial Proposal. The format includes specific expenditures, which may or may not be required or applicable but are indicated to serve as examples.

### A. Cost Breakdown per Deliverable\*

|   | <b>Deliverables</b><br><i>[list them as referred to in the RFP]</i> | <b>Percentage of Total Price</b><br><i>(Weight for payment)</i> | <b>Price</b><br><i>(Lump Sum, All Inclusive)</i> |
|---|---|---|--|
| 1 | Deliverable 1   |   |  |
| 2 | Deliverable 2   |   |  |
| 3 | ....  |   |  |
|   | Applicable taxes  |   |  |
|   | <b>Total</b>  | <b>100%</b>   |  |

### B. Cost Breakdown by Cost Component *[This is only an Example]:*

| Description of Activity           | Remuneration<br>per Unit of Time | Total Period of<br>Engagement | No. of<br>Personnel | Total Rate |
|-----------------------------------|----------------------------------|-------------------------------|---------------------|------------|
| <b>I. Personnel Services</b>      |                                  |                               |                     |            |
| 1. Services from Home Office      |                                  |                               |                     |            |
| a. Expertise 1                    |                                  |                               |                     |            |
| b. Expertise 2                    |                                  |                               |                     |            |
| 2. Services from Field Offices    |                                  |                               |                     |            |
| a. Expertise 1                    |                                  |                               |                     |            |
| b. Expertise 2                    |                                  |                               |                     |            |
| <b>II. Out of Pocket Expenses</b> |                                  |                               |                     |            |
| 1. Travel Costs                   |                                  |                               |                     |            |
| 2. Daily Allowance                |                                  |                               |                     |            |
| 3. Communications                 |                                  |                               |                     |            |
| 4. Reproduction                   |                                  |                               |                     |            |
| 5. Equipment Lease                |                                  |                               |                     |            |
| 6. Others                         |                                  |                               |                     |            |

<sup>5</sup> This serves as a guide to the Service Provider in preparing the Proposal.

<sup>6</sup> Official Letterhead/Stationery must indicate contact details – addresses, email, phone and fax numbers – for verification purposes

|                                 |  |  |  |  |
|---------------------------------|--|--|--|--|
| <b>III. Other Related Costs</b> |  |  |  |  |
| <b>Applicable taxes</b>         |  |  |  |  |

We agree to abide by this Proposal for 120 days from the date of proposal submission deadline.

[Name and Signature of the Service Provider's Authorized Person]  
 [Designation]  
 [Date]

## CHECK LIST OF DOCUMENTS SUBMITTED BY BIDDERS

**Note:**

- Bidders are required to review carefully this checklist before submitting proposal to ensure complete submission.
- Maximum email size: 07 MB/email. Bidders can split proposal into several emails if the file size is large
- Technical and Financial Proposals are to be submitted in separate envelop/email by 29 November 2017 (Hanoi time).
- Email and proposal should indicate clearly the name of tender.

| Item | Documents   | To be completed by bidders |                    |         |
|------|---|----------------------------|--------------------|---------|
|      |   | Doc submitted<br>Y/N       | Number of<br>pages | Remarks |
| 1    | Fully filled Technical proposal (pls. refer to template in Annex 2-a) with copies/scan of supporting documents i.e. company profile, company registration certificate, CVs of experts...  |                            |                    |         |
| 2    | Dully signed Price Schedule (pls. Refer to template in Annex 2-b)   |                            |                    |         |
| 3    | This duly filled, checked, certified submission checklist to be attached to the submission  |                            |                    |         |
| 4    | Send email (without attachment) to <a href="mailto:procurement.vn@undp.org">procurement.vn@undp.org</a> notifying that you already submitted proposal and the number of email/envelop submitted. Notification emails should be sent to above email address by submission deadline or right after you submit proposals (either by email or hard copy). |                            |                    |         |

*[Name and Signature of the Service Provider's Authorized Person]*

*[Designation]*

*[Date]*

## TERMS OF REFERENCE

### INTERNATIONAL CONSULTANCY FIRM TO PROVIDE TECHNICAL ASSISTANCE ON THE ASSESSMENT OF INDUSTRIAL AND PRODUCTION SECTORS THAT PRESENT OPPORTUNITIES FOR THE INTRODUCTION OF GREEN CHEMISTRY AND ENERGY SAVING MEASURES IN VIETNAM

#### 1) GENERAL BACKGROUND

The Viet Nam Chemical Agency (Vinachemia) under Ministry of Industry and Trade (MOIT) is implementing the Project “Application of Green Chemistry in Viet Nam to support green growth and reduction in the use and release of POPs/harmful chemicals (Green Chemistry)” funded by GEF/UNDP and with co-financing by Viet Nam agencies/institutions and companies. The project is currently in its first year of implementation.

The project aims to create the enabling environment for the introduction of Green Chemistry in Viet Nam and introduce Green Chemistry applications in productive sectors with the purpose of reducing the use and release of chemicals controlled under Stockholm and Minamata Conventions. The project also expects to result in a reduction in the use and release of chemicals of concern not covered under the MEAs, as well as improve energy and natural resource efficiency and generate Green House Gas (GHG) release reduction co-benefits in the sectors and industries supported by the project.

The project will reduce the use of Persistent Organic Pollutants (POPs) and release of Unintentional Persistent Organic Pollutants (U-POPs) through the introduction of green chemistry approach in six industrial sectors in Viet Nam: chrome plating, pulp and paper manufacturing, plastic manufacturing, textile, pesticides and solvents. Specific guidance for each sector will be developed, and the green chemistry approach will be streamlined into the relevant legislation. Two industrial facilities from 2 different sectors (out of the above six sectors) will be selected for the practical demonstration of the green chemistry approach. The project is structured in 3 components:

1. Developing the enabling environment for Green Chemistry in Viet Nam;
2. Promote awareness on Green Chemistry and the benefits of the application of Green Chemistry and its guiding principles; and
3. Introduce Green Chemistry approaches into priority sectors and at least 2 entities.

The activities to be carried out under this contract are related to Output 3.1.1. (In-depth GC assessments concluded of priority production / manufacturing sectors.) of the project, which is one of the outputs under project Outcome 3.1 (15 g-TEQ/a of UPOPs releases, 1 tonne of POPs, 0.002 tonnes of mercury reduced and at least 65 tons of CO<sub>2</sub> through the introduction of GC in priority sectors),

Output 3.1.1 concerns the assessment of industrial and production sectors that present opportunities for the introduction of Green Chemistry. Based on the preliminary outcomes achieved during the project preparation phase, the following shortlist of priority sectors for the application of GC principles has been identified:

- 1) **Electro-plating industry**, due to its use of PFOS as etching agent and mist suppressant;
- 2) **Plastic manufacturing industry**, due to its use of deca-BDE (which has the potential to be degraded into POPs-PBDE) as well as PBBs (flame retardant) used in many plastic polymers and due to the use of short chain chlorinated paraffins;

- 3) **The textile industry**, due to the potential release U-POPs into products associated with contaminated raw materials (i.e. dyes), the potential use of PFOS and PFAS for water – repellency purposes, the potential use of deca-BDEs as flame retardant, and the use of chlorine as bleaching agent;
- 4) **The pulp and paper industry**, due to the use of chlorine-based bleaching agents that may result in the secondary formation of chlorinated compounds in the environment (including PCDD/F);
- 5) **The pesticide sector**, due to the continuation of the import and use of some restricted chemicals including POPs, and for the use of mercury in some pesticide or biocide formulations
- 6) **The solvent and paint sector**, due to the use of chlorinated solvents and short chain chlorinated paraffins in paints, as well as the use of mercury in some paint formulations.

For common understanding, green chemistry (GC) is defined as “the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances “. The green chemistry approach has been standardized in 12 general principles: 1. Prevent waste; 2. Maximize atom economy; 3. Design less hazardous chemical syntheses; 4. Design safer chemicals and products; 5. Use safer solvents and reaction conditions; 6. Increase energy efficiency; 7. Use renewable feedstocks; 8. Avoid chemical derivatives; 9. Use catalysts, not stoichiometric reagents; 10. Design chemicals and products to degrade after use; 11. Analyse in real time to prevent pollution; 12. Minimize the potential for accidents<sup>7</sup>.

Studies undertaken as part of this output will allow for the establishment of baselines and identify opportunities for green chemistry introduction on a sector-based approach. Assessment results will be presented in sector-specific reports.

The baseline situation and potential for implementation in the 6 industrial sectors which will be covered under the Green Chemistry project are reported in Annex I

UNDP, the GEF Implementation Agency for this project, is seeking an international consultancy firm to provide technical assistance, guidance, training and supervision to the Vietnamese national consultancy firm recruited with a separate TOR to undertake assessment the above mentioned six targeted industrial sectors.

## 2) OBJECTIVES OF THIS ASSIGNMENT

The objectives of the assignment are to provide technical support, guidance, training and supervision to a Vietnamese consultancy firm and national consultants.

The national consultancy firm to be supported has been recruited to undertake in-depth GC assessment of the six targeted industrial sectors in order to select two facilities (out of the six targeted industries) for demonstration of the green chemistry. The national consultants to be supported has been recruited to undertake to select two factories and to prepare demonstration plans for those two selected factories as well as develop criteria for POPs/mercury baseline assessment and calculations of POPs/mercury baseline and reduction.

## 3) SCOPE OF WORK

Under this assignment, the international consultants are expected to provide technical support, guidance, training and supervision to a Vietnamese consultancy firm and national consultants to facilitate the completion and ensuring the quality of the following tasks: 1) site visits in a relevant number of factories / plants for each of the six targeted industrial sectors (textile, plastic, pulp and paper, electro-plating, pesticide and solvent), 2) assessment of data gathered during site surveys, and drafting of survey and sector reports; 3) selection of 2 demonstration facilities and development of Green Chemistry demonstration plans for these facilities / factories; 4) criteria for POPs/mercury baseline assessment and calculation of POPs/mercury baseline and reduction of the above six sectors.

For this purpose, the international consultants will work in close coordination and cooperation with the national consultancy firm and national consultants.

<sup>7</sup> Anastas, P. T.; Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press: New York, 1998, p.30.

## 4) TASKS

The International consultancy firm will perform the following tasks:

### **Task 1: Support national consultancy firm to undertaking survey of the six industrial sectors**

- 1) Provide assistance to the consultancy firm in the drafting of the work-plan for the activity, including the plan for the 48 site visits in industrial sites;
- 2) Provide training to the Vietnamese consultancy team on the implementation of Green Chemistry in the 6 sectors of textile, plastic, electro-plating, pulp and paper, solvent and pesticides, before starting the site visits to the industrial sites. More specifically, the training should be addressed at.
  - a. Analysis of the production processes for the six sectors;
  - b. Criteria for the assessment of POPs use and release, and compliance with Green Chemistry principle at baseline.
  - c. Methodology for studying the Chemical profile of factories (simplified mass balances, type and amount of chemicals and raw material used in the production process, with CAS code) with specific reference to the use / release of POPs, mercury and other POPs/PTSs;
  - d. Methodologies for conducting waste inventory;
  - e. Methodologies for the assessment of energy profile of industrial plants;
  - f. Techniques and equipment for environmental monitoring in industrial sites (online monitoring of stack flue gas, periodical sampling of effluents, etc.);
  - g. Methodologies for the assessment and reduction of water consumption.
- 3) Introduce, as part of the training, a template report to be used for reporting the outcome of the site survey at the industries in a consistent and standardised manner;
- 4) Lead and conduct the site visit of at least 2 out of the 8 manufacturing plants to be visited by the Vietnamese consultancy from each sector (total of 12 site visits). The factories to be visited will cover both Small and Medium Enterprises (SMEs) and largescale plants. During each visit, the expert group (the team of the selected Vietnamese national consultancy plus the international consultant) will discuss with the plant managers the possible GC interventions for the sector in order to raise awareness and collect advice on the practical application of these interventions.
- 5) Provide assistance to the consultancy in the drafting of the site visit reports and revise the site visit reports;

### **Task 2: Provide assistance to the consultancy firm the preparation of sectoral assessment reports and in the selection of demonstration plants**

- 1) Guiding the national consultancy team to assess data collected during the field surveys of the targeted industrial sectors, identify gaps/shortcomings against GC principles and propose possible interventions for each sector to implement at least some of the Green Chemistry principles in its production process;
- 2) Review the sectorial report drafted by the Vietnamese consultancy for each of the 6 sectors examined, which will contain a proposal for a number of possible interventions for each sector to implement at least some of the Green Chemistry principle in the production process.

### **Task 3: Provide support to the national consultants to prepare a Green Chemistry demonstration plan for two selected plants**

- 1) Provide support and advice on the selection of two plants for the demonstration of Green Chemistry.
- 2) Provide assistance to the Vietnamese consultancy in drafting the implementation plan for the demonstration of Green Chemistry in two plants / factories. This support may include advice on required modification of the production process, substitution of hazardous (POPs, PTS, mercury) chemicals with safer ones, or both.
- 3) Provide guidance on the methods for monitoring of the demonstration process as well as methods for calculation of the chemicals/POPs/mercury used and released, GHGs emissions and energy savings, after the implementation of GC approaches in comparison with the baseline, should be also supported by the international consultant and included in the demonstration plan



#### Task 4: Criteria for POPs/mercury baseline assessment and calculation of POPs/mercury baseline and reduction of the above six sectors

- 1) Provide support and advice to national consultants on the development of criteria for POPs/mercury baseline assessment for each sector.
- 2) Provide support and advice to national consultants on the methodology to calculate POPs/mercury baseline and reduction

The international team will consist of at least two (02) international consultants – one team leader and one team member. The team leader is in charge of Task 1, 2 & 3. The team member is in charge of Task 4.

#### 5) METHODOLOGY:

The selected consultancy firm will propose and discuss with UNDP and MOIT the approach in undertaking the assignment. The detailed assignment plan will be submitted and approved by UNDP and the PMU before commencing the assignment.

#### 6) DURATION OF ASSIGNMENT, DUTY STATION AND EXPECTED PLACES OF TRAVEL

Duration and Timing: approximate 50 working man-day is expected during the period from December 2018– July 2019 including two missions to Hanoi and project provinces.

Duty station: Home based with travel to Hanoi, and other provinces in Vietnam.

The international consultants will have two missions, 10 days each mission to Viet Nam (at PMU office in Hanoi and project provinces). Travel cost to project provinces will be paid separately by PMU based on the UN-EU cost norms.

#### 7) FINAL PRODUCTS

The international consultants shall deliver the following:

| No. | Type of deliverables   | Deadline                                   |
|-----|--|--|
| 1   | Detailed workplan of the assignment  | Two weeks upon the signing of the contract |
| 2   | Training material and guidelines for the site visit (inspection) in 6 industrial sectors with the purpose to assess Green Chemistry implementability | 15 January 2019                            |
| 3   | Templates for the site visits (inspection) in 6 industrial sectors   | 15 January 2019                            |
| 4   | Revision of the sectorial reports developed by the consultancy with proposal for the implementation of Green Chemistry by sector                     | 30 March 2019                              |
| 5   | Criteria for POPs/mercury baseline assessment for each sector  | 30 January 2019                            |
| 6   | Calculations of POPs/mercury baseline and reduction  | 30 April 2019                              |
| 7   | Revision of the implementation plan for the demonstration of Green Chemistry in two industrial facilities  | 30 June 2019                               |

#### 8) PROVISION OF MONITORING AND PROGRESS CONTROLS

**Coordination and reporting.** The selected international consultancy firm will coordinate with PMU staff and the UNDP Programme Officer with regular consultation and guidance by the MOIT.

**Technical support and supervision.** The international consultants will support and supervise the activity of the Vietnamese consultancy, by specifically providing experience on POPs and green chemistry. Therefore, the international consultant shall coordinate all activities with the Vietnamese consultancy, and will also provide specific training for the execution of specific tasks to be carried by the Vietnamese consultancy out under their assignment.

**Administrative support will be provided by the PMU/MOIT and UNDP**

## 9) REQUIRED QUALIFICATIONS AND REQUIREMENTS

To be eligible, bidders should have minimum following qualifications:

- At least 5 years of experience in the field of chemistry and environment and more specially, in the management of POPs, hazardous chemicals and hazardous waste, green chemistry, cleaner production
- At least 5 years of experience in calculating POP and UPOP release and mercury
- Working experience with enterprises, industrial facilities/areas
- Working experience with Viet Nam

**The Team Leader should have knowledge, skills and experience as follows:**

- Postgraduate or higher education degree in chemistry, , environment, engineering, or related fields;
- At least 10 years of practical working experience in environmental management, chemical and waste management in industrial processes, management of hazardous and toxic chemical including POPs/PTSs and Mercury;
- At least 10 years of experience in environmental audits, such as: energy saving in industrial processes, management of POPs, management of hazardous chemicals and hazardous waste, environmental monitoring of industrial processes (including the development of monitoring plans), sampling of waste and environmental indicators, handling of waste and hazardous substances;
- Knowledge of the use of chemicals in industrial processes with specific reference to two or more sectors among the six targeted industrial sectors;
- Good understanding and knowledge of MEAs (especially Stockholm Convention on POPs, Minamata Convention on Mercury, Basel Convention)
- Fluent in written and spoken English (with submission of at least two sample reports)

**The Team Member should have knowledge, skills and experience as follows:**

- Postgraduate or higher education degree in chemistry, , environment, engineering, or related fields;
- At least 10 years of practical working experience in environmental management, chemical and waste management in industrial processes, management of hazardous and toxic chemical including POPs/PTSs and Mercury;
- Good understanding and experience in POPs/mercury baseline assessment and calculation;
- Good understanding and knowledge of MEAs (especially Stockholm Convention on POPs, Minamata Convention on Mercury, Basel Convention)
- Have working experience in developing countries, experience of Viet Nam is an advantage.
- Fluent in written and spoken English (with submission of at least two sample reports)

## 10) PAYMENT TERMS

- The first instalment of 10% contract amount will be paid upon submission of the detail assignment plan agreed by the UNDP, PMU/MOIT;
- The second instalment of 40% contract amount will be paid upon completion of the first mission to Viet Nam with submission deliverables 2, 3, 5, with satisfactory acceptance by UNDP and MOIT/PMU,
- The last payment of 50% will be paid upon the completion of the second mission to Viet Nam and all products required by the assignment, with satisfactory acceptance by UNDP and MOIT/PMU.

## ANNEX I: ANALYSIS OF GC POTENTIAL IMPLEMENTATION IN THE 6 INDUSTRIAL SECTORS IN VIETNAM

**Table 1 Electro-Plating Sector - Green Chemistry interventions capable to reduce the use and releases of POPs.**

| Green Chemistry principle                                      | Situation in the Chrome Plating industry in Viet Nam  | Potential GC intervention  | Relevance to POP       |
|--|---|--|------------------------|
| <b>1. Prevent waste:</b>                                       | Waste slug and wastewater containing POPs and toxic metal are a common issue of the Chrome Plating Industry in Viet Nam.  | Increase the number of closed-loop processes to prevent the release of contaminants in wastewater, including PFOS. Ensure rinse water is treated before release. Improve waste treatment processes. Reduce CrVI to CrIII before discharge. | Yes, direct            |
| <b>2. Maximize atom economy:</b>                               | Most small scale chrome-plating plants use basic processes without automated control of bath conditions.  | Reduce/optimize the use of etching agents. Adopt Direct Current (DC) rectifiers and automated control of the chromium bath to reduce the loss of the plating agent (chromium).   | Yes, direct            |
| <b>3. Design less hazardous chemical syntheses:</b>            | Chrome plating processes making use of PFOS as etching agent and mist suppressant.  | Use alternative non-PFOS mist suppressant -see below   | Yes, direct            |
| <b>4. Design safer chemicals and products:</b>                 | N/A   | N/A  | N/A                    |
| <b>5. Use safer solvents and reaction conditions:</b>          | PFOS based mist suppressants used for the prevention of chrome-contaminated mists in the workplace.   | Use non chemical mist-suppressants (like poly-propylene floating balls) or non PFOS mist suppressants. Introduce alternative chrome-plating processes (under development: trivalent chromium, spray and PVD coatings).                     | Yes, direct            |
| <b>6. Increase energy efficiency:</b>                          | Most chrome-plating small-scale plants use basic processes without process control to reduce energy consumption.  | Introduce process control to reduce energy use for heating baths (e.g. insulation of plating baths to prevent energy losses).  | Yes, indirect (U-POPs) |
| <b>7. Use renewable feedstocks:</b>                            | N/A   | N/A  | N/A                    |
| <b>8. Avoid chemical derivatives:</b>                          | N/A   | N/A  | N/A                    |
| <b>9. Use catalysts, not stoichiometric reagents:</b>          | Sulfuric acid mostly used as catalytic agent  | Use of less toxic, more balanced, mixtures of catalysts to reduce toxicity of the bath.  | No                     |
| <b>10. Design chemicals and products to degrade after use:</b> | N/A   | N/A  | N/A                    |
| <b>11. Analyse in real time to prevent pollution:</b>          | No real-time monitoring of effluent implemented in most of the small scale plants   | Real time monitoring of air and wastewater effluents.  | Yes, indirect          |
| <b>12. Minimize the potential for accidents:</b>               | Airborne release of chromic acid in the workplace is one of the major causes of worker illness. However, the use of PFOS as mist suppressant introduces a new source of risks in case of non-closed loop processes. | Use of non-chemical mist suppressant like poly-propylene floating balls on the bath surface. Use of chromic acid scrubbers.  | Yes, direct            |

Table 2 Plastic manufacturing sector - Green Chemistry measures and prevention of POPs use and releases.

| GC category  | Situation in the polymer industry<br>In Viet Nam   | Potential GC interventions  | Relevance to POP |
|--|--|---|------------------|
| <b>1. Prevent waste:</b>                                       | Waste from polymer production may contain flame-retardants.                                      | Better control of waste effluent. Reuse/recycle plastic wasted during manufacturing.  | Yes, direct      |
| <b>2. Maximize atom economy:</b>                               | Optimization of processes in a few advanced factories.   | Improvement of the polymerization process. Reduce the amount of additives through optimized processes.                          | Yes, direct      |
| <b>3. Design less hazardous chemical syntheses:</b>            | Deca-BDEs are still being imported and used as additives in a number of plastic polymers.        | Replace brominated flame retardants with non-brominated non-POPs flame-retardants.  | Yes, direct      |
| <b>4. Design safer chemicals and products:</b>                 | Deca-BDEs are not produced in Viet Nam.  | Restrict / control the import of deca-BDE in the country.   | Yes, direct      |
| <b>5. Use safer solvents and reaction conditions:</b>          | Deca-BDEs are still imported and incorporated as part of a number of plastic polymers.           | Improve design of articles so that Flame Retardants are not necessary (introduce alternative measures to reduce fire risk).     | Yes, direct      |
| <b>6. Increase energy efficiency:</b>                          | Adoption of energy saving measures is currently very limited.                                    | Reduce heating through better process control and insulation of reactors.   | Yes, direct      |
| <b>7. Use renewable feedstocks:</b>                            | The plastic sector in Viet Nam often recycles plastic without checking for the content of PBDEs. | Introduce quality criteria for plastic manufacturing, including the use of recycled plastic.                                    | Yes, direct      |
| <b>8. Avoid chemical derivatives:</b>                          | Not relevant for this type of industry   | Not relevant for this type of industry  | N/R              |
| <b>9. Use catalysts, not stoichiometric reagents:</b>          | Not relevant for this type of industry   | Not relevant for this type of industry  | N/R              |
| <b>10. Design chemicals and products to degrade after use:</b> | No biodegradable plastics are being produced in Viet Nam.  | Production of bio-degradable/bio-plastics, which may prevent the release of U-POPs as a result of accidental combustion.        | Yes, direct      |
| <b>11. Analyze in real time to prevent pollution:</b>          | Few plants are adopting real time monitoring.  | Real time monitoring of air and wastewater effluents introduced.  | Yes, indirect    |
| <b>12. Minimize the potential for accidents:</b>               | Storage of hazardous chemicals may represent a potential risk.                                   | Improve the storage of hazardous chemicals, by optimizing and reducing the quantities stored, and by establishing surveillance. | Yes, indirect    |

**Table 3. Textile sector - Green Chemistry measures and prevention of POPs use and releases.**

| <b>GC category</b>   | <b>Situation in the polymer industry in Viet Nam</b>   | <b>Potential GC intervention</b>   | <b>Relevance to POP</b>  |
|--|--|--|--------------------------|
| <b>1. Prevent waste:</b>                                       | Waste from polymer production may contain flame retardants.  | Quality management of incoming fibers. Better control of waste effluent. Avoid processing fibers contaminated with hazardous chemicals, such as pesticides, unless an analytical certificate has been provided. Optimize water consumption and online control of wastewater quality. | Yes, direct and indirect |
| <b>2. Maximize atom economy:</b>                               | Optimisation of processes has only been introduced in a few advanced factories.  | Improve the quality and quantity of chemicals used, including regular revision and assessment of the recipes, optimal scheduling in production, etc.   | Yes, direct              |
| <b>3. Design less hazardous chemical syntheses:</b>            | PFOS or PFAS may be used in the finishing process to provide water-repellent features to the fibers.                   | Replace PFOS and PFAs with other water-repellent substances. Replace PBDEs flame retardants with other FR substances. Build a database of the chemicals and mixtures used in the textile sector to facilitate the identification of alternatives.                                    | Yes, direct              |
| <b>4. Design safer chemicals and products:</b>                 | PFOS or PFAS are not produced in Viet Nam.   | Restrict/control the import of PFOS and PFAS substances in the country. Restrict/control the import of PBDEs flame retardants in the country. Adopt Hydrogen Peroxide bleaching as a substitute of Sodium Hypochlorite bleaching.  | Yes, direct              |
| <b>5. Use safer solvents and reaction conditions:</b>          | PFOS are still used in a number of textile application. No data is available on the use of PBDEs.                      | Identify / develop alternative to PFOS as water-repellent substances. Identify / develop alternatives to PBDEs as flame retardants.  | Yes, direct              |
| <b>6. Increase energy efficiency:</b>                          | The adoption of energy saving measures is very limited.  | Reduce heating through better process control and insulation of vessels.   | Yes, indirect (U-POP)    |
| <b>7. Use renewable feedstocks:</b>                            | The textile sector already makes wide use of natural fibers.   | Introduce quality criteria for natural fibers, including verification of organic residues. Perform testing of intermediate and final products to verify the presence of hazardous substances.  | Yes, direct and indirect |
| <b>8. Avoid chemical derivatives:</b>                          | Not relevant   | Not relevant   | Not Relevant             |
| <b>9. Use catalysts, not stoichiometric reagents:</b>          | N/A  | N/A  | Not Available            |
| <b>10. Design chemicals and products to degrade after use:</b> | Many substances used are not biodegradable and are released in the environment during / after manufacturing processes. | Promote the use of surfactants that may easily degrade after release without forming toxic metabolites. Use of non-PFOS antifoaming agents. Develop bio dyes for the replacement of toxic dyestuff   | Yes, indirect and direct |
| <b>11. Analyse in real time to prevent pollution:</b>          | Most plants are of small scale and do not adopt real time monitoring.  | Real time monitoring of air and wastewater effluents. Adopt automated control of process parameters (e.g. temperature, liquor level, chemicals feed) to reduce the use of chemicals and auxiliaries.   | Yes, indirect            |
| <b>12. Minimize the potential for accidents:</b>               | Storage of chemicals, including bleaching substances, represent a substantial risk.                                    | Improve the storage of hazardous chemicals, by optimizing and reducing the quantities stored, and by establishing surveillance.  | Yes, direct and indirect |

Table 4. Pulp and Paper Sector - Green Chemistry measures and prevention of POPs use and releases.

| GC category  | Situation in the pulp and paper industry In Viet Nam  | Potential GC intervention  | Relevance to POP         |
|--|---|--|--------------------------|
| <b>1. Prevent waste:</b>                                       | Poor recycling of the lignin residue from pulping results in a very high organic load released to wastewater, which when associated with high chlorine content (derived from chlorine bleaching) results in a high level of chlorinated compounds released to wastewater. | Improve recycling of lignin from the wastewater process. Improve wastewater treatment. Assess and implement water reuse in various processes.  | Yes, indirect            |
| <b>2. Maximize atom economy:</b>                               | Optimisation of processes has only been introduced in a few advanced factories.   | Improve the recycling of lignin before bleaching may lead to a reduction of chemicals needed for bleaching.  | Yes,, indirect           |
| <b>3. Design less hazardous chemical syntheses:</b>            | Very often there little knowledge about chemicals used. PFOS or PFAS may be used in the finishing process to provide water- repellent features to the paper.  | Build a database of chemicals used in the pulp and paper sector to increase awareness. Replace PFOS and PFAs with other water-repellent substances.  | Yes, direct and indirect |
| <b>4. Design safer chemicals and products:</b>                 | PFOS or PFAS are not only being produced in Viet Nam.   | Restrict/control the import of PFOS and PFAS substances in the country. Adopt Hydrogen Peroxide bleaching or ozone bleaching as a substitute to Sodium Hypochlorite bleaching.   | Yes, direct and indirect |
| <b>5. Use safer solvents and reaction conditions:</b>          | PFOS is still used in a number of water or grease repellent paper applications.   | Identify / develop alternatives to PFOS as water-repellent substances.   | Yes, direct              |
| <b>6. Increase energy efficiency:</b>                          | Adoption of energy saving measures is very limited.   | Reduce heating through better process control and insulation of vessels.   | Yes, indirect (U-POPs)   |
| <b>7. Use renewable feedstocks:</b>                            | Pulp and paper is made from natural fibers, however deforestation and sustainability of plantations for the pulp and paper industry remains an issue.   | Introduce quality criteria for natural fibers, including verification of organic residues. Test the final product for the presence of chemical residues, including POPs.   | Yes, direct and indirect |
| <b>8. Avoid chemical derivatives:</b>                          | Not relevant.   | Not relevant.  | N/R                      |
| <b>9. Use catalysts, not stoichiometric reagents:</b>          | Only applicable to large plants.  | Using a solid metal catalyst and a hydrogen peroxide solution as an 'activator' to kill microorganisms by oxidation.   | N/R                      |
| <b>10. Design chemicals and products to degrade after use:</b> | Paper is mostly biodegradable, However it may contain additives or trace chemicals, which are persistent or not easily biodegradable.   | Develop a database of chemicals used in the pulp and paper industry. Test final product for the presence of POPs and other hazardous substances.   | Yes, direct and indirect |
| <b>11. Analyse in real time to prevent pollution:</b>          | Most plants are small scale and have not adopted real time monitoring.  | Real time monitoring of all process modules. Real time monitoring of air and wastewater effluents. Adopt automated control of process parameters (e.g. temperature, liquor level, chemicals feed) to reduce applied chemicals and auxiliaries. | Yes, indirect            |
| <b>12. Minimize the potential for accidents:</b>               | Storage of chemicals including acid tanks and chlorine may represent a serious risk in the pulp and paper sector.   | Improve the storage of hazardous chemicals, optimizing and reducing the quantities stored, and establishing surveillance.  | Yes, direct and indirect |

Table 5. Solvent and Paint Industry - Green Chemistry measures and prevention of POPs use and releases

| GC category   | Situation in the solvent and bio-solvent industry in Viet Nam   | Potential GC intervention  | Relevance to POP / mercury |
|---|---|--|----------------------------|
| 1. Prevent waste:                                       | N/A   | N/A  |                            |
| 2. Maximize atom economy:                               | N/A   | N/A  |                            |
| 3. Design less hazardous chemical syntheses:            | The petro-chemical industry and the chlor-alkali process, produce most of the solvents used in Viet Nam.  | Firms manufacturing non-harmful bio-solvents are emerging. Promote the development of industries in the bio-solvent sector.  | Yes, direct and indirect   |
| 4. Design safer chemicals and products:                 | The use of chlorinated and halogenated solvents is widespread in industrial processes. Some solvents produced by the petro-chemical industry (BTEX series) are also commonly used and known for their toxicity. SCCP are used in the formulation of paints. | Design solvents, which can replace halogenated solvents or BTEX solvents commonly used in products. Redesign paint mixtures to avoid the use of SCCP.                        | Yes, direct and indirect   |
| 5. Use safer solvents and reaction conditions:          | N/A   | N/A  |                            |
| 6. Increase energy efficiency:                          | N/A   | N/A  |                            |
| 7. Use renewable feedstocks:                            | As the petro-chemical industry and the chlor-alkali process produce most of the solvents used in Viet Nam, feedstocks are non-renewable. A limited number of firms are currently investing in bio-solvents.   | Production of solvents from the distillation of vegetable, renewable feedstock.  | No – however reduce GHG    |
| 8. Avoid chemical derivatives:                          | N/A   | N/A  |                            |
| 9. Use catalysts, not stoichiometric reagents:          | N/A   | N/A  |                            |
| 10. Design chemicals and products to degrade after use: | Chlorinated solvents and aromatic solvents are usually hard to degrade. Most of the solvents used in Vietnamese industry are imported chlorinated or aromatic solvents. Some paint formulation are still based on the use of SCCP.                          | Develop the production and promote the use of bio-degradable solvents to replace chlorinated, non-degradable solvents. Develop the production of paints not containing SCCP. | Yes – direct and indirect  |
| 11. Analyse in real time to prevent pollution:          | N/A   | N/A  |                            |
| 12. Minimize the potential for accidents:               | N/A   | N/A  |                            |

**Table 6. Pesticide Production and Application - Green Chemistry measures and prevention of POPs use and releases**

| <b>GC category</b>   | <b>Situation of the pesticide production and application in Viet Nam</b>   | <b>Potential GC intervention</b>  | <b>Relevance to POP / mercury</b> |
|--|--|---|-----------------------------------|
| <b>1. Prevent waste:</b>                                       | As in many other countries, the issue of pesticide waste containers is serious and not addressed yet.  | Reduce the amount of pesticide containers. Ensure that after use containers are not dumped in the environment.  |                                   |
| <b>2. Maximize atom economy:</b>                               | Pesticides are not manufactured in Viet Nam. In most cases pesticides are re-formulated.   | Promote the use of bio-pesticides. As bio-pesticides are synthesized by living organisms, the promotion of their use will ensure maximum atom economy in their synthesis.   | Limited – indirect                |
| <b>3. Design less hazardous chemical syntheses:</b>            | As historically demonstrated, the design of pesticides is linked to the production and release of many POPs as intermediate substances or impurities in the final product. | Replace the production of traditional pesticides with bio-pesticides, as the biosynthesis of pesticide is intrinsically safe and extremely efficient.   | Yes – indirect relevance          |
| <b>4. Design safer chemicals and products:</b>                 | Most pesticides are imported in Viet Nam.  | Bio pesticides - although in some cases they may be very effective like conventional pesticides - in general do not exhibit the properties of POPs and are biodegradable. In Viet Nam, 49 bio-pesticides have been registered as active ingredients, however these are in the early stages of commercialisation. Promoting the use of bio-pesticide would limit the use of conventional pesticides including POPs pesticides. | Yes - Indirect                    |
| <b>5. Use safer solvents and reaction conditions:</b>          | No specific action in Viet Nam has been taken to introduce the use of safer solvents in pesticide production.  | Promote the use of bio-solvents in the formulation of bio pesticides.   | Yes – indirect                    |
| <b>6. Increase energy efficiency:</b>                          | Synthetic chemistry may require high energy processes.   | The active ingredients of bio-pesticides have been synthesized by plants. Energy may be required for extraction – concentration. Promoting the use of bio-pesticides would limit the use of energy as compared to the manufacturing of synthetic pesticides.  | No                                |
| <b>7. Use renewable feedstocks:</b>                            | Most pesticides are synthetic pesticides manufactured abroad.  | Bio-pesticides are always extracted from natural, renewable materials.  | No                                |
| <b>8. Avoid chemical derivatives:</b>                          | Most pesticides are synthetic pesticides manufactured abroad.  | Not relevant  | No                                |
| <b>9. Use catalysts, not stoichiometric reagents:</b>          | Most pesticides are synthetic pesticides manufactured abroad.  | Not relevant  | No                                |
| <b>10. Design chemicals and products to degrade after use:</b> | Most pesticides are synthetic pesticides manufactured abroad. Some of the synthetic pesticides recently imported in Viet Nam are designed to ensure biodegradability.      | Bio-pesticides are normally biodegradable, therefore do not exhibit POPs characteristics.   | Yes                               |
| <b>11. Analyse in real time ...</b>                            | N/A  | N/A   |                                   |
| <b>12. Minimize the potential for accidents:</b>               | N/A  | As bio-pesticides are generally biodegradable, accidental releases would be easier to remediate.  | Indirect                          |



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